DOE/OR/07-1857
Internal Draft
Primary Document

Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky

Volume 4. Appendix C Supporting Information for Feasibility Study

Cleared for Public Release

00-001(doc)/061201

DOE/OR/07-1857
Internal Draft
Primary Document

Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky

Volume 4. Appendix C Supporting Information for Feasibility Study

Date Issued—July 2000

Prepared for the
Department of Energy
Office of Environmental Management

By
Bechtel Jacobs Company LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001
managed by
Bechtel Jacobs Company LLC
for the
U.S. Department of Energy
under contract DE-AC05-98OR22700

APPENDIX C1

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C1

RESTORATION TIMEFRAME ANALYSIS USING GROUNDWATER MODELING PREDICTIVE SIMULATIONS

This appendix contains the preliminary modeling results for predictive simulations conducted in support of the Groundwater OU Feasibility Study. The predictive transport simulations were run using the most recently calibrated flow model (June 1999). The transport code employed is MODFLOWT, an enhanced version of the USGS's MODFLOW code (MacDonald and Harbaugh 1988). The simulations were conducted to provide a basis for comparison between a range of options to evaluate possible restoration timeframes for the Regional Gravel Aquifer for trichloroethylene (TCE) and technetium-99 (Tc-99) contamination at the Paducah Gaseous Diffusion Plant (PGDP). Following six scenarios were run for TCE and Tc-99:

1. **No Action**: No source containment (a continuous source loading is assumed) and passive flushing without the current Northwest and Northeast plume wells operating.

2. **No Action**: No source containment (a continuous source loading is assumed) and passive flushing with the current Northwest and Northeast plume wells operating.

3. **Source Containment**: Source is removed (plume concentrations are initialized) with passive flushing without the current Northwest and Northeast plume wells operating.

4. **Source Containment**: Source is removed (plume concentrations are initialized) with passive flushing with the current Northwest and Northeast plume wells operating.

5. **Pump-and-Treat**: No source containment (a continuous source loading is assumed) but active extraction and treatment only. Constraints were that the total number of wells had to be less than 20, with none operating any higher than 150 gpm. Locations were selected to minimize residual concentrations.

6. **Pump-and-Treat with Source Containment**: Source is removed (plume concentrations are initialized) and active extraction and treatment is in place. Same details of wells as previous scenario apply here.

For these six scenarios, a total of twelve distinct predictive simulations were necessary to fully evaluate the alternatives for both TCE and Tc-99. Table C1.1 summarizes these simulations. The extraction rates used for the Northwest and Northeast Plume pumping wells are presented in Table C1.2.

Table C1.1. Summary of Predictive Simulations Conducted for GWOU FS at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Constituents	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
TCE	1TCESP2T	12TCESP2T	2TCESP2T	22TCESP2T	3TCESP2T	4TCESP2T
Tc-99	1T99SP2	12T99SP2	2T99SP2	22T99SP2	3T99SP2	4T99SP2

Table C1.2. Extraction Rates for the Northwest Plume and Northeast Plume Extraction Wells used for Predictive Simulations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Well ID	PGDP Coordinates		Model Coordinates		Northwest Plume Extraction Rate	
	X	Y	X	Y	[ft^3/day]	[gpm]
EW-228	-5347.4	7599.463	12640.07	21246.76	9240.64	48.00
EW-229	-5196.9	7337.24	12790.59	20984.537	8663.1	45.00
EW-230	-7301.5	1405.806	10686.01	15053.103	11550.8	60.00
EW-231	-7439.9	1351.924	10547.56	14999.221	10588.2	55.00
Northeast Plume Extraction Wells						
EW-331	1574.41	837.03	19561.91	14484.327	19251.3	100.00
EW-332	1764.4	754.19	19751.9	14401.487	15401.1	80.00

For the Pump-and-Treat options, a total of 18 additional wells were simulated around the plant property, each pumping at 100 gpm. Figure C1-1 depicts the locations of these pumping wells. The total pumping rate for these scenarios, including the Northwest and Northeast Plume extraction wells is 2,188 gpm.

All simulations were conducted using 2 stress periods. Stress period 1 is defined from 0 to 10 years, and boundary conditions were representative of median 1992 conditions. Stress period 2 is defined from 10 to 100 years where boundary conditions for the Ohio River and recharge are modified to represent stage changes due to the completions of the Olmsted lock and dam, and the closing of the PGDP, respectively. The Ohio River stage in layer 3 of the model was changed to 306.86 ft amsl. Recharge in layer 1 was changed to 0 where building and concrete cover exists, and to the regional value (1.5E-3 ft/day) where no concrete cover exists. Layer 1 wells representing anthropogenic recharge in stress period 1, were changed to 0 in stress period 2.

SOURCES

Sources for TCE and Tc-99 were initialized in model layer 3 (RGA) using existing groundwater concentration data. Table C1.3 presents the TCE and Tc-99 source term locations and values within the model. The locations of these sources are depicted in Fig. C1-2. All sources are modeled as constant concentrations, and do not therefore simulate a degrading source term.

Table C1.3. TCE and Tc-99 Source Term Information for Predictive Simulations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Source	Plant Location	Model Location*	Constant Source Concentration	
			(µg/L)	(pCi/L)
		TCE		
	C-720 Area	A	10,000	
	C-720 Area	B	1,230	
	SW Corner, C-400 Building	C	100,000	
	SE Corner, C-400 Building	D	700,000	
	NE Corner, C-400 Building	E	19,000	
		Tc-99		
	NW Corner, C-400 Building	F		43,000

* For model location see map in Fig. C1-2.

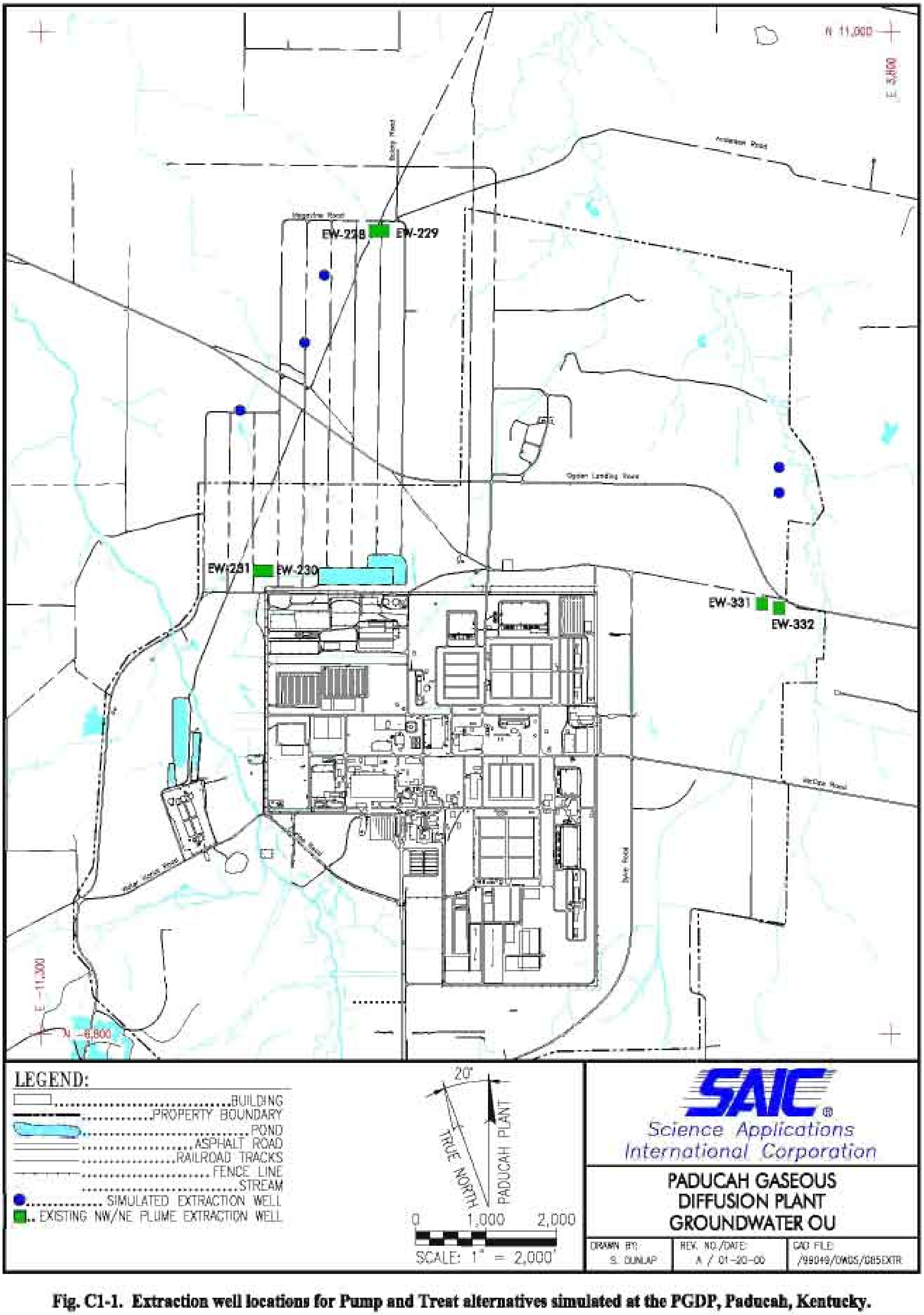


Fig. C1-1. Extraction well locations for Pump and Treat alternatives simulated at the PGDP, Paducah, Kentucky.

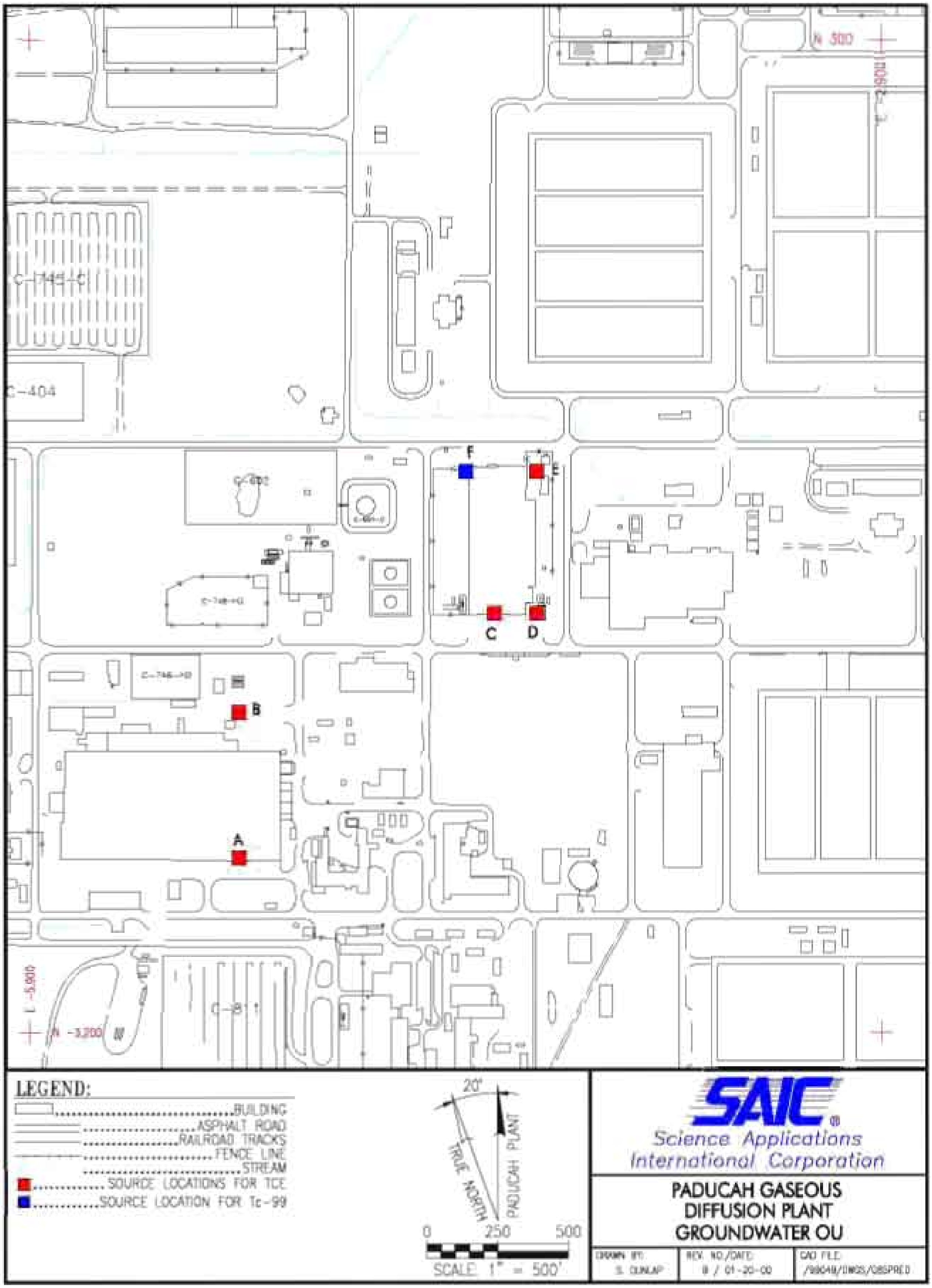


Fig. C1-2. TCE and Tc-99 sources for predictive simulations at the PGDP, Paducah, Kentucky.

TRANSPORT PARAMETERS

Transport parameters for TCE and Tc-99 used for the predictive simulations are presented in Table C1.4. The K_d-value of TCE was determined through a series of trial and error runs. The half-life was calculated from the degradation rate presented in a *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* (LMES 1997). The bulk density of the soil and the effective porosity were taken from the results of the WAG 6 RI investigation (DOE 1999). To be conservative, negligible retardation of Tc-99 without any decay was considered. Therefore, the model was run with zero K_d-value and decay constant for Tc-99.

Table C1.4. TCE and Tc- 99 Transport Parameters for Predictive Simulations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Parameters	TCE	Tc- 99
Distribution coefficient (K_d), L/kg	0.05	0
Half Life, days	9730	No decay
Bulk Density, g/cm^3	1.9	1.9
Porosity, %	30	30

RESULTS

Results for the predictive simulations were generated in the form of simulated concentration maps for the PGDP and vicinity. Results are generated at increments of 5, 10, 30, 60 and 100 year time periods. Figures C1-3a through C1-14c depict these results.

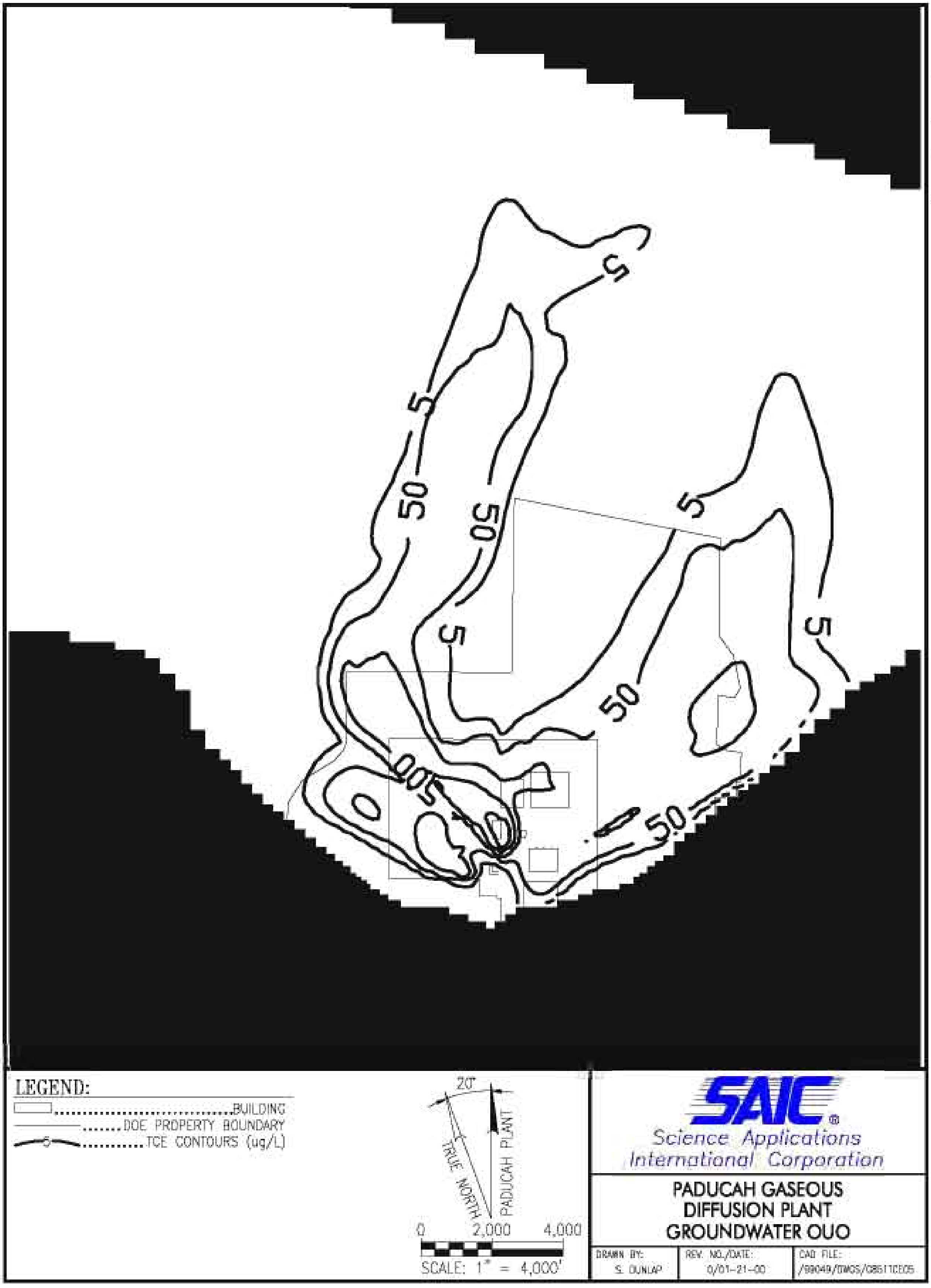


Fig. C1-3a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the No Action Alternative (1TCESP2T) at the PGDP, Paducah, Kentucky.

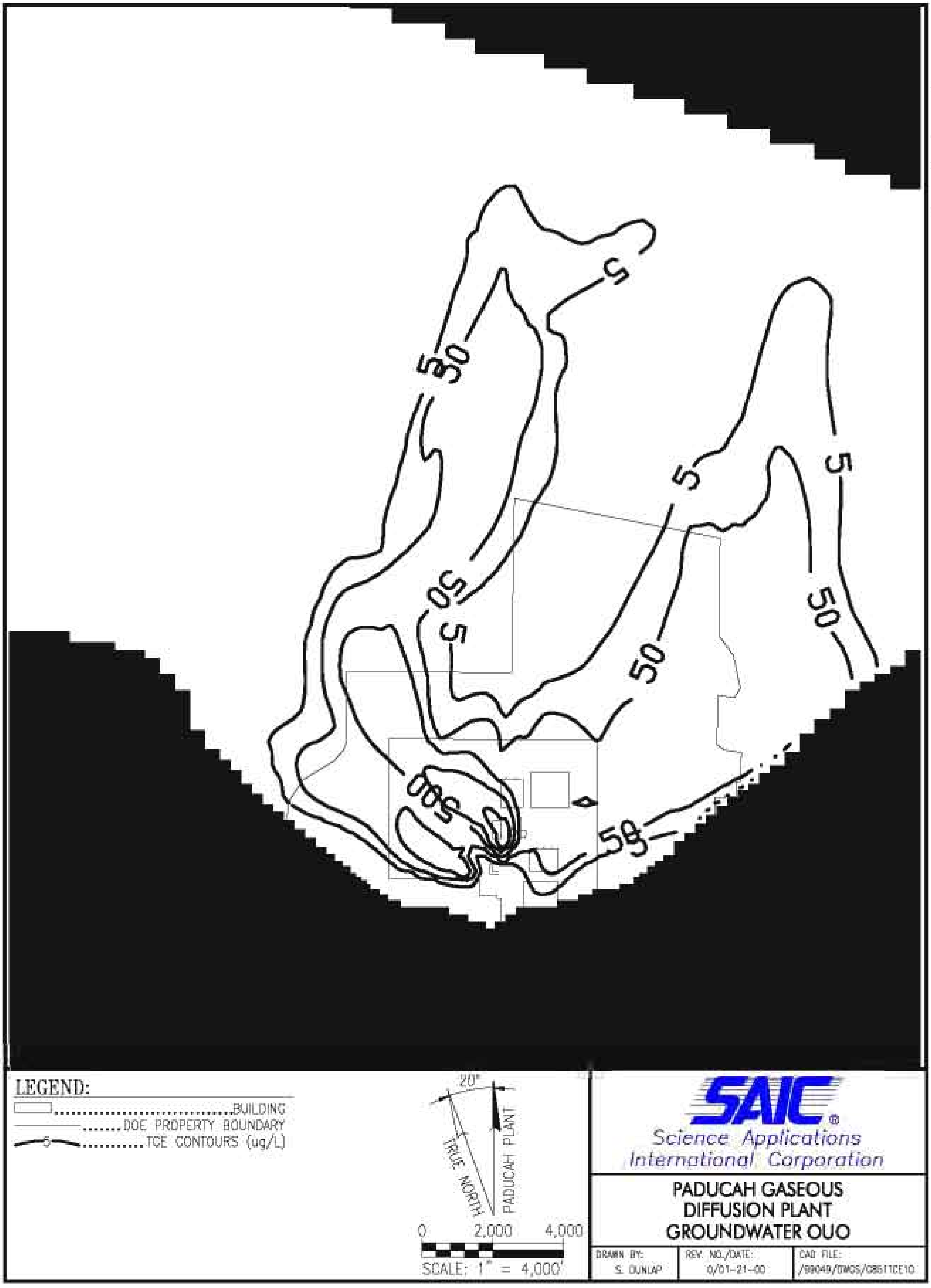


Fig. C1-3b. Predicted TCE concentration contours in μg/L at the end of 10-year simulation period for the No Action Alternative (1TCESP2T) at the PGDP, Paducah, Kentucky.

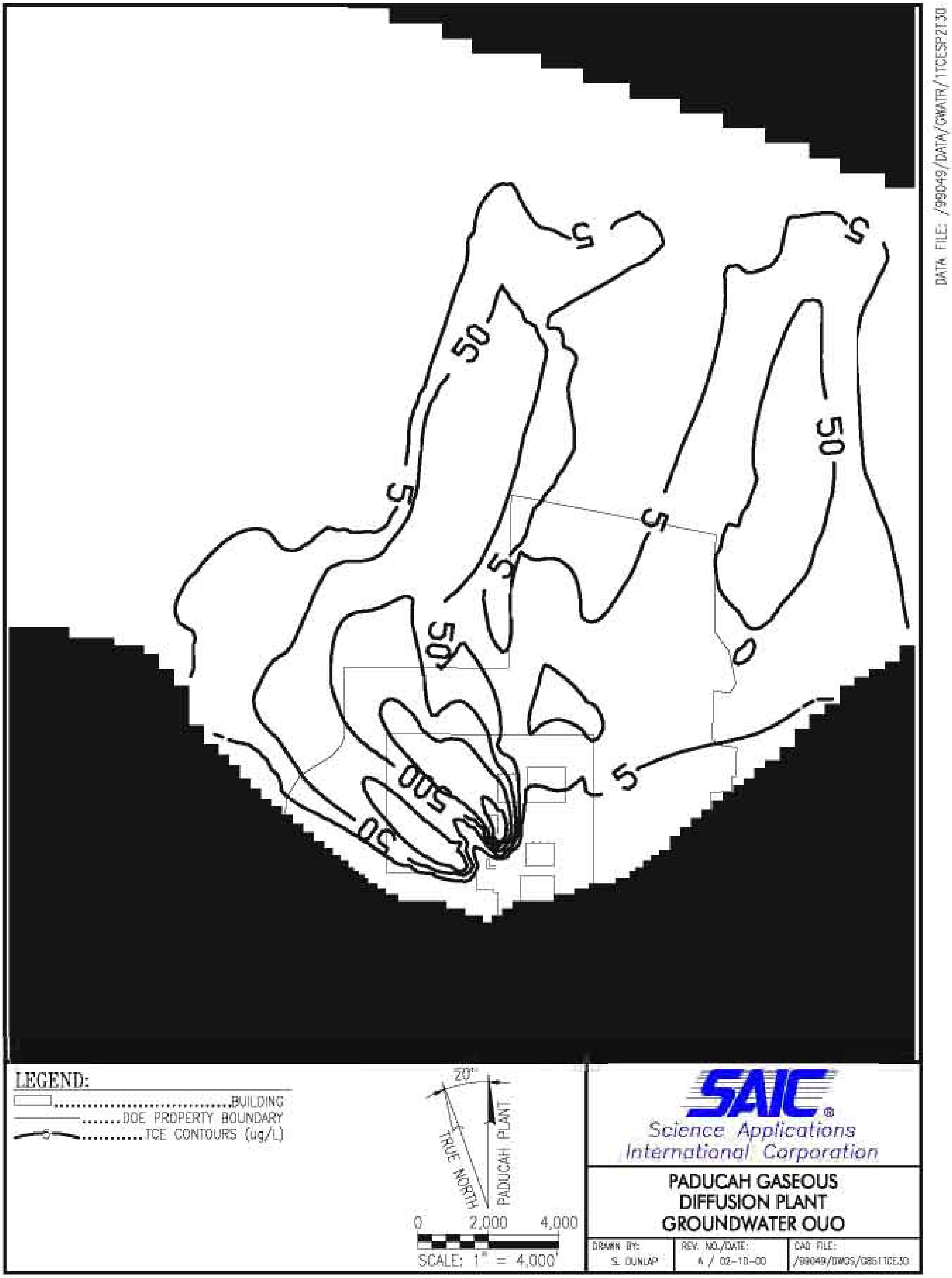


Fig. C1-3c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the No Action Alternative (1TCESP2T) at the PGDP, Paducah Kentucky.

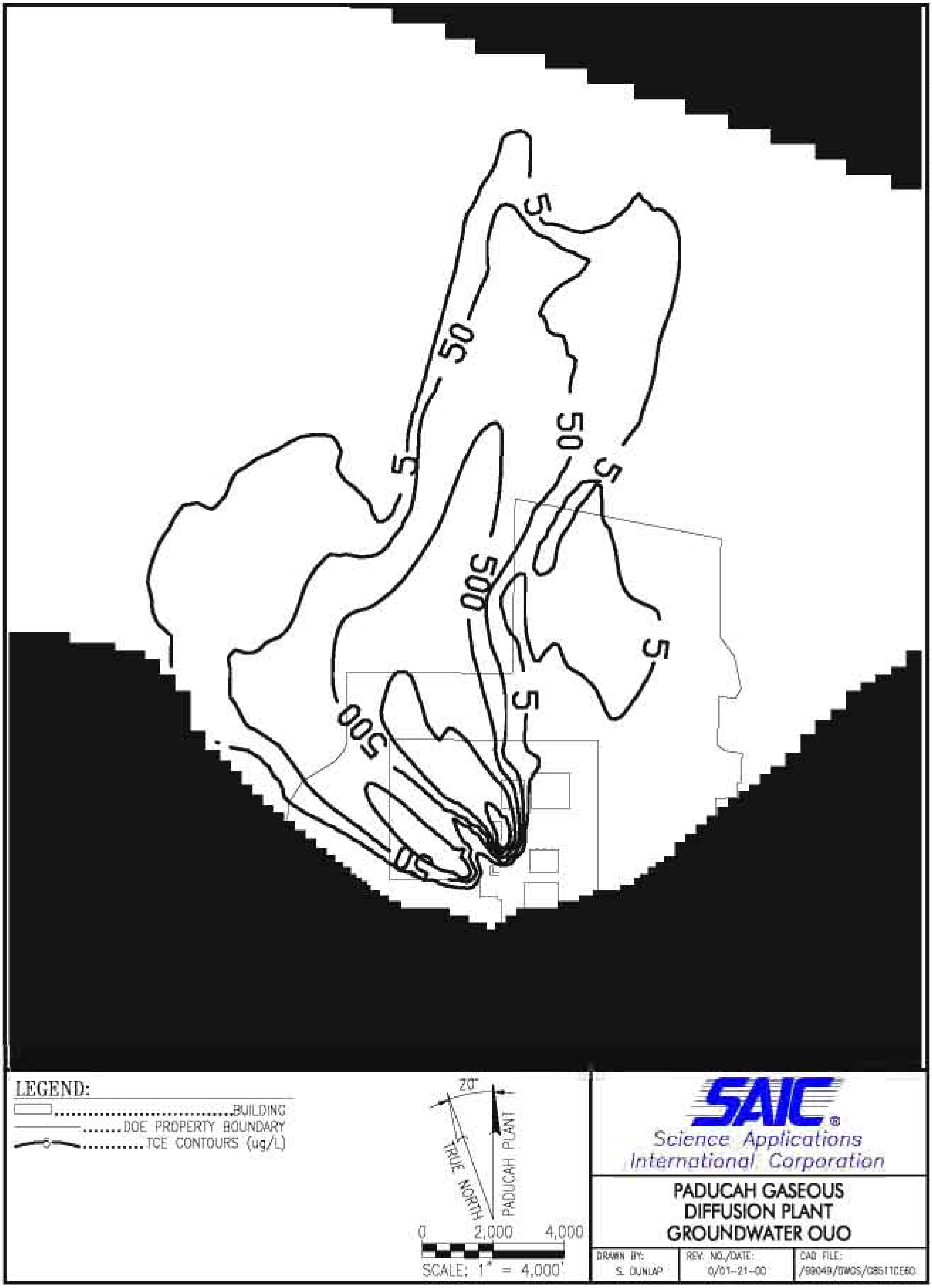


Fig. C1-3d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the No Action Alternative (1TCESP2T) at the PGDP, Paducah Kentucky.

Fig. C1-3e. Predicted TCE concentration contours in μg/L at the end of 100-year simulation period for the No Action Alternative (1TCESP2T) at the PGDP, Paducah Kentucky.

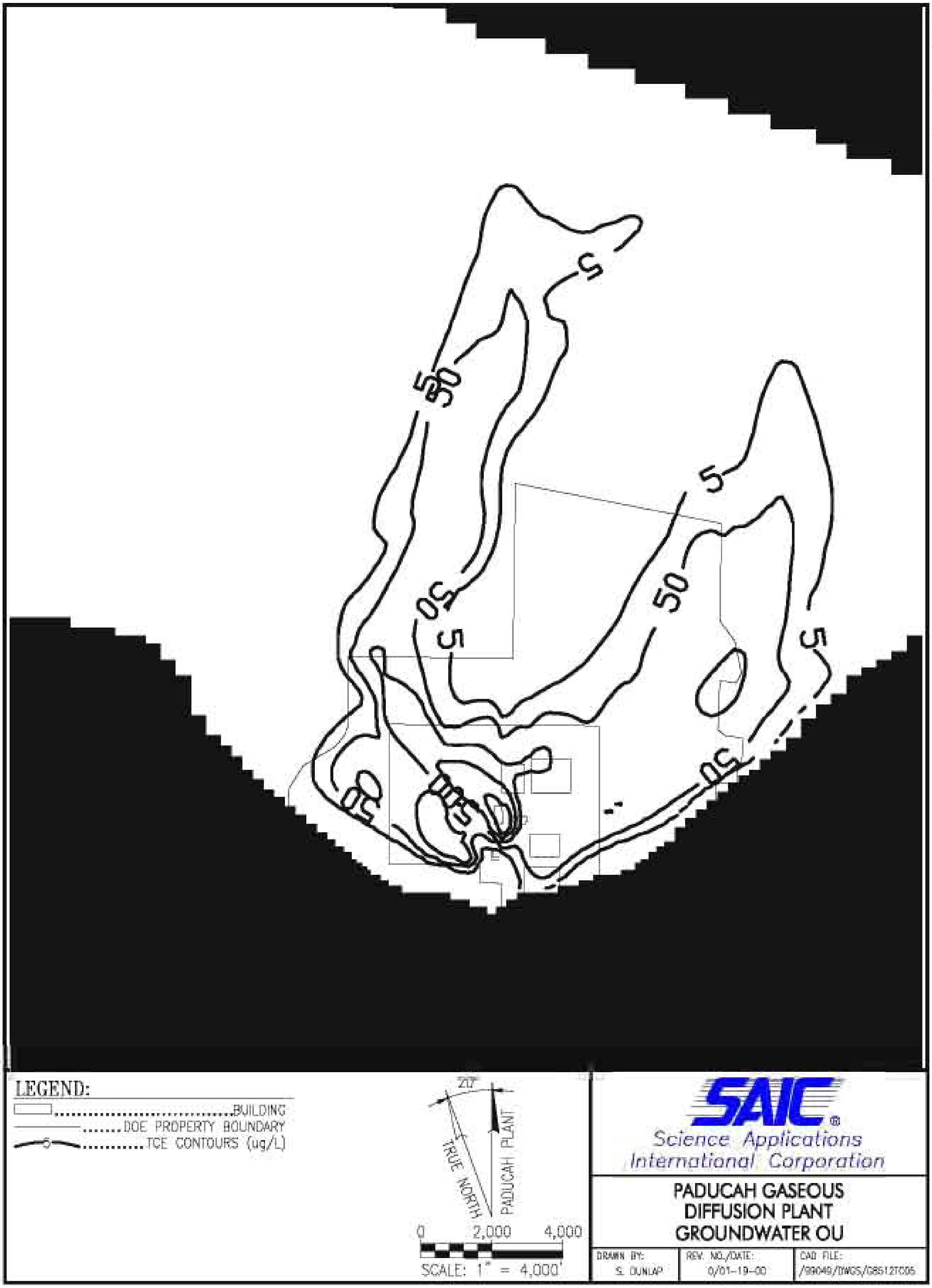


Fig. C1-4a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the No Action Alternative with NW/NE Wells pumping (12TCESP2T) at the PGDP, Paducah, Kentucky.

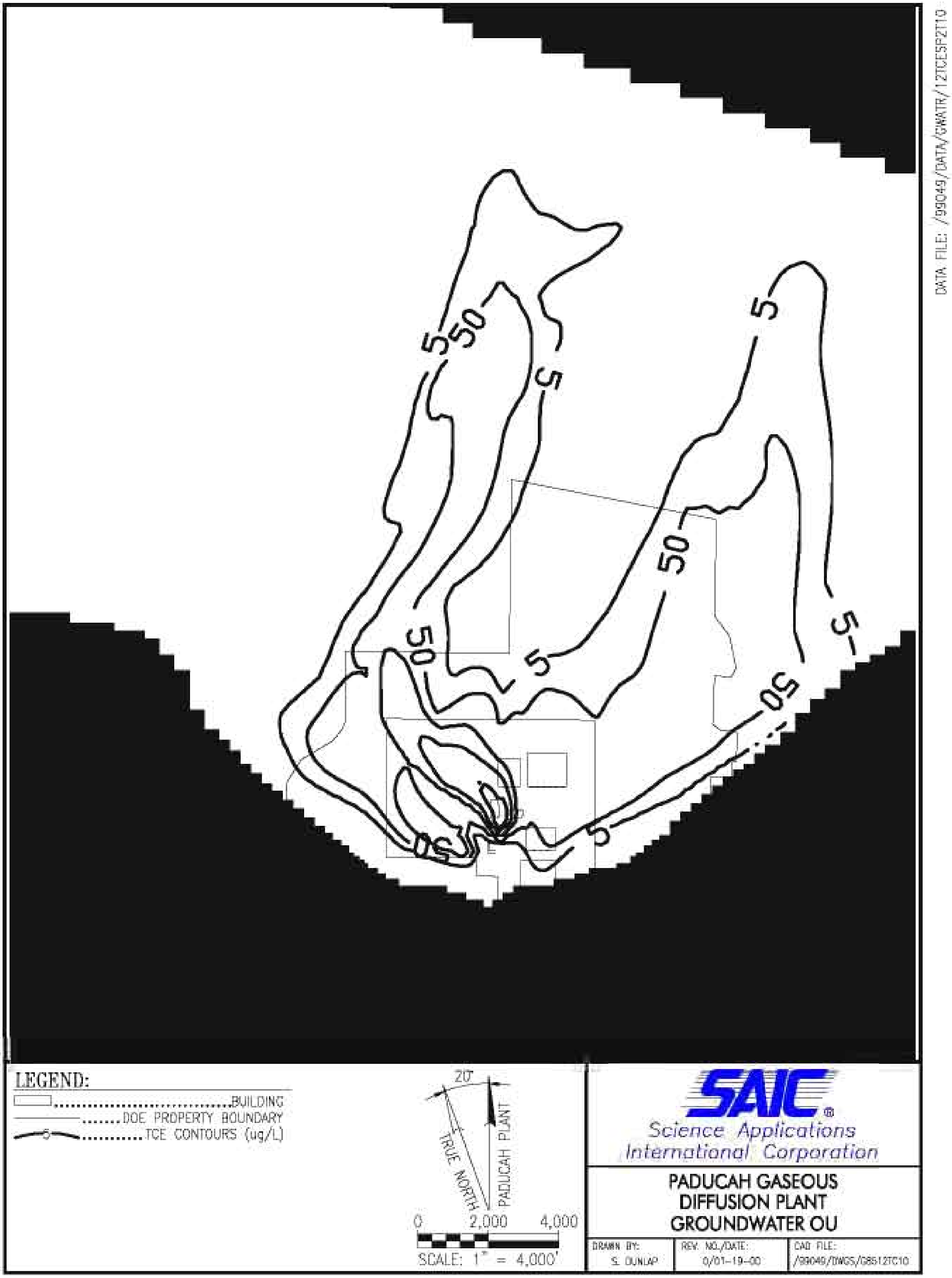


Fig. C1-4b. Predicted TCE concentration contours in μg/L at the end of 10-year simulation period for the No Action Alternative with NW/NE Wells pumping (12TCESP2T) at the PGDP, Paducah, Kentucky.

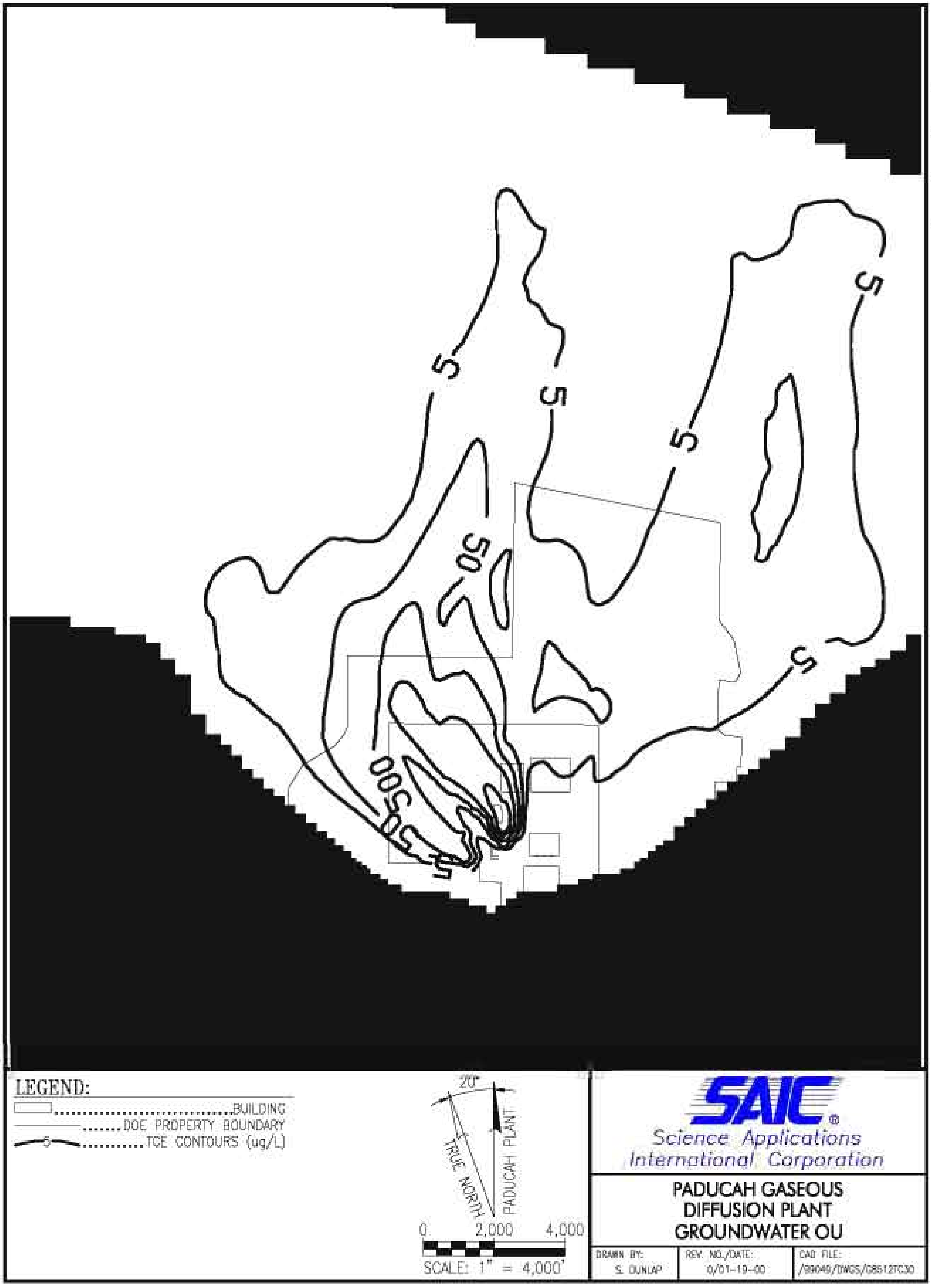


Fig. C1-4c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the No Action Alternative with NW/NE Wells pumping (12TCESP2T) at the PGDP, Paducah Kentucky.

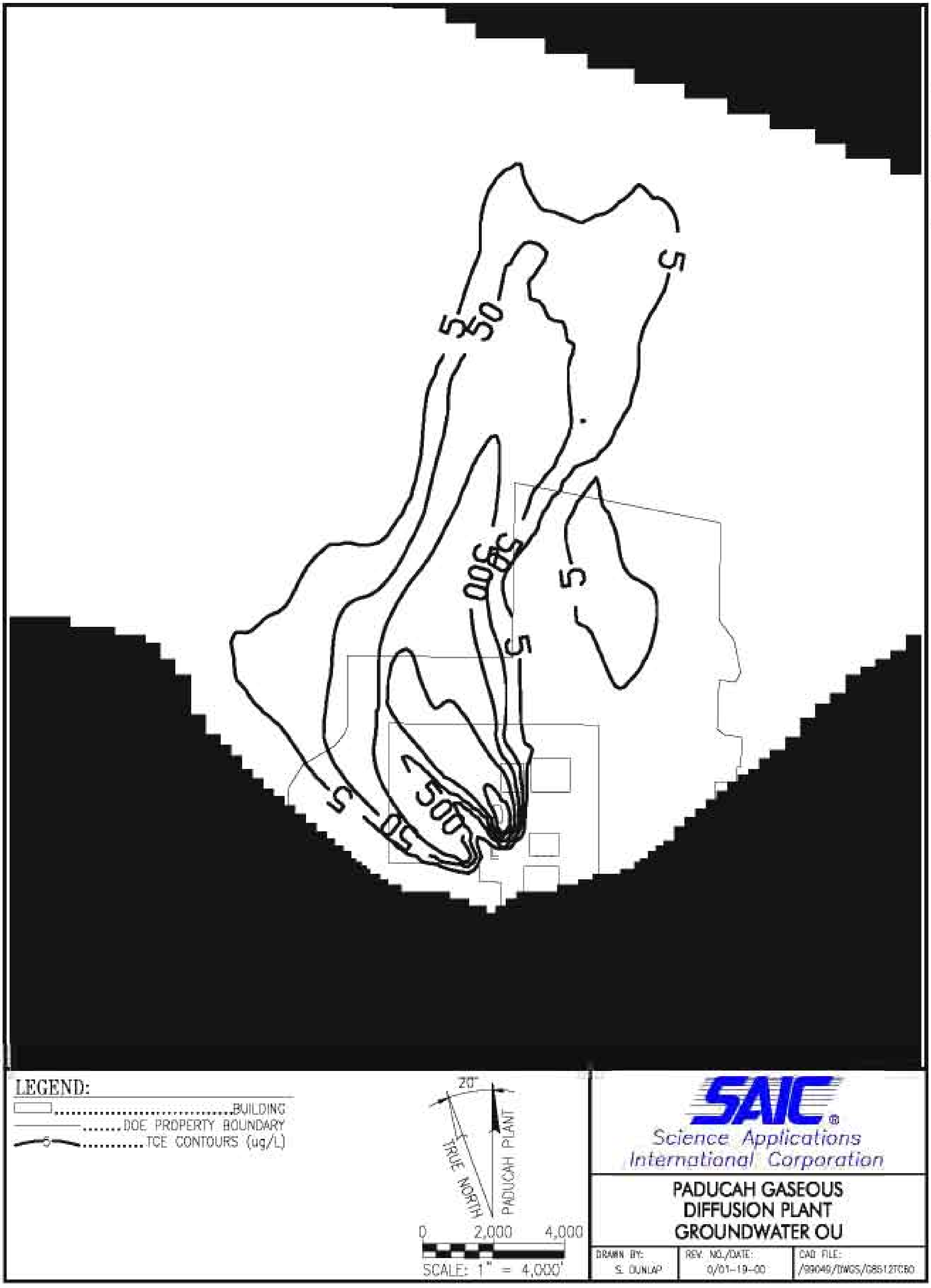


Fig. C1-4d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the No Action Alternative with NW/NE Wells pumping (12TCESP2T) at the PGDP, Paducah, Kentucky.

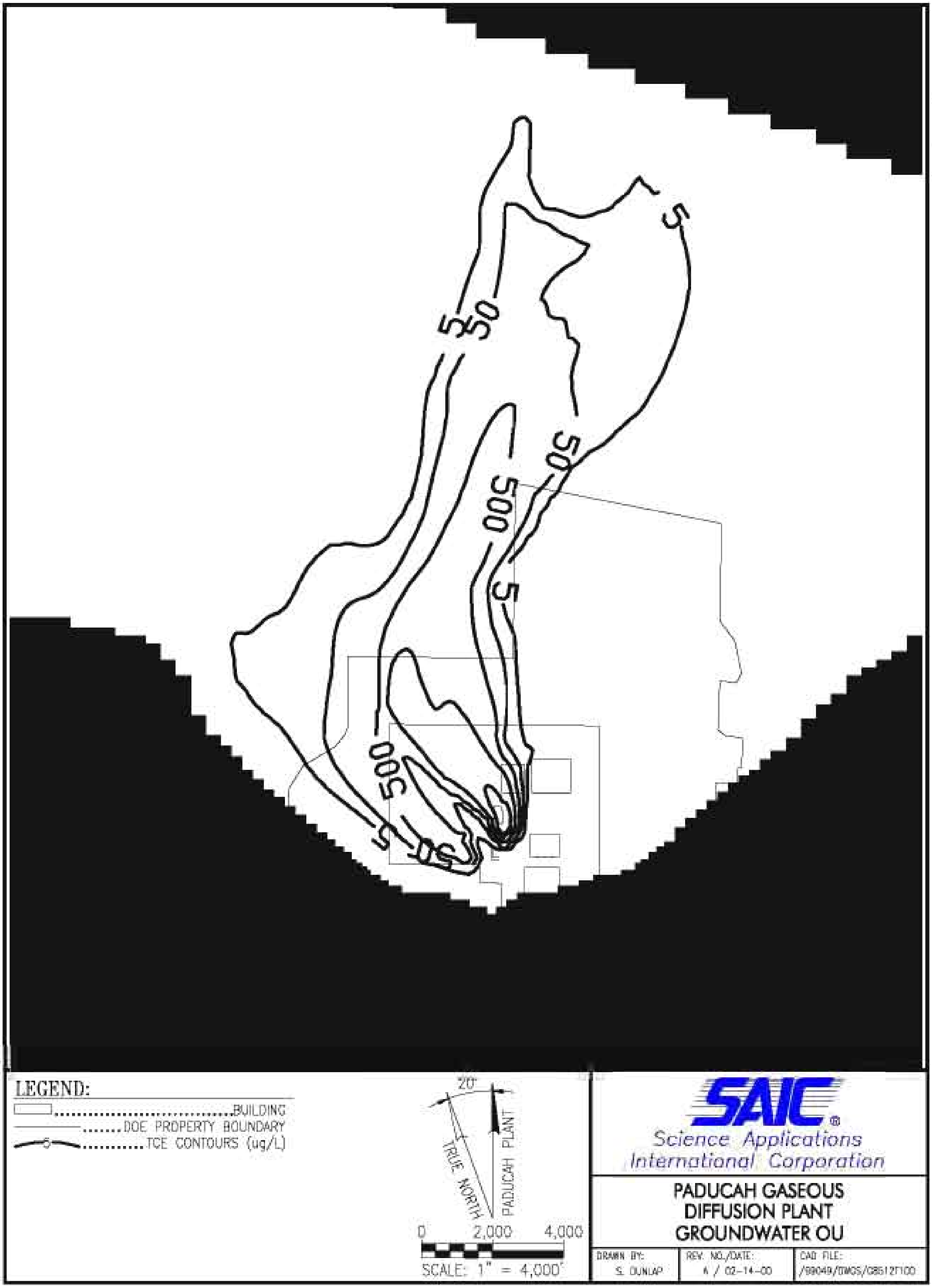


Fig. C1-4e. Predicted TCE concentration contours in μg/L at the end of 100-year simulation period for the No Action Alternative with NW/NE Wells pumping (12TCESP2T) at the PGDP, Paducah, Kentucky.

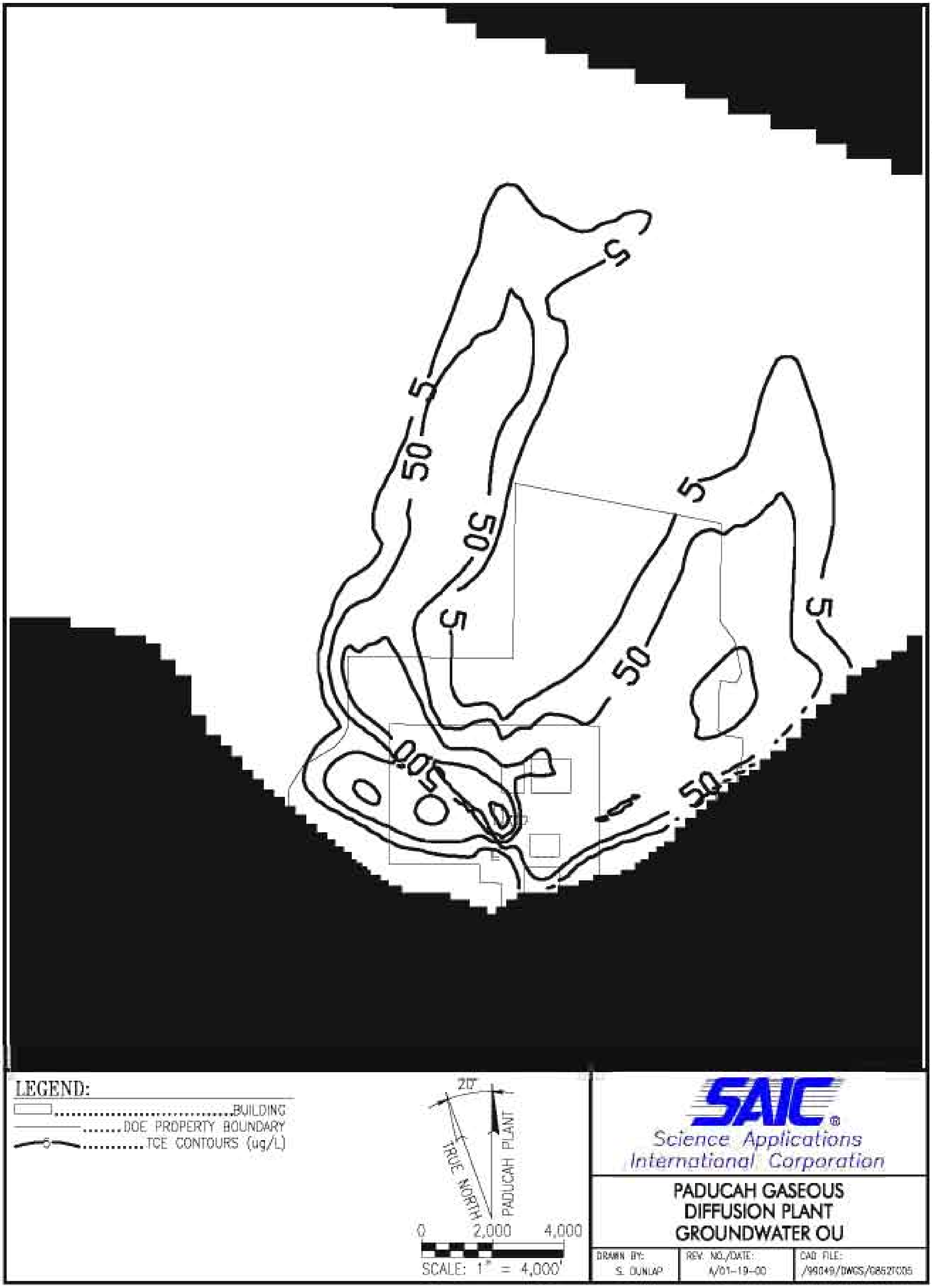


Fig. C1-5a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the Source Containment Alternative (2TCESP2T) at the PGDP, Paducah, Kentucky.

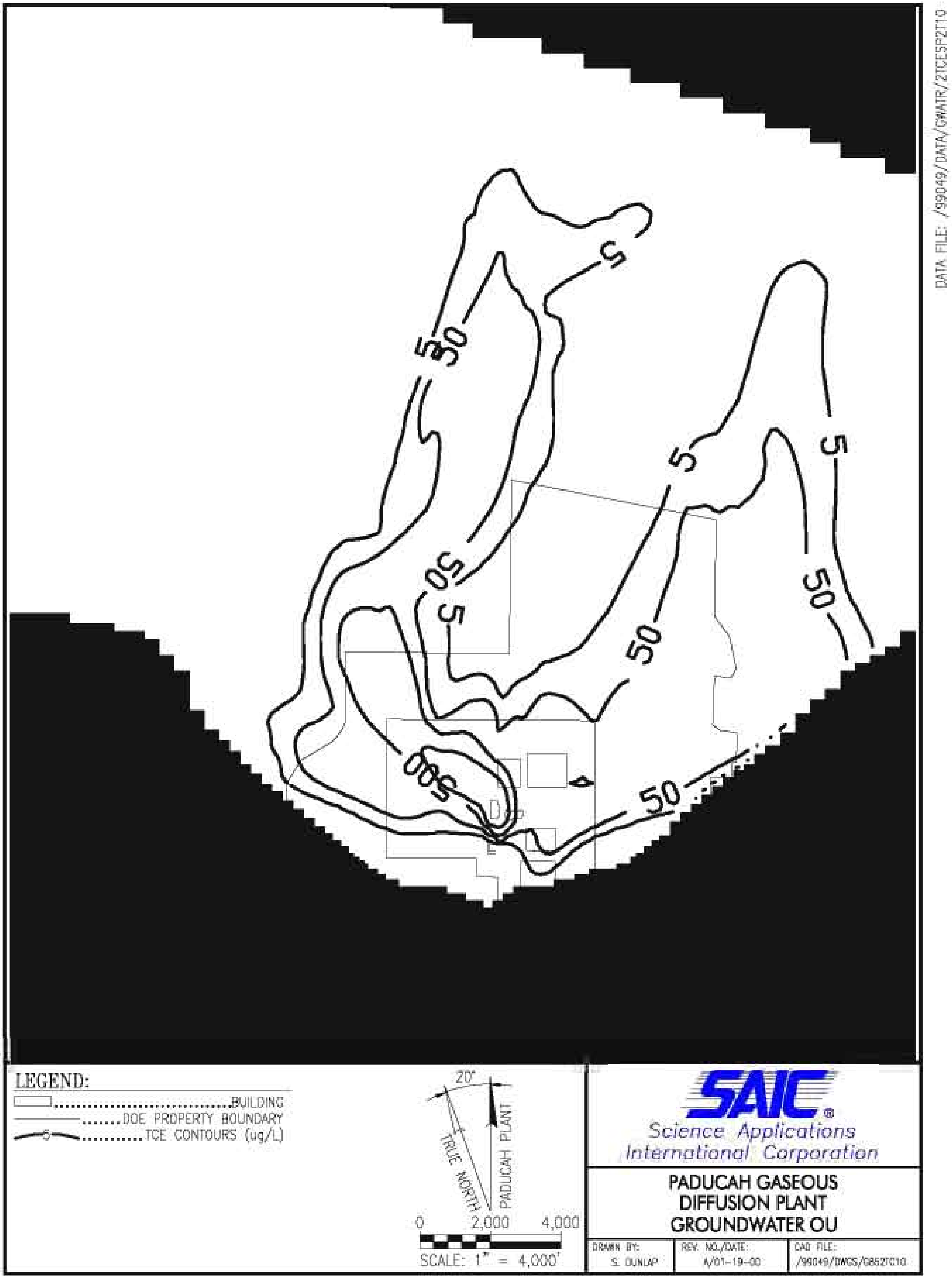


Fig. C1-5b. Predicted TCE concentration contours in μg/L at the end of 10-year simulation period for the Source Containment Alternative (2TCESP2T) at the PGDP, Paducah, Kentucky.

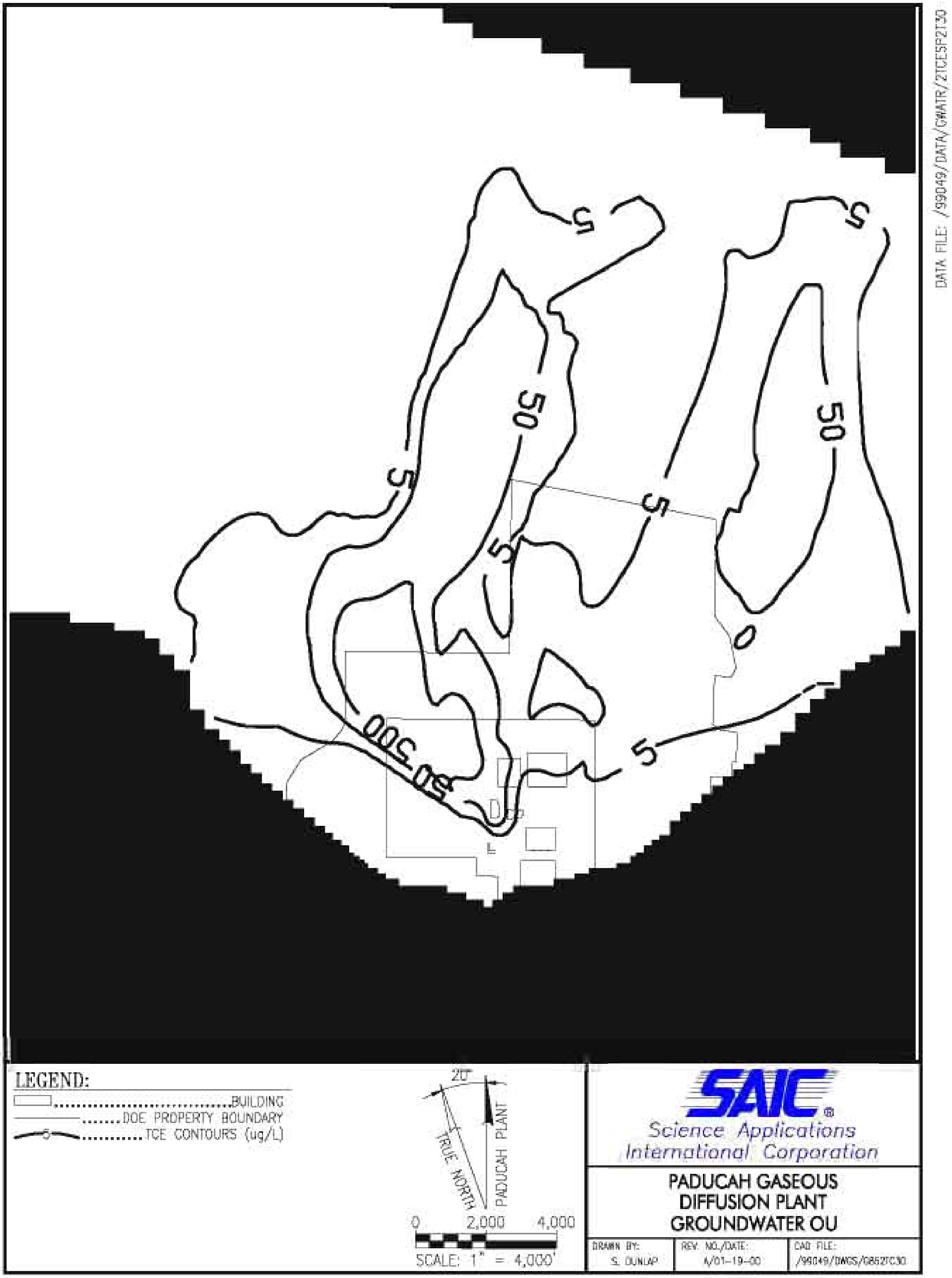


Fig. C1-5c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the Source Containment Alternative (2TCESP2T) at the PGDP, Paducah, Kentucky.

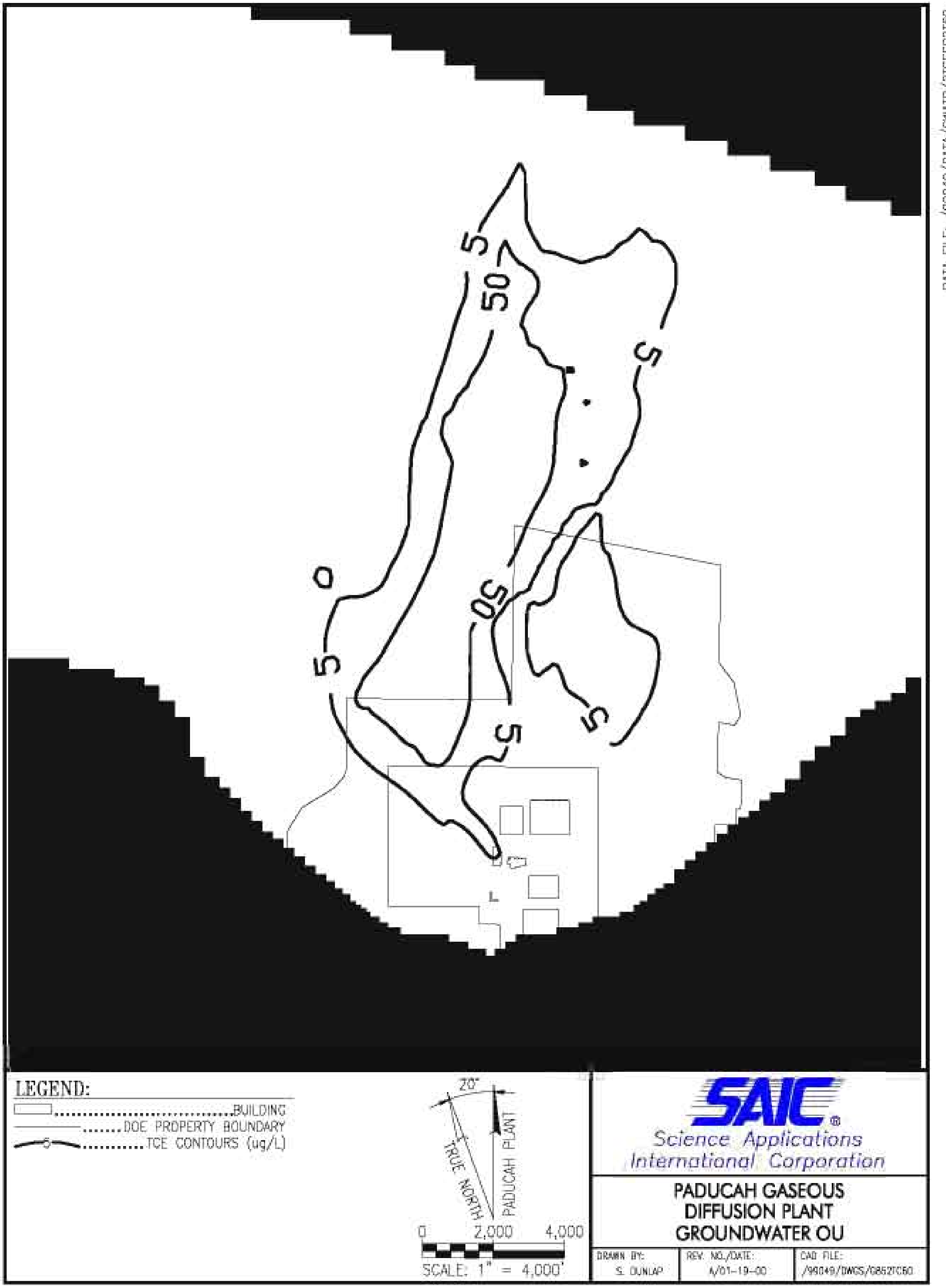


Fig. C1-5d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the Source Containment Alternative (2TCESP2T) at the PGDP, Paducah, Kentucky.

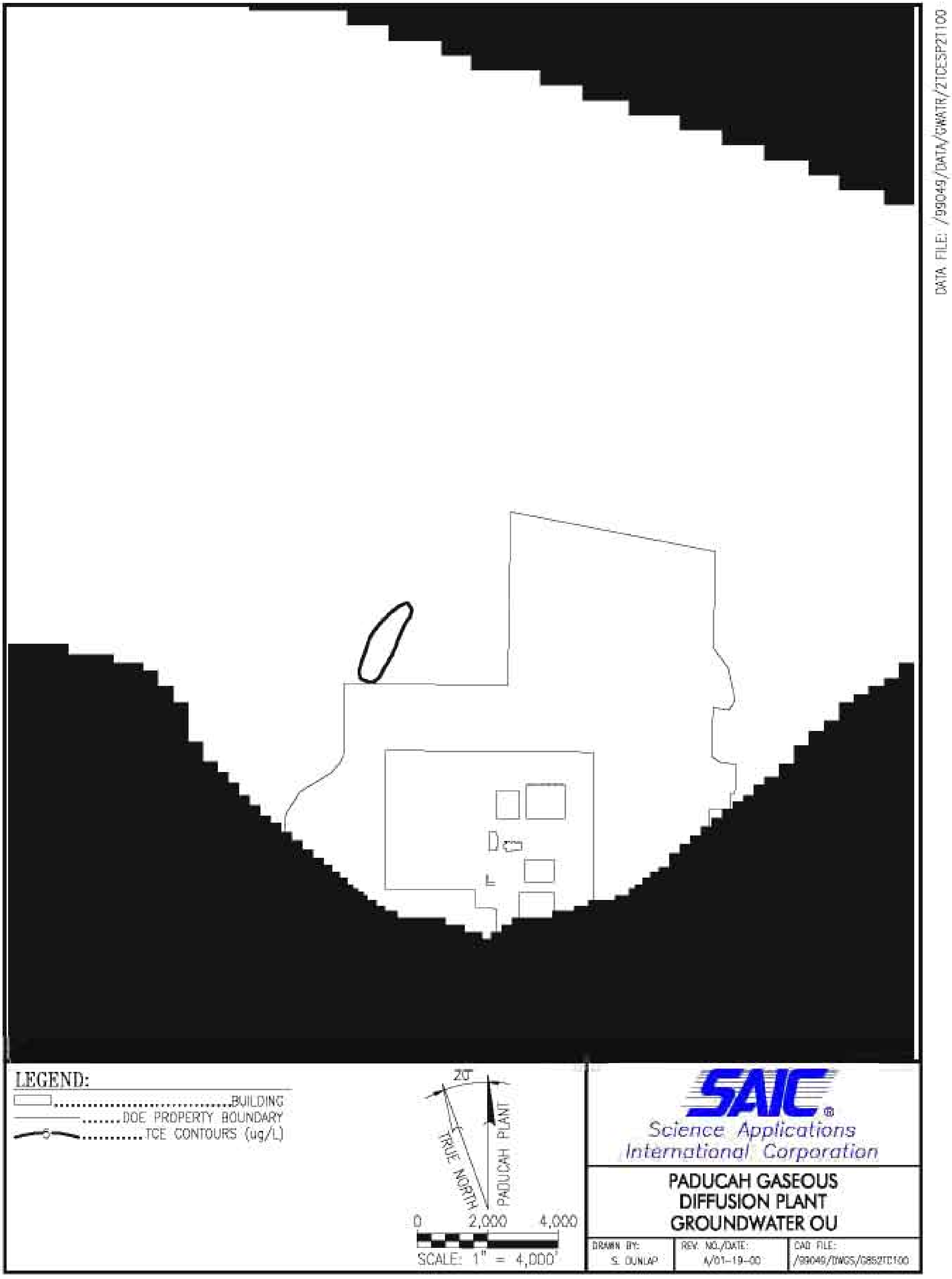


Fig. C1-5e. Predicted TCE concentration contours in μg/L at the end of 100-year simulation period for the Source Containment Alternative (2TCESP2T) at the PGDP, Paducah, Kentucky.

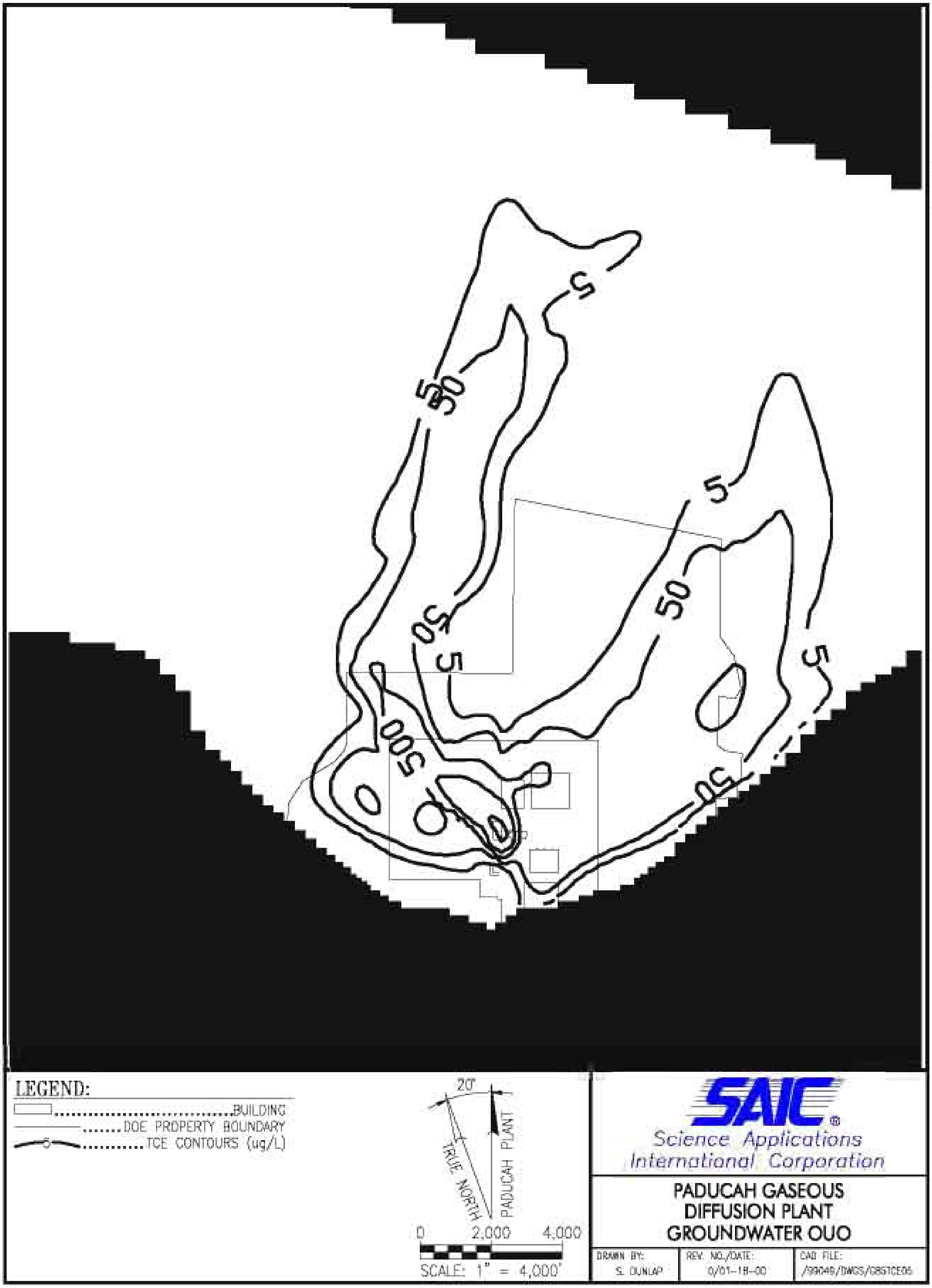


Fig. C1-6a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22TCESP2T) at the PGDP, Paducah, Kentucky.

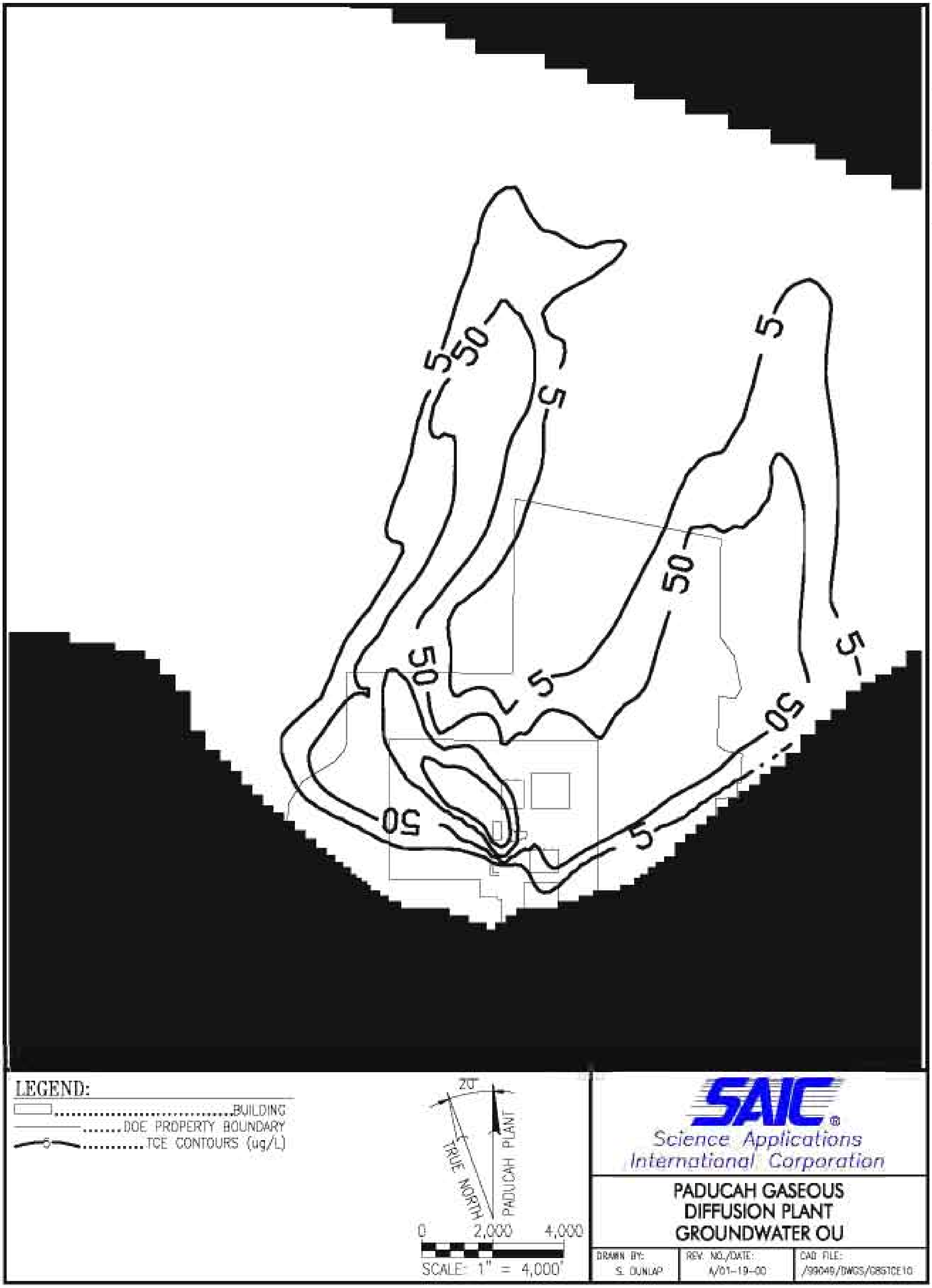


Fig. C1-6b. Predicted TCE concentration contonrs in μg/L at the end of 10-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22TCESP2T) at the PGDP, Padncah, Kentucky.

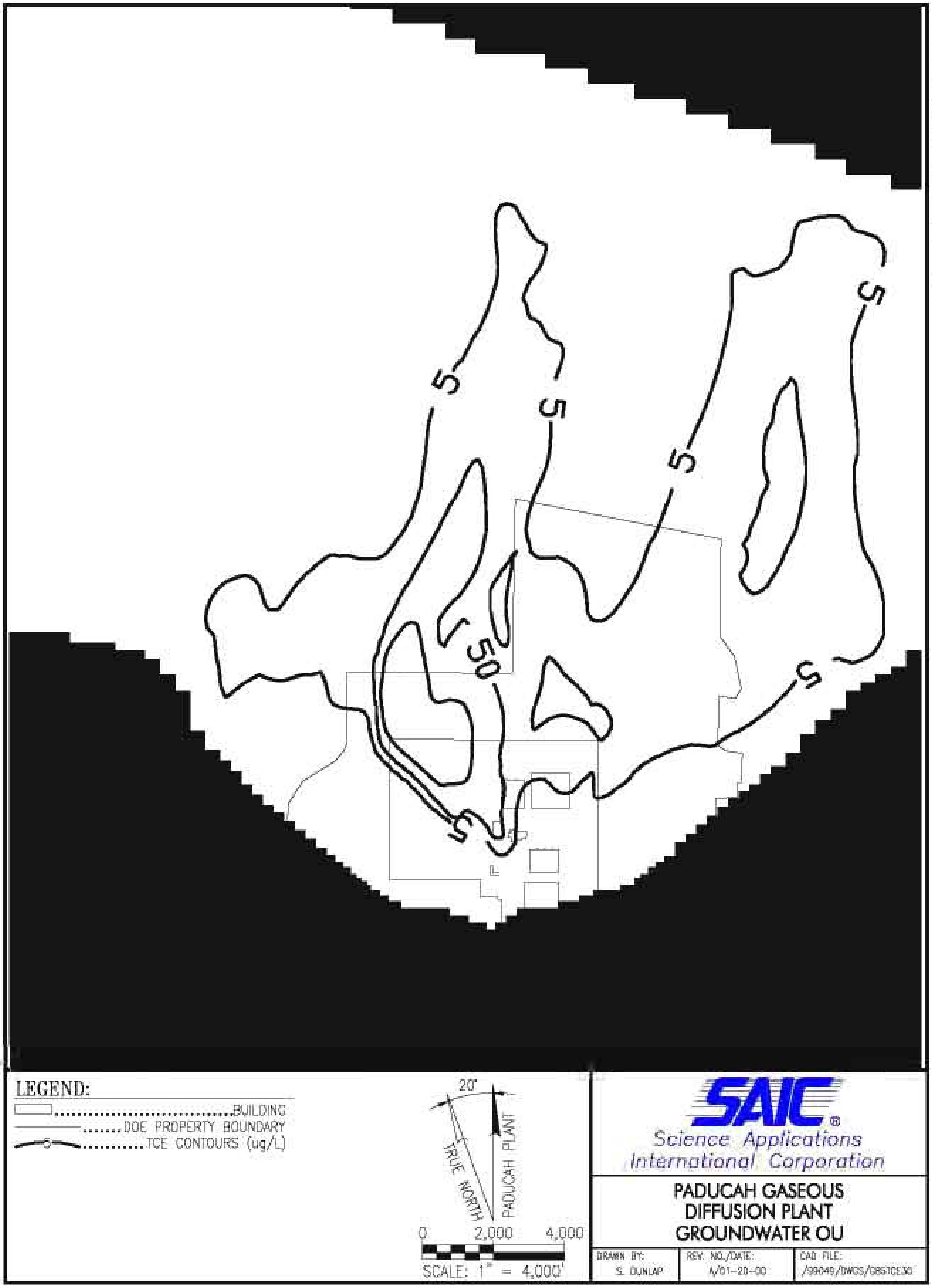


Fig. C1-6c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22TCESP2T) at the PGDP, Paducah, Kentucky.

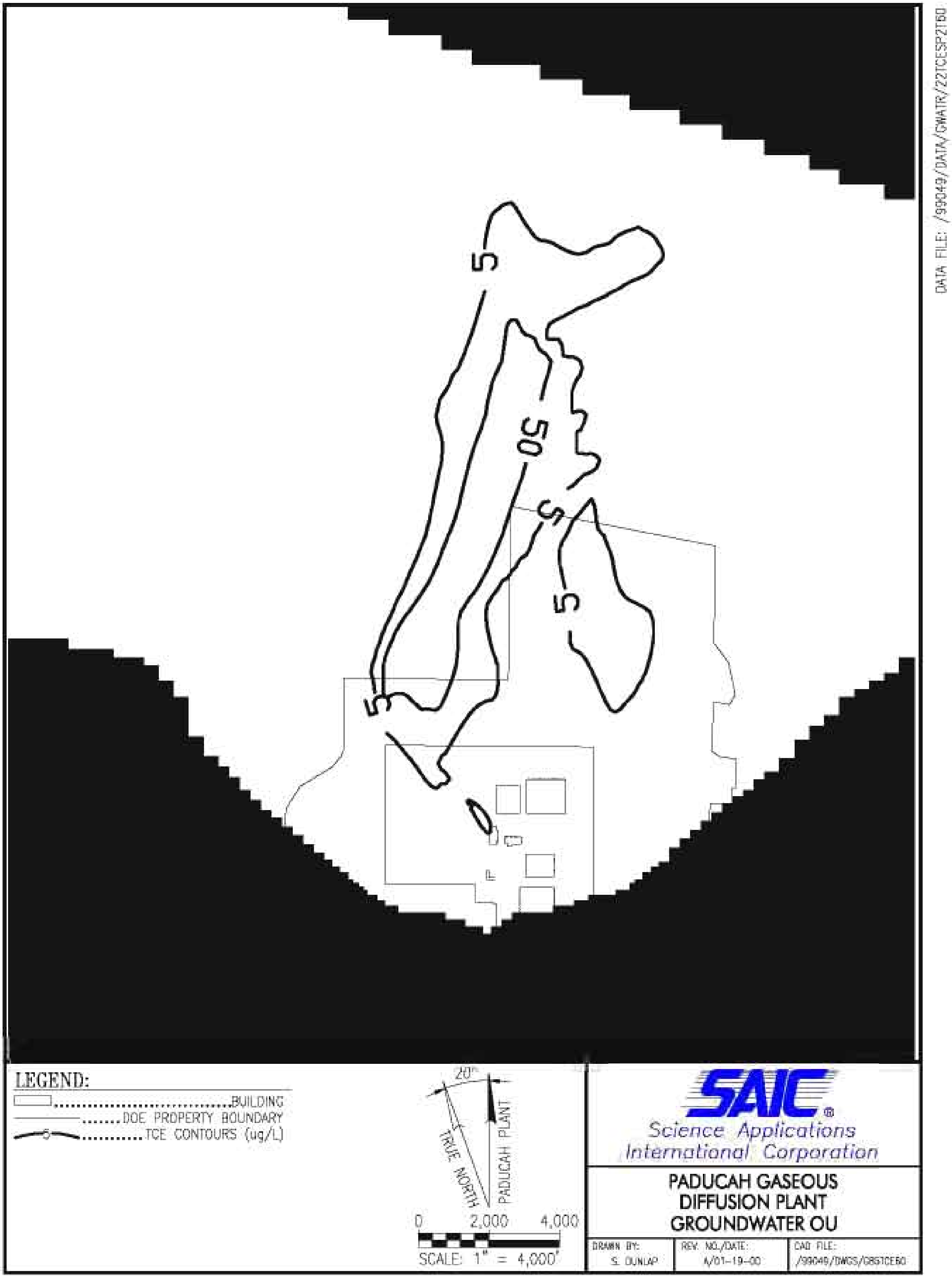


Fig. C1-6d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22TCESP2T) at the PGDP, Paducah, Kentucky.

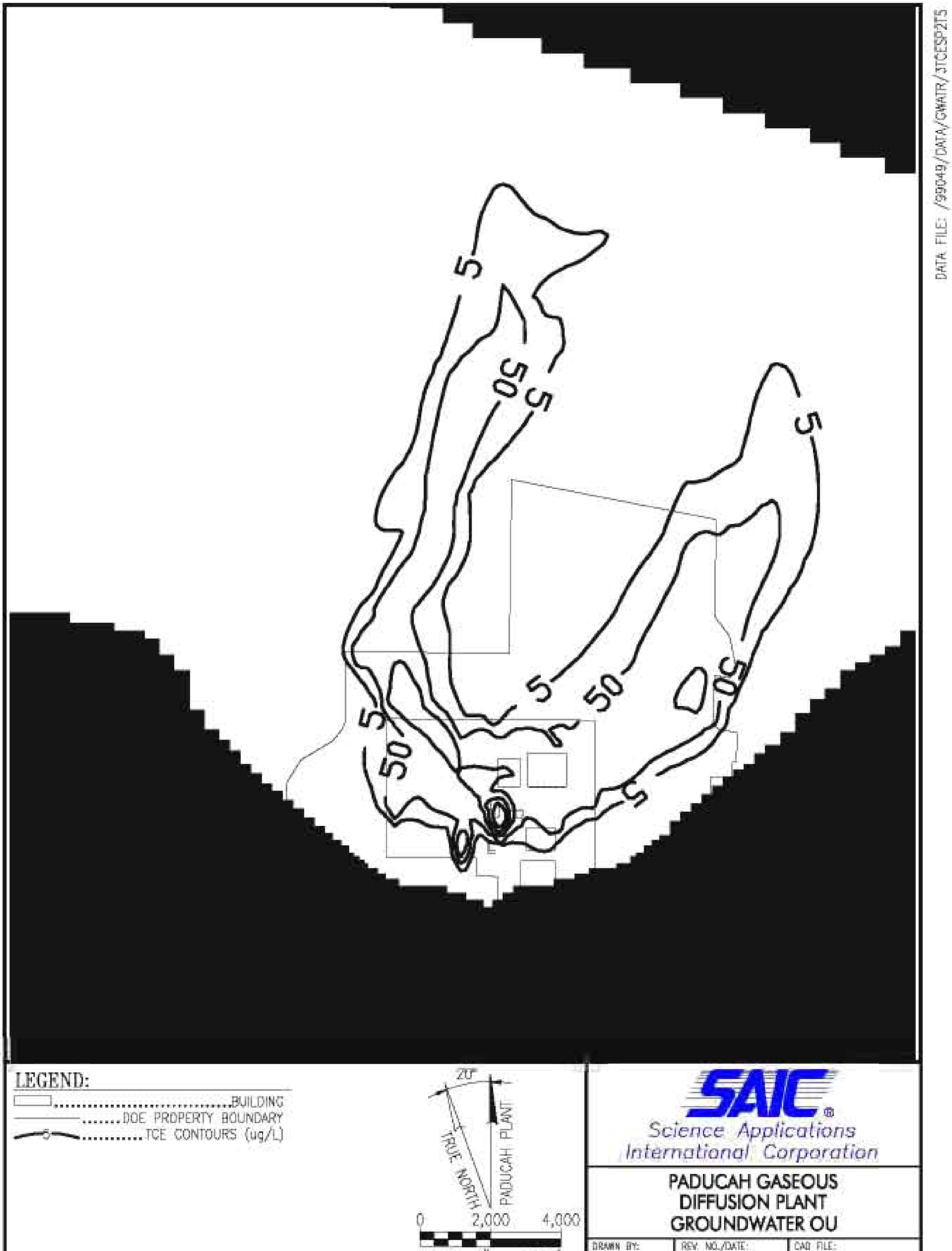


Fig. C1-7a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the Pump and Treat Alternative (3TCESP2T) at the PGDP, Paducah, Kentucky.

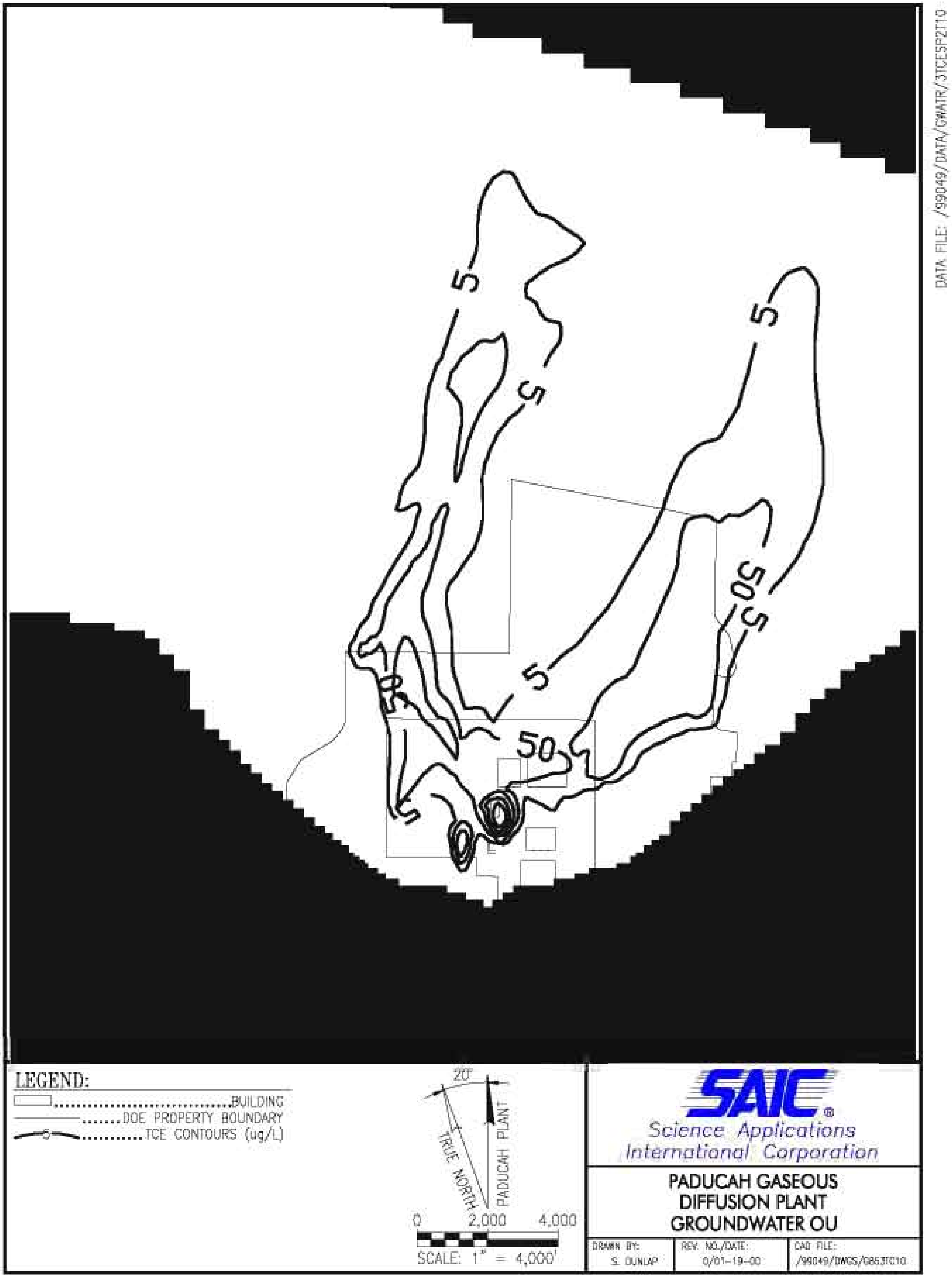


Fig. C1-7b. Predicted TCE concentration contours in μg/L at the end of 10-year simulation period for the pump and treat Alternative (3TCESP2T) at the PGDP, Paducah, Kentucky.

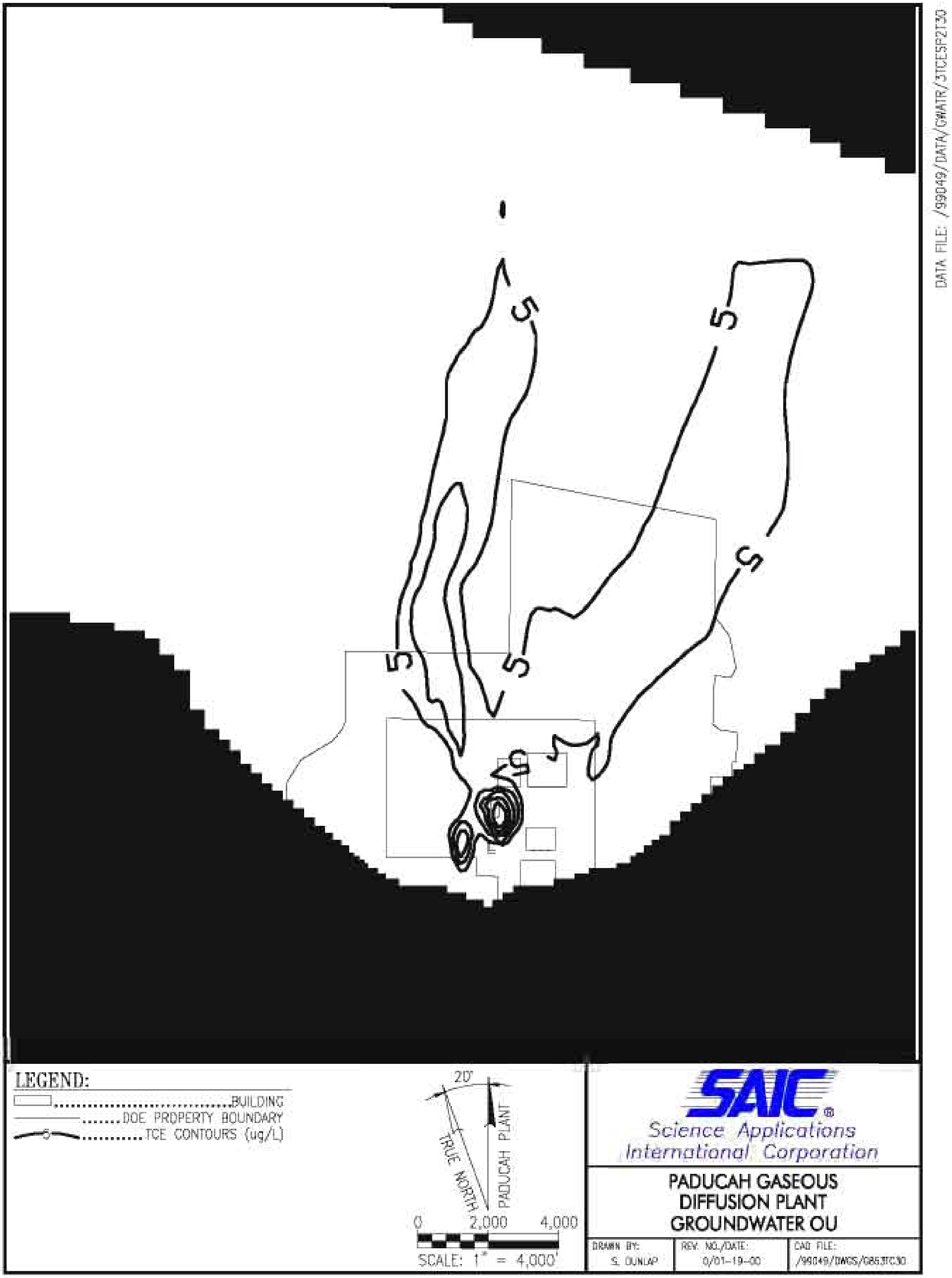


Fig. C1-7c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the Pump and Treat Alternative (3TCESP2T) at the PGDP, Paducah, Kentucky.

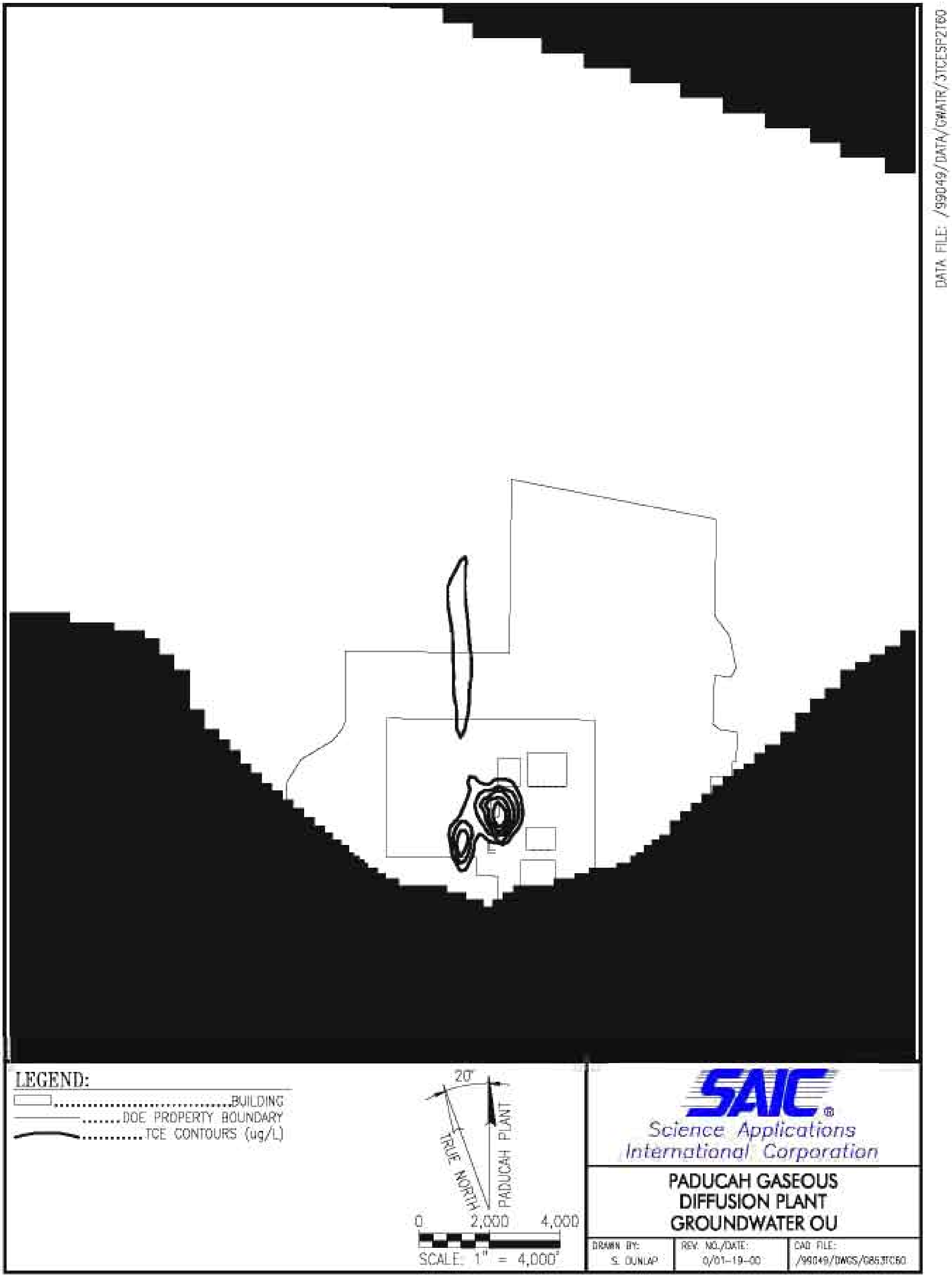


Fig. C1-7d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the Pump and Treat Alternative (3TCESP2T) at the PGDP, Paducah, Kentucky.

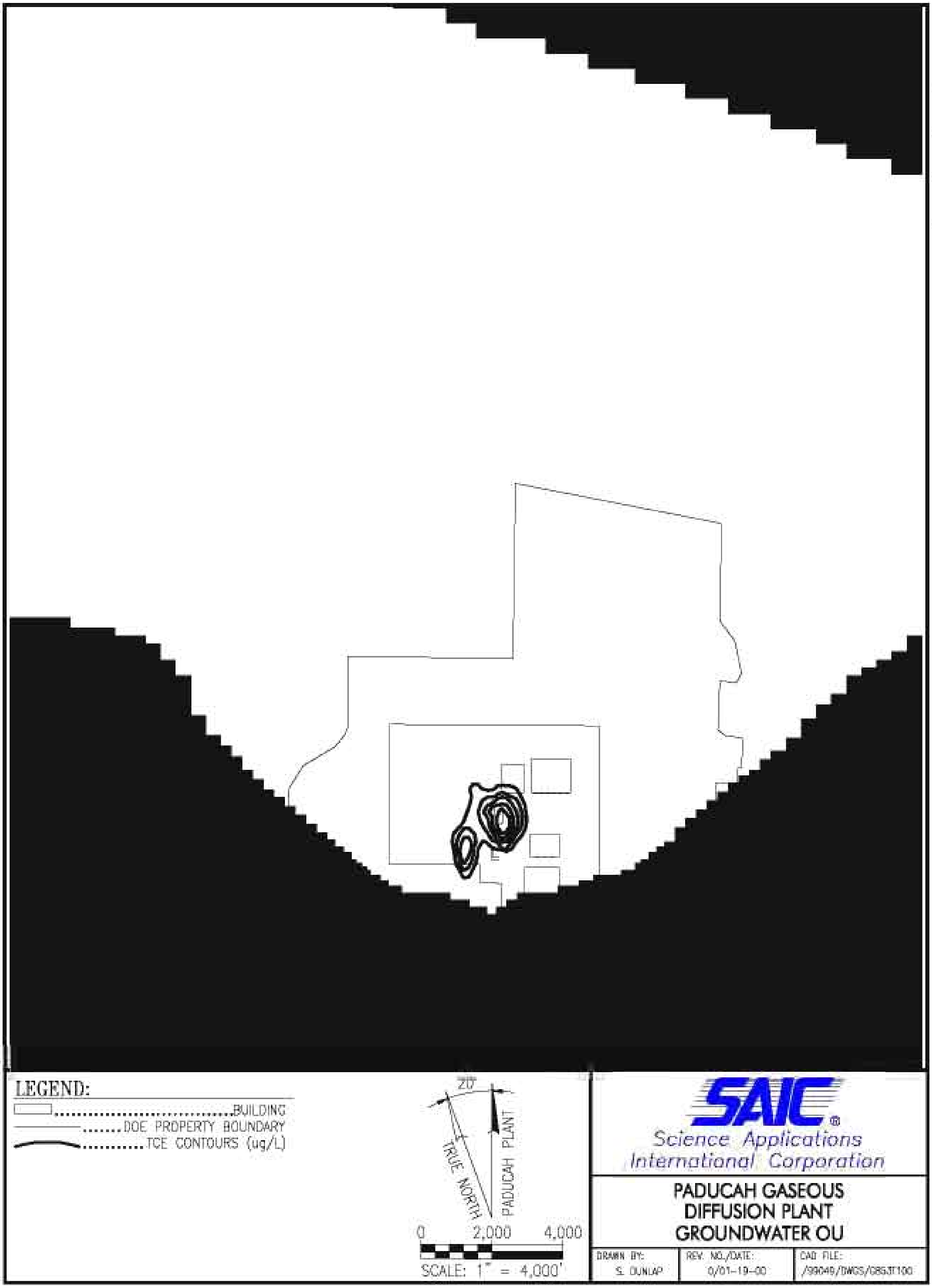


Fig. C1-7e. Predicted TCE concentration contours in μg/L at the end of 100-year simulation period for the Pump and Treat Alternative (3TCESP2T) at the PGDP, Paducah, Kentucky.

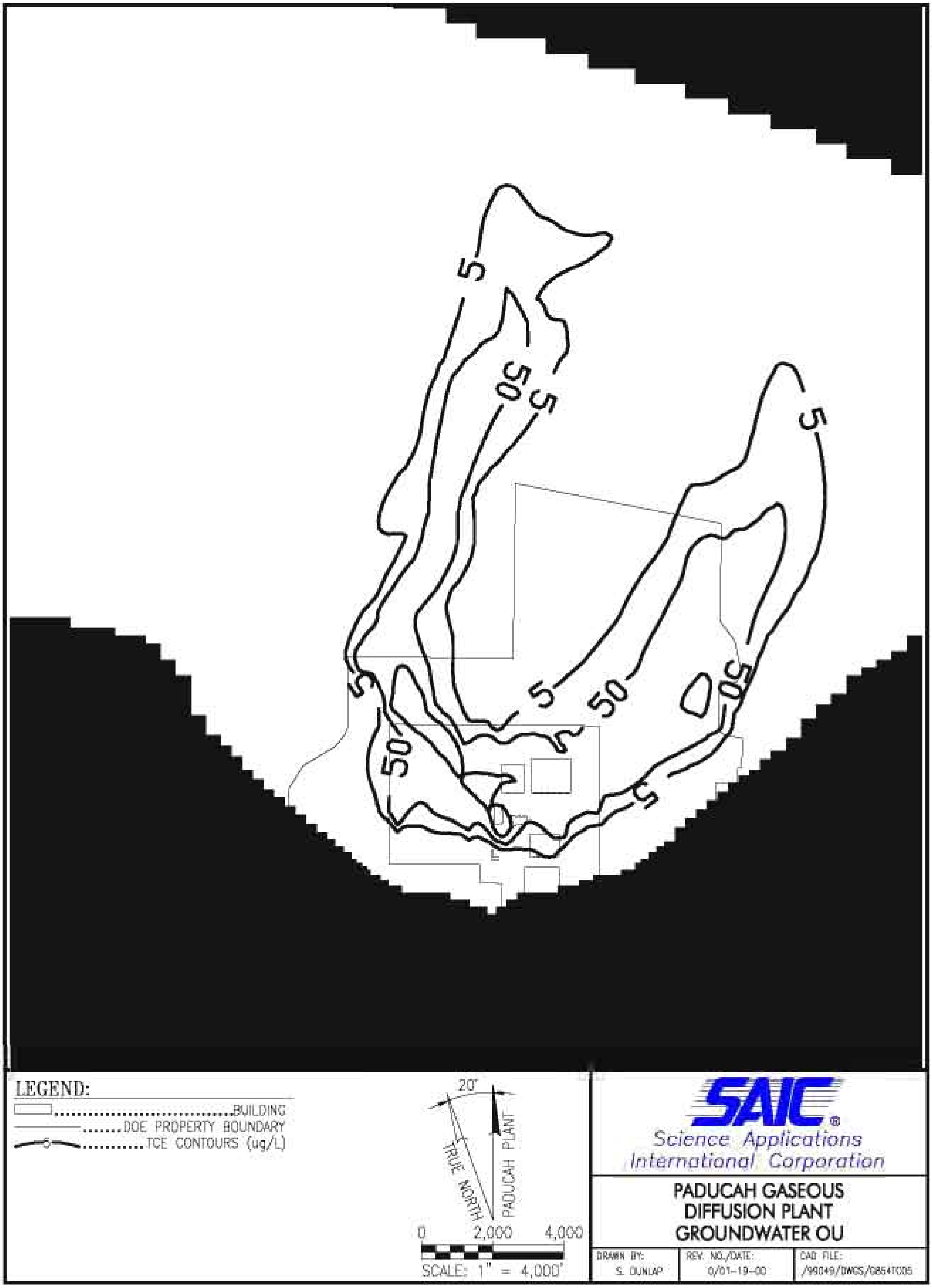


Fig. C1-8a. Predicted TCE concentration contours in μg/L at the end of 5-year simulation period for the Source Containment Alternative with Pump and Treat (4TCESP2T) at the PGDP, Paducah, Kentucky.

Fig. C1-8b. Predicted TCE concentration contours in μg/L at the end of 10-year simulation period for the Sonrce Containment Alternative with Pump and Treat (4TCESP2T) at the PGDP, Paducah, Kentucky.

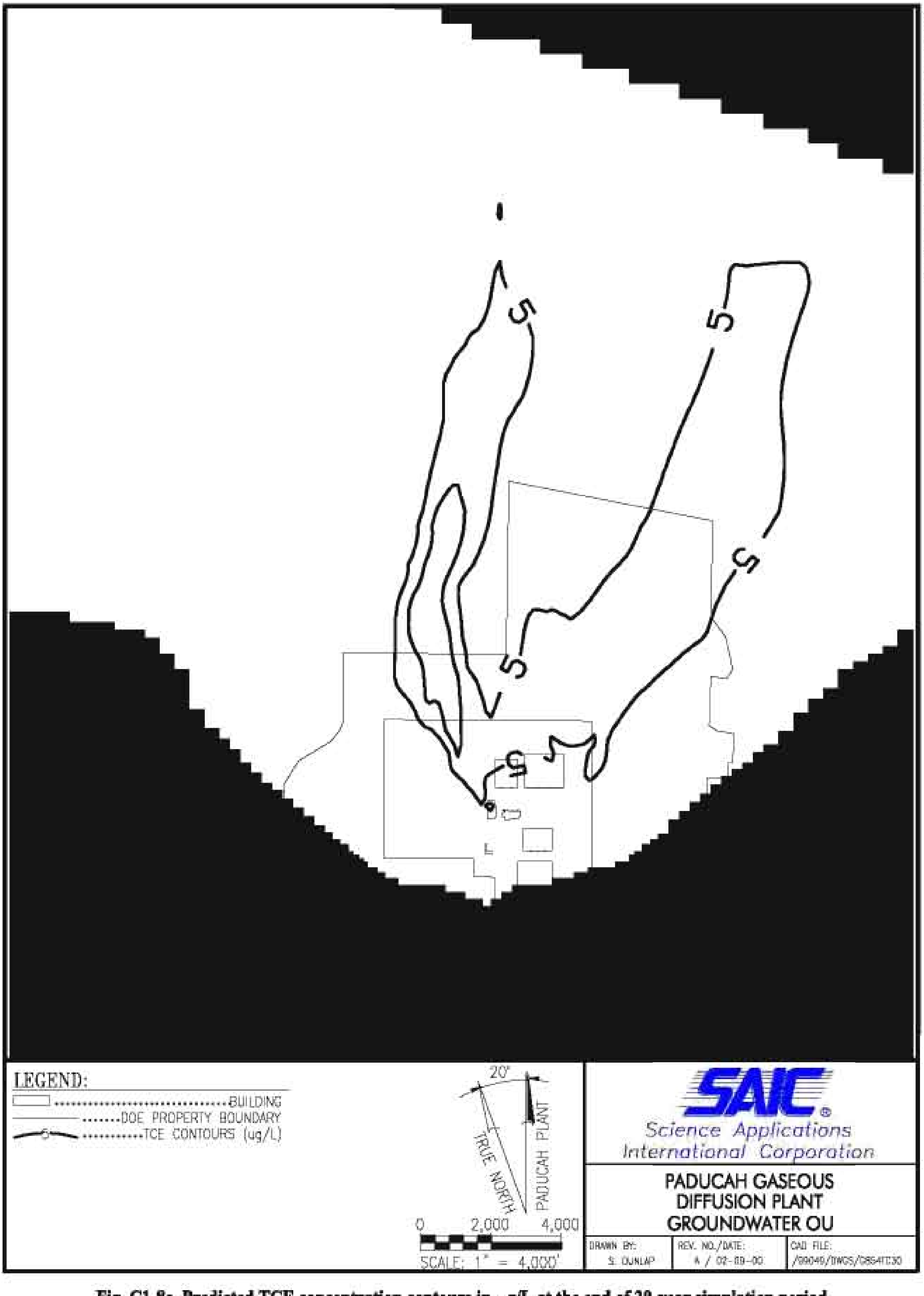


Fig. C1-8c. Predicted TCE concentration contours in μg/L at the end of 30-year simulation period for the Source Containment Alternative with Pump and Treat (4TCESP2T) at the PGDP, Paducah, Kentucky.

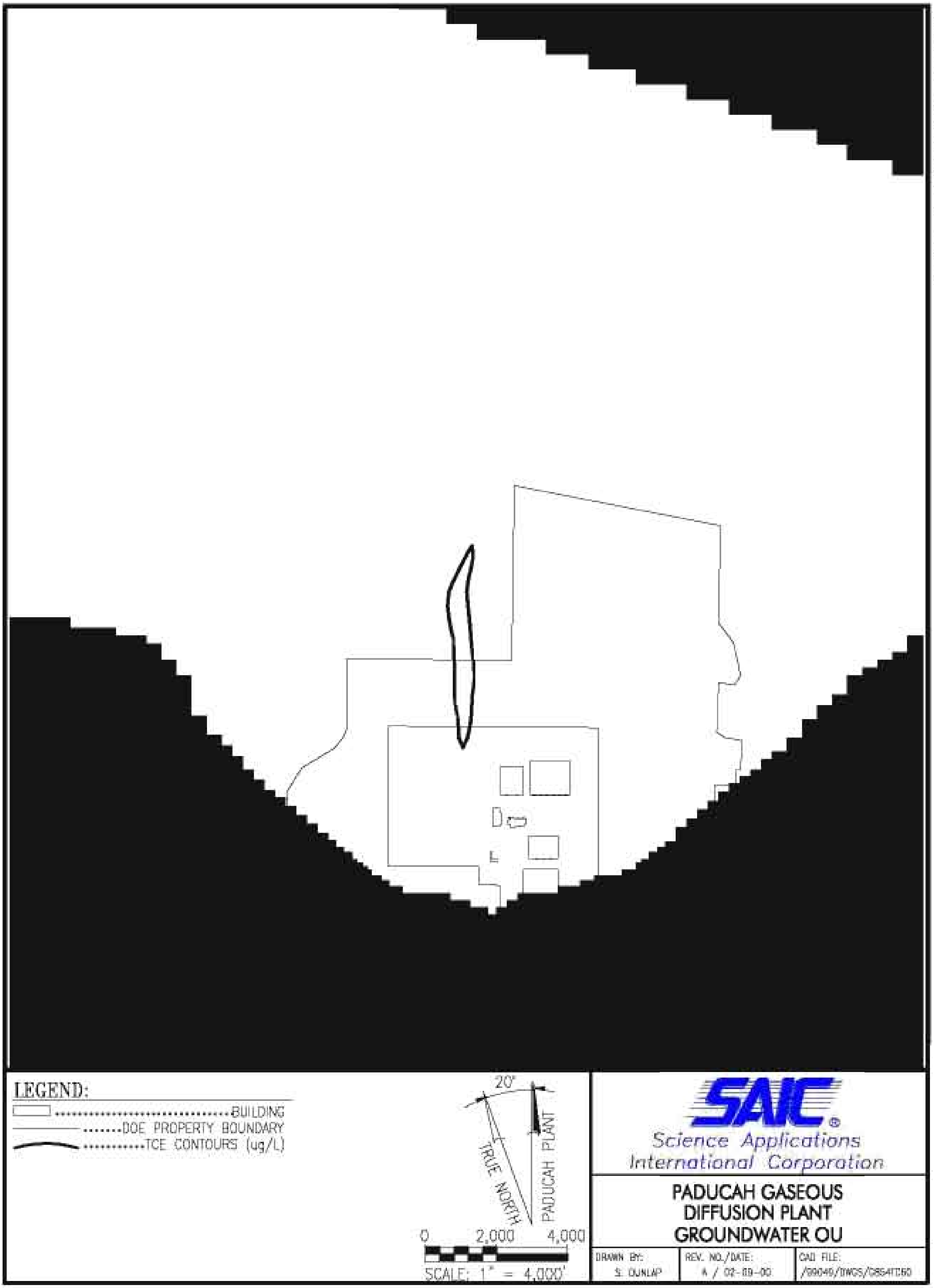


Fig. C1-8d. Predicted TCE concentration contours in μg/L at the end of 60-year simulation period for the Sonrce Containment Alternative with Pump and Treat (4TCESP2T) at the PGDP, Paducah, Kentucky.

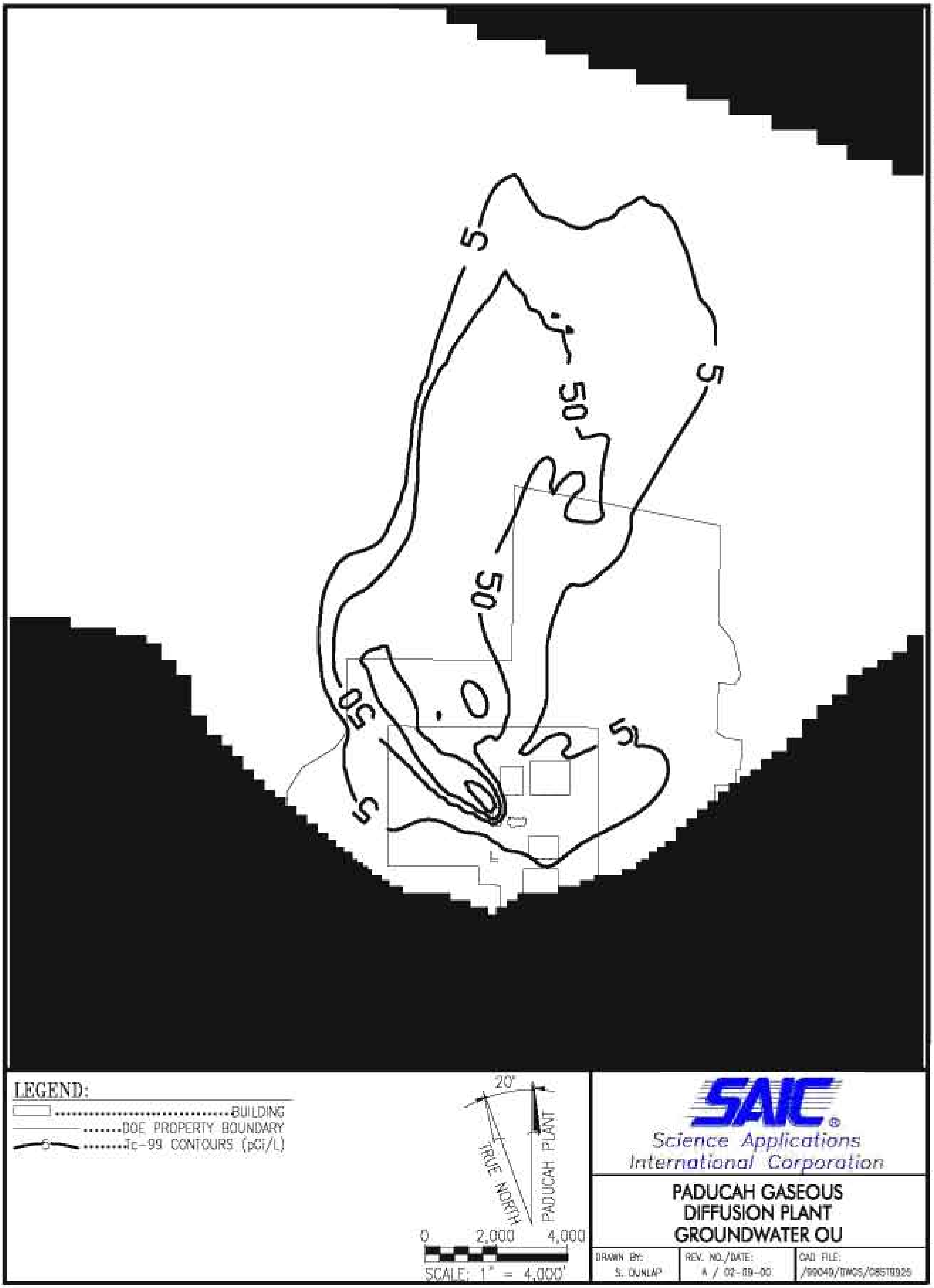


Fig. C1-9a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah, Kentucky.

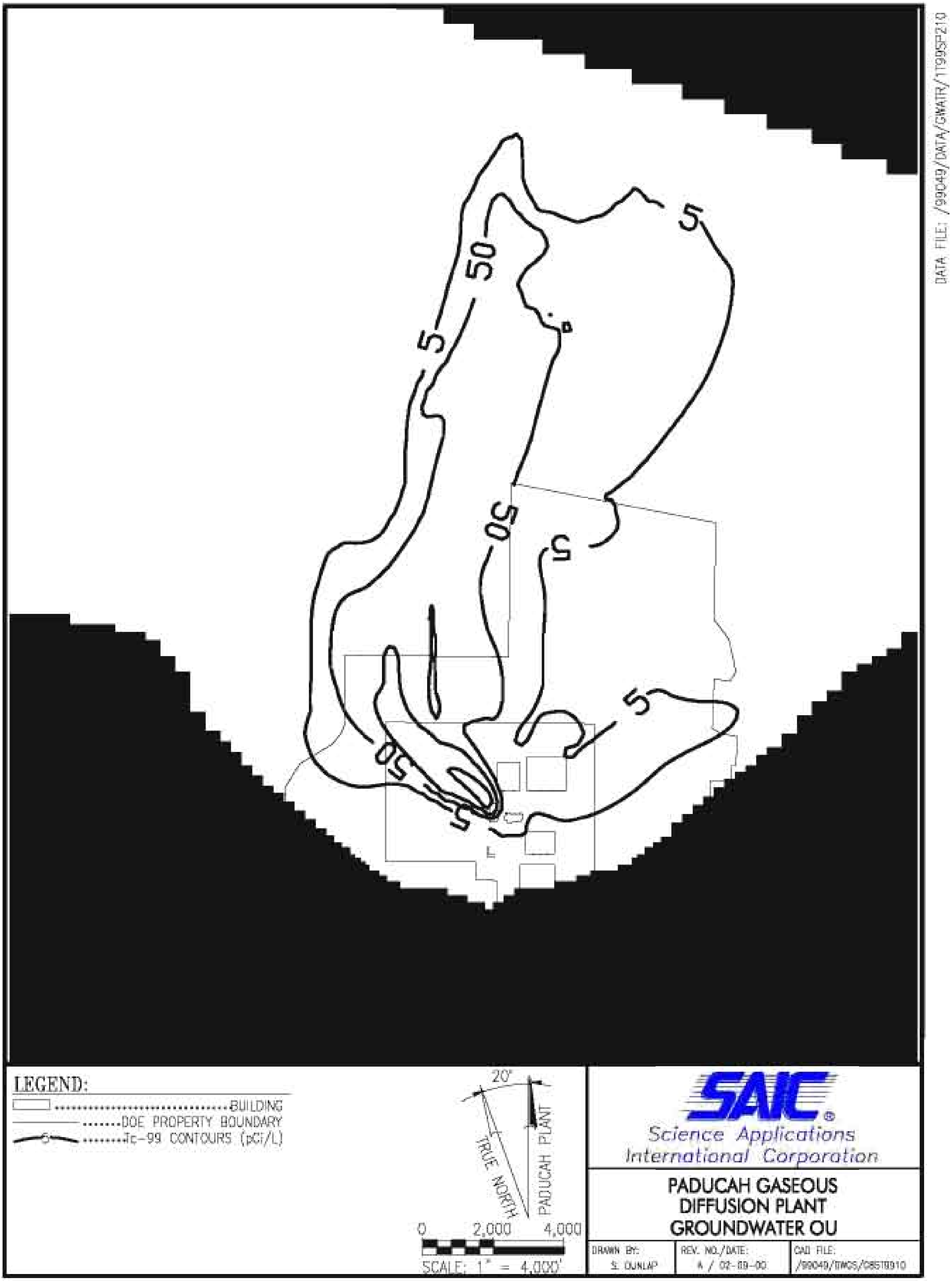


Fig. C1-9b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah, Kentucky.

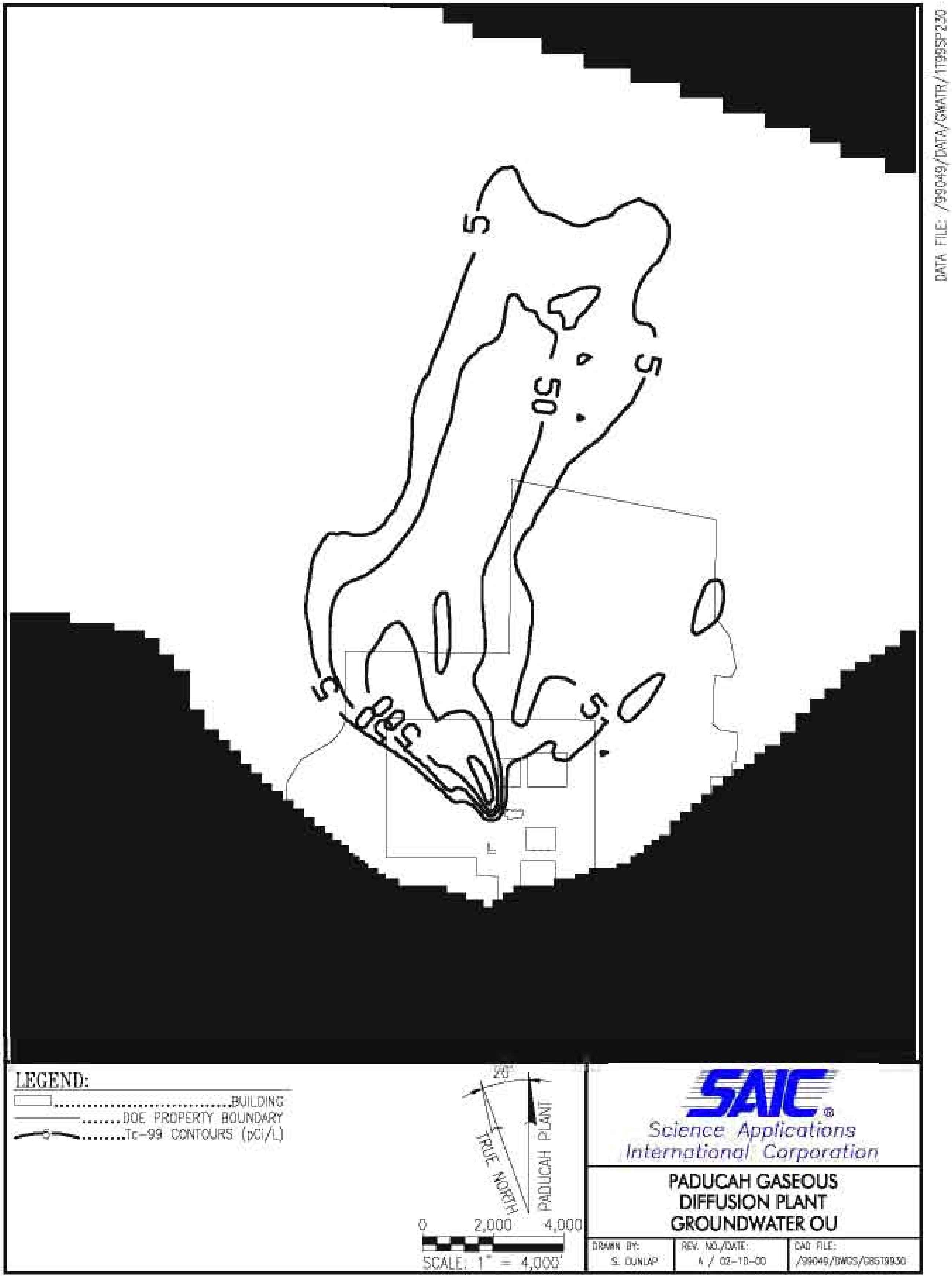


Fig. C1-9c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah Kentucky.

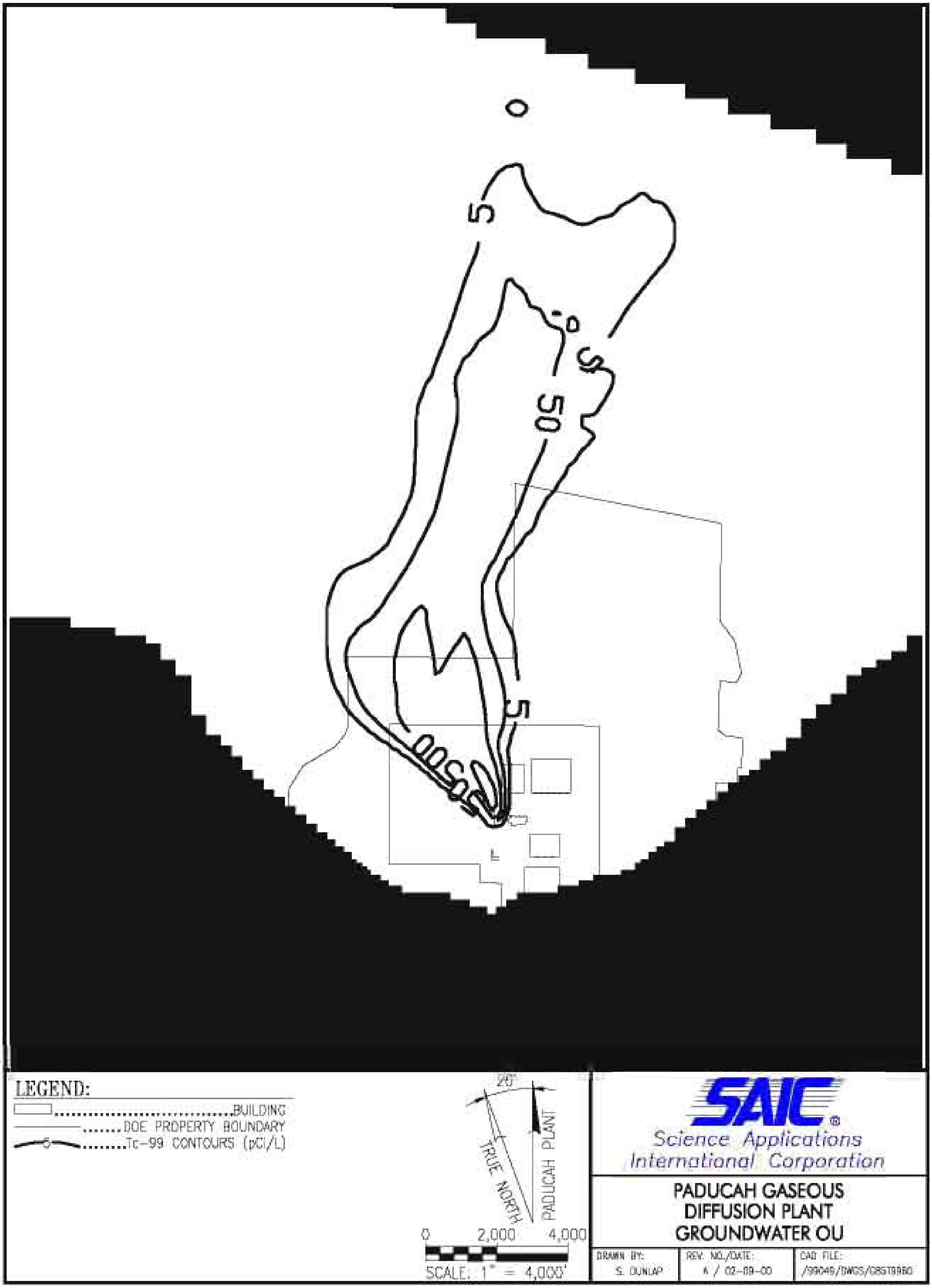


Fig. C1-9d. Predicted Tc-99 concentration contours in pCi/L at the end of 60-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah Kentucky.

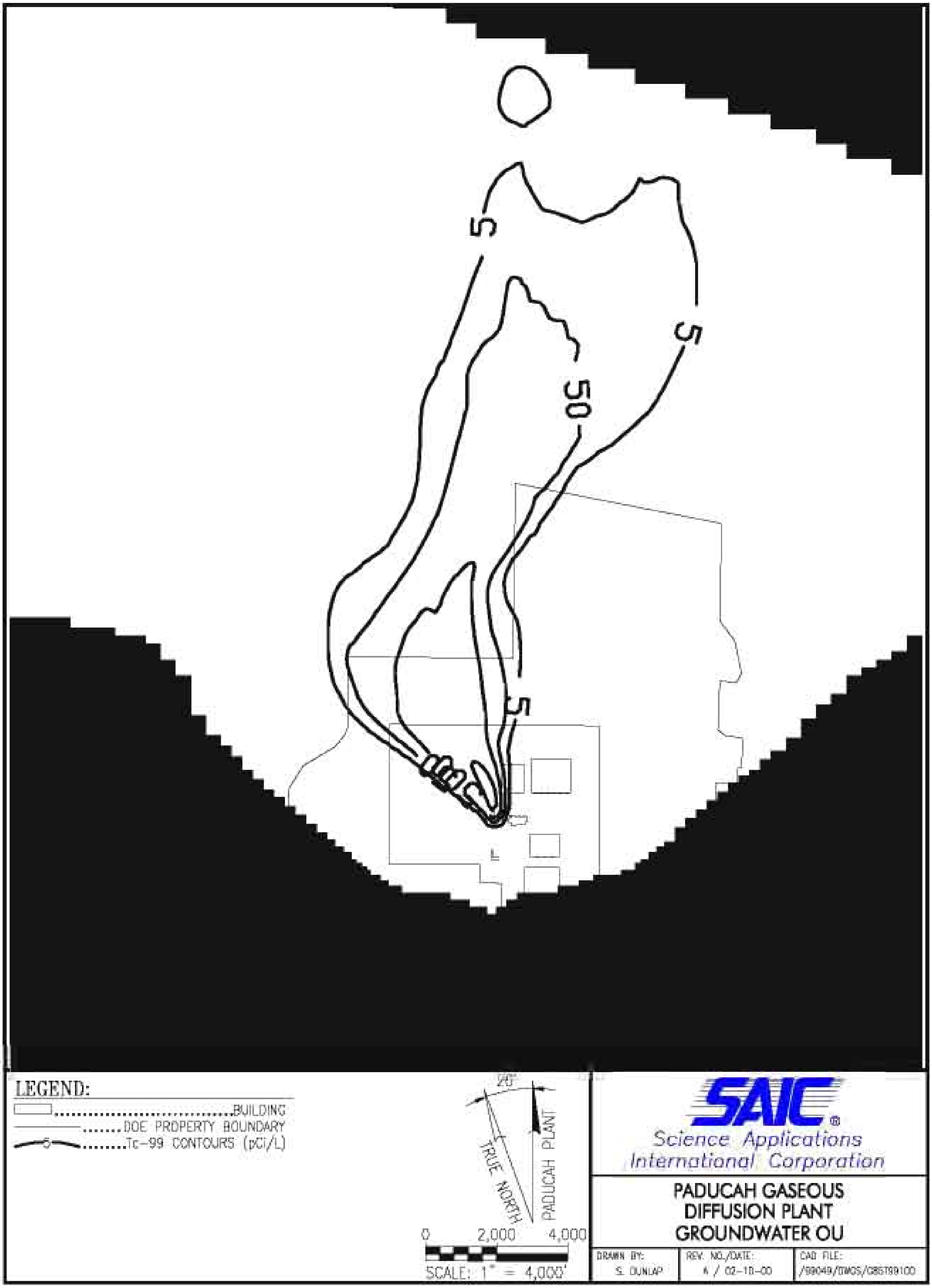


Fig. C1-9e. Predicted Tc-99 concentration contours in pCi/L at the end of 100-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah Kentucky.

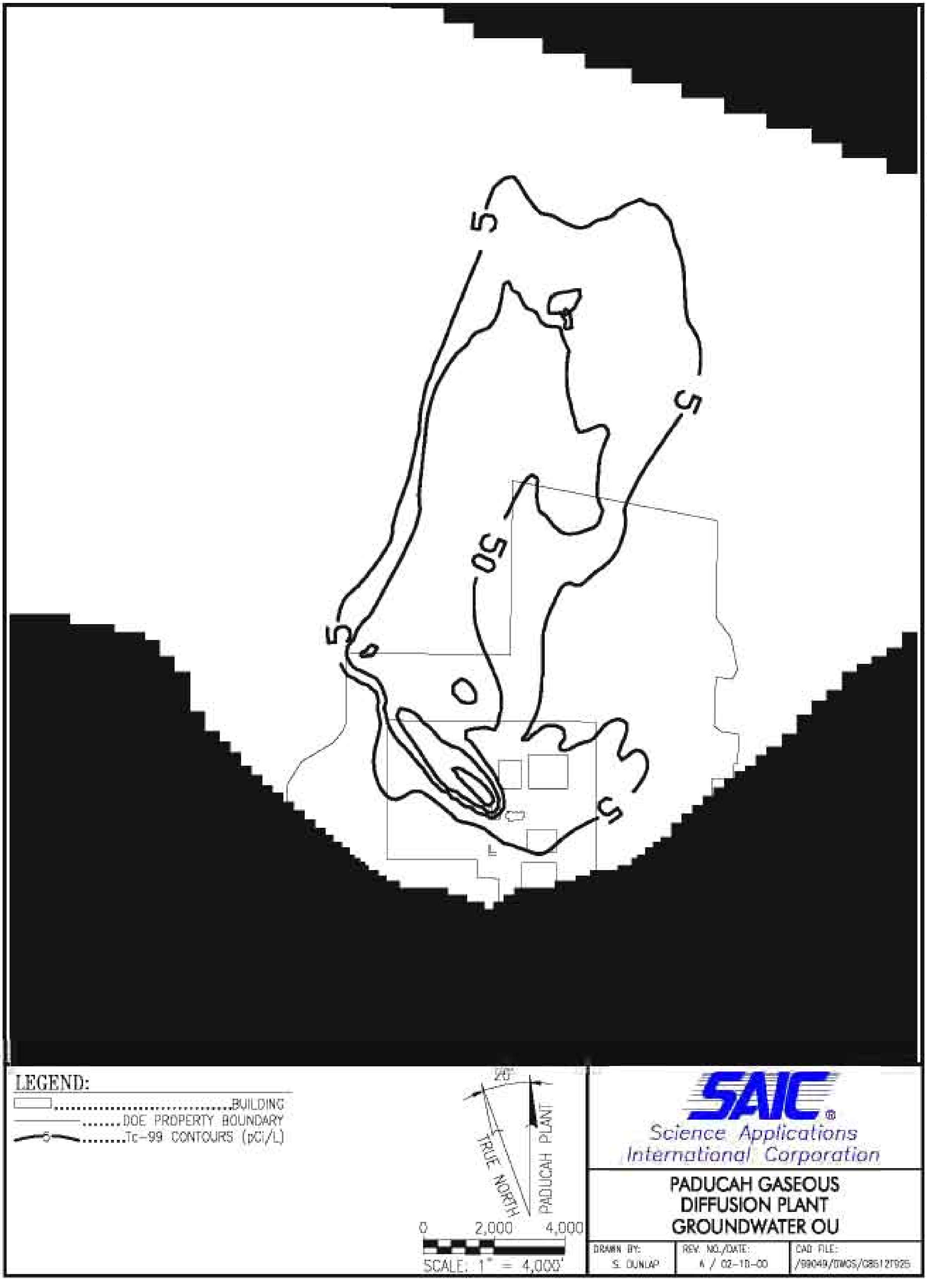


Fig. C1-10a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the No Action Alternative with NW/NE Wells pumping (12T99SP2) at the PGDP, Paducah, Kentucky.

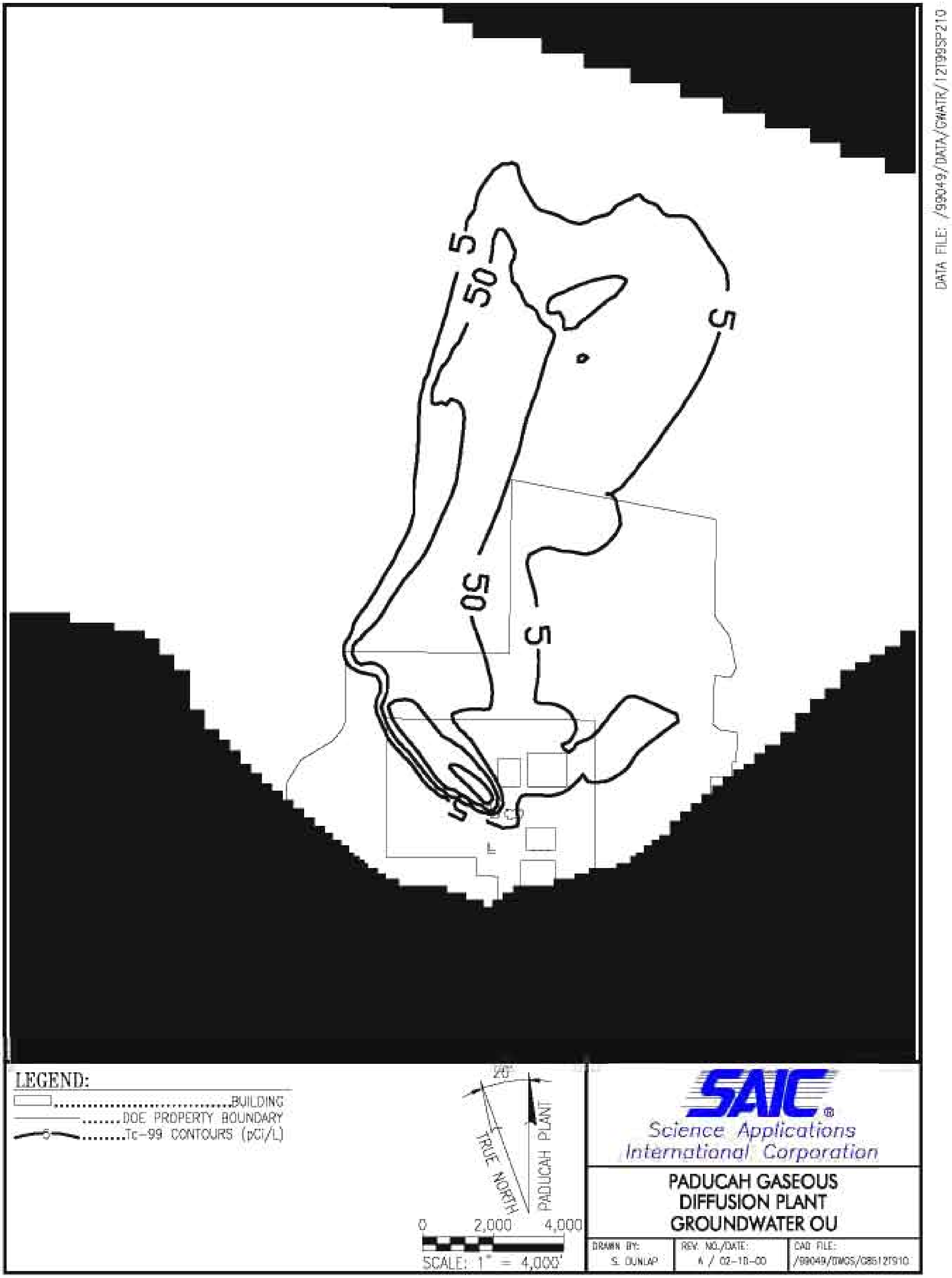


Fig. C1-10b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the No Action Alternative with NW/NE Wells pumping (12T99SP2) at the PGDP, Paducah, Kentucky.

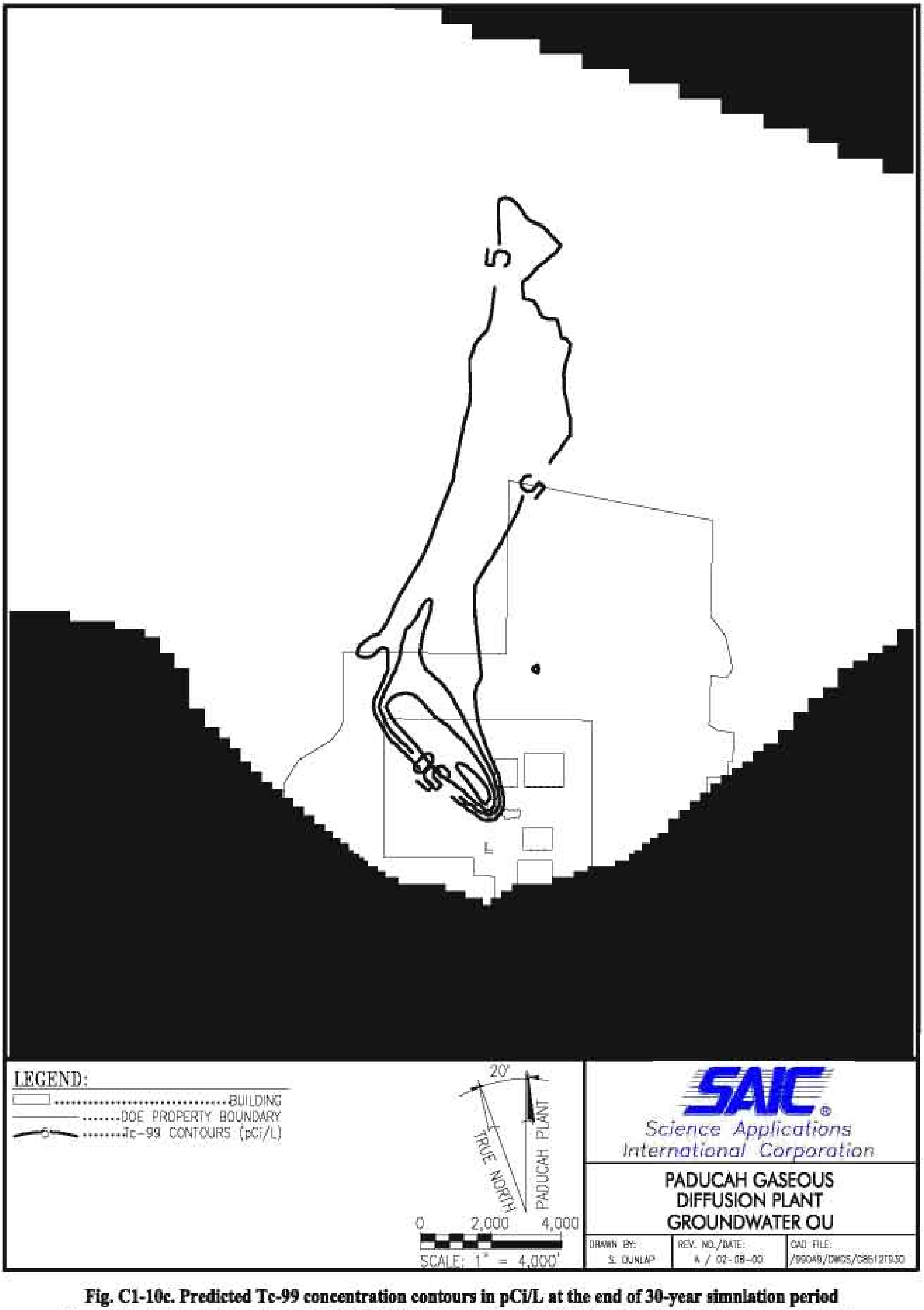


Fig. C1-10c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simulation period for the No Action Alternative with NW/NE Wells pumping (12T99SP2) at the PGDP, Paducah, Kentucky.

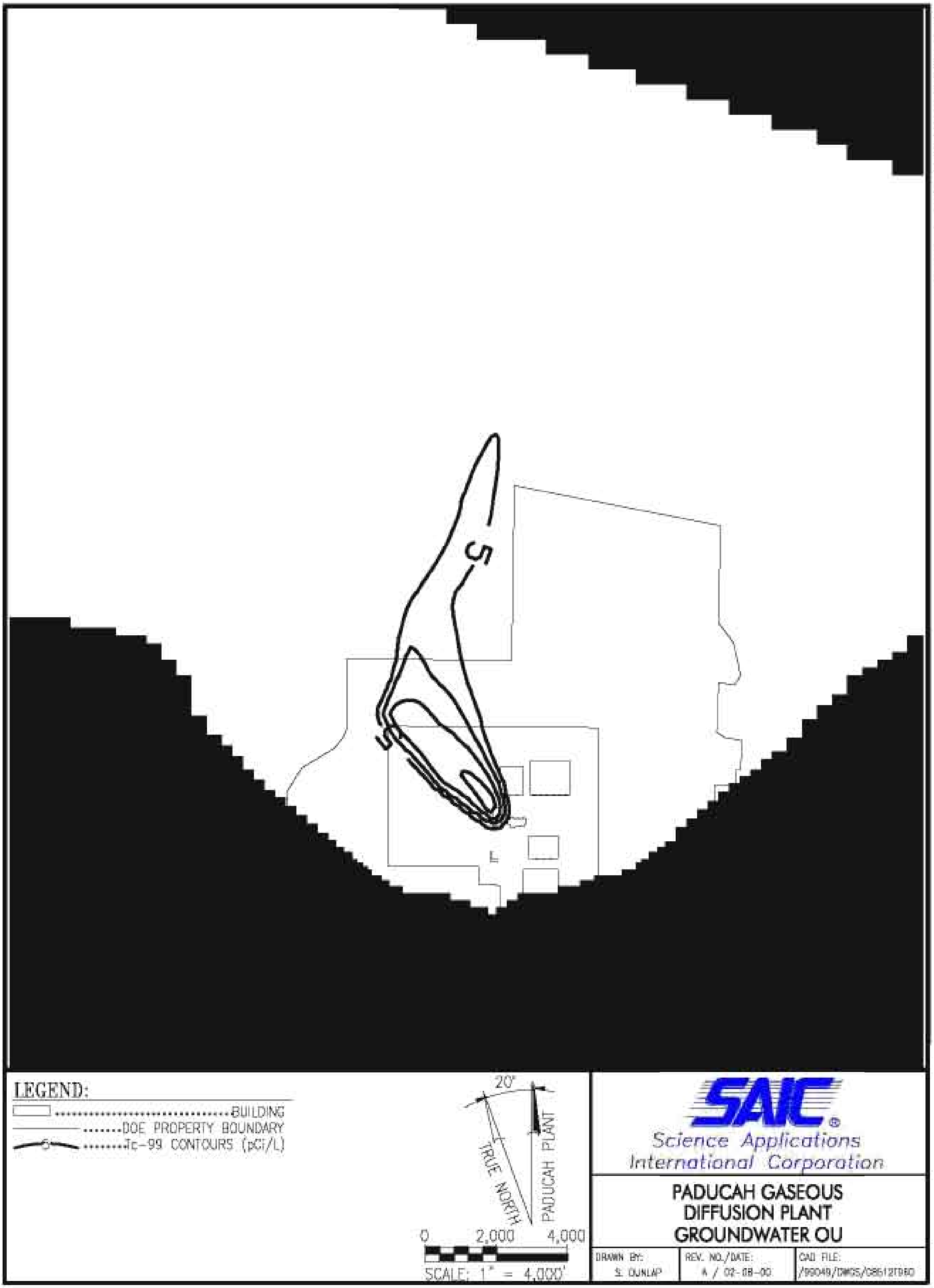


Fig. C1-10d. Predicted Tc-99 concentration contours in pCi/L at the end of 60-year simulation period for the No Action Alternative with NW/NE Wells pumping (12T99SP2) at the PGDP, Paducah, Kentucky.

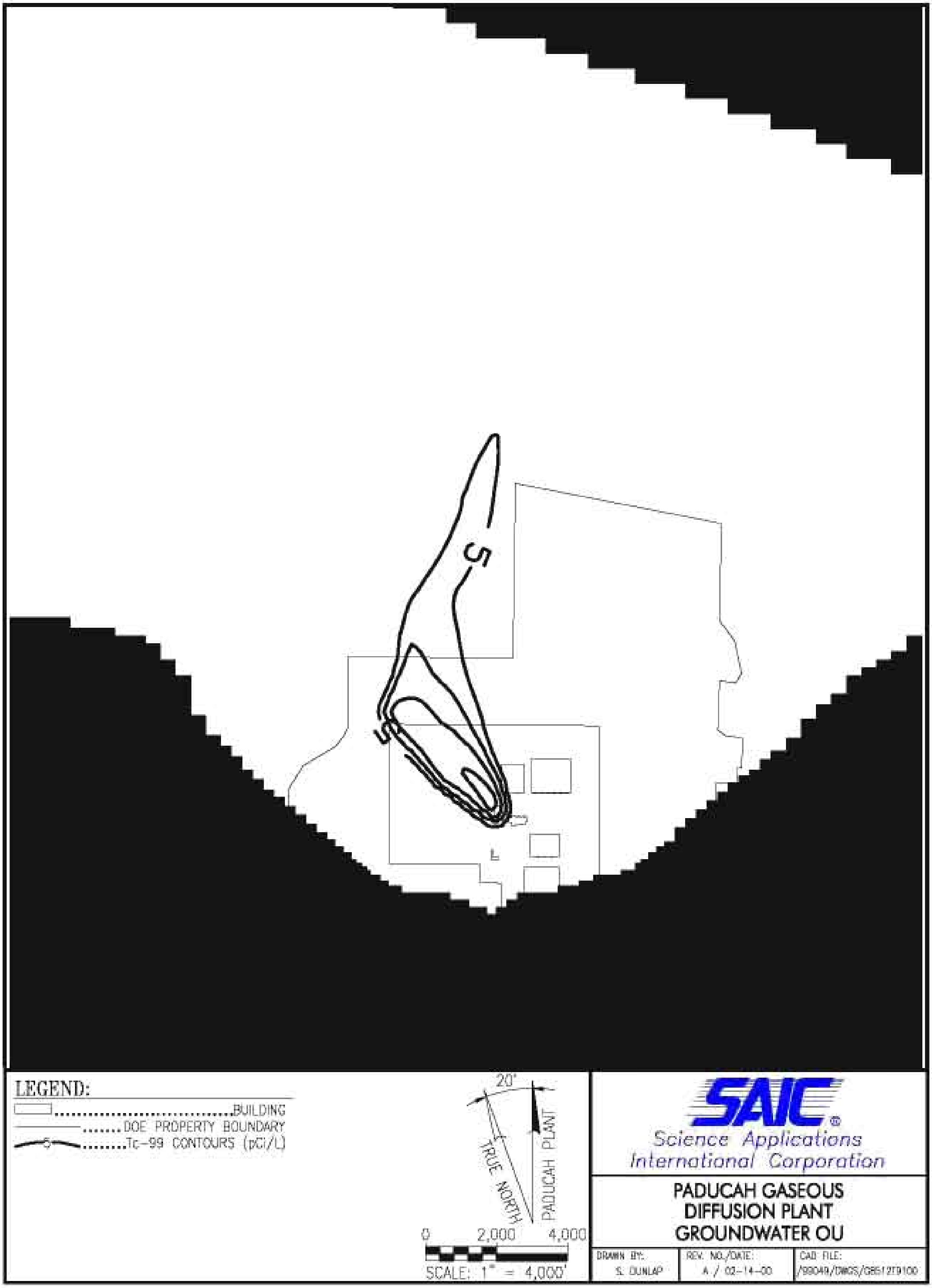


Fig. C1-10e. Predicted Tc-99 concentration contours in pCi/L at the end of 100-year simulation period for the No Action Alternative with NW/NE Wells pumping (12T99SP2) at the PGDP, Paducah, Kentucky.

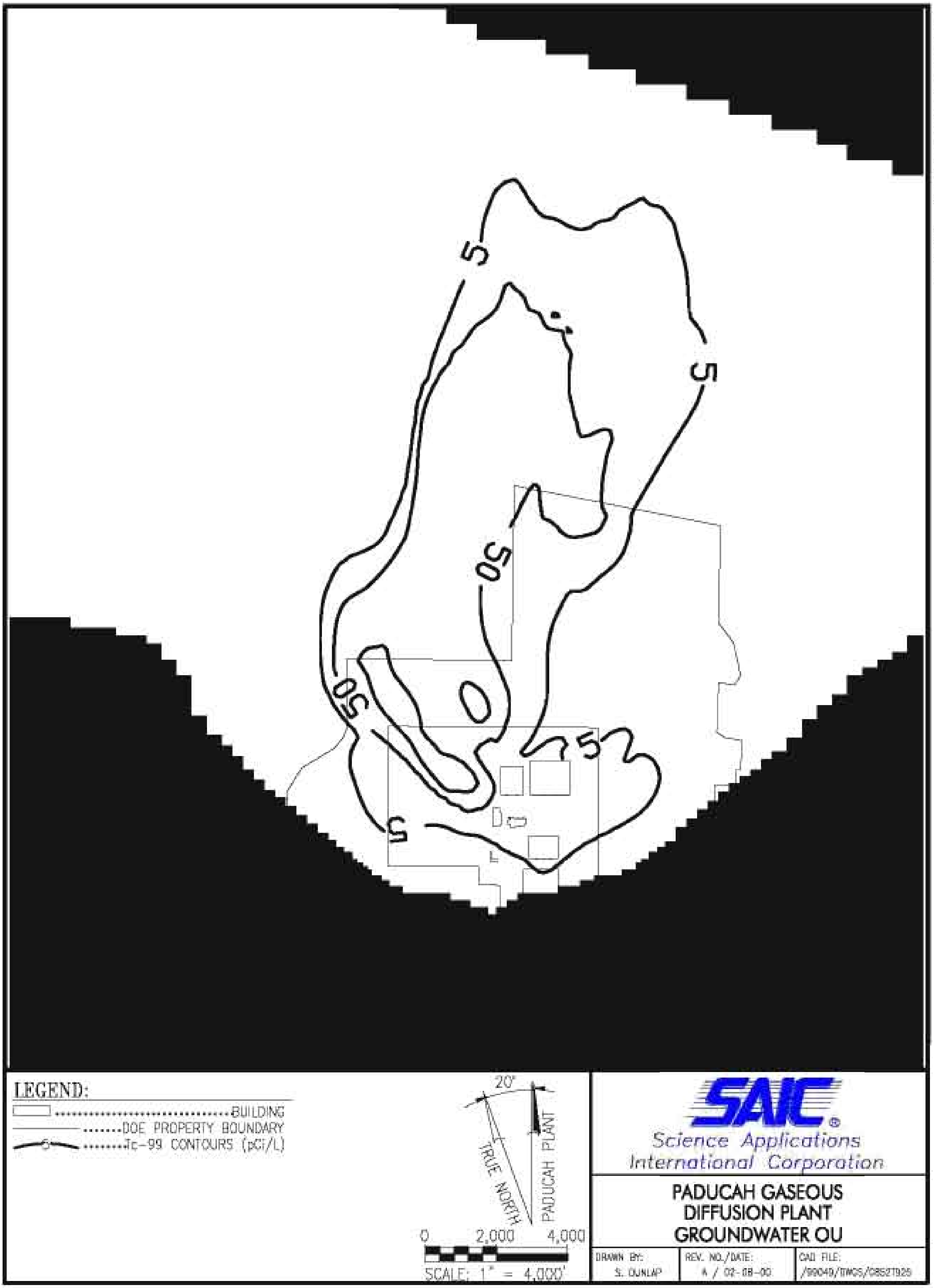


Fig. C1-11a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the Source Containment Alternative (12T99SP2) at the PGDP, Paducah, Kentucky.

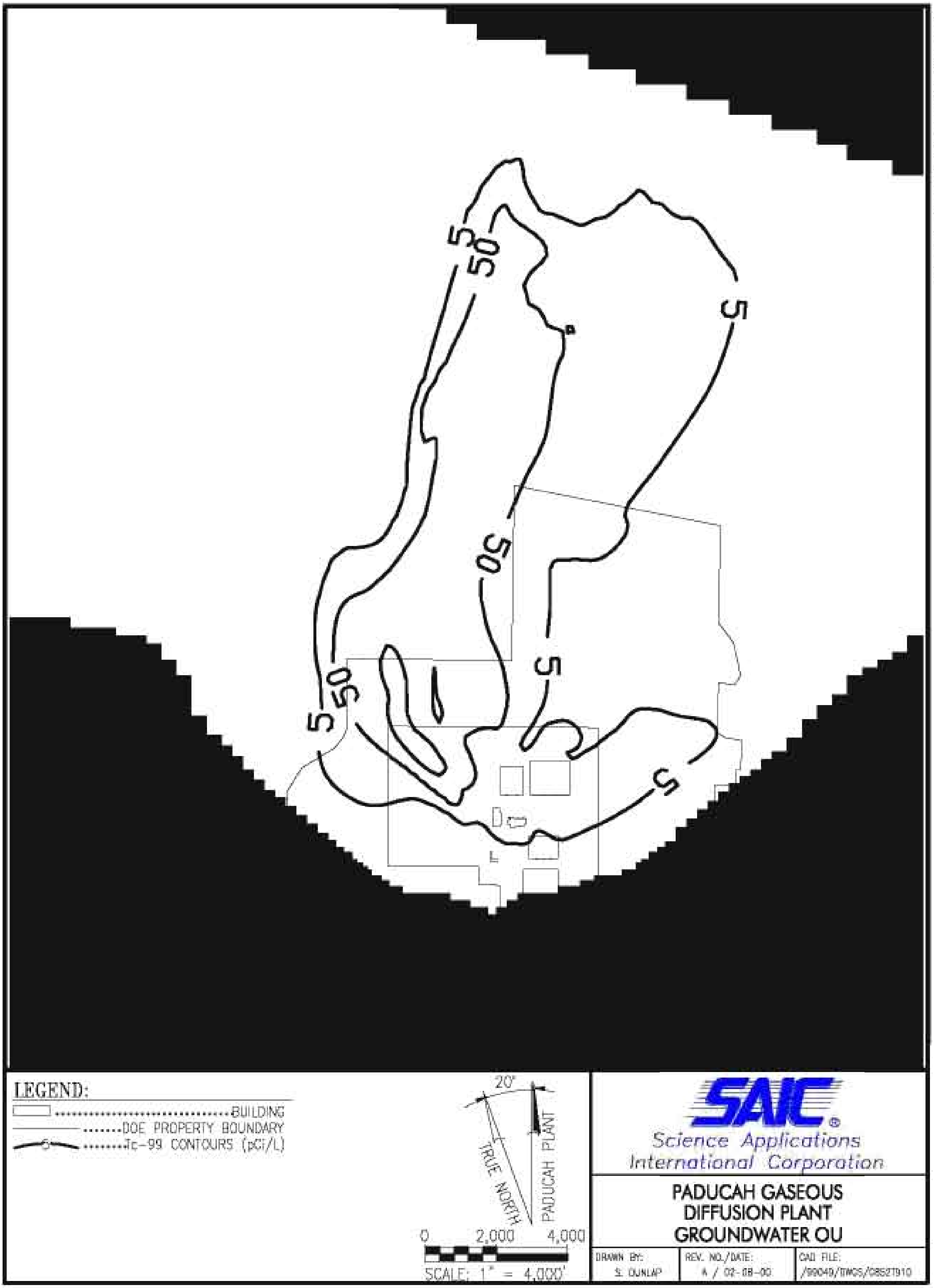


Fig. C1-11b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the Source Containment Alternative (2T99SP2) at the PGDP, Paducah, Kentucky.

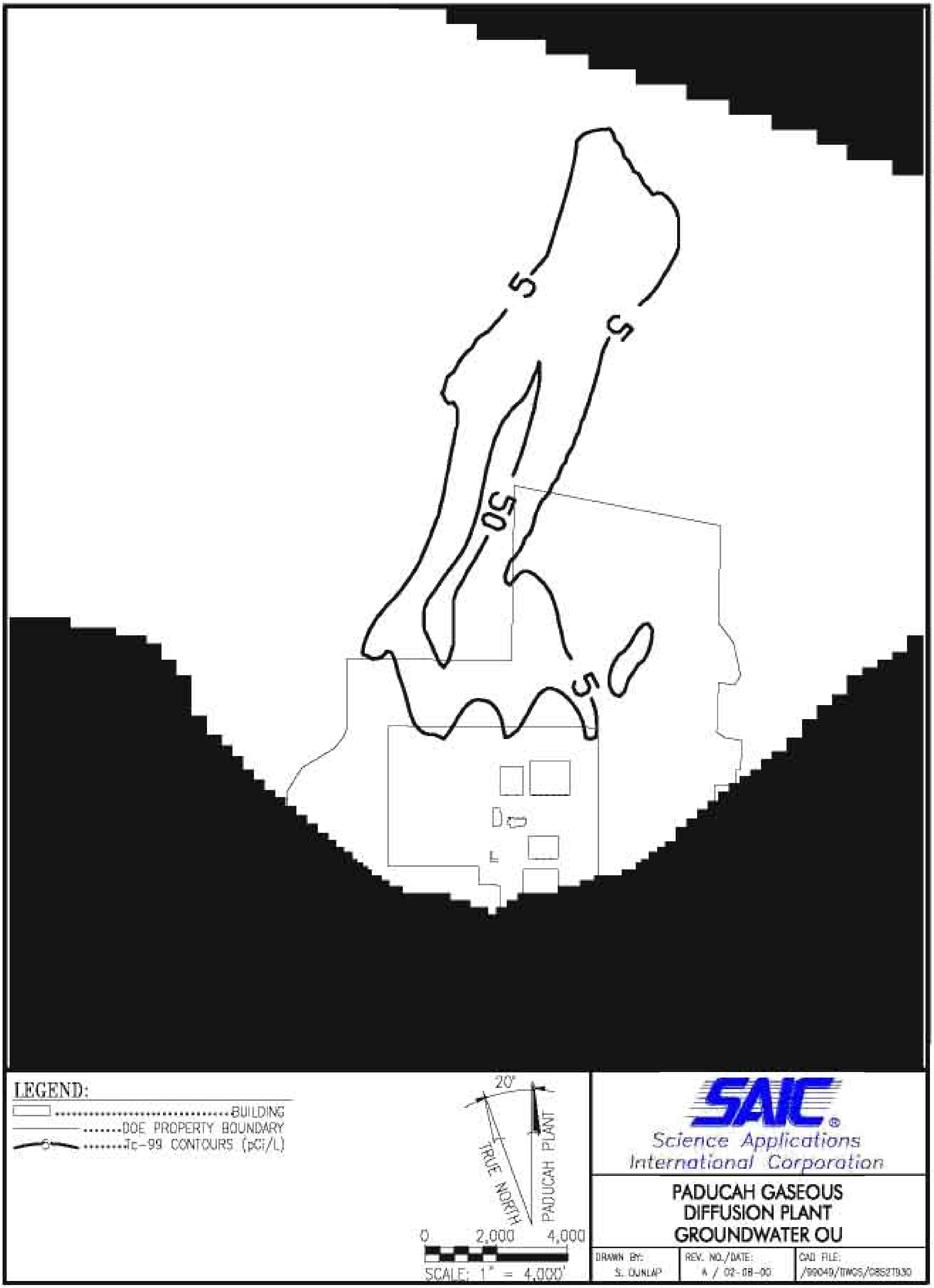


Fig. C1-11c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simulation period for the Source Containment Alternative (2T99SP2) at the PGDP, Paducah, Kentucky.

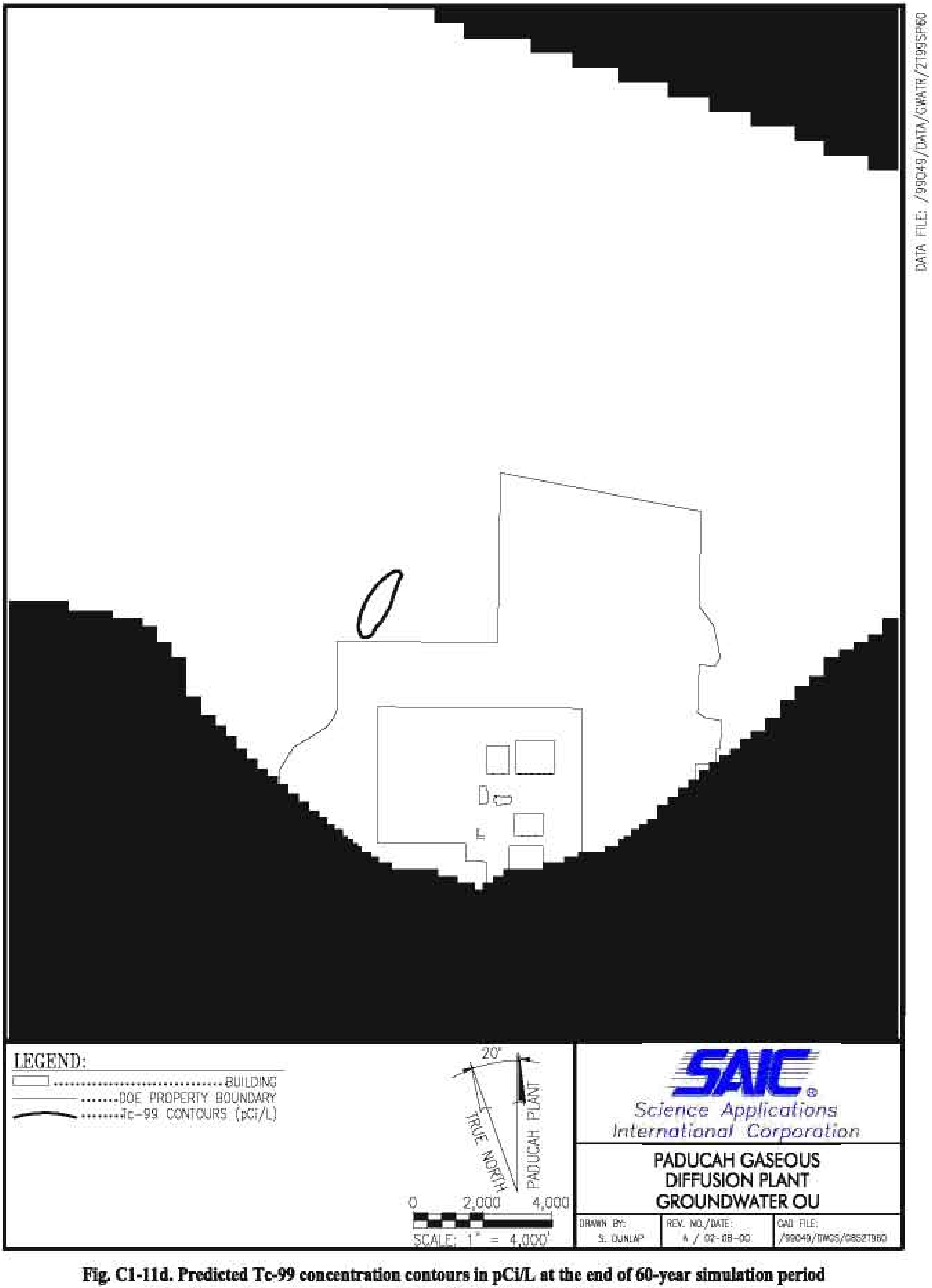


Fig. C1-11d. Predicted Tc-99 concentration contours in pCi/L at the end of 60-year simulation period for the Source Containment Alternative (2T99SP2) at the PGDP, Paducah, Kentucky.

Fig. C1-12a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22T99SP2) at the PGDP, Paducah, Kentucky.

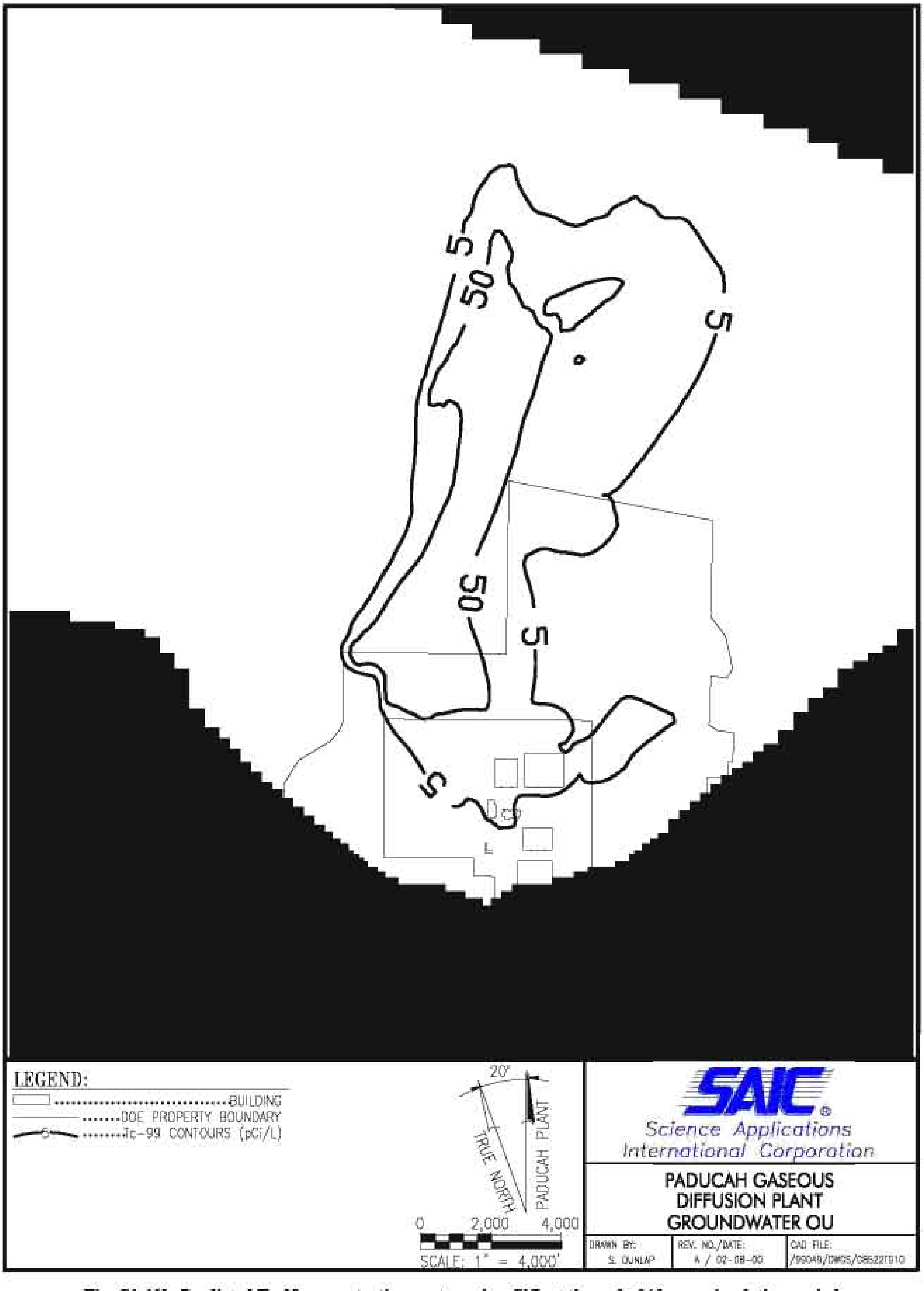


Fig. C1-12b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the Source Containment Alternative with NW/NE Wells pumping (22T99SP2) at the PGDP, Paducah, Kentucky.

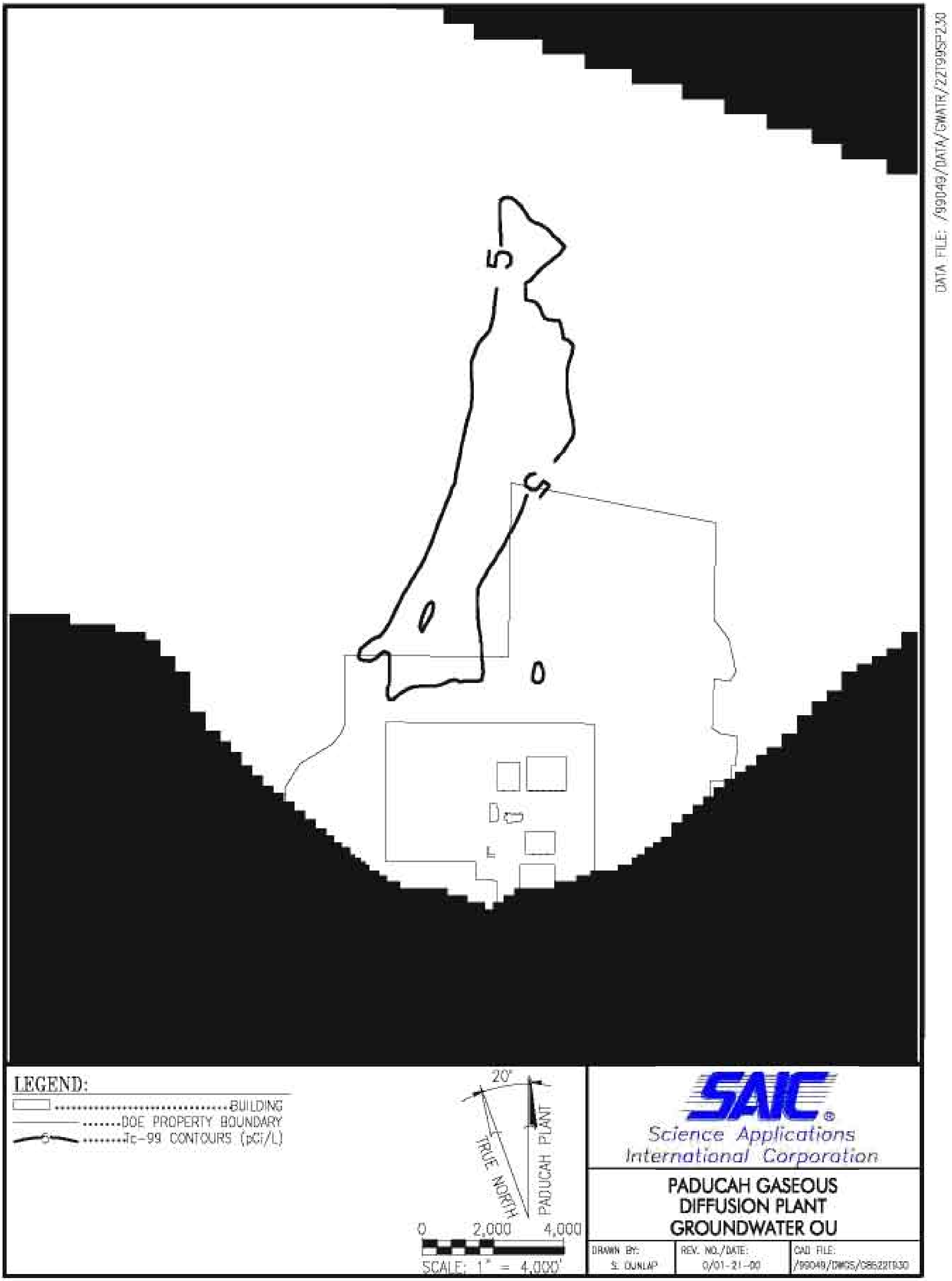


Fig. C1-12c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simnlation period for the Source Containment Alternative with NW/NE Wells pumping (22T99SP2) at the PGDP, Paducah, Kentucky.

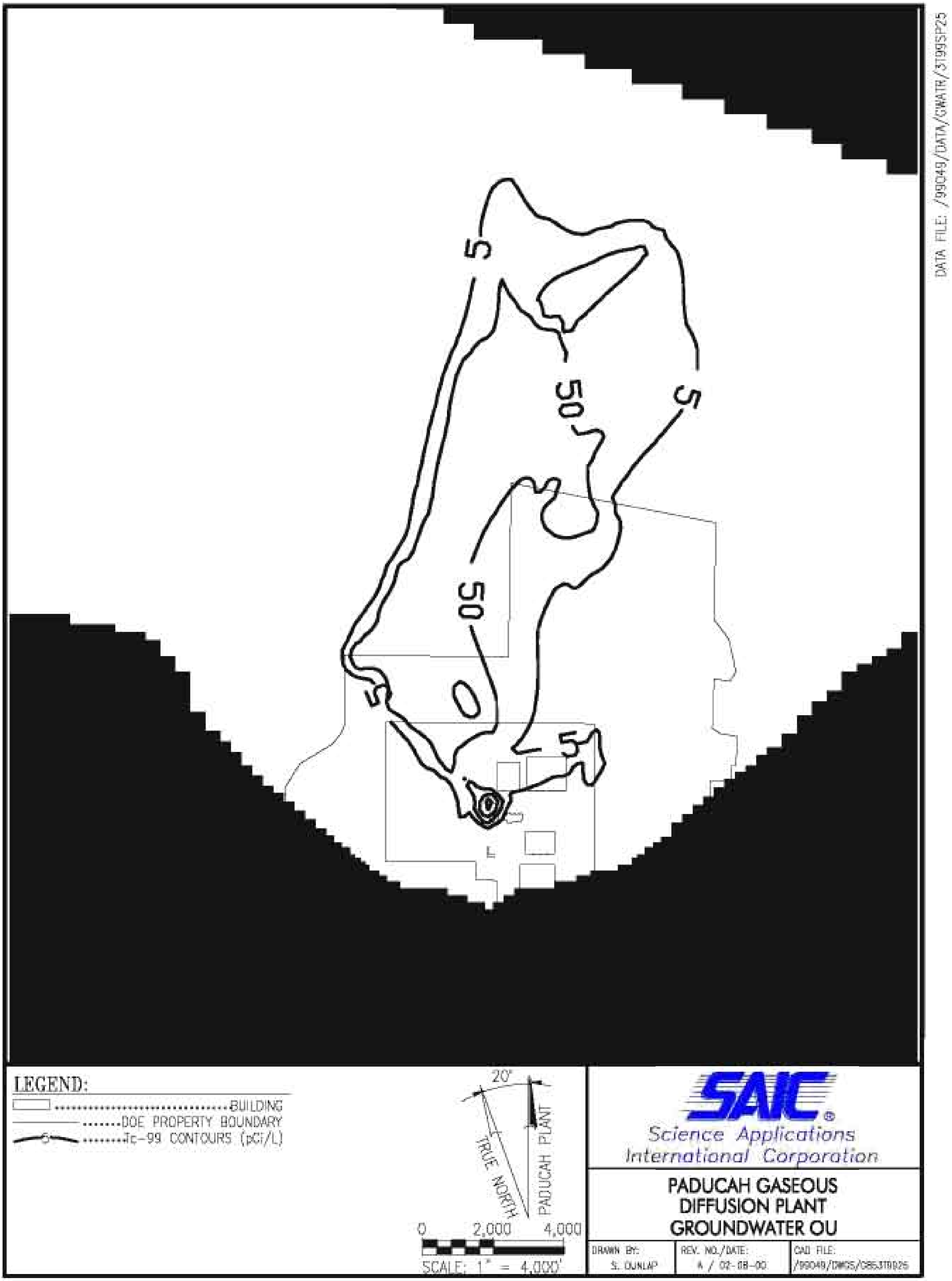


Fig. C1-13a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the Pump and Treat Alternative (3T99SP2) at the PGDP, Paducah, Kentucky.

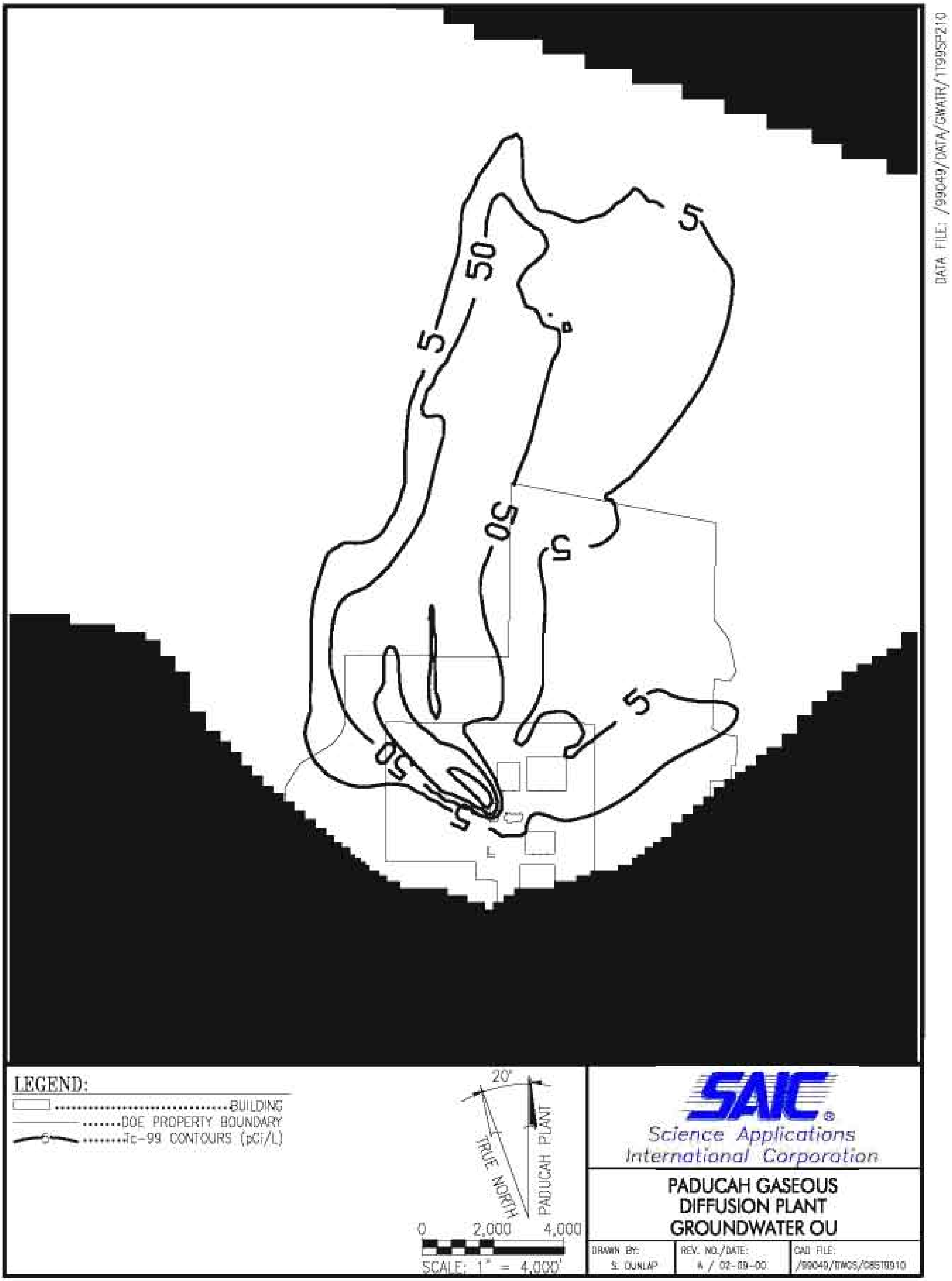


Fig. C1-9b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the No Action Alternative (1T99SP2) at the PGDP, Paducah, Kentucky.

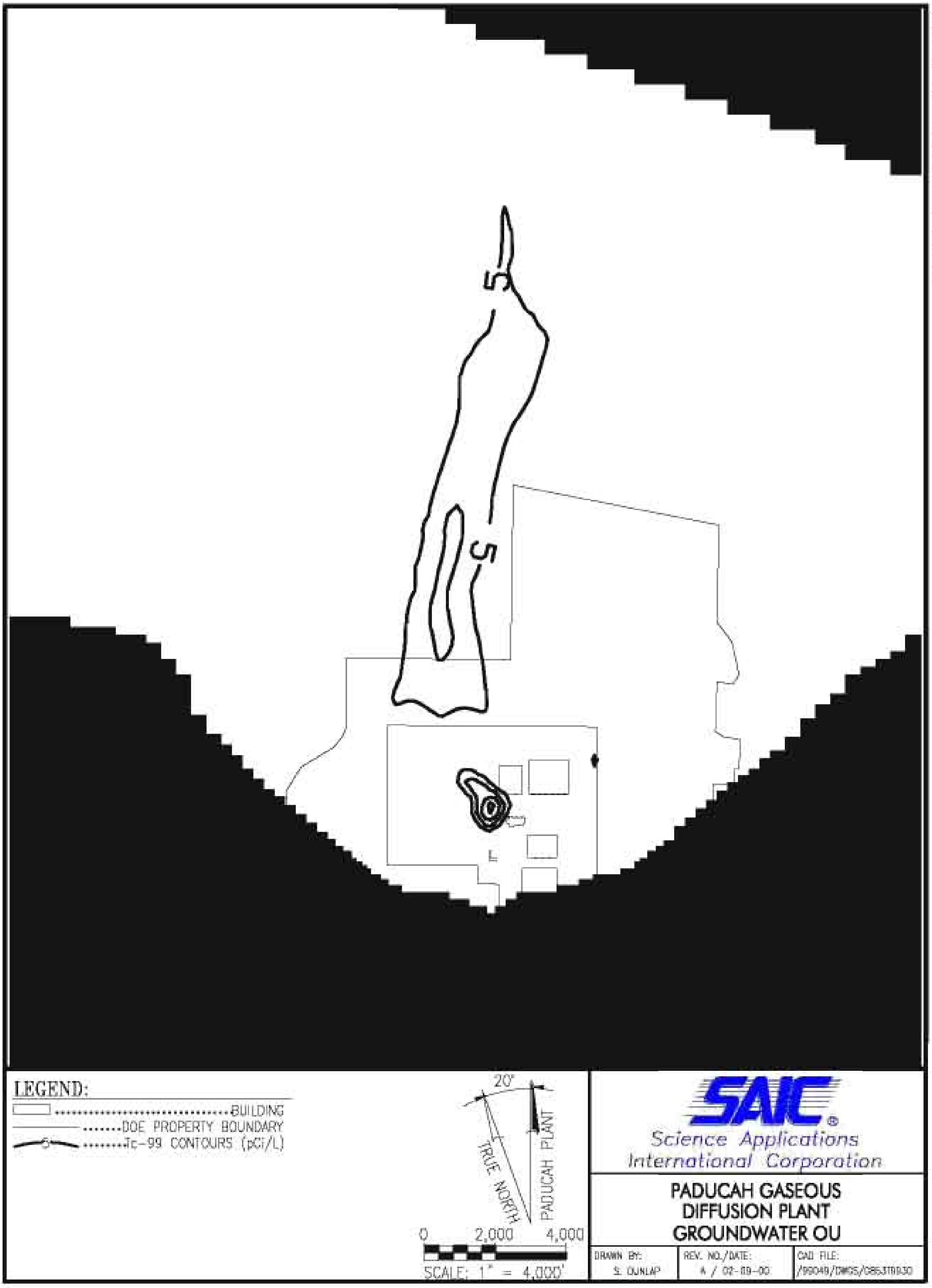


Fig. C1-13c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simnlation period for the Pump and Treat Alternative (3T99SP2) at the PGDP, Paducah, Kentucky.

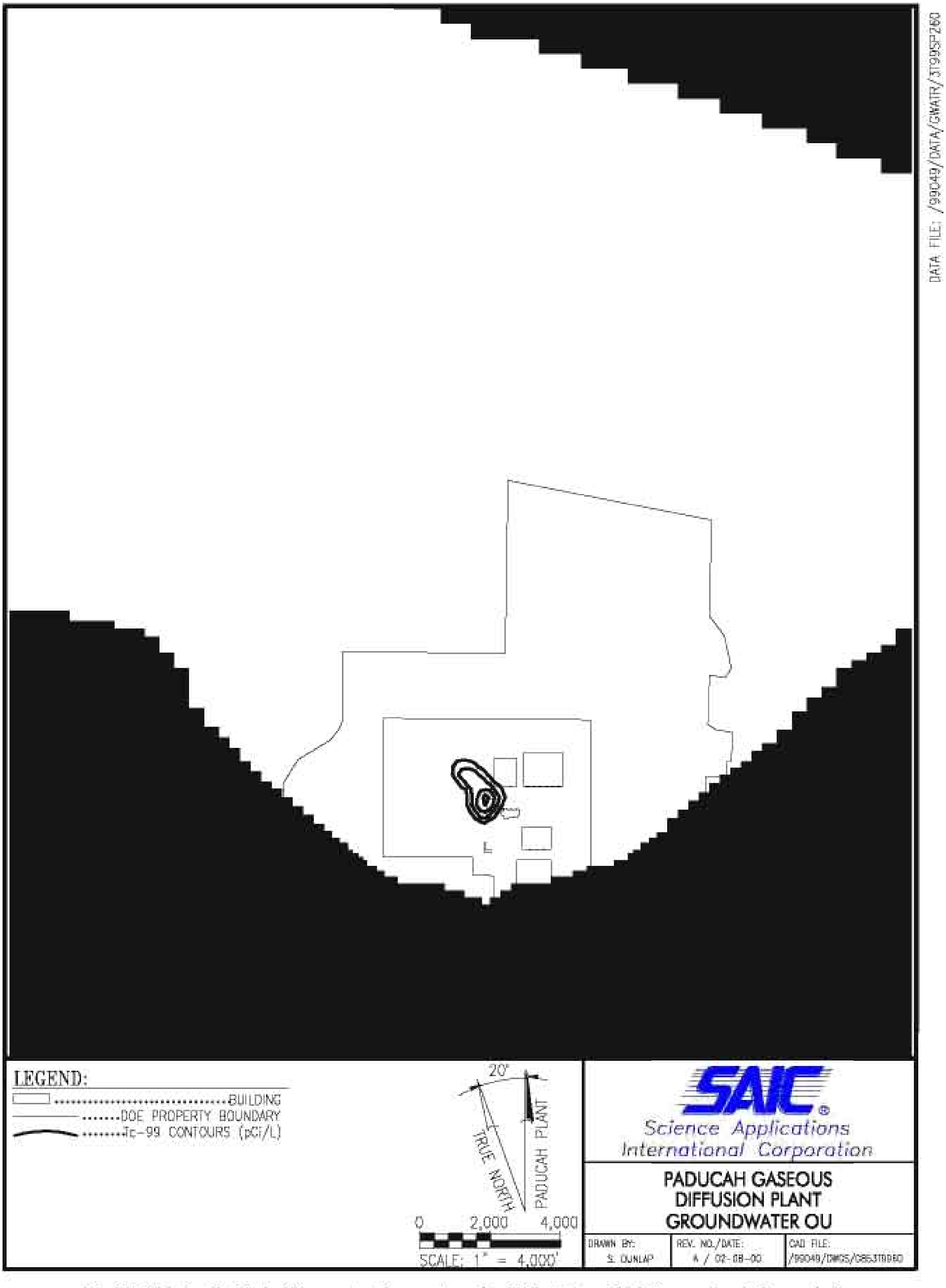


Fig. C1-13d. Predicted Tc-99 concentration contours in pCi/L at the end of 60-year simulation period for the Pump and Treat Alternative (3T99SP2) at the PGDP, Paducah, Kentucky.

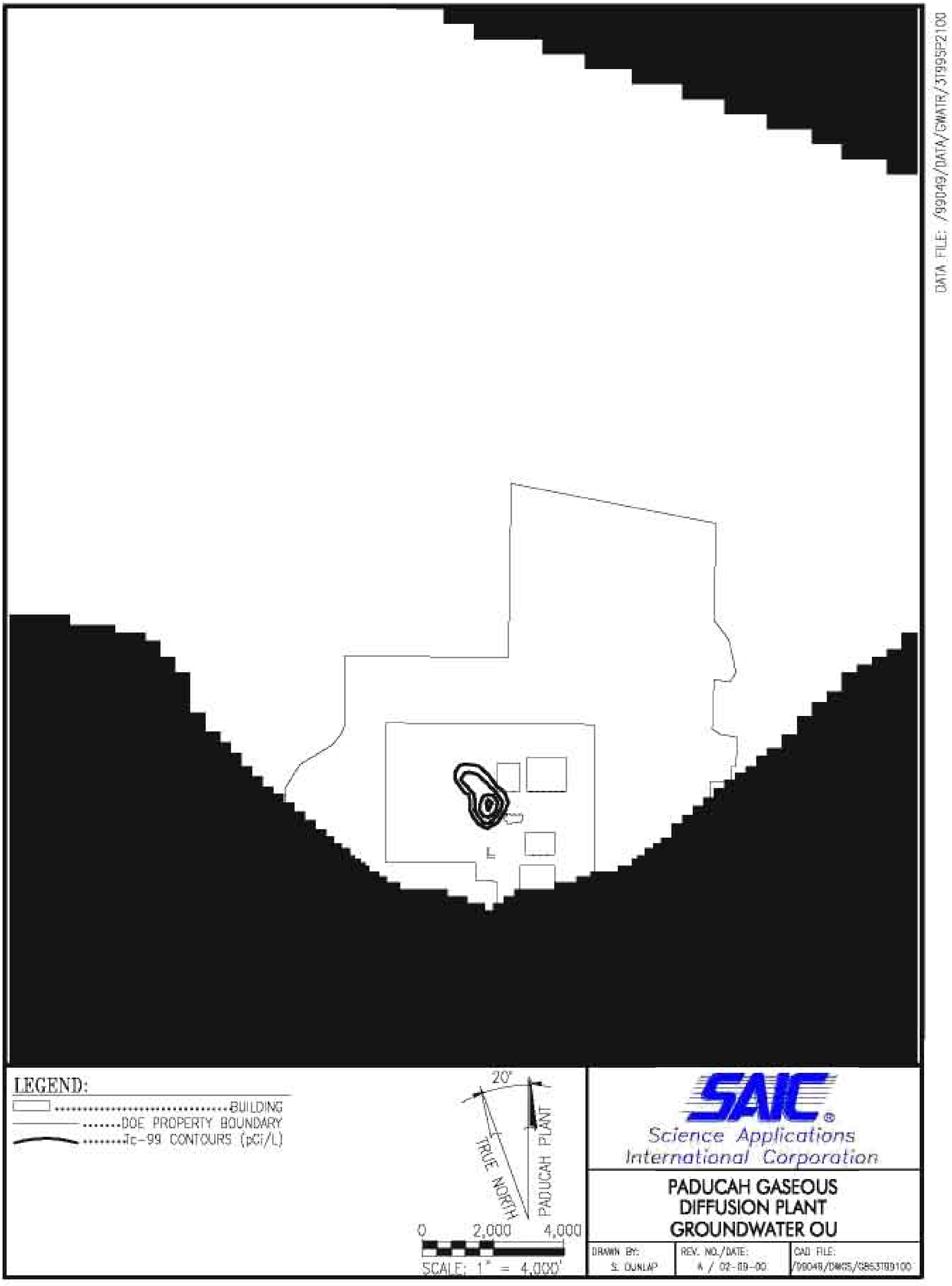


Fig. C1-13e. Predicted Tc-99 concentration contours in pCi/L at the end of 100-year simulation period for the Pump and Treat Alternative (3T99SP2) at the PGDP, Paducah, Kentucky.

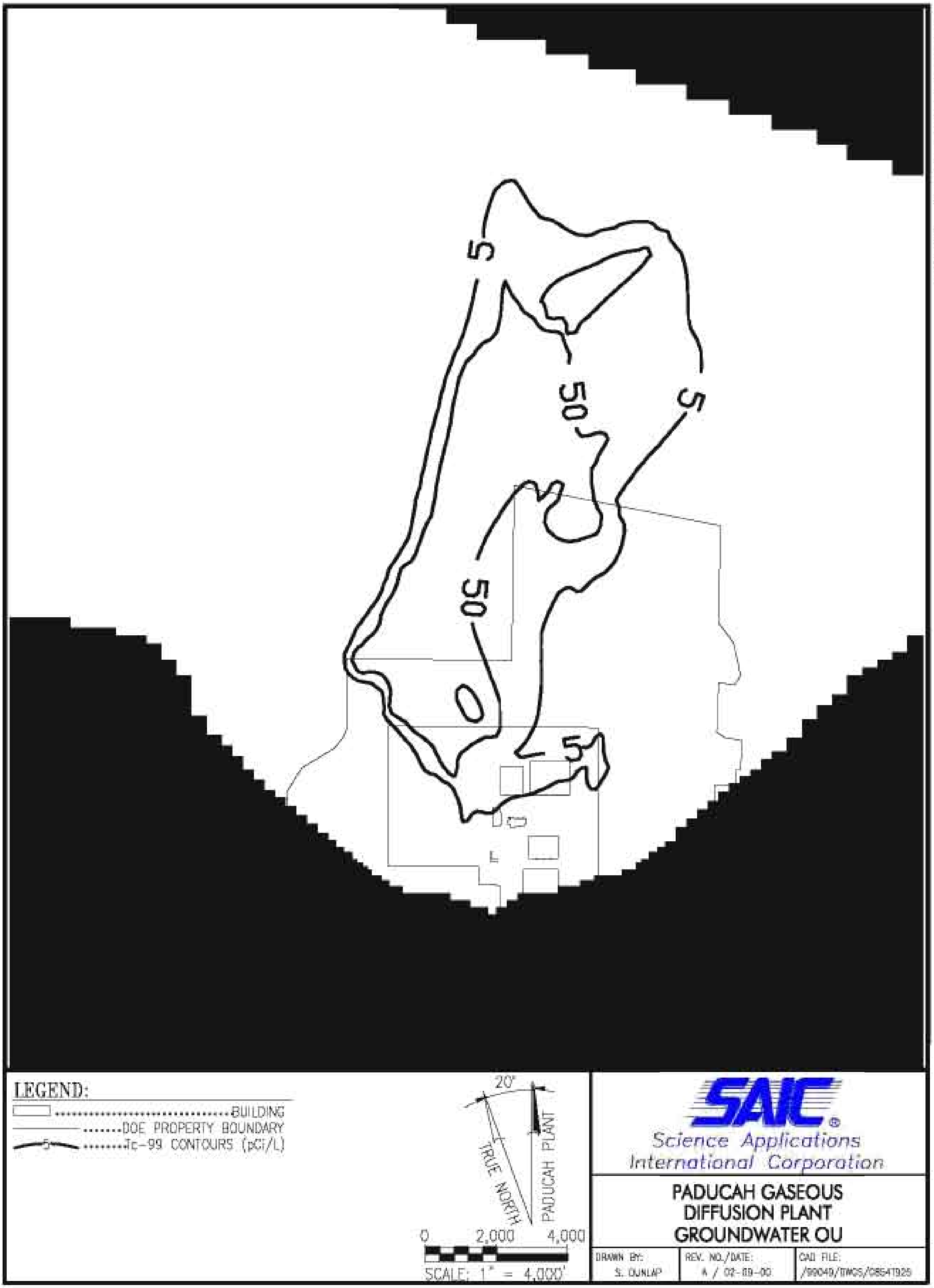


Fig. C1-14a. Predicted Tc-99 concentration contours in pCi/L at the end of 5-year simulation period for the Source Containment Alternative with Pump and Treat (4T99SP2) at the PGDP, Paducah, Kentucky.

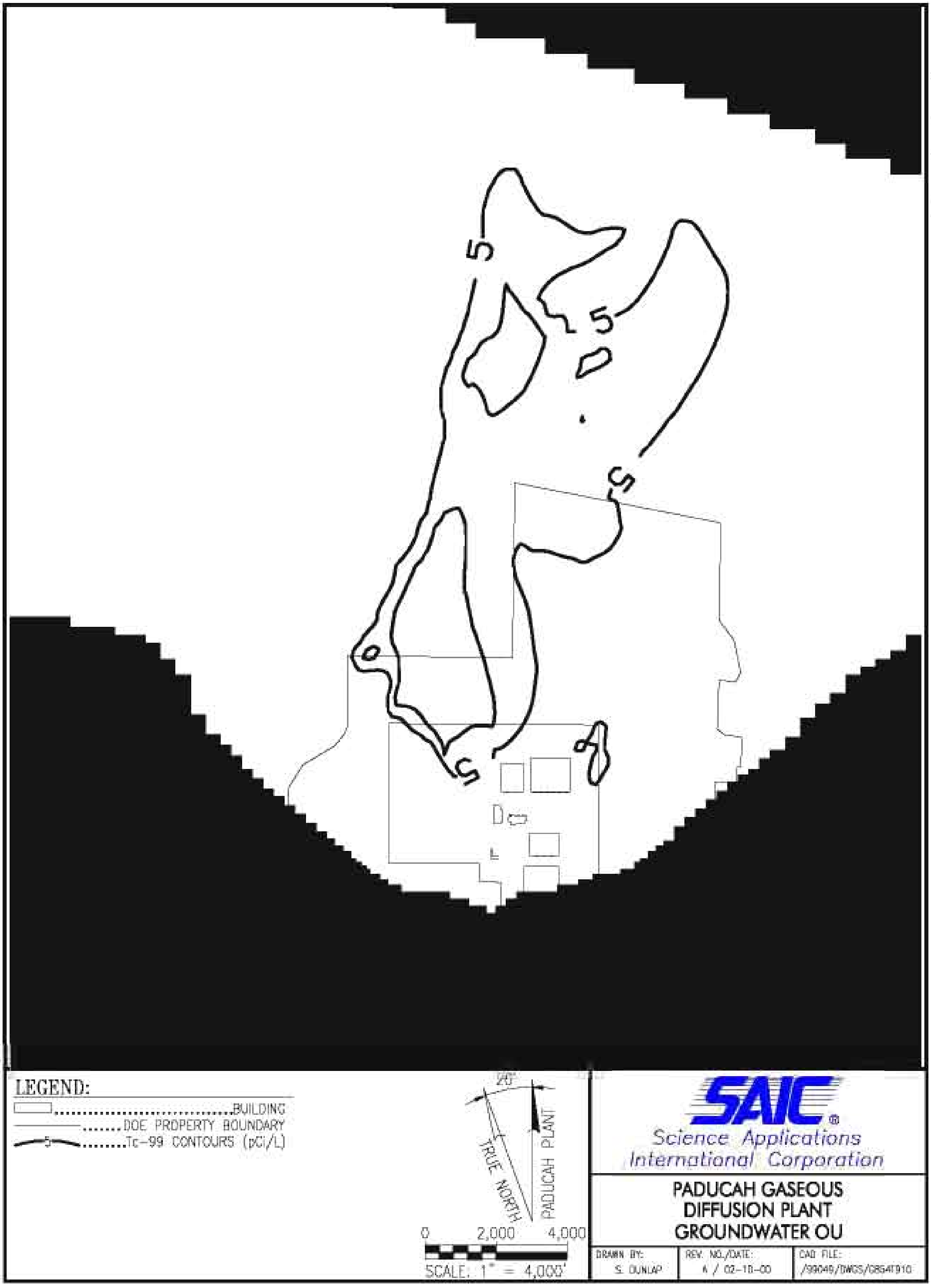


Fig. C1-14b. Predicted Tc-99 concentration contours in pCi/L at the end of 10-year simulation period for the Source Containment Alternative (4T99SP2) at the PGDP, Paducah, Kentucky.

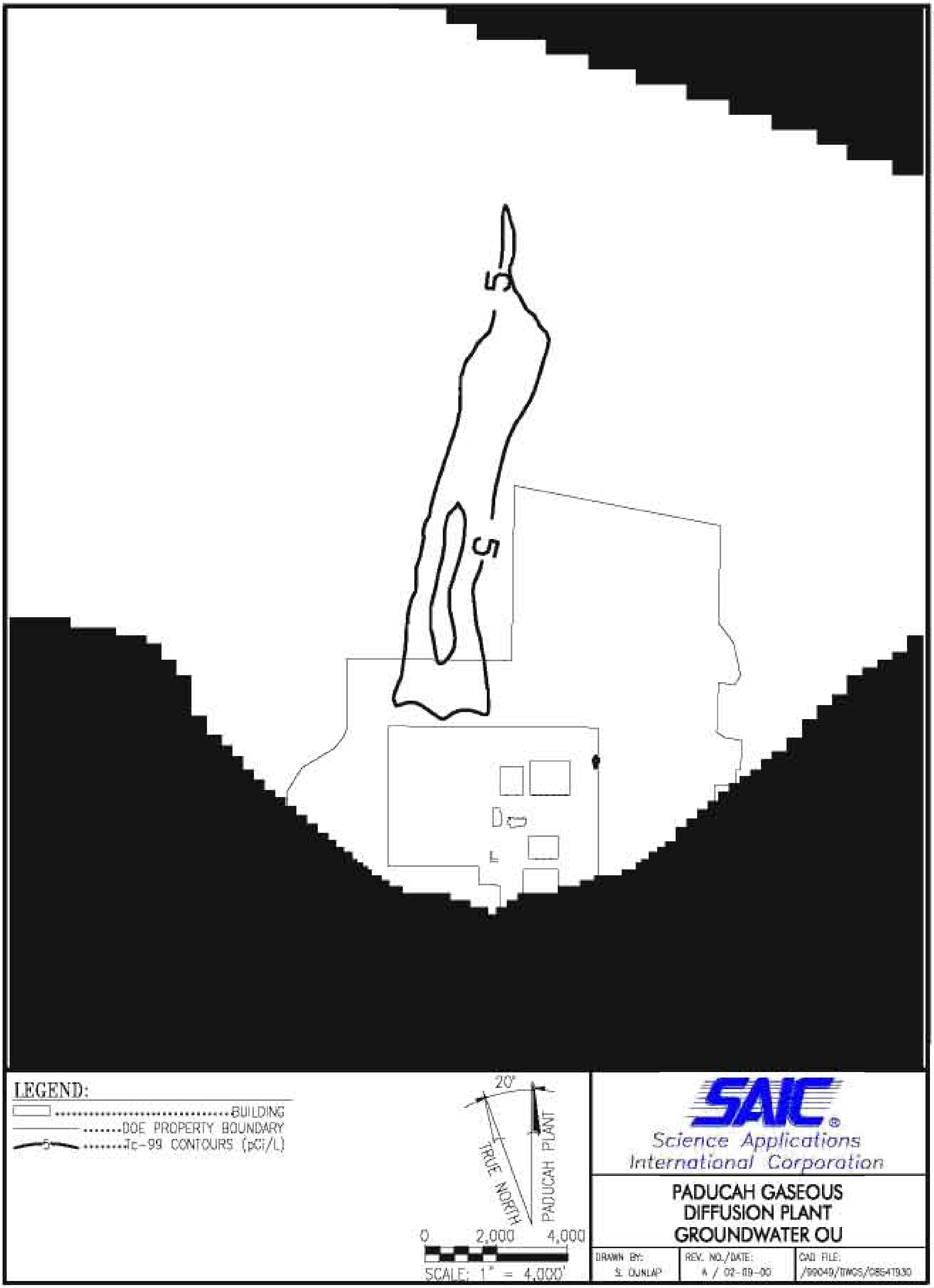


Fig. C1-14c. Predicted Tc-99 concentration contours in pCi/L at the end of 30-year simulation period for the Source Containment Alternative with Pump and Treat (4T99SP2) at the PGDP, Paducah, Kentucky.

REFERENCES

DOE 1999. *Waste Area Grouping 6 (C-400 Area) Remedial Investigation Report Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1727&D2, United States Department of Energy, Paducah, KY, May 1999.

LMES 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/EM-113, Lockheed Martin Energy Systems, November 25, 1997.

McDonald and Harbaugh, 1988. McDonald, M.G., and A.W. Harbaugh, "A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model," *Techniques of Water-Resources Investigations*, Book 6, Chapter A1, United States Geological Survey, Reston, VA, 1988.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C2

INNOVATIVE TREATMENT REMEDIATION DEMONSTRATION PROGRAM

PADUCAH PROJECT
INNOVATIVE TECHNOLOGY REVIEW

December 1999

Technical Advisory Group
Paducah Project
Innovative Treatment Remediation Demonstration Program

Mike Hightower, Technical Coordinator
Sandia National Laboratories
Albuquerque, New Mexico

DRAFT 12/22/99

CONTENTS

TABLES

FIGURES

INNOVATIVE TREATMENT REMEDIATION DEMONSTRATION PROGRAM

PADUCAH PROJECT
INNOVATIVE TECHNOLOGY REVIEW

1. INTRODUCTION

This document discusses in detail the efforts of the Paducah Project ITRD Technical Advisory Group to identify and assess technologies capable of enhancing and accelerating the remediation of chlorinated solvent and radionuclide contamination, specifically trichloroethene (TCE) and technetium-99 (Tc99) at the plant. Based on a review of the site contamination, site conditions, and the remediation goals of the Paducah ER Program, potentially applicable technologies were considered for detailed evaluation, treatability studies, and engineering evaluation and modeling of expected cost and performance if implemented at Paducah.

The issues considered included; implementation costs and ease of implementation, technology maturity and appropriateness, life-cycle costs and overall cost-effectiveness, ability to reduce the contaminants of concern to regulatory levels at the identified points of compliance, compatibility with existing site constraints and existing treatment systems, stakeholder considerations, and regulatory permitting issues. The intent was to identify various technologies, options, and strategies available to the site, review the risks and benefits, and suggest for possible implementation the most appropriate options to enhance remediation of the Paducah contamination areas affecting off-site migration of the TCE and Tc99.

The Technical Advisory Group identified and reviewed approximately thirty technologies we thought might be applicable to enhance the remediation of the Paducah TCE and Tc99 contamination. The technology categories considered included: insitu treatment of contaminated low-permeability soils, both saturated and vadose zone soils; insitu treatment of contaminated ground water; and insitu treatment of high-permeability saturated soils and gravel. The general maturity, cost, and performance characteristics of the technologies identified as they apply to Paducah are reviewed in detail in the following sections. Based on this information, the most promising technologies were further assessed through engineering evaluations with several technology vendors. Review of this information by the Technical Advisory Group was used to identify the most appropriate technologies and strategies for implementation at Paducah. The results of these efforts, discussions, engineering evaluations, and technology and strategy suggestions are presented in this report.

2. INITIAL REVIEW OF INNOVATIVE TECHNOLOGIES

The DOE's Paducah Gaseous Diffusion Plant is an active uranium enrichment plant located on approximately sixteen hundred-acres in western Kentucky along the Ohio River. Enrichment operations at the plant began in 1952, with the plant becoming fully operational in 1955. Both hazardous and radioactive wastes have been generated and disposed of at the site as a part of plant operations. Several areas associated with these past operations and disposal practices at the plant have contributed to soil and ground water contamination that has migrated over a mile off-site[1].

Three large plumes of ground water contamination have migrated outside the plant boundaries as shown in Figures 1 and 2. The primary contaminants of concern in these plumes are TCE and Tc99. These contaminants have migrated down through the top sixty feet of low permeability silt and clay soil lenses at the site to contaminate a high permeability regional ground water aquifer, which has resulted in several large contaminant plumes. The water table at the site is approximately 10-30 feet deep. Below the upper soil unit is an aerobic, high permeability, sandy-gravel, aquifer that varies in thickness from about 30'-60'. The hydraulic conductivity of the upper clay soils is aobut .01 to .28 ft/day while the hydraulic conductivity of the gravel aquifer varies from about 1-3 ft/day. Contaminant concentrations in the aquifer vary widely as shown in Figures 1 and 2, though TCE and Tc99 levels of up to10 ppm and 1000 pci/L, respectively, have been identified at the DOE property boundaries.

The baseline remediation technology for the site is containment of the source areas and the installation of reactive treatment walls at the site boundaries. A pump-and-treat system was assessed and is expected to have to pump as much as 3000-4000 gpm to contain the existing plumes and prevent additional off-site contaminant migration. The capital and operating costs associated with this large a system would be significant. The important consideration for this project was to help identify ways to accelerate the remediation of the site while significantly reducing overall remediation costs.

The initial Paducah ITRD Project meeting was held on February 10-11, 1999 in Paducah, Kentucky. Twenty-seven participants representing the DOE, national laboratories, EPA laboratories, State of Kentucky regulators, Paducah site management and integrating contractor, and EPA Region IV attended this initial meeting. Technical presentations were given on the history of the site and the Ground Water Operable Unit, the hydrologic setting, contaminants of concern and their concentrations, site accessibility issues, and baseline technologies. A site tour of the facility was also conducted. Approximately twenty nine technologies were identified at this meeting to treat either the contaminated soil, ground water, both, or improve the baseline pump-and-treat system. The technologies identified, their application, and the contact person identified from the Technical Advisory Group (TAG) charged with obtaining additional information on each technology are listed in Table 1[2].

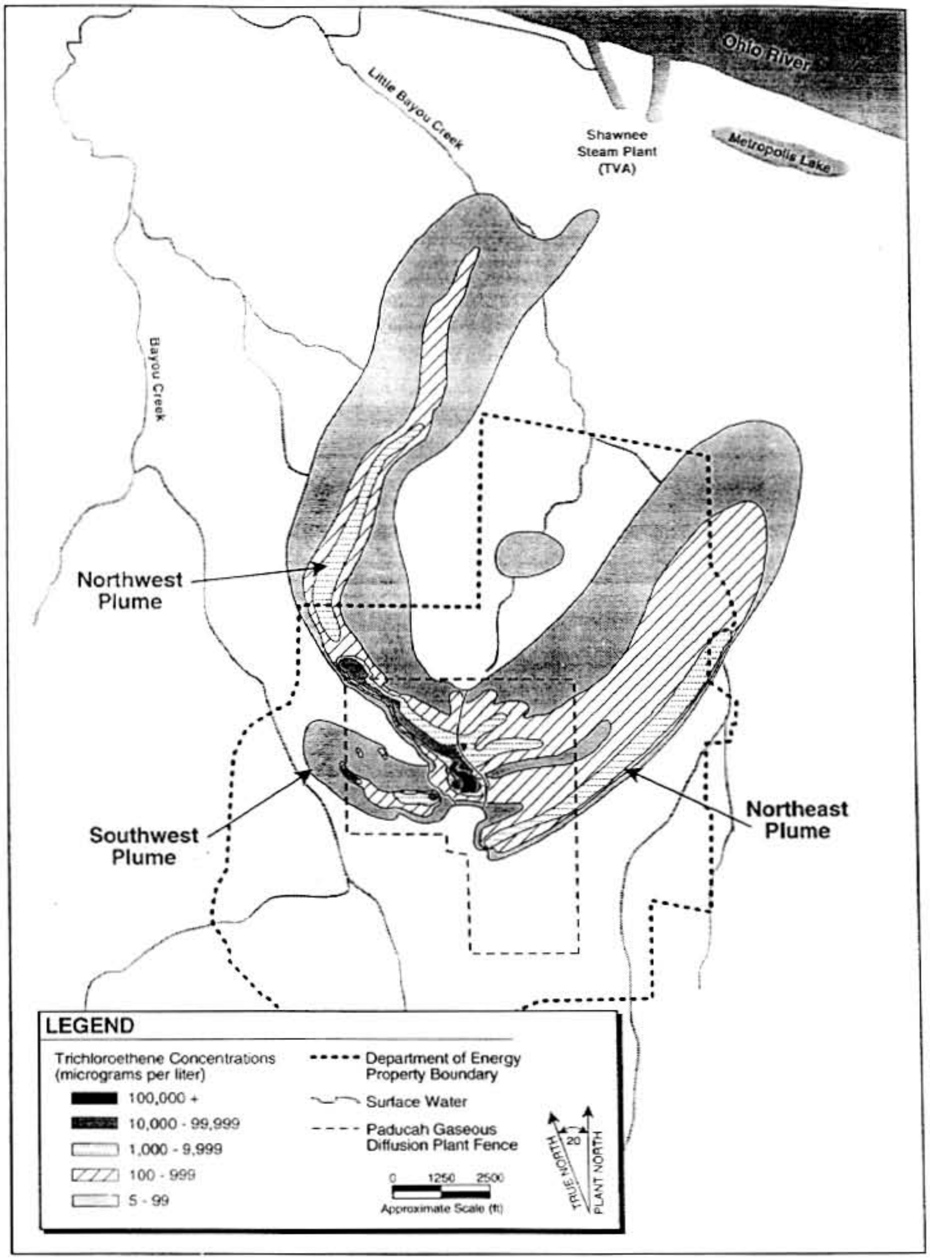


Figure 1. Trichlorethene Contamination in Groundwater at the Paducah Gaseous Diffusion Plant[1]

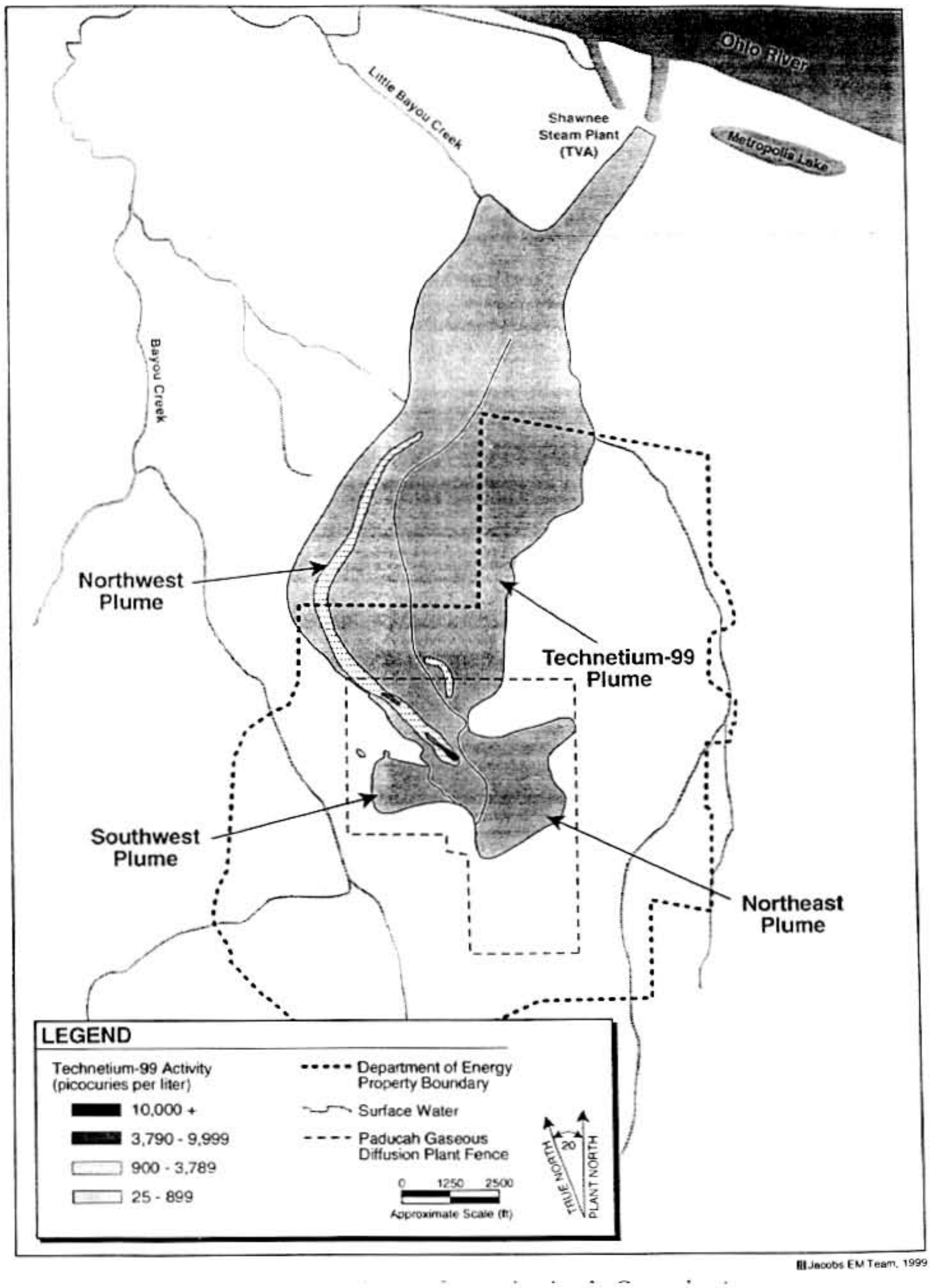


Figure 2. Technetium-99 Contamination in Groundwater at the Paducah Gaseous Diffusion Plant[1]

Table 1: Candidate Technology Matrix and Assignments

Technology	Application	POC	Comments
Sonic-assisted Cone Penetrometer	Characterization	W. Richards, BJ 270-576-2103 T. Early, ORNL 423-576-2103	Unable to reach bottom of RGA with conventional cone penetrometer; need to determine if vehicle can be scheduled
Bio-barrier	Containment Barrier	B. Clayton, BJ 270-462-4548	OST funding available for FY99 field test
Redox Manipulation	Treatment of Dissolved Phase Plume	J. Sheppard, DOE 270-441-6804	Looking for a field test site for VOC remediation; used on TCE/PCE at Ft. Lewis, WA;
Huma-Sorb™	Treatment for TCE, may sorb ^{99}Tc	J. Sheppard, Carl Enfield, EPA 513-567-7489	May want to field test (treatability study) in FY99);
Iron Reactive Wall (Vertical hydraulic fracture)	^{99}Tc capture, TCE destruction	W. Richards/B. Puls, EPA 580-436-8543	Issues of life and capacity of reactive material
Chemical Oxidation	Dissolved phase and Source removal	T. Early	
Underground Steam Stripping	Source removal	M. Hightower, SNL 505-844-5499	
Flushing technologies [solvents; surfactants]	Source removal	L. Wood, EPA 580-436-8552	Oak Ridge has expertise in ^{99}Tc behavior;
Direct thermal approaches (6 phase heating, etc)	Dissolved phase and Source removal	J. Douthitt, Geoconsultants 270-534-0033	
Pump and Treat with Reinjection	^{99}Tc and TCE removal	K. Davis, S. Maudlin, BJ 270-462-4553	
High Vacuum Enhanced Recovery	TCE removal	M. Hightower	Has info on high vacuum extraction systems
Steam injection with high vacuum extraction	Dissolved phase removal	M. Hightower, W. Richards	Need to focus on site specific lithology to avoid controlled steam breakouts
Microwave heating	Dissolved phase and source removal	T. Early	PGDP has been contacted to assume ownership of existing DOE microwave equipment prior to disposal;
Aerobic Bioremediation	TCE treatment	de Percin/G. Sayles/EPA 513-569-7797	Success claimed in lab and other sites
Air Sparging (In-well vapor stripping)	TCE stripping	M. Hightower	Several applications
Gaseous Reduction	^{99}Tc removal	T. Early	
Horizontal Reactive Barriers [Hydrofracture (o permanganate grout)]	Containment	T. Early	
Multi-Phase Extraction	Dissolved phase and Source treatment	M. Hightower/C.Rightmire	Related to High Vacuum Extraction/Air Sparging
Horizontal Wells		C. Rightmire, BJ 865-574-7285	Enabling technology
Natural Attenuation with	All areas	B. Clayton	Paducah study data exists

Technology	Application	POC	Comments
source control			by J. Claussen
Aquifer Leveling	Reduce hydraulic gradient in RGA	D. Pflug 630-252-6682	Not pump and treat (outside contaminant zone)
Horizontal Wells-Dual Phase	RGA	D. Pflug	
Grout Walls/Barriers	Containment	P. de Percin	
Permeation Grouting	Containment	K. Davis	
Electrokinetic recovery (Electromigration)	^{99}Tc and TCE treatment	K. Davis, BJ, Ken Kuzio, SNL, 505-284-3145	Possible to address both major contaminants
Rotary Steam Stripping	UCRS	M. Hightower	Infrastructure concerns
Passive Barriers Deep Injection(Iron or bio)	Reactive media or nutrient injection for dissolved plume	M. Hightower	
Bio-sparging	Dissolved phase plume	M. Hightower	(Enhancement to air sparging)
Barometric Pumping	Dissolved phase soil	M. Hightower	Low cost

Based on this initial identification of technologies, the TAG moved forward with assessing the applicability of these technologies to remediate the contaminated soil and ground water at the site. Existing Remedial Investigation/Feasibility Study (RI/FS) data and information was provided to the TAG to assist in this effort.

During the next several meetings the TAG discussions were oriented toward evaluating the applicability of the proposed treatment technologies identified in Table 1 to contain and/or treat the Tc99 and TCE contamination present at the site.[3,4,5] Additionally, any technologies not originally identified and found to be potentially applicable at the site were introduced and evaluated. The general schedule for the Paducah ITRD project was to provide timely input to the Feasibility Study technology selection process, thereby aiding the site in meeting its Federal Facility Agreement milestones. Identification of the leading four to five technology candidates needed to be completed in time to allow treatability studies to be conducted to obtain key performance data to be developed for inclusion in the Internal Review version of the site Feasibility Study.

The TAG agreed that the complexity of hydrogeologic and infrastructure issues at the site made it imperative that well understood and readily available technologies would be needed for application at the site, and that varying combinations of technologies would be required to address all remediation issues. The technologies presented in Table 1 were reviewed in detail by the TAG. The review is summarized in the next sections, which are separated into two categories: technologies for treatment or containment of contaminants in the low-permeability vadose soils and technologies for treatment of the saturated low-permeability and high-permeability soils and ground water. The preliminary application of each of the technologies initially identified by the TAG is presented in Table 2 below.

Table 2. Preliminary Technology Applications by Geologic Unit.

<table>
<tr><th>Formation</th><th>Source
(Easy Access)</th><th>Source
(Hard Access)</th><th>Low
Concentrations</th></tr>
<tr><td>UCRS
Vadose Zone
K= $1x10^{-2}$ to 10^{-5} cm/s
Depth 0-40 ft bgs</td><td>• Direct Heating
• Rotary Steam Stripping
• Electrokinetics
• Horizontal Reactive Barriers
• HVSVE
• Gaseous Chemical Oxidation
• Natural Attenuation & Containment</td><td>• HVSVE (with enhancements)
• Gaseous Chemical Oxidation
• Horizontal Reactive Barriers
• Direct Heating
• Electrokinetics
• Natural Attenuation & Containment</td><td>• Rotary Steam Stripping
• Electrokinetics
• HVSVE
• Gaseous Chemical Oxidation
• Direct Heating
• Natural Attenuation & Containment
• Horizontal Reactive Barriers</td></tr>
<tr><td>UCRS/Saturated
Depth 30-60 ft bgs</td><td colspan="2">• Two Phase Vapor Extraction
• Direct Heating
• Rotary Steam Stripping
• Electrokinetics
• Horizontal Reactive Barriers</td><td>• Rotary Steam Stripping
• Electrokinetics
• Multi-phase HVSVE
• Horizontal Reactive Barriers</td></tr>
<tr><td>RGA
K= $1x10^{-0}$ to 10^{-2} cm/s
Depth 60-130 ft bgs</td><td colspan="2">• Dynamic Underground Stripping/Hydrous Pyrolysis-Oxidation
• Chemical Oxidation
• Soil Flushing
• Direct Heating
• Air Sparging (w/o ozone)
• Pump and Treat</td><td>• Aerobic Bio; Bio-venting
• Air Sparging/SVE
• Chemical Oxidation
• Steam Stripping
• Reactive Walls
• Pump and Treat
• Natural Attenuation</td></tr>
</table>

Exsitu treatment technologies for contaminated soils, where the soil would have to be excavated for treatment, were not considered realistic options for this project because of the issues with foundations, utilities, and most importantly costs. Exsitu treatment technologies for contaminated ground water, where the water would be pumped to the surface, were not specifically considered. The existing pump-and treat systems used for plume control, which consists of air strippers for the TCE and ion exchange for the Tc99 are effective, but costly, exsitu treatment techniques for the contaminated ground water. The issue with this technology is the significant costs of a much larger system required for containment of the existing plumes on-site and the significant period of time required to operate this type of system to approach any type of reasonable site cleanup levels.

3. INNOVATGIVE INSITU VADOSE ZONE SOIL TREATMENT TECHNOLOGIES

One group of innovative technologies reviewed by the Technical Advisory Group were those with the capability of remediating the contaminated lower permeability soils in the UCRS. Based on the site characterization data, the consensus of the Advisory Group was that the contaminant levels in some areas are high enough that they could act as a continuing source of ground water contamination unless these potential sources were treated or contained. Therefore, the Advisory Group worked at identifying technologies that could effectively address the low permeability contaminated vadose zone soil in the UCRS. The technologies reviewed for this application included; high vacuum extraction, thermal treatment, steam stripping, chemical oxidation, electrokinetics, horizontal reactive barriers, and natural attenuation with source term containment. Details of each of these technologies is discussed below.

High Vacuum Extraction

This commercially available technology consists of three types of soil vapor extraction (SVE) processes: Passive SVE; Standard SVE (5-10 inches Hg vacuum); High Vacuum SVE (15-29 inches Hg vacuum). The High Vacuum technology is primarily used in tight vadose zone soils with hydraulic conductivities ranging from 10^{-6} to 10^{-7} cm/sec to remove VOCs. This technology can be used in layered soils with varying hydraulic conductivities for VOC concentrations up to 10,000 ppm, although most common applications are for VOC concentrations of 500 ppm. The High Vacuum SVE's radius of influence is 10'-20' in tight soils, and 30'-50' in more permeable soils. Contaminant removal efficiencies of greater than 90% are achievable, with typical treatment periods of 2-4 years at costs of $20-40/yd of treated soil have been suggested, though actual costs vary significantly by site.

High vacuum extraction has been successfully applied by many vndors to soils with permeabilities as low as those seen in the UCRS. The technology uses a very high vacuum (approximately 20-25 inches of mercury) to withdraw volatile organics from the vadose above the water table. Several vendors including Haley & Aldrich, IT, and McLaren-Hart are using this technology to clean up contamination in tight soils, often in conjunction with soil fracturing. Since this technology seemed to be appropriate for this site and could potentially address the UCRS soils, the Advisory Group conducted an engineering evaluation of the application of this technology at Paducah. The results of that evaluation are discussed in Sections 5 and 6.

Thermal Treatment Technologies

The advisory group considered both direct or resistive heating and microwave heating of the soil and ground water as treatment options. A vendor could not be identified with the experience and equipment for microwave heating. It appears that the initial pilot tests using this technology have not gone to full-scale. Therefore, we concentrated on direct heating applications, particularly Six-Phase Heating available through Current Environmental Solutions (CES).

The CES technology typically uses a six-phase array (SPA) with 6 electrodes located in a hexagonal shape and a neutral electrode located in the center of the hexagon serving as a vapor extraction well. A typical array diameter is 25-35' with the heated zone being approximately 40% larger than the array diameter. The deepest installation of this technology to date is 60' bgs. The technology uses insitu heating where the soil matrix becomes a resistive heater, raising the temperature of the soil to a level such that the target contaminant(s) are volatilized. The technology can be deployed in the vadose and saturated zones, and may be used in low permeability or highly heterogeneous soils. Common power sources (60 Hz) may be used to heat the ground (typical sub-surface applied voltages range from 150-600 volts), producing insitu steam to liberate the contaminants, which are removed by way of a center vapor extraction well.

The technology's benefits include more uniform soil heating. Key issues with using this technology include the effects of soil heating on surrounding plastic-encased utilities and effective treatment of infrastructure-laden areas. Angle borings can be used to accommodate infrastructure concerns. Cleanup efficiencies typically reach 99+%. The technology may be used to heat aquifers, however large amounts of water increase overall project costs and extend project completion times. The process does not adversely impact any metals of radionuclides present in the soil or ground water. Similarly, the presence of these elements or materials has no adverse impact on the heating process. Several large-scale applications have been completed with costs varying from $40-80/yd.

Because of the relative maturity and somewhat low overall costs the technology remained a candidate for soil and ground water treatment in several areas. The applicability to the UCRS soils were reviewed in detail by the Advisory Group. An engineering evaluation of the application of this technology at Paducah was conducted and is presented in Sections 5 and 6.

<u>Rotary Steam Stripping</u>

This technology uses deep soil mixing equipment to inject a range of materials including stabilization media, bioremediation nutrients, hot air and steam, and reactive media. There are two to three companies that provide this technology including In-Situ Fixation, Geo-Solutions, and Geo-Con. Volatilized organic contaminants are forced to the surface via steam injection and are collected and treated. The technology is applicable to soil and ground water contamination in the vadose and saturated zones, low permeability soils, and can be applied to high contamination areas (i.e., 100-300,000 ppm). Treatment rates range from 20-40 yds/hr with typical contaminant removal efficiencies of 80-90%. Residual contaminant concentration ranges from 20-50 ppm using steam injection only, and from 5-10 ppm using steam followed by iron injection. Some vendors are also working with chemical oxidation companies on injection of Fenton's reagent as an additional treatment method. Typical treatment depths range to 40', although depths to 70' are possible. The effective treatment area is approximately 40-75 sq ft per borehole. Based on the maturity of the technology the Advisory Group conducted an engineering evaluation of the application of the technology at Paducah that is presented in Sections 5 and 6.

Chemical Oxidation

Chemical oxidation is the process of injecting low concentrations of oxidants to oxidize the organic contaminants in the subsurface. Commercially available chemical oxidation technologies include:

- Fenton's processes which use high concentrations of hydrogen peroxide together with iron sulfate,
- Low concentration hydrogen peroxide, which can be injected with iron and a catalyst,
- Ozonation which can be used in either the saturated or vadose zone, and
- Permanganate.

Off gas control is often important with chemical oxidation technologies to reduce unintentional violent reactions with soil organics. The Fenton's process appeared more hazardous and costly to implement at this site in the vadose zone due to the high organic content and its high reactivity with organic material. Of the technologies identified, it appeared at Paducah that ozone and permanganate were the best options. The benefits of using ozone and permanganate include low material cost and handling safety.

The use of permanganate technology to degrade DNAPLs results in the generation of salts and hydrogen or hydroxyl ions (acids or bases) with no significant pH shifts. The direct application of permanganate is often used to levels of up to 100 ppm to avoid off-gassing issues but has recently been applied to contaminant levels exceeding 1000 ppm. The material should be applied after a heavy mass of contaminant has been removed by other means. Once applied to an aquifer, the path of permanganate migration may be tracked using the material's electrical resistance properties. Permanganate has been used in tight clays and for soil and groundwater injection. Oxidation of permanganate by-product compounds occurs faster than oxidation of DNAPLs. The compatability of humic materials with permanganate products may be a concern but current research shows no adverse reactions.

Since this technology has potential application to all the contaminated soil and ground water, the Advisory Group conducted and engineering evaluation of the expected costs and treatment performance for the different oxidants on the contaminants of concern. The results of this evaluation are presented in Sections 5 and 6.

Electrokinetics

This technology uses electrical current to move charged particles through subsurface soil. The technology has been used extensively over the past 50 years to dewater clays for the construction industry. The application to treatment of contaminated soils has been recently investigated. Positive and negative electrodes can be placed in the soil to move charged contaminants through the soil to a collection or treatment point. The technology has been recently used for movement of a variety of charged species including nutrients, VOCs, and heavy metals through the soil. Other applications include insitu destruction of volatile organic contaminants.

Applications considered included insitu treatment such as the Lasagna Process and Weiss and Associates. Costs for the Lasagna Process at Paducah vary from $100-175/yd of soil treated, while other vendors suggest costs of $50-100/yd. Advantages of the technology are that both TCE and Tc99 could possibly be removed at the same time. The Lasagna Process has been demonstrated at Paducah with some success. Because of past performance, an engineering evaluation of the technology was evaluated of widespread use of the technology at Paducah was conducted and the results presented in Sections 5 and 6.

<u>Horizontal Reactive Treatment Zones</u>

This is a combination of recently maturing remediation techniques. It combines hydraulic fracturing and jet grouting techniques with chemical treatment techniques such as zero-valent iron or permanganate. Injected into the soil is a high-permeability mixture containing either a chemical oxidant, such as permanganate, or another reactive media such as zero-valent iron. These are injected in a horizontal layer at the bottom of a vadose zone soil right above the water table. The zero-valent iron or the permanganate in the mixture reacts with the contaminants in source-term areas that migrate down through the reactive zone. This can reduce the chances that residual soil contamination would be a continuing source to the aquifer and ground water as long as the treatment zone remains active.

The reactive mixture or grout concept has been demonstrated in a few field demonstrations and has shown significant promise. Companies such as McLaren-Hart, Foremost Solutions, IT and others have developed these concepts. Issues of fracturing the soil near utilities are a concern at the site with this technology. Because it provides alternatives in case full remediation of an area of high-concentration can not be accomplished, the Advisory Group decided to retain this technology for consideration as a remediation strategy for the site. An engineering evaluation of the application of the technique suggested that active treatment of the vadose soils might be only slightly more costly than using a horizontal reactive barrier, suggesting that this technique be considered further if active remediation techniques are shown to be ineffective at the site.

<u>Source Term Containment</u>

A set of technologies reviewed by the Technical Advisory Group were those capable of containing the contaminated soil and ground water source term areas. The contamination levels identified in these areas suggested the potential for large areas of non-aqueous phase TCE in both the soil and ground water. If not treated or contained, these areas have the potential to be a continuing source of contamination. Several containment technologies were reviewed including biological barriers and grouting.

Biological Barriers

This technology has been used in the petroleum industry for several decades to manipulate fluid flow and media permeability. Recent laboratory research has been conducted on technique for environmental applications. The technique uses the addition of nutrients and biological amendments to soil and ground water in order to create a dense biological growth. This biological growth has been shown in the laboratory to reduce the hydraulic conductivity of the soil to levels on the order of 10-7 cm/sec. This level of reduction is roughly equivalent to the hydraulic conductivity created through permeation or injection grouting techniques. Suggested environmental applications include; containment barriers, flow control for pump-and-treat systems, or as part of a funnel and gate system. The benefits of this technique include; simple maintenance that requires only periodic nutrient addition, expected to be very cost-effective, and it provides an easily removable barrier.

The work to date for environmental applications has been at laboratory-scale the full-scale costs and performance have not yet been determined. There also is no data on whether contaminants such as high levels of TCE would be toxic to the microbes. It may be several years before system optimization data would be available. Because of the lack of environmental applications and overall cost and performance data it was suggested that the technology be considered in more detail only if cost-effective treatment technologies could not be identified for treatment of high concentration or source areas.

Grouting

Grouting, both permeation and jet grouting are mature technologies and are being widely used for environmental applications. Typically, cementitious or plastic based grouts are used to fill voids in the soil and create a zone of relatively low permeability, on the order of 10-7 cm/sec. For environmental applications the technology has most often been used as cut-off walls, containment walls, etc. to reduce the migration of both metal and organic contaminants. Permeation grouting is most applied at shallow depths and in soils or aquifers of relatively high permeability. Jet grouting is being applied to depths from 70-120 feet. Some companies suggest that depths of 300 feet can be achieved. The cost of the application varies with the type of grout used and the depth to be deployed, but industry costs generally have ranged from $5-10/ sq. ft. One of the major concerns at this site was the relative permanence of the grout barriers. Another was trying to create a successful barrier around the many utilities at the site because the grouting requires injection holes at about 5-foot centers. As with the previous barrier technology, it was suggested that the technology be considered in more detail only if cost-effective treatment technologies could not be identified for treatment of the high concentration or source areas.

4. INNOVATIVE INSITU GROUND WATER AND SATURATED SOIL TREATMENT TECHNOLOGIES

A set of technologies reviewed by the Technical Advisory Group were those capable of enhancing or accelerating the treatment of the contaminated ground water and the associated contaminated soils of the Regional Gravel Aquifer. The contamination levels identified vary widely. Near the source term areas, TCE concentrations over 1000 ppm have been measured. As the contamination enters the RGA and becomes diluted by the high flow velocities in the aquifer, the TCE concentrations at the site boundaries generally vary from 1-10 ppm. This suggested that technologies should be considered that could be used to aggressively treat the source term areas as well as technologies that could be used passively to treat the contaminant plumes at the site boundaries. Therefore, both active and passive treatment technologies were reviewed in detail to help identify the expected cost and performance of various combinations of techniques. The technologies evaluated included; dual-phase extraction, in-well sparging, air sparging/soil vapor extraction, soil venting, bioremediation, chemical oxidation, soil flushing with surfactants, thermal remediation, and several reactive treatment-wall concepts. Each of these technologies is discussed in detail below. After reviewing these technologies several were identified for detailed engineering evaluation with commercial vendors. The results of those evaluations are presented in Sections 5 and 6.

<u>Multi-Phase Extraction</u>

Several technologies are available for treating multi-phases, such as saturated vadose soils or ground water and the vadose zone. These can be used differently and several of the possible options were considered by the Advisory Group. Dual-phase extraction uses a typical ground water pumping well screened over the vadose and saturated zones to remove both ground water and soil vapor from the contaminated vadose zone soils. Draw down of the water table due to pumping also exposes more of the contaminated soil to vapor extraction from the well. This technique was viewed by the group as a way to treat both the contaminated ground water and soil simultaneously. The technology has seen most application where the contaminants of concern are lighter than water and float on the water table. This type of system then can remove this contaminant layer and treat the contaminated soil at the water table/vadose zone interface at the same time. The technology's effective radius is approximately 10-50' depending upon site-specific conditions. The process has been used to depths of approximately 100-120' bgs. For our application, this technology would not significantly improve remediation schedules or costs over a standard pump-and-treat system.

Two-phase vacuum extraction has been successfully applied to soils with permeabilities as low as those seen in the UCRS that are saturated. The technology uses a very high vacuum (approximately 20-25 inches of mercury) to withdraw volatile organics from the vadose zone above the water table and a method to extract water drawn in by the vacuum. Several vendors including Haley & Aldrich, Radian, and McLaren-Hart are using variations of this technology to clean up contamination in saturated tight soils, sometimes in conjunction with soil fracturing. Since this technology seemed to be appropriate for this site and could potentially address the saturated UCRS soils, the Advisory Group conducted an engineering evaluation of the application of this technology at Paducah. The results of this evaluation are presented in Sections 5 and 6.

Recirculating Wells

Several technologies are available that use the same general concept, pumping and reinjecting air or water within the same well in order to set up a recirculation cell within the aquifer. The recirculation pattern therefore theoretically treats the same water over and over without continually drawing in noncontaminated ground water for treatment. In essence the systems continuously flush the local area around the well, increasing contaminant removal efficiency. Removal efficiencies of up to 90-95% have been reported in as little as eighteen months for some systems. A radius of influence for the wells of as much as 80-100 feet have been seen. For those wells that recirculate the ground water, flushing of the vadose zone soils can sometimes be obtained. For any of these systems to work effectively, the subsurface geology must be appropriate and without any low permeability lenses.

The EPA recently published a report on the various pilot and full-scale applications of the associated recirculation technologies. The technologies and their performance were reviewed by the Advisory Group. Based on this review, the C-Sparge technology appeared to be the best application at this site. The technology provides insitu remediation of chlorinated solvents and hydrocarbons by combining air stripping and encapsulated ozone processes. A typical system uses a compressor to pump an air/ozone mixture through a patented discharge device placed in either the vadose or saturated zone. In aquifers, the resulting “microfine” bubbles penetrate the interstitial spaces of saturated formations and surrounding water under low pressure, becoming part of the fluid flow and minimizing channelization. This process allows concurrent stripping of VOCs, chemical oxidation, and provides oxygen to enhance microbial activity. The system has been successfully used in over 60 field applications in soil permeabilities ranging from $10^{-1} - 10^{-6}$ cm/sec at depths up to of 350 ft bgs.

Additionally, the C-Sparge can possibly be configured to contain internally and ion exchange media for removal of Tc99. Since the technology has application to treat vadose or saturated soils with high or low contaminant concentrations an engineering evaluation of this technology was conducted. The results of that evaluation are provided in Sections 5 and 6.

Air sparging/soil vapor extraction

An air sparging/soil vapor extraction (AS/SVE) system is a series of simple air injection and extraction wells. The injection wells inject air into the contaminated ground water, essentially stripping the contaminants while the extraction wells use a low vacuum system to extract the volatilized contaminants from the permeable vadose zone soil above the ground water. In this way, the contaminated ground water and soil are remediated at the same time. Since only vapor is moved by this type of system, the operating and installation costs are very low and have made this technology a common technique for remediation of low concentration contaminated soils and ground water. The typical radius of influence in gravel aquifers is 30-40 feet. Recent data from some vendors has shown that this technology has been used to reduce contaminant levels to the 5 ppb level. Application of the technology must be compatible with the site geochemistry. Based on available data, insitu sparging of the high quality water in the RGA would probably not degrade or foul the system.

The technology has recently been applied with a line of up to 20 sparge wells to create a sparge-curtain at several sites. The curtain behaves as a reactive treatment wall and has application for ground water concentrations in the few tens of ppm, as occurs at Paducah at the site boundaries. This active reactive wall then reduces the need to treat the entire on-site plume, potentially significantly reducing overall remediation costs. Because of the success of this technology in similar applications, its potential low cost, and ability to speed up remediations, an engineering evaluation of the expected cost and performance of this type of system at Paducah was conducted. The results of that study are provided in Table 3.

Biological Treatment

Insitu biological treatment of contaminated ground water is now being more often considered for remediation as the factors that control microbial degradation of VOCs become understood. This potential low cost technology is finding use throughout the United States and has significant potential for both VOC and metal reduction. For these reasons we worked with the EPA and industry to evaluate the applicability of this technology at this site. The ground water aquifer at Paducah is aerobic and therefore degradation of TCE might need to be conducted under aerobic conditions. Aerobic aquifers in some cases can be driven to anaerobic conditions, but this often takes injection of large quantities of organics. Initial estimates suggested that this could be rather expensive at Paducah and that aerobic bioremediation should be more closely investigated. Low levels of TCE (up to tens of ppm) have been shown to be degraded aerobically by injecting cometabolties such as methane, propane, or toluene into contaminated aquifers. The aerobic degradation process does not create any toxic by-products as can occur in anaerobic bioremediation of chlorinated solvents. Another advantage is that the stimulated microbes could create a reducing environment such that the Tc99 concentrations could be reduced, as has been identified for uranium. Aerobic bioremediation has been shown to be very sensitive to the types and kinds of indigenous bacteria, and the EPA has suggested that column studies be conducted before any full-scale applications are attempted. Some vendors are overcoming some of the cometabolic issues by injecting large quantities of microbes and nutrients together.

As being applied, overall aerobic bioremediation costs are similar and somewhat lower than equivalent air sparging systems. As in air sparging, several companies are looking at the application of the technology as a biosparging curtain as a way to reduce site remediation costs. Application of this technique at Paducah could be cost-effective if the appropriate studies could be completed. The expected costs and performance versus other technologies could be relative inexpensive. Therefore, an engineering evaluation of the expected cost and performance of this technology was coordinated with two technology vendors who have conducted several aerobic remediations of chlorinated solvents. The results of that evaluation are discussed in Sections 5 and 6.

Surfactant Flushing Technologies

Soil flushing with surfactants is being pursued by the EPA and other groups as a method to remove high concentrations of chlorinated solvents. Successful demonstrations of the technology have been obtained with the use of food grade surfactants and co-solvents. These technologies include surfactants, cosolvents, surfactant/cosolvent mixtures, and macromolecules, and are commercially available through Duke Engineering, Surbec/ART, and one or two additional vendors. The technology is being mostly applied to non-aqueous phase contaminants where concentration levels exceed the contaminant solubility and where the chemistry of the soil is such that it is particularly adept at adsorbing contaminants. Initial studies have shown that approximately 3-4 pore volume flushes can reduce contaminant levels by over 90%. For lower levels of contamination this could be even shorter. To date, several pilot and a few full-scale applications have been conducted.[18] Controlling the flushing of the aquifer and increased mobility of the contaminants is an issue. Adequate hydraulic control of the remediation area is required for effective treatment. This technology is most applicable to source areas, permeable formations, and sparingly soluble contaminants.

A proprietary partnering technology used to assess DNAPL volumes is the Partitioning Interwell Tracer Test (PITT) marketed by Duke. The PITT uses surfactant techniques to measure the volume and describe the spatial distribution of sub-surface DNAPL contamination zones. The PITT may be used in both the vadose and saturated zones, and can locate low volume quantities (1 gallon) of DNAPL.

At Paducah, the technology has most application in those areas in the RGA of high contaminant concentration. The cost of the technology can often be quite high and must be compared to the associated costs of similar technologies. Costs estimates of the technology were developed from a commercial vendor and are presented in Section 5.

Chemical Oxidation

Chemical oxidation is the process of injecting low concentrations of oxidants to oxidize the organic contaminants in the subsurface. As discussed previously, commercially available chemical oxidation technologies include: Fenton's processes that use high concentrations of hydrogen peroxide together with iron sulfate; low concentration hydrogen peroxide that can be injected with iron and a catalyst; ozonation that can be used in either the saturated or vadose zone, and permanganate. As discussed previously, the technology has potential application to both the contaminated soil and ground water problems at the site. Costs at a site will vary directly by the contaminant concentration. Therefore, the technical advisory group tried to identify the expected costs and treatment performance for the different oxidants on the contaminants of concern. Cost and performance estimates were obtained for application of the technology in several areas and are presented in Section 5.

Thermal Treatment Technologies

The advisory group considered both direct or resistive heating and microwave heating of the soil and ground water as treatment options. A vendor could not be identified with the experience and equipment for microwave heating. It appears that the initial pilot tests using this technology have not gone to full-scale. Therefore, as mention previously, we concentrated on direct heating applications, particularly Six-Phase Heating.

Because of the relative maturity and somewhat low overall costs the technology remains a candidate for ground water treatment though costs are expected to be higher than the application of this technology in the vadose zone. Cost estimates were obtained for applying this technology to treat the contaminated ground water and are presented in Section 5.

Steam Stripping

This technology uses a 3-phase (i.e., NAPL/water/gas phase) extraction principle. The technology cycle alternatively injects low-pressure steam (12-25 psig) and oxygen (air) into contaminated zones displacing contaminated ground water and creating a thermal destruction zone. Contaminated ground water flows into the hot reaction zone when injection stops and the contaminants are destroyed. The cycle is repeated until remediation objectives are met. The use of steam at lower pressures reduces the steam's potential to rise vertically and encourages horizontal penetration/contaminant mobilization. Near-surface technology concerns include elevated pressures and temperatures and adequate overburden characterization to ensure steam breakthrough does not occur. Vendors of the technology include IT, IWT, and Steam Tech. Some vendors use electro-resistance technology [ERT] (similar to CAT scan; resolution to 1 yd^3) to monitor the sub-surface flow of steam. Monitoring is crucial to directing the remediation path.

The technology works best in RGA-type of permeable soils. A typical remediation pattern is to work from outside contamination inwards. Horizontal drilling has been used to maneuver under building foundations to enhance contamination zone access. Several recent large-scale applications have been conducted. Estimated costs range from $50-75/yd. The technology appears appropriate for application to the RGA in the areas with high contaminant concentrations and estimates of the cost of using the technology at Paducah were assessed and are presented in Section 5.

Aquifer Leveling

Aquifer leveling includes the use of vertical or horizontal wells to reduce the hydraulic heads often driving contaminant migration. In many cases the pumped water is not contaminated and therefore does not require treatment. By decreasing the hydraulic heads, migration can often be stopped or reversed, minimizing the areas needing treatment. At Paducah it appears that large volumes of process water (possibly up to 1 MGD) might be lost on-site. This volume of water could be contributing to or modifying contaminant migration. If this is the case, then aquifer leveling may be an appropriate technique to include in an overall site remediation strategy. The advisory group chose to continue to look at the process water infiltration volumes to determine if aquifer leveling would be a cost-effective enhancement to the site remediation strategy. System costs will vary based on the volume and area of ground water to be manipulated.

Passive Reactive Treatment Walls

This technology has been demonstrated to be a low-cost passive insitu treatment option by several commercial firms including Golder-Sierra, Foremost Solutions, and McLaren-Hart. For deep applications as needed at Paduch, the technology typically uses jet grouting or hydraulic fracturing with injection of iron filings or other reactive media to create reactive treatment zones. The standard reactive wall thickness is approximately 3'-0" with deep walls being approximately 4”-6" thick while hydraulic fracturing can provide much wider treatment zones. There have been 4 deep projects completed to date addressing chlorinated solvent contamination of ground water. The technology has been used in depths ranging from 50'-120' bgs. Most reactive wall applications are designed for contamination levels in the 1-10 ppm range due to the size of the permeable treatment wall required for higher contaminant concentrations. Typical VOC reductions can be as much as 50 ppm, and the expected life of an iron filing wall can exceed 10 years. The number of deep reactive walls needed depends on the residence time desired for contaminant treatment/removal.

Treatment wall performance is very site-specific, and it is essential to have good geochemical characterization of ground waters to understand barrier wall treatment processes and expected performance. Installation costs range from \$5-10/ft^2 and O&M costs can vary depending on the reactive media selected. Issues related to reactive wall technology include:

- Reactive media may create by-products (e.g., vinyl chloride, methylene chloride) that must be addressed,
- Concerns regarding the long-term effects of leaving captured concentrated ^{99}Tc/iron media in the RGA.
- Capacity of the reactive media and expected life.

The technique appears to have application at Paducah but both Tc99 and TCE need to be removed and therefore the appropriate reactive media must be identified for installation. Because of this issue, the advisory group decided to look at several reactive media with the potential to remove both Tc99 and TCE from the ground water plumes. These media are being investigated in laboratory column studies. An estimate of reactive treatment zone costs and performance for several options and techniques are presented in Section 5.

Aquifer Redox Manipulation

A technology to create a reducing environment in the subsurface has been demonstrated by DOE. The injection of dithionite has been used in a few applications to reduce insitu iron to develop a reactive treatment cell or wall. Application of the technology depends on the correct soil mineralogy such that the available iron can be effectively reduced. The technology has had some success at in large-scale applications. Commercial vendors are being asked to help commercialize this technology. The technology is not quite as mature as other chemical treatment or reactive wall technologies. Therefore, the advisory group continues to watch the development of the technology but chose to concentrate on the more mature technologies with available vendors.

Pump and Treat with Reinjection

This technology can be used in a recirculation mode to accelerate flushing of the soil and ground water for dissolved phase contaminant extraction. The technique has been used successfully to accelerate cleanups and limit off-site migration of contaminants using the reinjected water as a containment system. The technique is often limited in its ability to treat areas of high contaminant concentration and therefore would probably be used in conjunction with other technologies. The cost-effectiveness of the technique will depend on how great a reduction in pumping rates would be required with the added reinjection.

Natural Attenuation with Source Control

Natural attenuation protocols have been established by the EPA to allow a site to take credit for a reduction in contaminants from natural processes such as decay, dilution, intrinsic bioremediation, etc. Application of this technique in conjunction with source term removal, containment, or control would appear to be a potentially cost-effective strategy. The biggest issue is trying to identify the natural attenuation mechanism at Paducah. Initial review suggests that few if any of the allowed natural attenuation mechanisms, i.e. intrinsic bioremediation, sorption, geochemical retardation, etc. are really taking place in the ground water aquifer to a large and quantifiable extent. Therefore, application of this technique could be very difficult to quantify. The advisory group proposed concentrating on assessing the cost-effectiveness of more aggressive remediation techniques first.

5. SUMMARY OF TECHNOLOG COST AND PERFORMANCE ESTIMATES FOR IMPLEMENTATION AT PADUCAH

Based on the technologies identified and reviewed, several were considered for detailed engineering evaluations for full-scale applications. Detailed information was provided to representative vendors of these promising technologies to develop cost and performance estimates of how these technologies could be best applied at Paducah. Information was provided for three areas at Paducah, the C400 Area, the C720 Area, and the C747 Area[6]. These areas are representative of the soil and ground water contamination problems that need to be addressed at paducah. The data provided included contaminant concentration contours and depths, information on utility corridors, overhead obstructions, and facility locations that might affect application of a technology in a specific area. Information was provided on the contamination in the UCRS soils and the soil and ground water contamination in the RGA.

The engineering cost and performance estimates of the different technologies presented in Table 3 are based on contaminant concentration levels and volumes identified by the Advisory Group as representative of the range of expected remediation efforts across the several sites at Paducah. For example, addressing soil contamination areas in the UCRS for TCE of above 100ppm will remove an estimated 95% of the total mass of TCE in the UCRS. In looking at the general volumes of soil to be remediated in the UCRS, several sites had individual areas with volumes that vary from about 10,000 yds up to 40,000 yds. By getting cost data at these two general volumes, remediation scale effects could be evaluated. This approach allows cost and performance estimates to be made for small, intermediate, and large sites by simply combining the costs of the appropriate treatment areas together. The two contamination levels identified in the UCRS to be treated, >100 ppm and >1000 ppm, are representative of the range of levels that should be addressed. It was expected that different technologies would have greater utility in one or the other areas and that the data cold be used to mix and match techniques to develop the optimum treatment strategy.

A similar approach was used in the evaluation of RGA treatment technologies. The concentration levels identified were based on the general plume concentrations and the probability of DNAPL. It was expected that most areas over approximately 1 ppm for TCE would need to be treated in order to minimize further contaminant migration. The areas at the site with this level of contamination in the ground water can be relatively large and therefore larger size system would be needed. It is a rule-of-thumb that areas with concentrations of greater than 10% of the contaminant solubility, for TCE this is about 100 ppm, are generally indicative of DNAPL. Therefore, we identified these areas for special consideration knowing that they are the areas most likely to provide a continuing source of contamination to the ground waster.

In evaluating the application of reactive walls or associated technologies, it was important to make sure that the technologies were designed for the appropriate scales to meet the needs for the multiple plumes at the site. It was also important that the reactive wall technologies be able to treat both the TCE and Tc99 in order to insure the reduction of both contaminants offsite.

Technology cost and performance estimates were supplied by several vendors. The Advisory Group compiled that information into Table 3, based upon our review of the information and knowledge of other applications of the technologies. The vendors and the technology cost and performance data provided include:

- Rotary Steam Stripping, Insitu Fixation[7]
- Chemical Oxidation, IT Corp.[8,9]
- Chemical Oxidation/Air Sparging, Morrison Knudsen[10]
- Biological Treatment, WMI[11] and Enzyme Technologies[12]
- Steam Stripping, Steam Tech[13]
- Electrokinetics, Weiss & Associates[14] and Bechtel Jacobs[15]
- High Vacuum Soil Vapor Extraction and fracturing, McLaren/Hart[16]
- Direct Heating, Current Environmental Solutions[17]
- Surfactant Remediation, Duke Engineering[18]
- Reactive Walls, Foremost Solutions[19], McLaren/Hart, and Weiss

The matrix of factors presented in Table 3, such as expected costs, performance, maturity, and implementation difficulty, provides an objective basis for developing recommendations for an overall remediation strategy for the site. It also provides an objective basis for recommendations of additional data or pilot-studies needed to verify the performance of the most promising technologies or to assist in optimizing a technology performance or cost. The evaluation and discussion of the results of Table 3 are presented in Section 6.

Table 3. Engineering Cost and Performance Estimates for Technology Applications at Paducah.

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
UCRS										
Rotary Steam (In-situ Fixation)	> 100	10,000	200K	350K	2 mo/250 yd^3/day	~ 5-10 ppm	Low (in easy access)	Self-contained treatment	No	550K
	> 100	40,000	200K	1.2M	7 mo/250 yd^3/day	~ 5-10 ppm	High (utilities probs.)	Self-contained treatment	No	1.6M
	> 1,000	10,000	200K	800K	4 mo/100 yd^3/day	~ 50 ppm	High (utilities probs.)	Self-contained treatment	No	1M
Ozone Sparge (IT Corp.)	> 100	10,000	-	40/yd	1 yr	~ 5-10 ppm	Med (effectiveness in clay)	Drill cuttings	No	400K
	> 100	40,000	-	35/yd	1 yr	~ 5-10 ppm	Med (effectiveness in clay)	Drill cuttings	No	1.4M
	> 1,000	10,000	-	55/yd	1 yr	~ 20-30 ppm	Med (effectiveness in clay)	Drill cuttings	No	550K
C-Sparge (KV Assoc.)	> 100	10,000	150K	50K	1 yr	~ 1-5 ppm	Med (effectiveness in clay)	Drill cuttings; GAC	No	200K
	> 100	40,000	250K	90K	1 yr	~ 5 ppm	"	"	No	340K
	> 1,000	10,000	150K	60K/yr	2 yrs	< 50 ppm	"	"	No	270K
Bio (WMI)	> 100	40,000	350K	500K	1 yr	~ **1-5 ppm (soil)** ~ 1-5 ppm (ground water)	High Effectiveness in clay?; Fouling	Trenching Waste	No	850K

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
Steam Enhanced Extraction & Destruction (SEED) [SteamTech]	> 100	10,000	-	137/yd	2-3 yrs (6-8 mos. [steam] w/ 1½ yrs [HPO])	< 100 µgms/kg residual	Medium-High Effectiveness in clay?	Drill cuttings; operational filter cake; PPE; contaminated equipment	No	1.4M
	> 1,000	10,000	-	113/yd	2-3 yrs (6-8 mos. [steam] w/ 1½ yrs [HPO])	<10ppm	High (utilities probs.)	Drill cuttings; operational filter cake; PPE; contaminated equipment	No	1.1M
ECGO (Electro-Chemical-Geo-Oxidation) ; [Weiss & Assoc.]	> 100	10,000	370K	540K	1 yr	10s ppb	Medium (trenching & drilling for conduits, cables & electrodes)	Electrodes plated with ^{99}Tc; drill cuttings	Yes	910K
	> 100	40,000	1.3M	1.6M	1 yr	10s-mid/high 100s ppb	Medium (trenching & drilling for conduits, cables & electrodes)	Electrodes plated with ^{99}Tc; drill cuttings	Yes	2.9M
	> 1,000	10,000	350K	600K	1 yr	mid-low 100s ppb	Medium (trenching & drilling for conduits, cables & electrodes)	Electrodes plated with ^{99}Tc; drill cuttings	Yes	950K

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
Lasagna (electro-kinetics)	> 100	10,000	-	140/yd	14 yrs	~ 1-50 ppm	Med-High (access probs.)	Ground water treatmt, Iron(?) GAC(?)	Yes	1.4M
	> 100	40,000	-	140/yd	62 yrs	~ 1-50 ppm	Med-High (access probs.)	Ground water treatmt, Iron(?) GAC(?)	Yes	5.6M
	> 1,000	10,000	-	115/yd	12 yrs	~ 10-500 ppm	Med-High (access probs.)	Ground water treatmt, Iron(?) GAC(?)	Yes	1.2M
ChemOx/ Permanganate (IT Corp.)	> 100	10,000	Did Not Estimate							
	> 100	40,000								
	> 1,000	10,000								
SVE w/ Fracturing (McLaren/ Hart)	> 100	10,000	606K	91K 77K 70K	1 2 3	30 ppm 10 ppm 5 ppm	-	Water from steam regen. of GAC; drill cuttings	No	697K 774K 844K
	> 100	40,000	1.1M	99K 91K 81K	1 2 3	30 ppm 10 ppm 5 ppm	-	Water from steam regen. of GAC; drill cuttings	No	1.2M 1.3M 1.4M
	> 1,000	10,000	614K	53K 50K 47K	1 2 3	30 ppm 10 ppm 5 ppm	-	Water from steam regen. of GAC; drill cuttings	No	667K 717K 764K

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
Six Phase Heating (Current Environ. Sols.)	> 100	10,000	315K	120K	6-12 mos.	~ 1 ppm	Low	Vapor/steam condensate; drill cuttings	No	435K
	> 1,000 (UCRS and RGA)	40,000	950K	900K	8 mos.	~ 1 ppm	Med	Vapor/steam condensate; drill cuttings	No	1.9M
Surfactant Flush (Duke Eng. Svcs.)	> 100	10,000	Not Applicable							
	> 100	40,000								
	> 1,000	10,000								
RGA										
C-Sparge (K-V Assoc.)	> 1	50,000	193K	32K/yr	2 yrs	< 5 ppb	Low	Spent IX resin	Yes	257K
	> 100	5,000	212K	59K	1 yr	< 5 ppb	Low	Spent IX resin	Yes	271K
Ozone Sparge (IT Corp.)	> 1	50,000	Did not estimate; "Suggests permanganate more efficient"							
	> 100	5,000	Did not estimate; "Suggests permanganate more efficient"							
Rotary Steam (In-situ Fixation)	Depth generally limited to 40'; not applicable to RGA									
Bio (aerobic; WMI)	> 1	50,000	300K	450K	1 yr	< 1-2 ppb	Medium	No waste	No	750K
	> 100									
Bio (aerobic; Enzyme)	> 100	5,000	100K	225K	1.5 yr	10 ppm	Medium	No waste	No	325K

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
Steam Enhanced Extraction & Destruction [Steam Stripping, SteamTech]	> 1	50,000	Not applicable							
	> 100	5,000	-	113/yd	2-3 yrs (6-8 mos. [steam] w/ 1½ yrs [HPO])	~ 1 ppm	High (utilities probs.)	Drill cuttings; operational filter cake; PPE; contaminated equipment	No	565K
ECGO (Electro-Chemical-Geo-Oxidation) [electro-kinetics] w/ in-well CO_2 stripping & GAC offgas treatment [Weiss & Assoc.]	> 1 (saturated UCRS & RGA)	2.4M	52M	19.2M	10 mos.	~ 5 ug/L	Medium (trenching & drilling for conduits, cables & electrodes)	Liquid waste from GAC regeneration; electrodes plated with ^{99}Tc; drill cuttings	Yes	71M
	> 100 (saturated UCRS & RGA)	3.0M	60M	24M	10 mos.	~ 5 ug/L	Medium (trenching & drilling for conduits, cables & electrodes)	Liquid waste from GAC regeneration; electrodes plated with ^{99}Tc; drill cuttings	Yes	84M

Technology	Concentration, ppm	Volume, yd^3	Capital Costs, $	Treatment Costs, $	Treatment Period/Rate	Residual Contaminant	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
Chemical Oxidation/ Permanganate (IT Corp.)	> 100	> 5,000 (NW Plume: 18.1M yd^3)	-	1.50-2.50/yd	-	< 100 µg/l	Medium (Geology causes preferential flow paths)	Drill cuttings	No	27-45M
	> 100	> 5,000 (NE Plume: 8.8M yd^3)	-	1.00-2.00/yd	-	< 100 µg/l	Medium (Geology causes preferential flow paths)	Drill cuttings	No	9-17M
	> 100	> 5,000 (SW Plume: 1.5M yd^3)	-	3.00-6.00/yd	-	< 100 µg/l	Medium (Geology causes preferential flow paths)	Drill cuttings	No	4-9M
SVE w/ Fracturing (McLaren/ Hart)	> 1	50,000	Not Applicable							
	> 100	5,000	Not Applicable							
Six Phase Heating (Current Environ. Sols.)	> 100	20,000 (UCRS) + 20,000 (RGA)	950K	900K	1 yr	~ 10s ppb	Low	Vapor/steam condensate	No	1.9M
Surfactant Flush (Duke Eng. Svcs.)	> 1	50,000	Not Applicable							
	> 100	5,000	317K	1,202	1 mo/35 gpm	< 2 ppm	-	Waste Water Trmt $4.2M	No	6M

Technology	Concentration, ppm	Area	Capital Costs, $	Maint. Costs, $	Useful Life, yrs	Contaminant Reduction	Implement Difficulty	Waste Generation	99Tc Treatment	Total Costs, $
REACTIVE WALLS										
Fe (jet grout) [Foremost Solutions]	1-10	4000'x50'	3M ($15/$ft^2$)	100K/yr	10 yr/wall (2 walls needed)	99% for TCE & ^{99}Tc	Medium Depth and continuity concerns	Iron(?)	Yes	8M (2 walls)
	1-10	1000'x50'	500K ($15/$ft^2$)	50K/yr	10 yrs/wall (2 walls needed)	"	Medium Depth and continuity concerns	Iron(?)	Yes	2.5M
C-Sparge (K-V Assoc.)	1-10	4000'x50'	850K	285K/yr	20	99.5% for TCE 97% for ^{99}Tc	Low	Spent IX resin	Yes	6.6M
ECGO (Weiss & Assoc.)	< 10	900K yd^3	25M	1M/yr	20	~ 5 µg/L	Medium	Liquid waste from GAC regeneration; electrodes plated with ^{99}Tc; drill cuttings	Yes	45M
Pneumatic Injection of Fe (McLaren/ Hart)	1-10	1000'x60'	8.5M	300K	20	> 90% for TCE and ^{99}Tc	Medium	Iron(?)	Yes	8.8M

6. SUMMARY OF TECHNOLOGIES SUGGESTED FOR POSSIBLE IMPLEMENTATION AT PADUCAH

The Advisory Group discussed in detail the information provided in Table 3. Based on expected cost and performance, the technologies were ranked for potential application in the UCRS, RGA, and as a reactive wall. The Advisory Group chose to include several technologies for suggested implementation. Enough technologies were retained to cover the range of concentrations, hard and easy access, and vadose and saturated soils. Most of the technologies suggested are generally lower in cost, have less waste generation, or are more mature than competing technologies in a treatment area. The results of the general ranking include:

ZONE	TECHNOLOGY SUGGESTIONS
UCRS	• Rotary Treatment • Chem Ox – Ozone/fracturing • Direct Heating • SVE/fracturing
RGA	• Chem Ox - C-Sparge • Direct Heating • Steam/DUS/HPO • Chem Ox - Permanganate
Reactive Wall	• Passive Reactive Media (iron) • Active System - C-Sparge

It should be noted that "Rotary Treatment" refers to processes that are facilitated by augar mixing of soil with the reactive agent, that is, the reactive agent could be steam, ozone, permanganate, or iron filings.

The UCRS technologies suggested provide options to treat both vadose and saturated zones. They cover a range of aggressive oxidation or heating techniques to less aggressive technologies like ozone oxidation. Exactly how each technology will perform in the UCRS must be evaluated in more detail in cooperation with Paducah. Some form of fracturing may be necessary to adequately treat the UCRS soils with the ozone or SVE technologies. The ability to do this in the areas of high utilities should be possible but needs to be looked at closely. The technologies identified for the UCRS do not specifically address the Tc99 in the vadose zone. The Advisory Group believes the Tc99 in the UCRS to be less of a concern as a continuing source to the RGA, though the C-Sparge technology was retained partially due to the fact that it may be able to treat both the TCE and Tc99. Insitu destruction is of major interest to the Advisory Group, predominately as a way to minimize wastes. If extraction technologies such as the SVE or direct heating are used, the group preferred direct treatment of collected gasses and water relative to sorption technologies such as activated carbon. This is because they would like to minimize any mixed wastes that might be generated. The Advisory Group suggested that exsitu biotreatment be considered as a primary method of minimizing wastes if one of the extraction technologies is selected.

The suggested RGA technologies also provide a range of options to treat the expected DNAPL areas and the much larger lower concentration areas. Insitu contaminant destruction was again preferred. Each of the technologies identified were suggested because they appear to be able to meet these expectations more cost-effectively than other systems. The C-Sparge system was suggested because in certain applications both TCE and Tc99 may be treated at the same time. The technologies identified also provide some options for the hard and easy access areas.

Since few technologies were identified to treat the Tc99 in the RGA effectively insitu, two reactive wall treatment technologies were retained with the potential to treat both the TCE and Tc99. The maturity of both technologies for this application at Paducah are limited and the Advisory Group thought that because of this reason the suggestion of a couple of alternatives would be prudent. Additional it is possible that the two technologies could complement each other in an actual deployment. To be effective, the C-Sparge system would require an adequate development of the ion exchange module suggested in their report.

The Advisory Group also discussed two other area, characterization and pilot studies. The group suggests that a range of characterization technologies able to look at wide areas of contamination be investigated in detail to help optimize the overall remedial design at the different areas. Better deep characterization and better characterization under buildings could help minimize remediation costs at Paducah. The types of technologies that need to be reviewed include geophysical, electromagnetic, magnetic resonance imaging, etc. A number of technologies appear to exist that could significantly reduce treatment costs at this site and better identify the selection of the most appropriate and most cost-effective technologies.

The Advisory Group endorsed the pilot study being planned for the iron reactive wall. This shuld provide the additional data needed to help make the best decision on a final remedial strategy for Paducah. The group also ranked the pilot studies they think are the most crucial for a final technology or strategy selection. These include:

- Priority 1:
  C-Sparge in the RGA with ion exchange for Tc99
  Fracturing with ozone and SVE in the UCRS
- Priority 2:
  Direct Heating – follow Cape Canaveral pilot results first
  Permanganate – follow Cape Canaveral pilot results first

It should be noted that the priority assigned to the technologies listed for potential pilot studies does not constitute favoring that technology but rather a need for further information regarding that technology's performance under the site specific conditions at Paducah. Both the top priority pilot studies were estimated by the vendors to cost $100-150K.

7. REFERENCES

1. Information Brief for Groundwater Operable Unit, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, January 12, 1999, DOE/OR/07-1786.

2. Kuzio, Ken, “Paducah ITRD Project Meeting Minutes, February 11-12, 1999, Paducah, Kentucky”, Sandia National Laboratories, Albuquerque, NM.

3. Kuzio, Ken, “Paducah ITRD Project Meeting Minutes, April 21-22, 1999, Cincinnati, Ohio”, Sandia National Laboratories, Albuquerque, NM.

4. Kuzio, Ken, “Paducah ITRD Project Meeting Minutes, June 21-22, 1999, Paducah, Kentucky”, Sandia National Laboratories, Albuquerque, NM.

5. Kuzio, Ken, “Paducah ITRD Project Meeting Minutes, August 18-19, 1999, Paducah, Kentucky”, Sandia National Laboratories, Albuquerque, NM.

6. Hightower, Mike, and Kuzio, Ken, “Paducah ITRD Project Contaminant Information”, Sandia National Laboratories, Albuquerque, NM, memo dated October 1,1999.

7. Murry, Richard, memo dated June 21, 1999, In-situ Fixation, Inc., Chandler, AZ.

8. Lewis, Rick, “Field Demonstration of In Situ Chemical Oxidation for Treatment of TCE Impacted Soils, PGDP, Paducah, Kentucky”, IT Corporation, Norwood, MA, letter dated November 12, 1999 and amended November 24, 1999.

9. Clayton, Wilson, “Pilot Scale Deployment of in-situ chemical oxidation using ozone, Paducah ITRD Project”, IT Corporation, Englewood, CO, letter dated November12, 1999 and amended December 13, 1999.

10. Ehleringer, Bruce, “Proposal for Ozone Sparging Demonstration Using the KVA C-Sparge Process at the PGDP, Paducah, Kentucky”, Morrison Knudsen Corporation, Cleveland, OH, letter dated October 19, 1999 and amended December 14, 1999.

11. Zielinski, John,”Feasibility Study for InSitu Bioremediation of TCE in the Paducah ITRD Project”, WMI International, Inc., Houston, TX, letter dated December 9,1999.

12. Laughlin, David, “Aerobic Biological Treatment of TCE-Contaminated Groundwater, Paducah, Kentucky”, Enzyme Technologies, Inc., Portland, OR, letter dated December 14, 1999.

13. La Brecque, Doug, letter dated November 5, 1999, Steam Tech Environmental Services, Sparks, NV.

14. Iovanetti, Joe, “Refined Preliminary Cost Estimate, WA Job#702-0015”, Weiss Associates, Emeryville, CA, letter dated December 1, 1999.

15. Ford, Bruce, “Paducah ITRD Project Engineering Cost and Performance Estimates for the Lasagna Electrokinetic Technology Candidate”, Bechtel Jacobs, Paducah, KY, presentation at the June 21-22, 1999 Paducah ITRD Project Meeting.

16. King, Treveor, “Paducah ITRD Project, Innovative Remedial Technology Applications to Treat Vadose Soils (UCRS) and Groundwater (RGA)”, McLaren/Hart, Inc., Warren, NJ, letter dated November 23, 1999 and amended December 7, 1999.

17. Beyke, Greg, “Six Phase Heating-Direct Heating Application”, Current Environmental Solutions, Atlanta, GA, presentation at the June 21-22, 1999 Paducah ITRD Project Meeting.

18. Jackson, Dick, “Surfactant-Enhanced Aquifer Remediation of SWMU 11”, Duke Engineering & Services, Austin, TX, December 1, 1999.

19. Meiggs, Ted, personal communications, Foremost Solutions, Golden, CO

APPENDIX C3

Fig. C3.1. Predicted Tc-99 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 22, PGDP

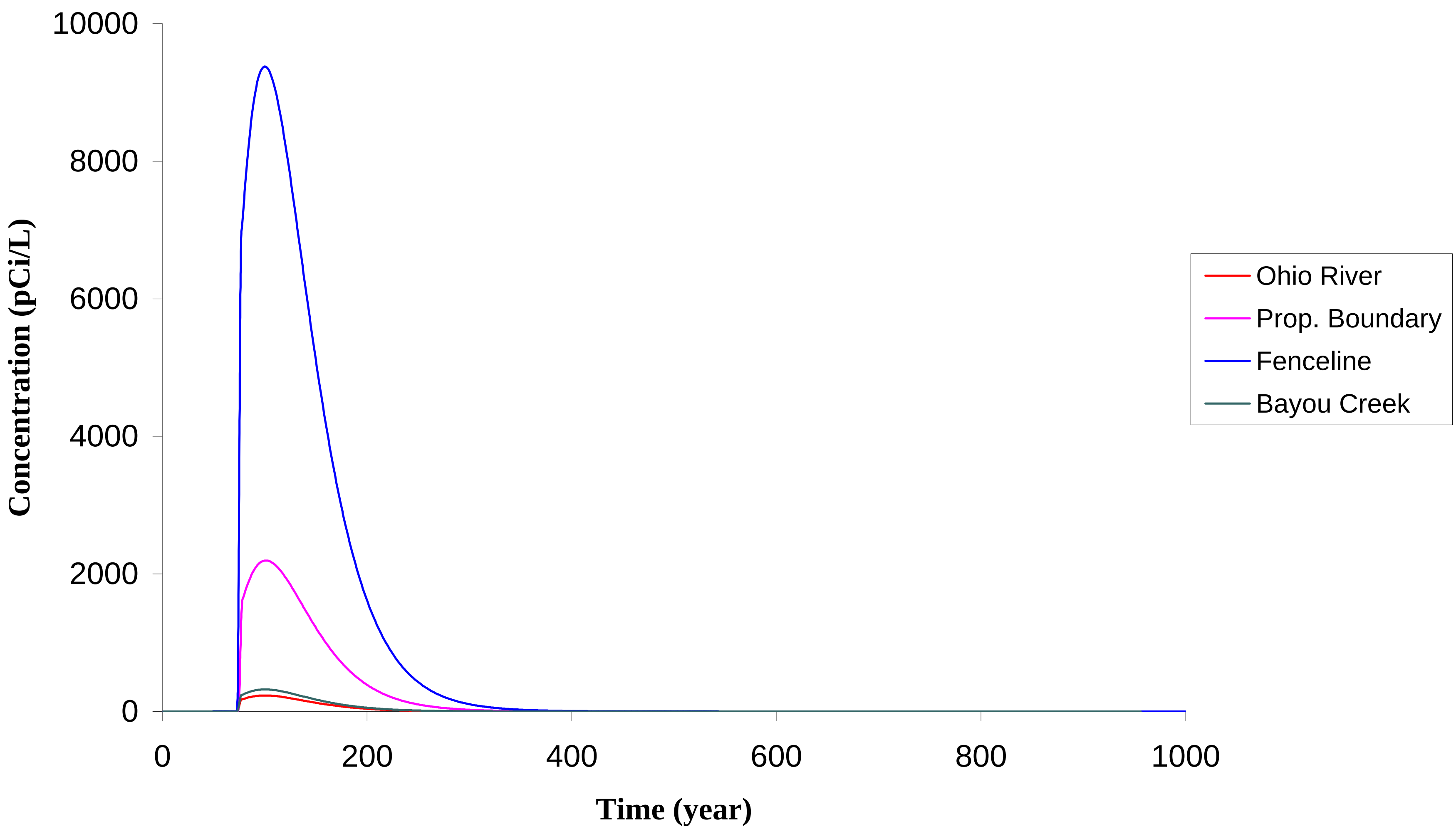


Figure C3.2. Predicted Tc-99 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 6

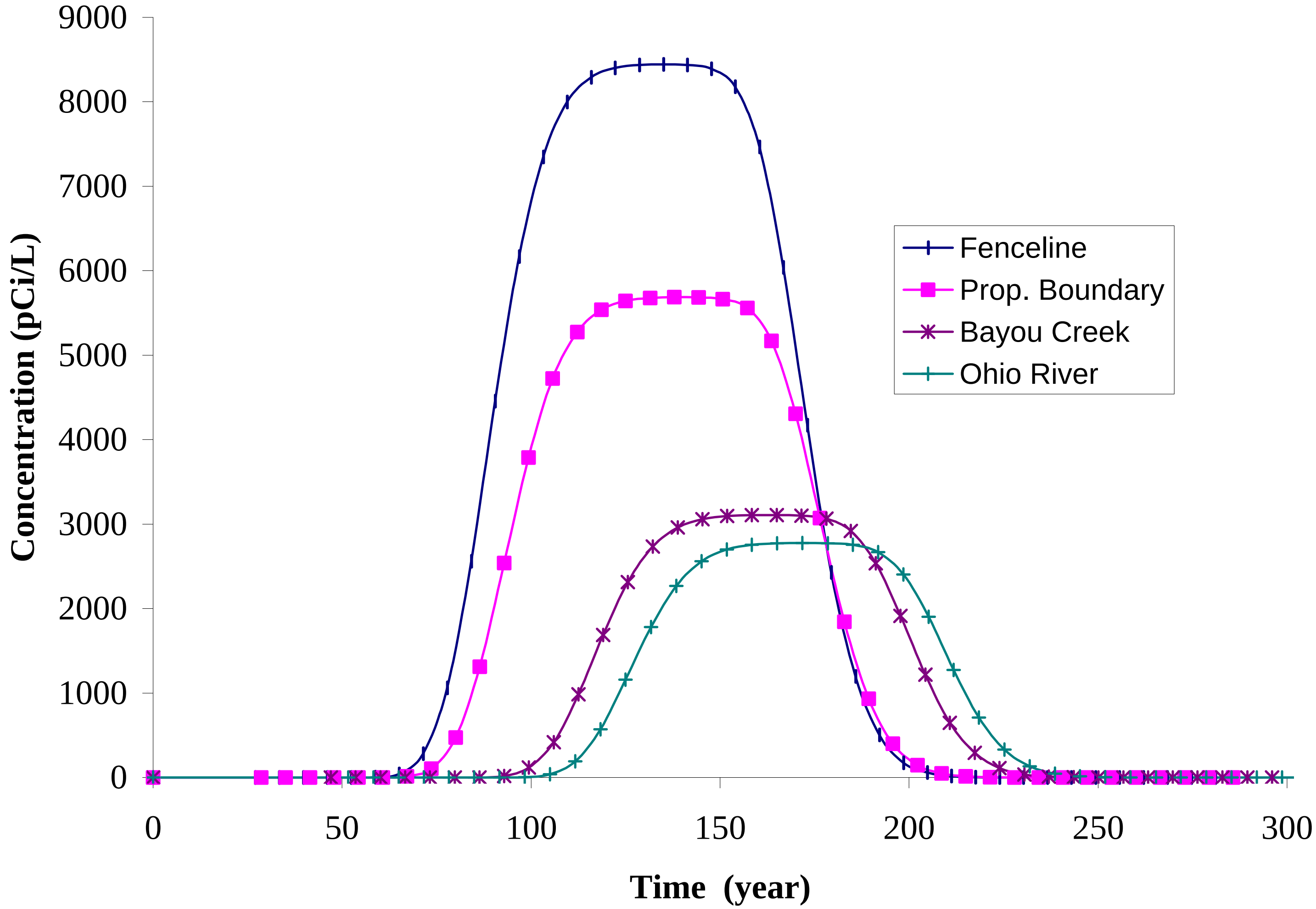


Figure C3.3. Predicted TCE Concentrations at the PGDP Receptor Locations due to loading from WAG 6

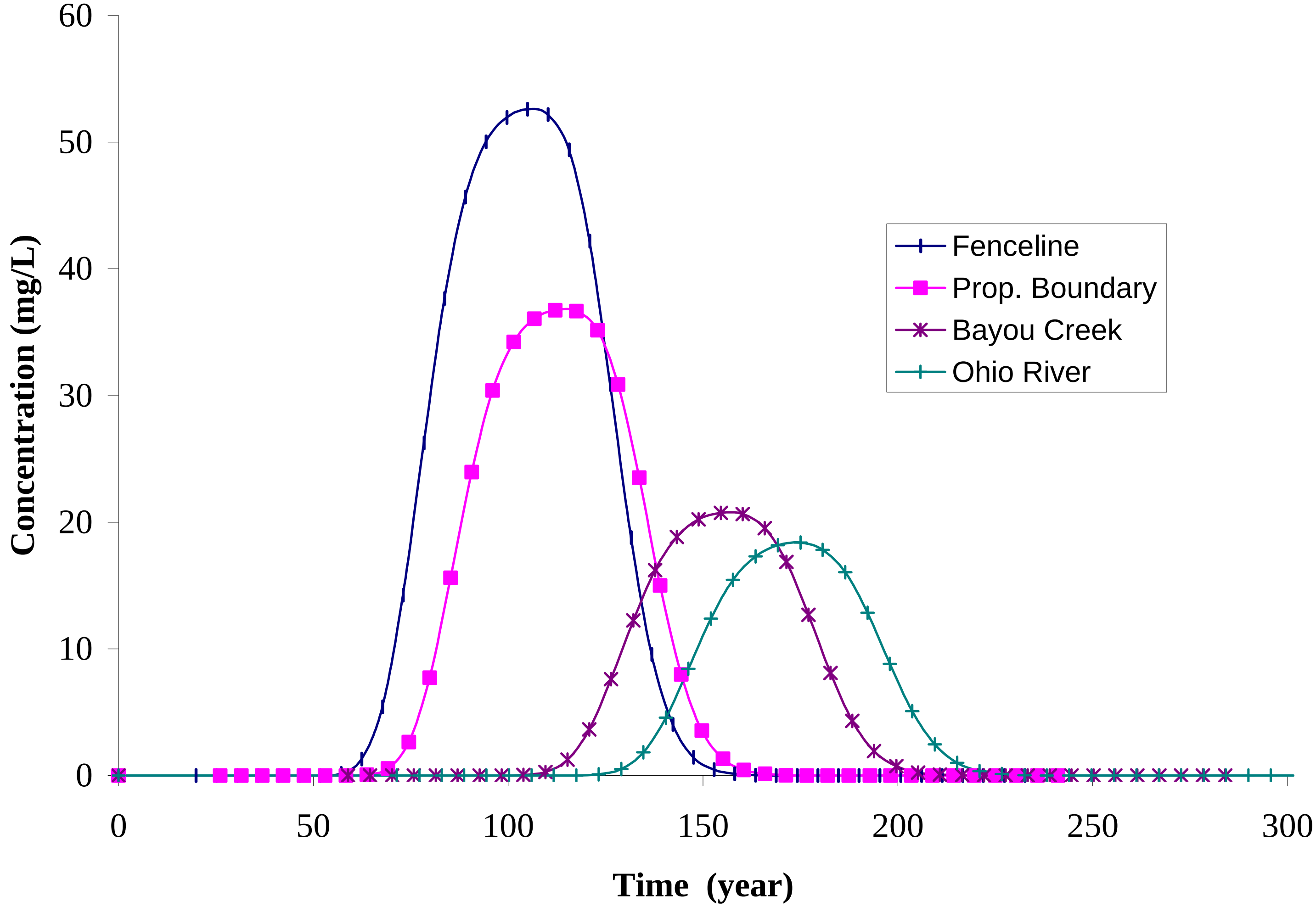


Figure C3.4. Predicted Vinyl Chloride Concentrations at the PGDP Receptor Locations due to loading from WAG 6

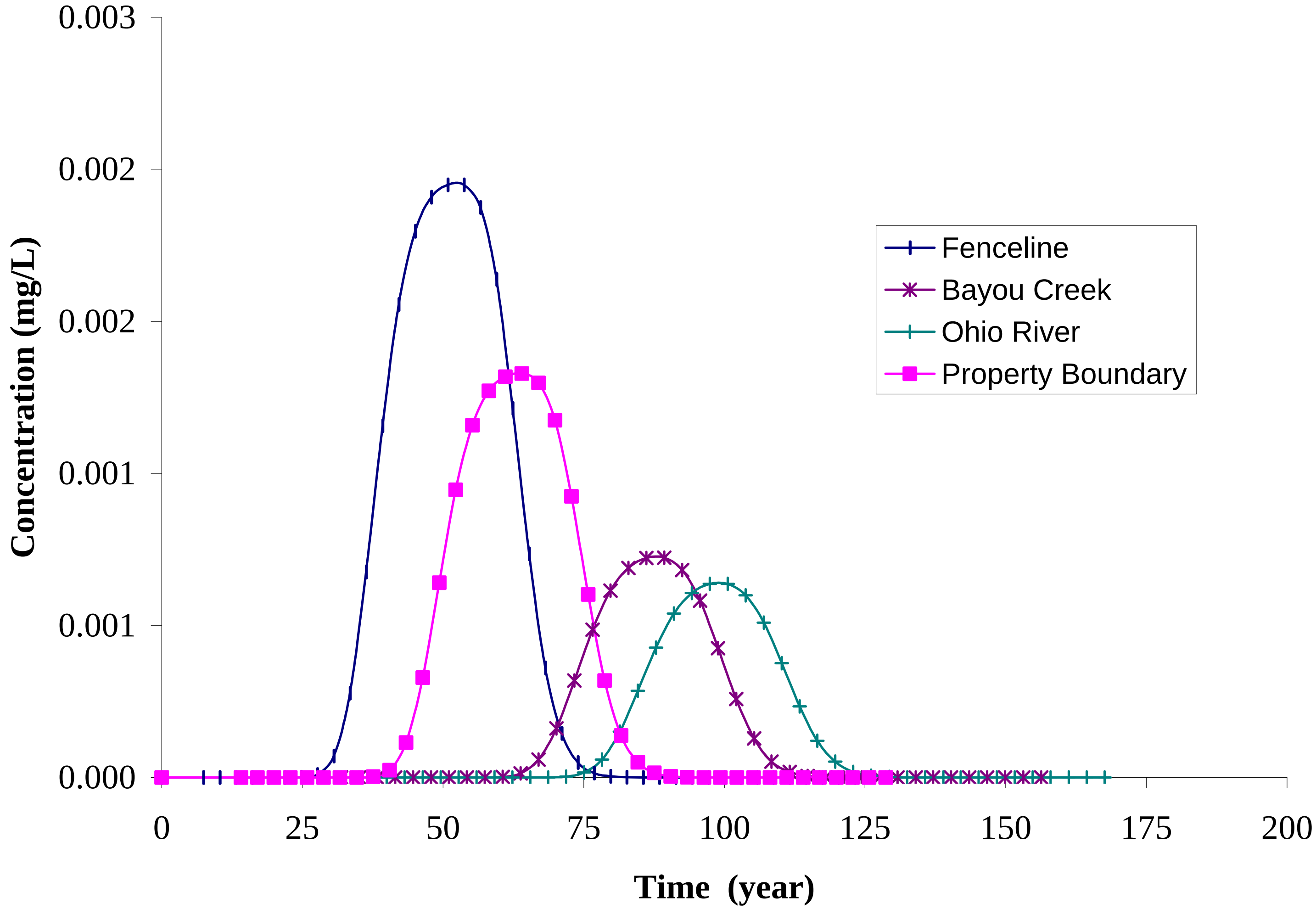


Figure C3.5. Predicted Antimony Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 6

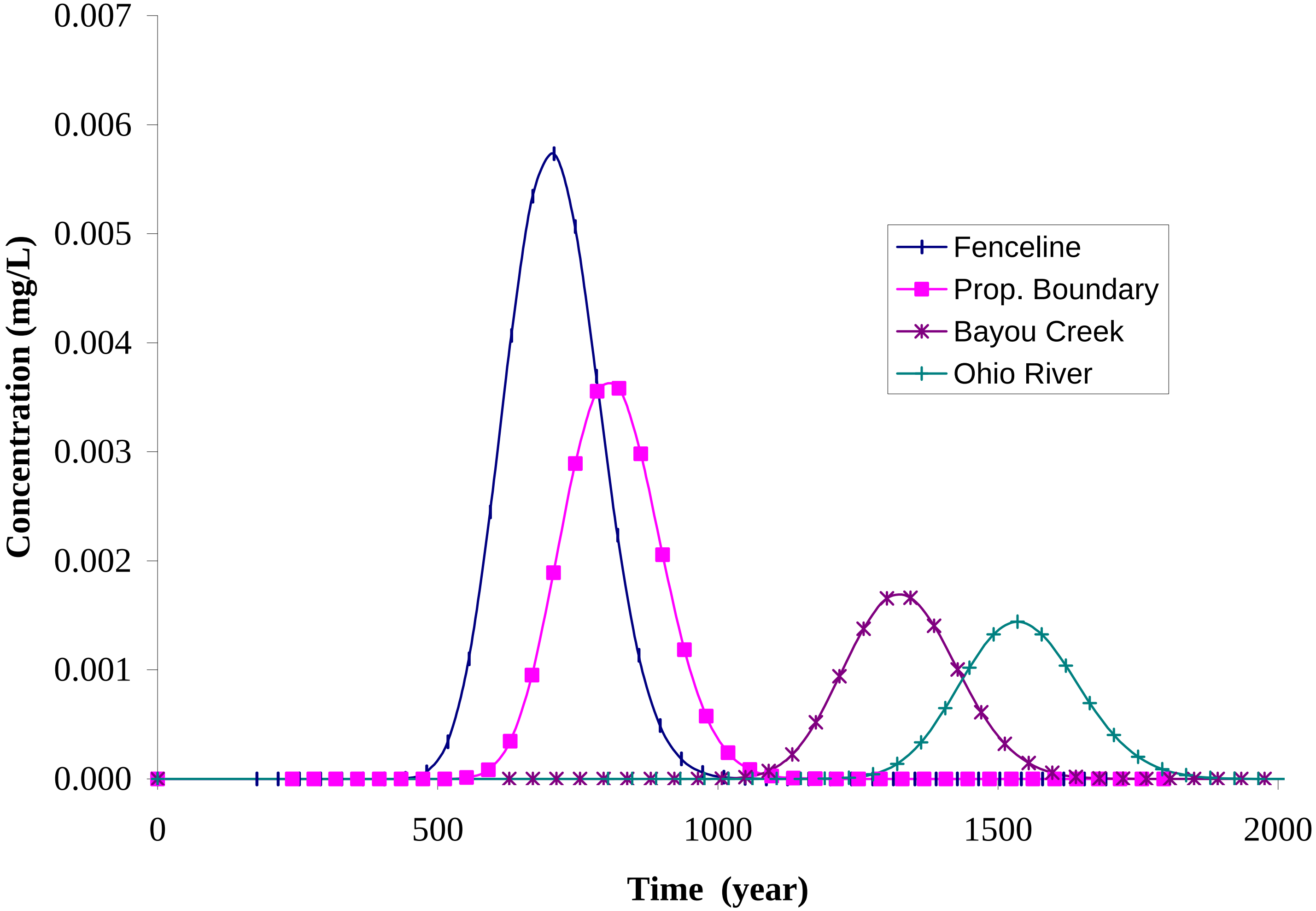


Figure C3.6. Predicted U-238 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 6

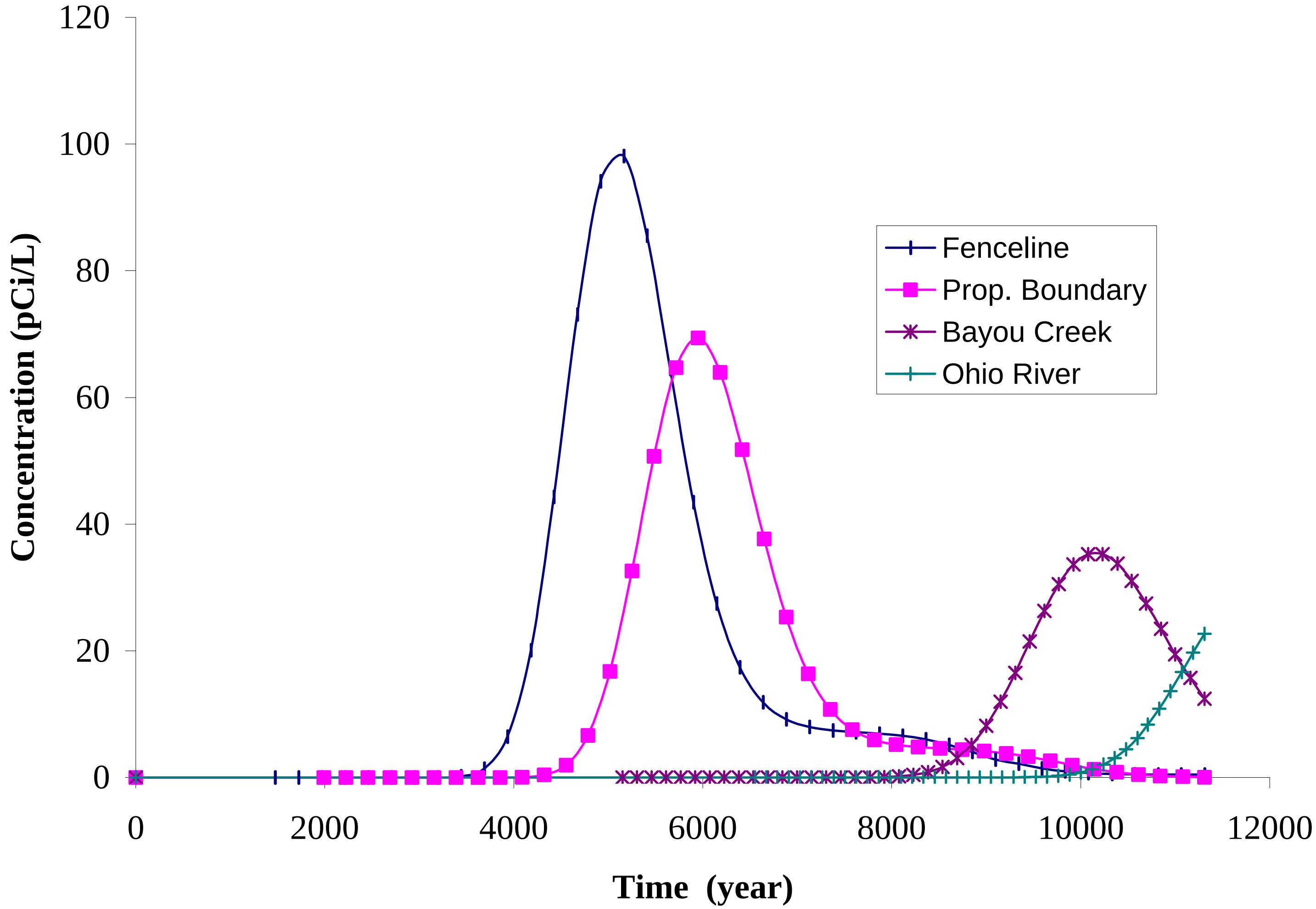


Figure C3.7. Predicted U-235 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 6

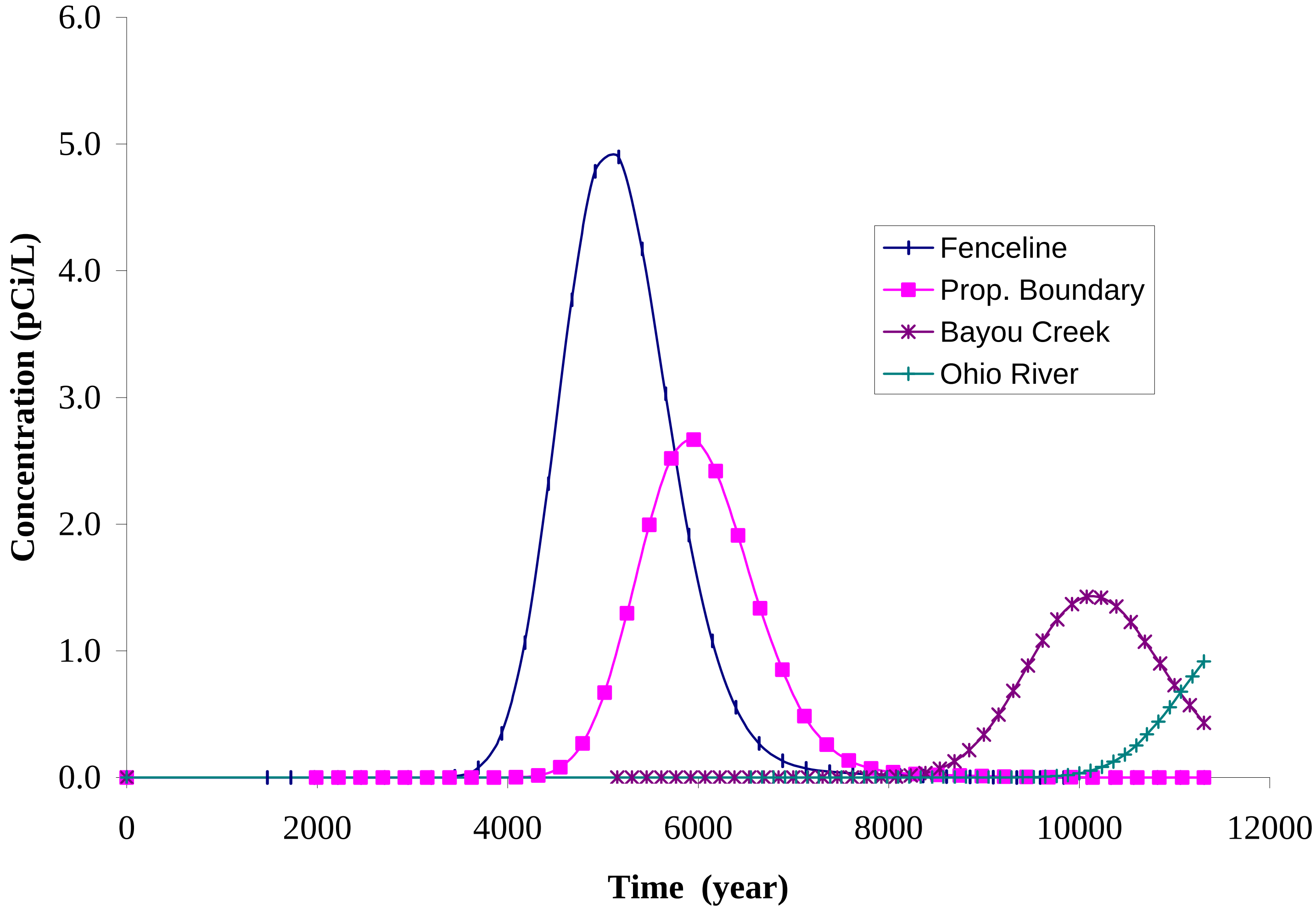


Figure C3.8. Predicted U-234 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 6

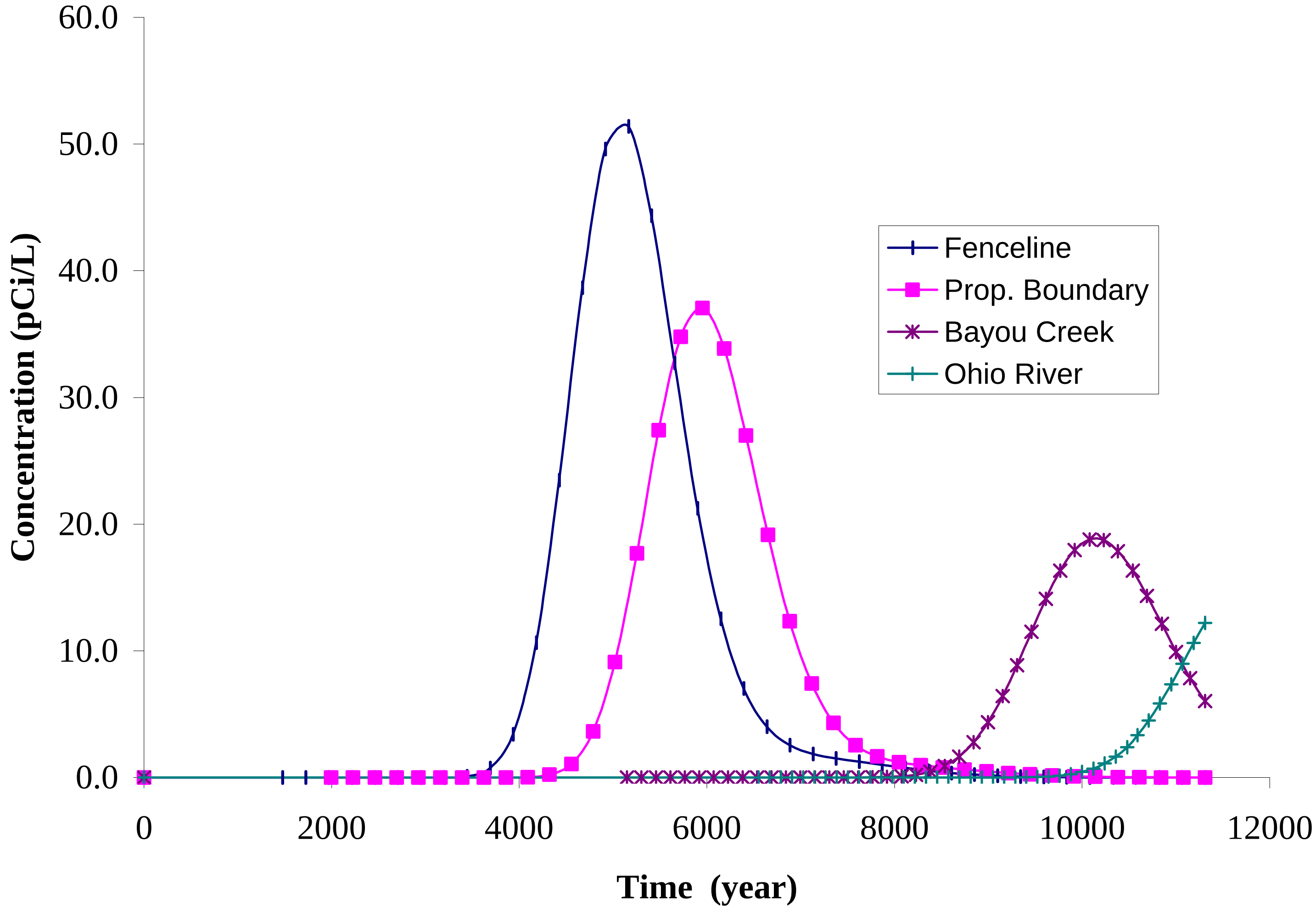


Fig. C3.9. Predicted Antimony Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 27

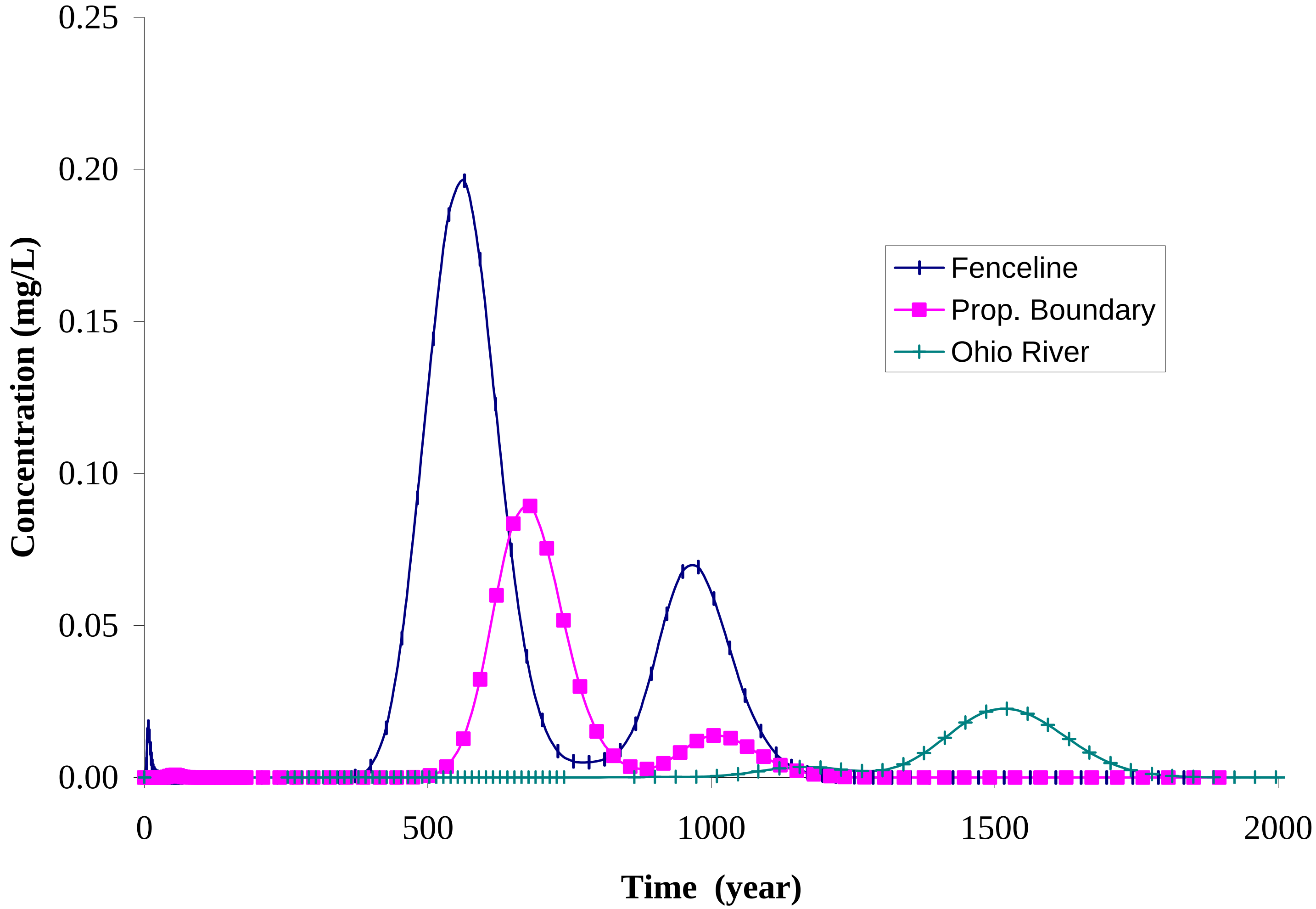


Figure C3.10. Predicted TCE Concentrations at the PGDP Receptor Locations due to loading from WAG 27

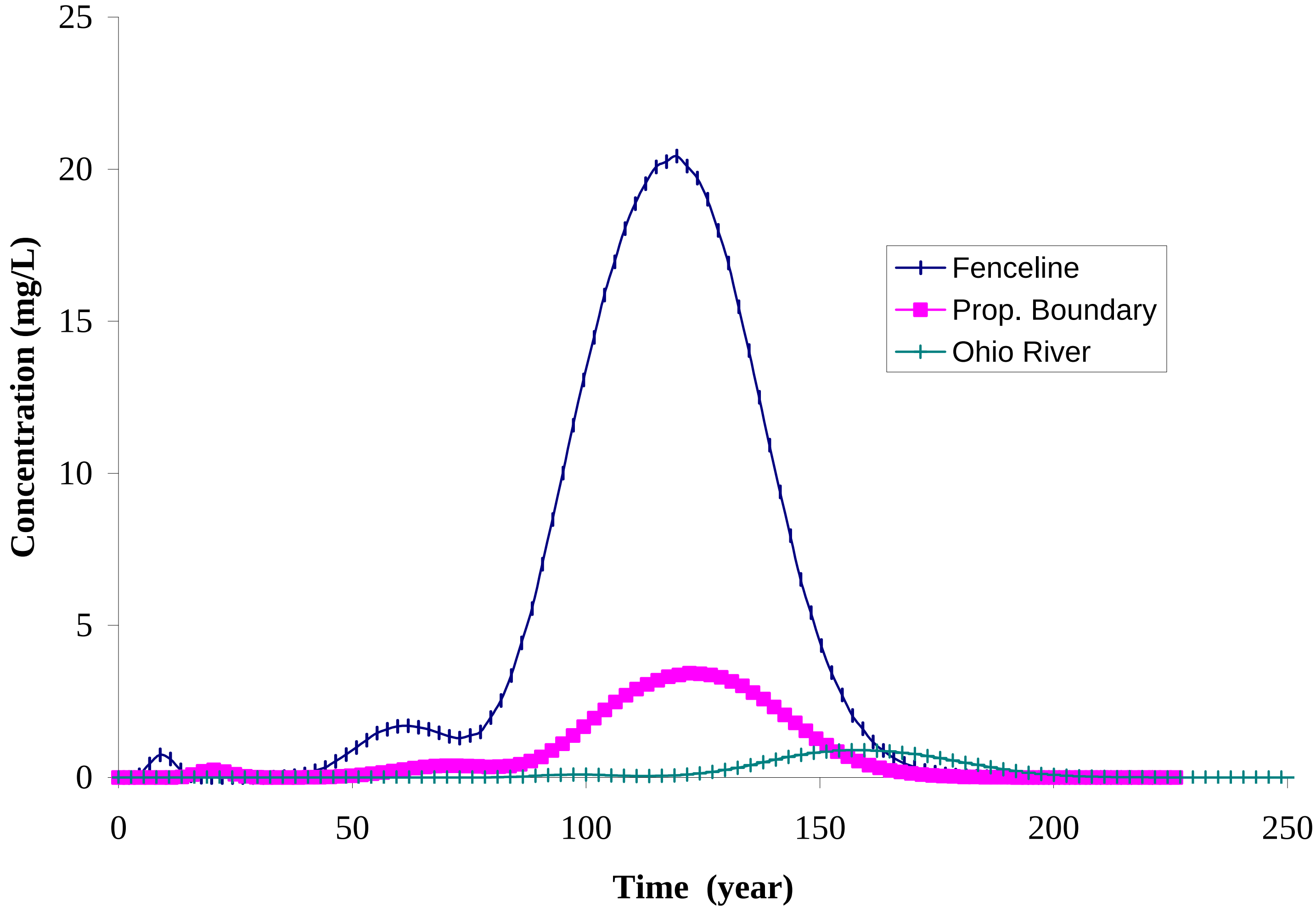


Fig. C3.11. Predicted Vinyl Chloride Concentrations at the PGDP Receptor Locations due to loading from WAG 27

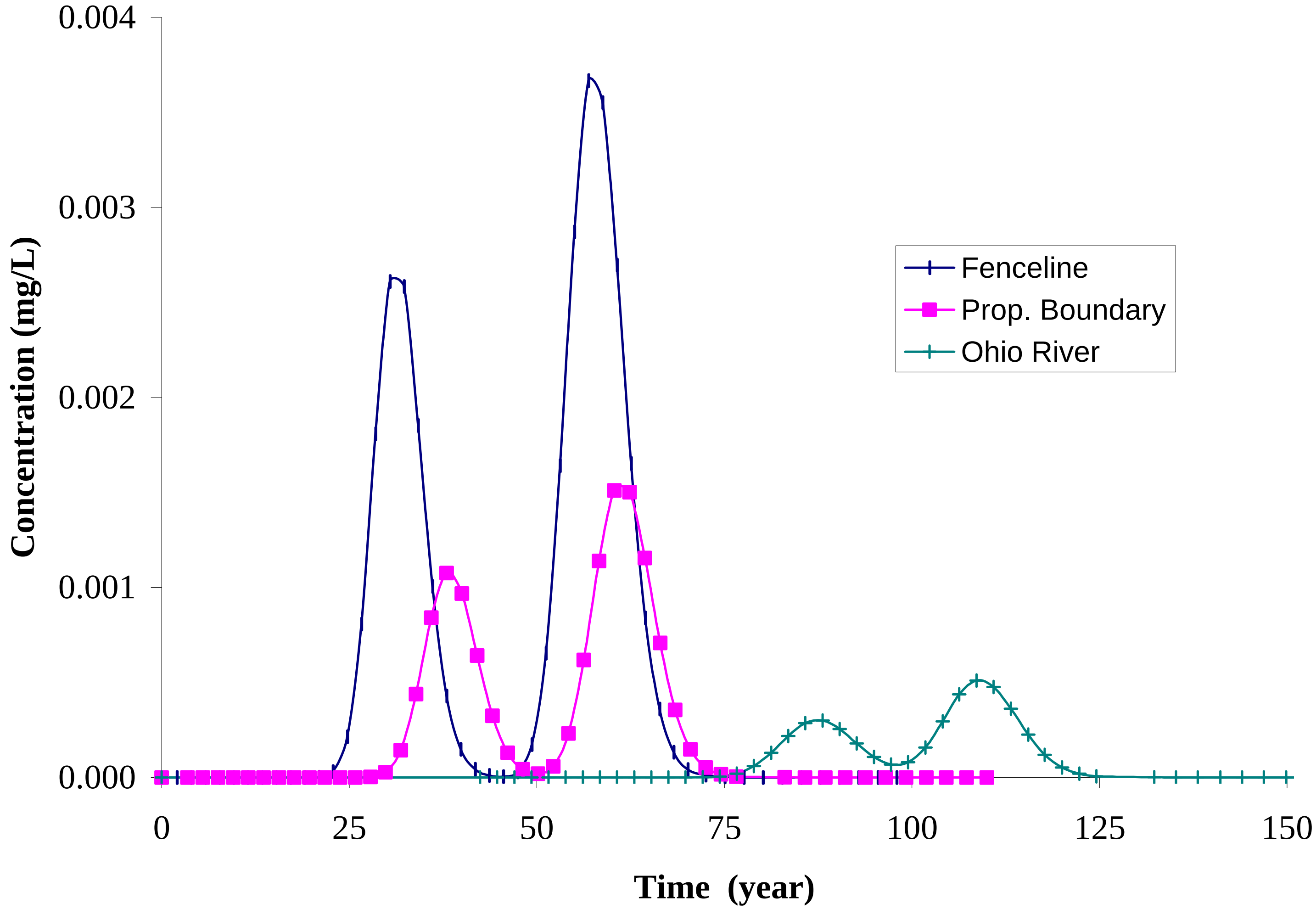


Fig. C3.12. Predicted Tc-99 Activity Concentrations at the PGDP Receptor Locations due to loading from WAG 28

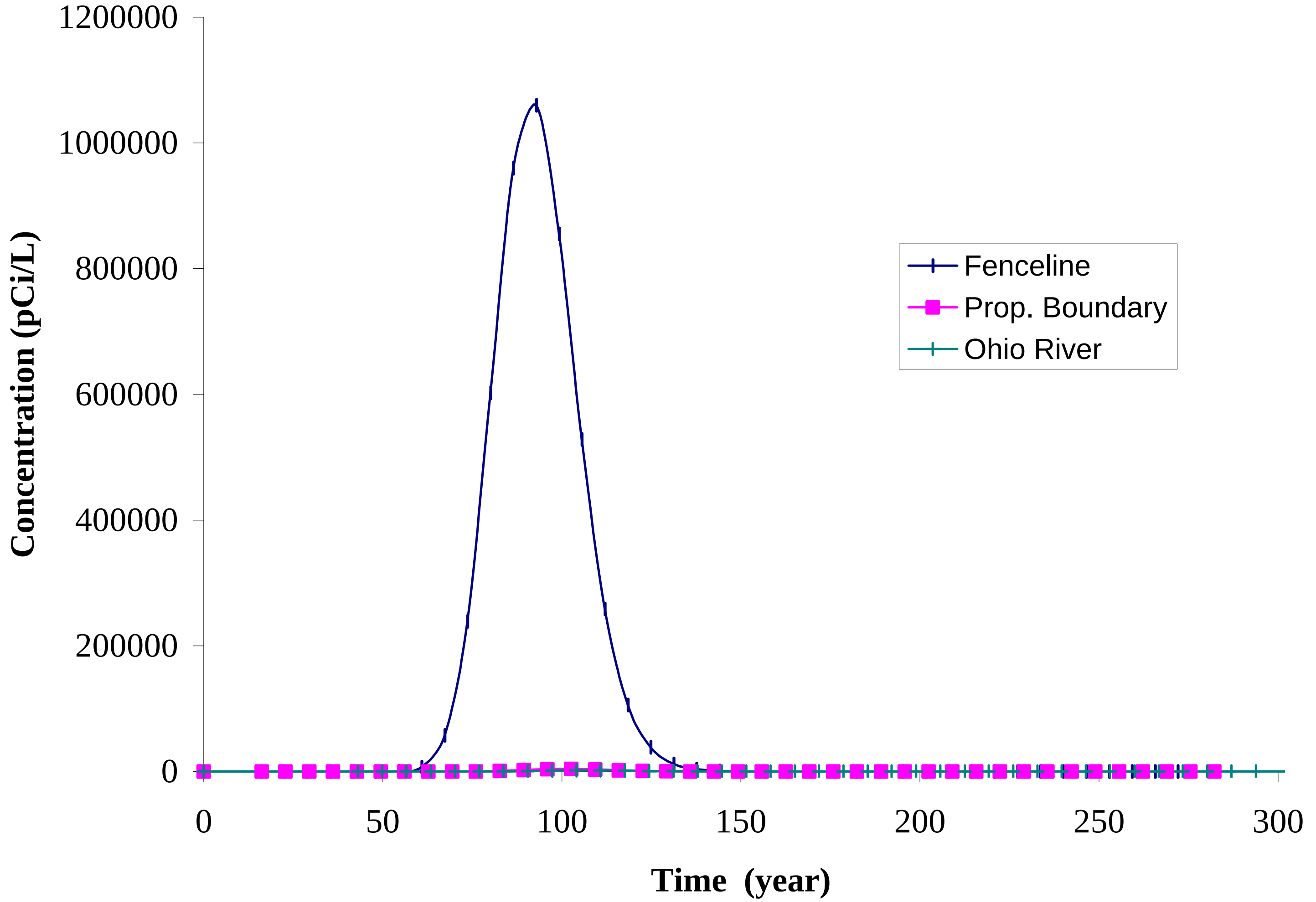


Fig. C3.13. Predicted TCE Concentrations at the PGDP Receptor Locations due to loading from WAG 28 (AOC204)

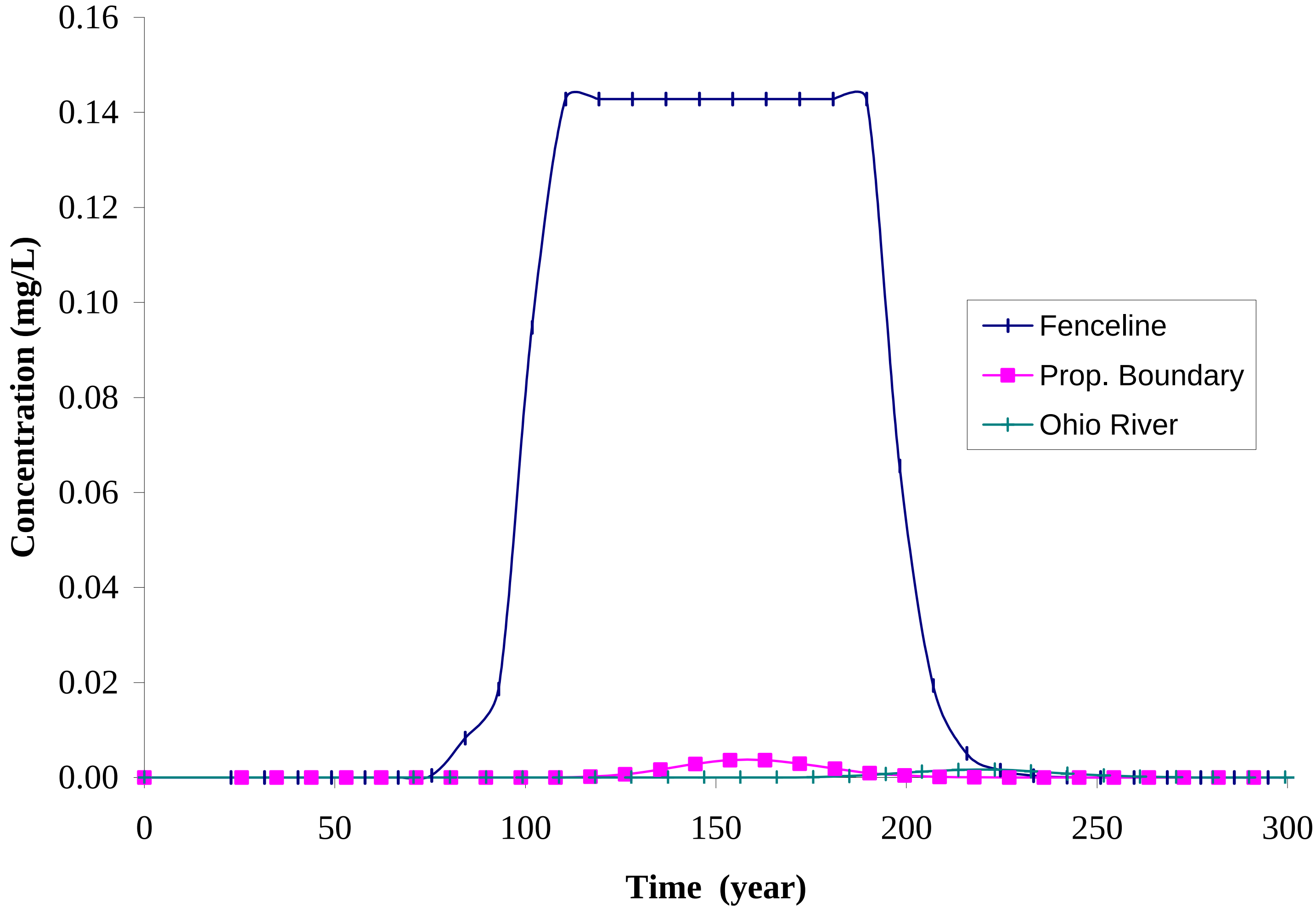


Fig. C3.14. Predicted Manganese Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 28

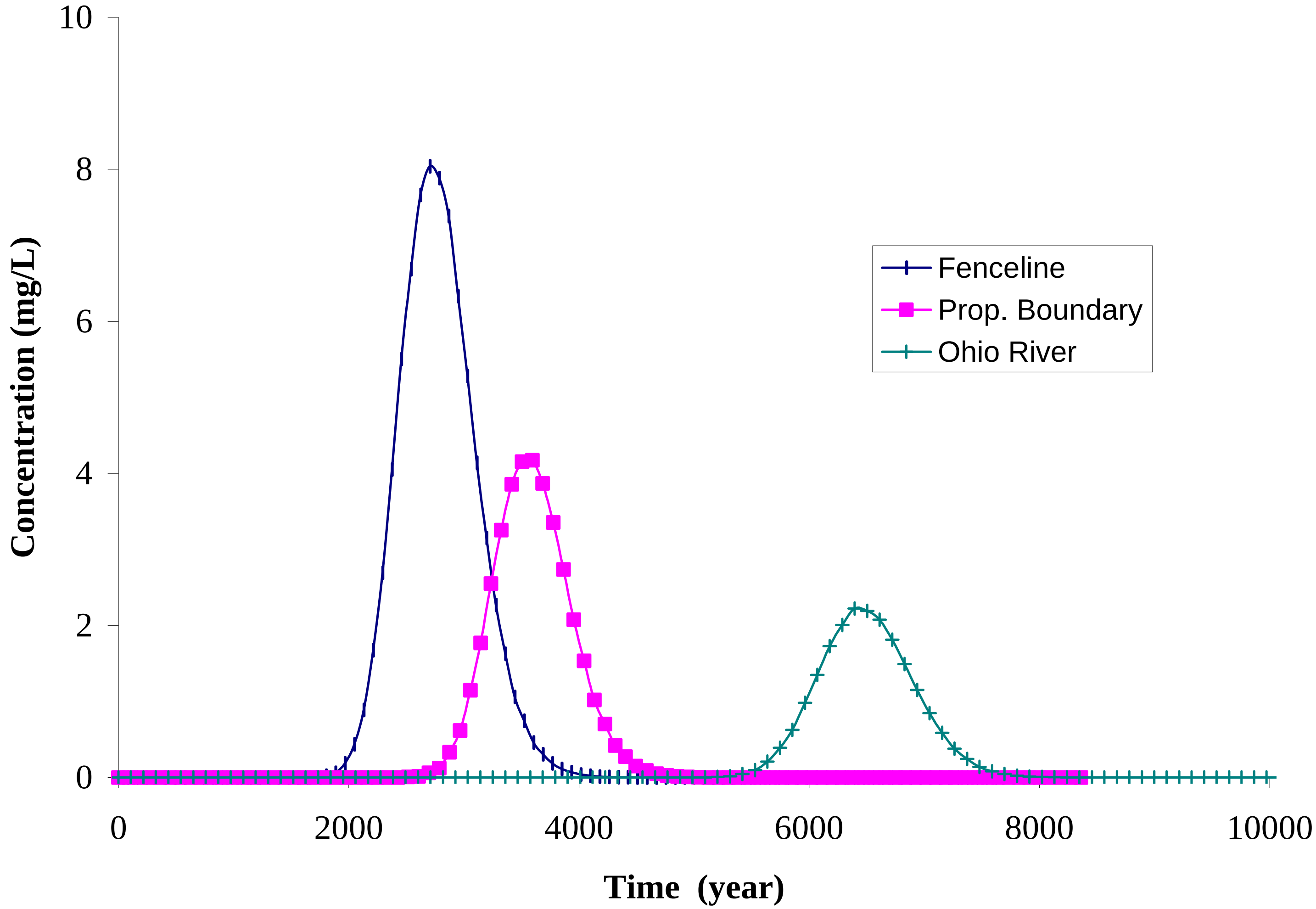


Fig. C3.15. Predicted Lithium Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 28

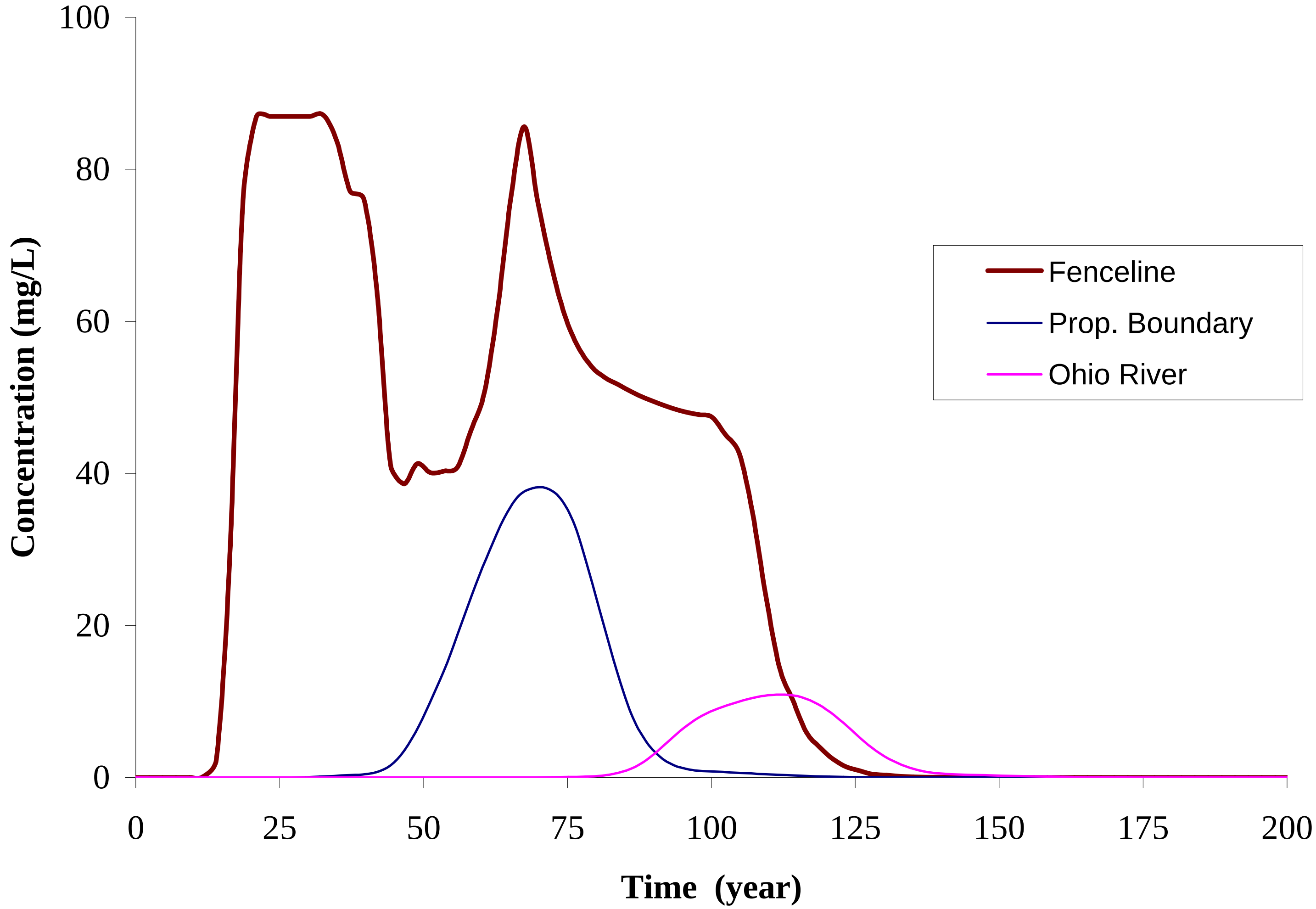


Fig. C3.16. Predicted Strontium Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 28

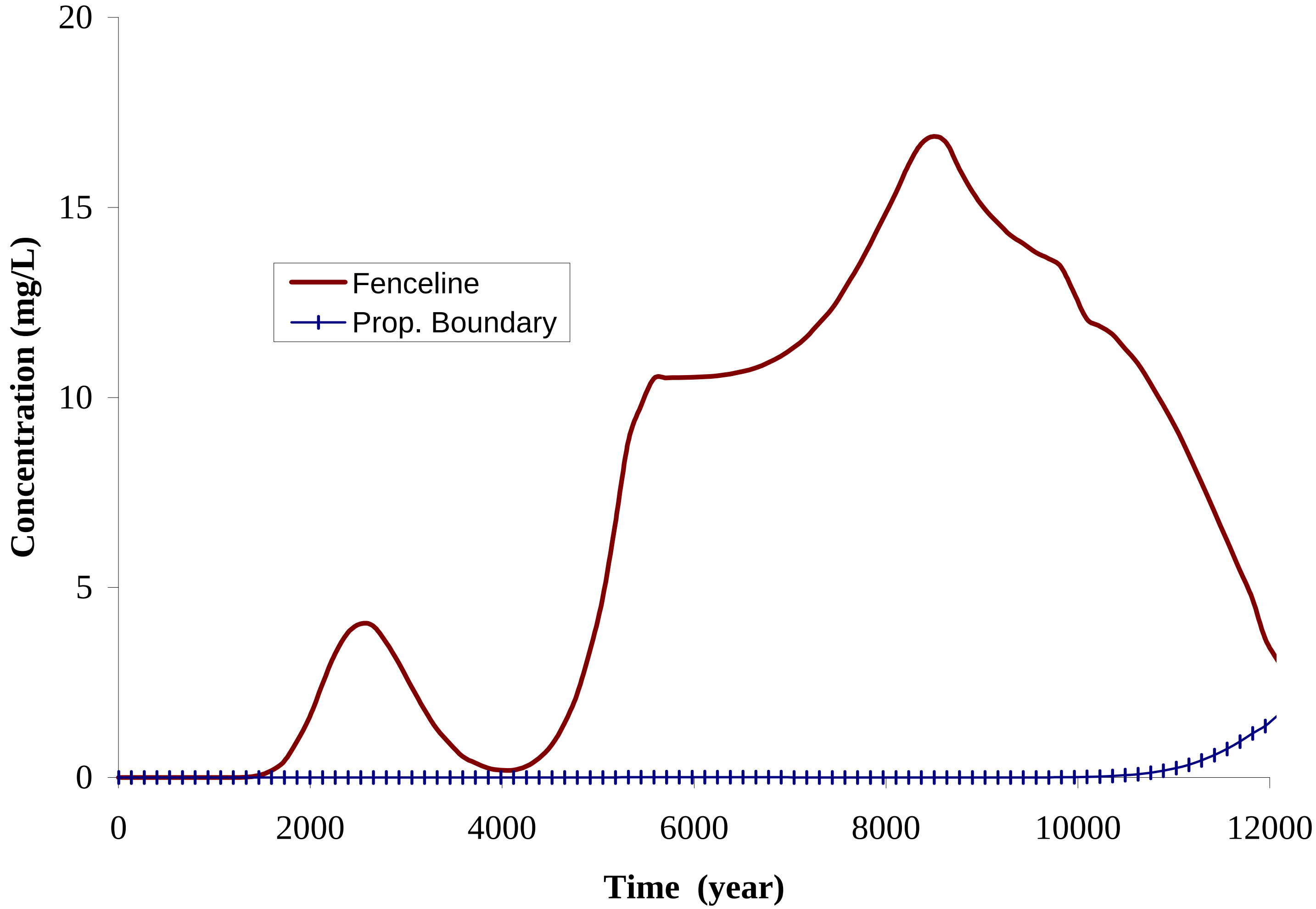


Figure C3.17. Predicted Chromium Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 28

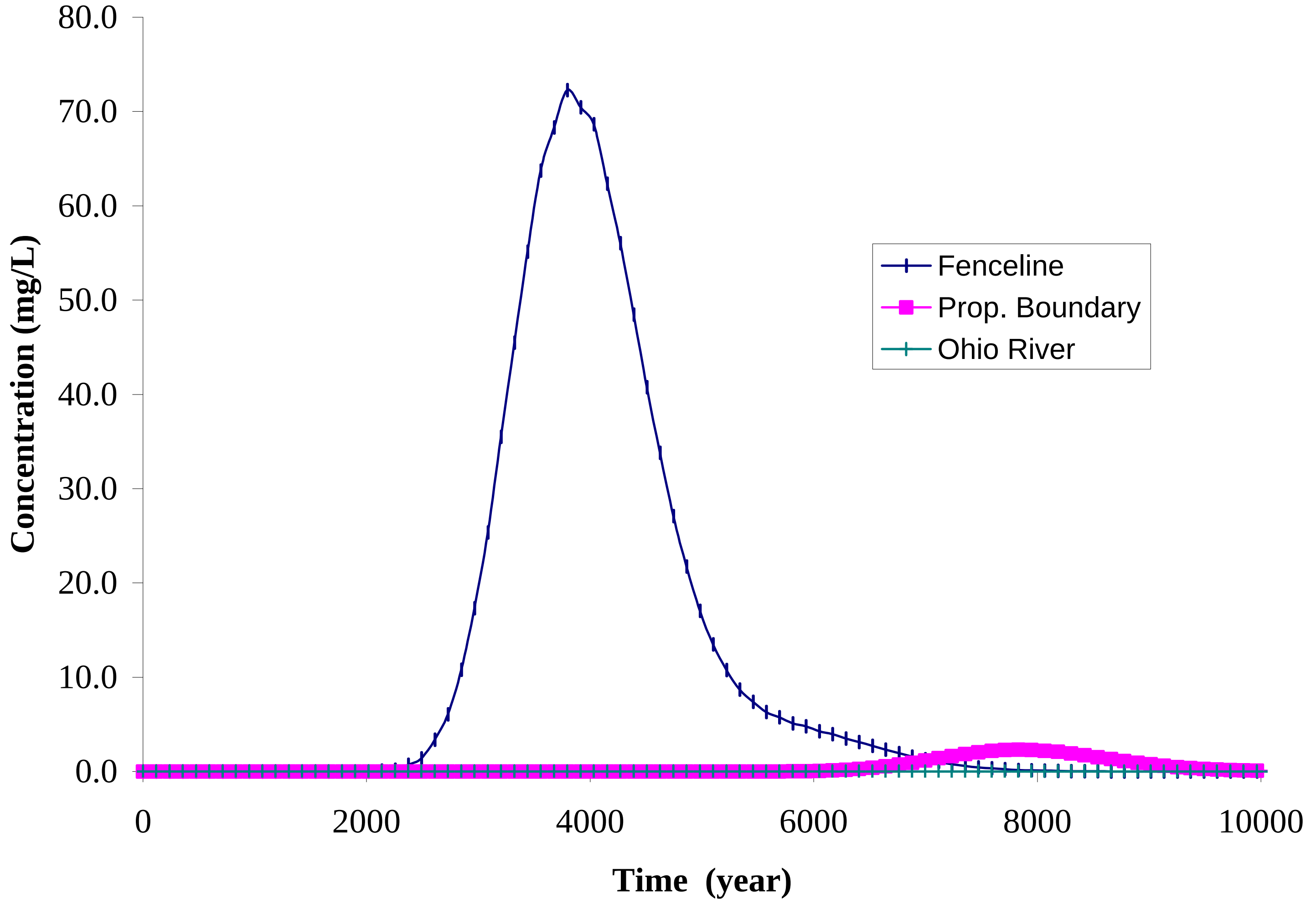


Figure C3.18. Predicted Cobalt Concentrations in the RGA Groundwater at the PGDP Receptor Locations due to loading from WAG 28

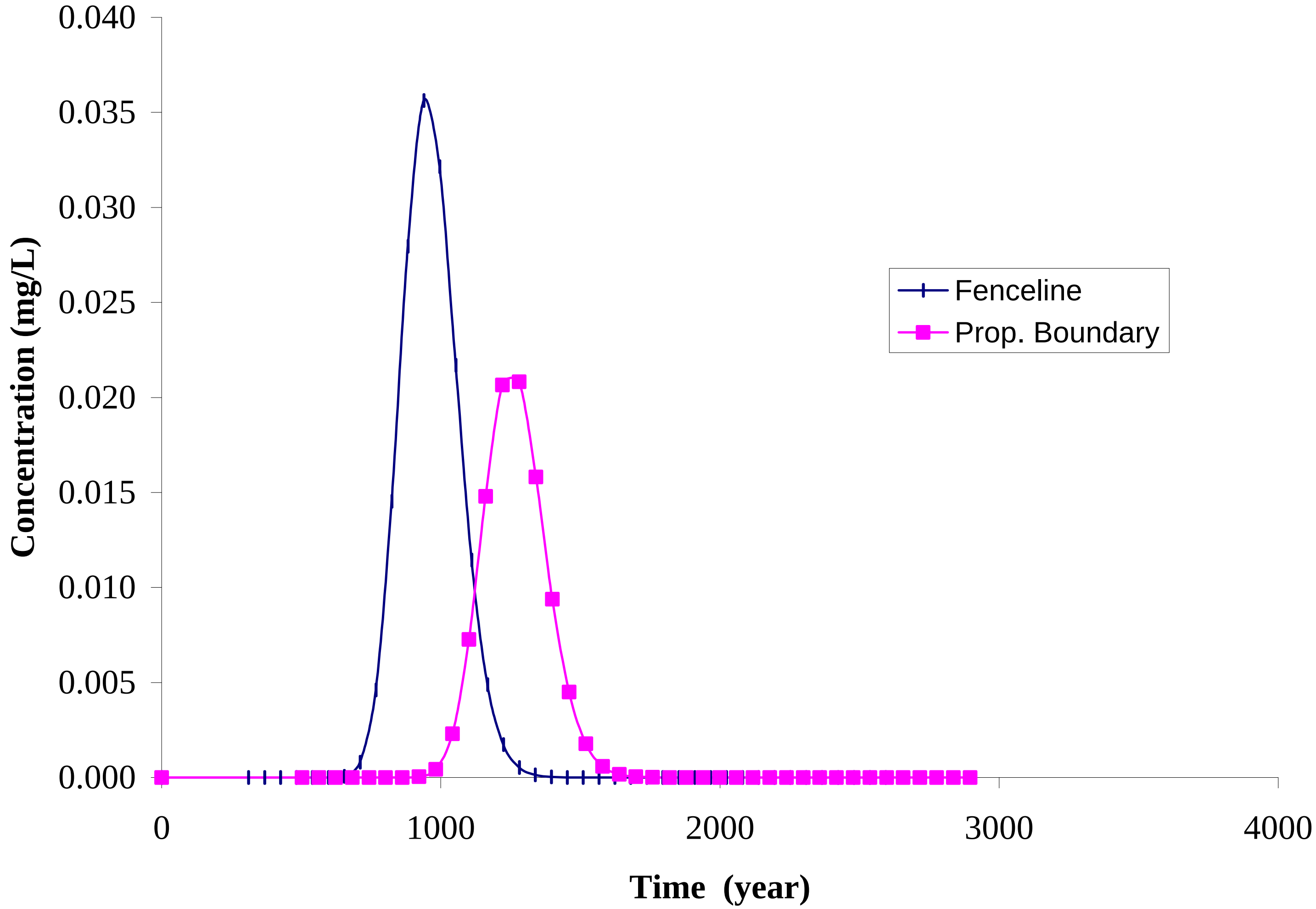


Fig. C3.19. Predicted Tc-99 Activity Concentrations at the DOE Fenceline due to Loading from PGDP Source Areas

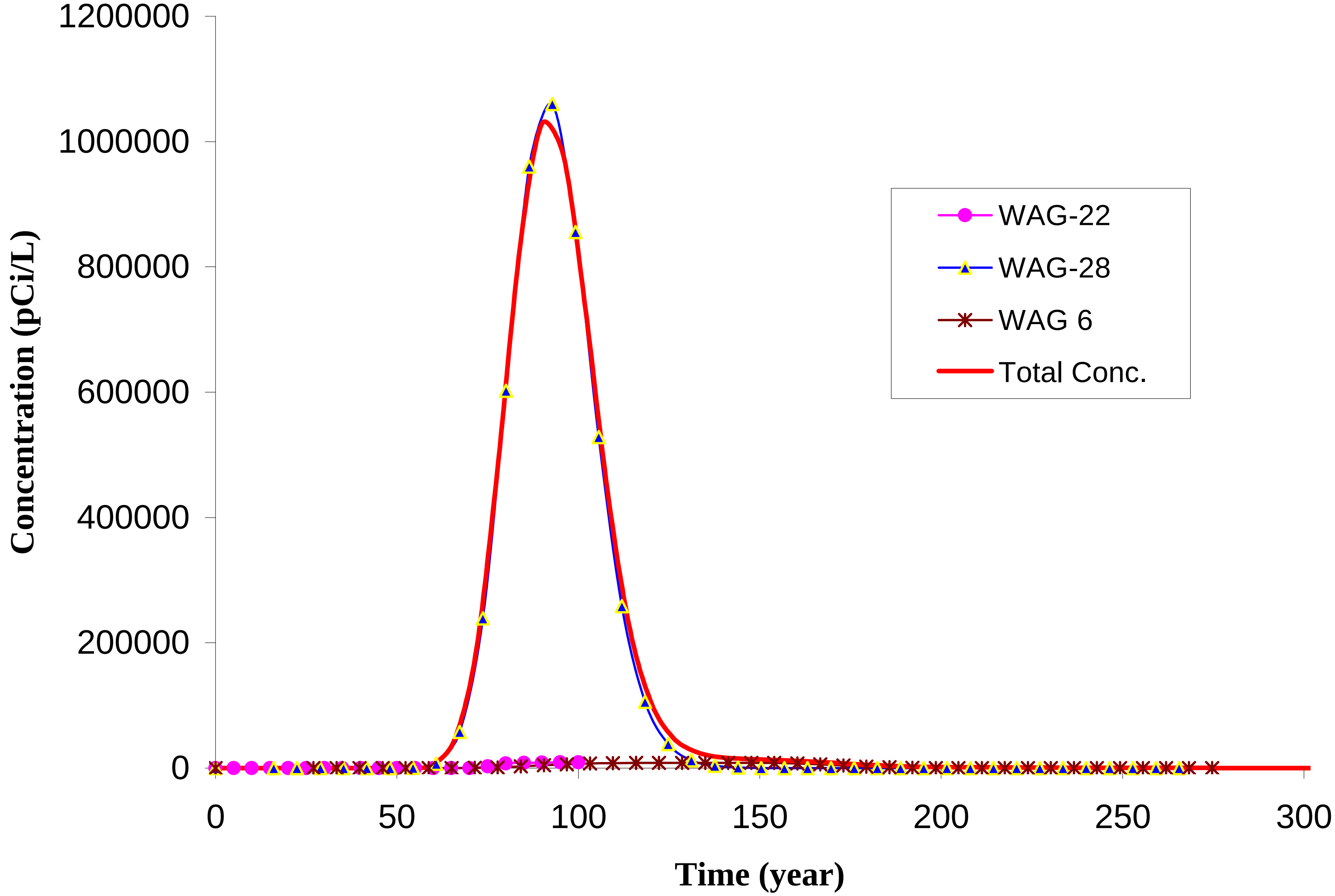


Fig. C3.20. Predicted Tc-99 Activity Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

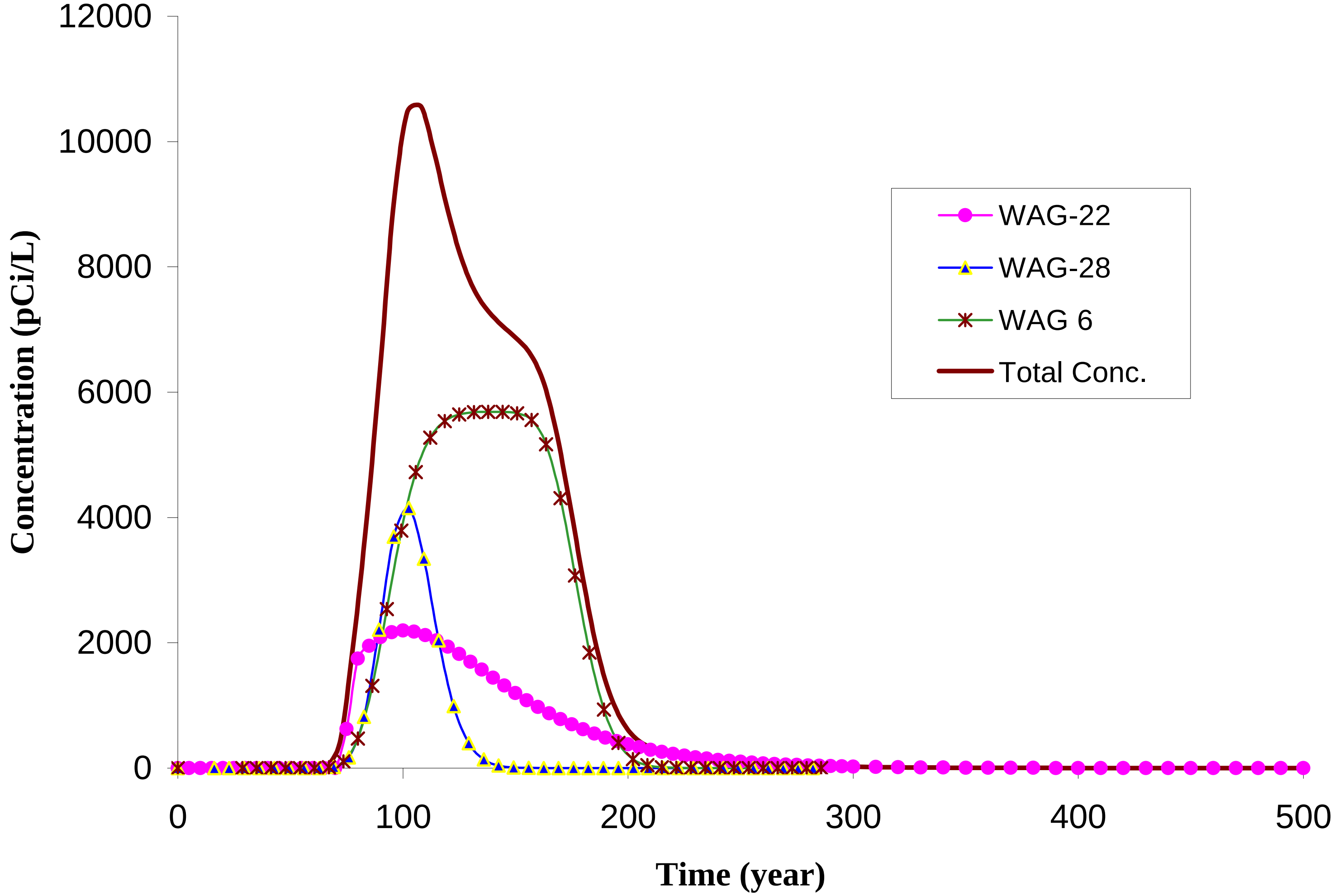


Fig. C3.21. Predicted Tc-99 Activity Concentrations at the Bayou Creek due to loading from PGDP Source Areas

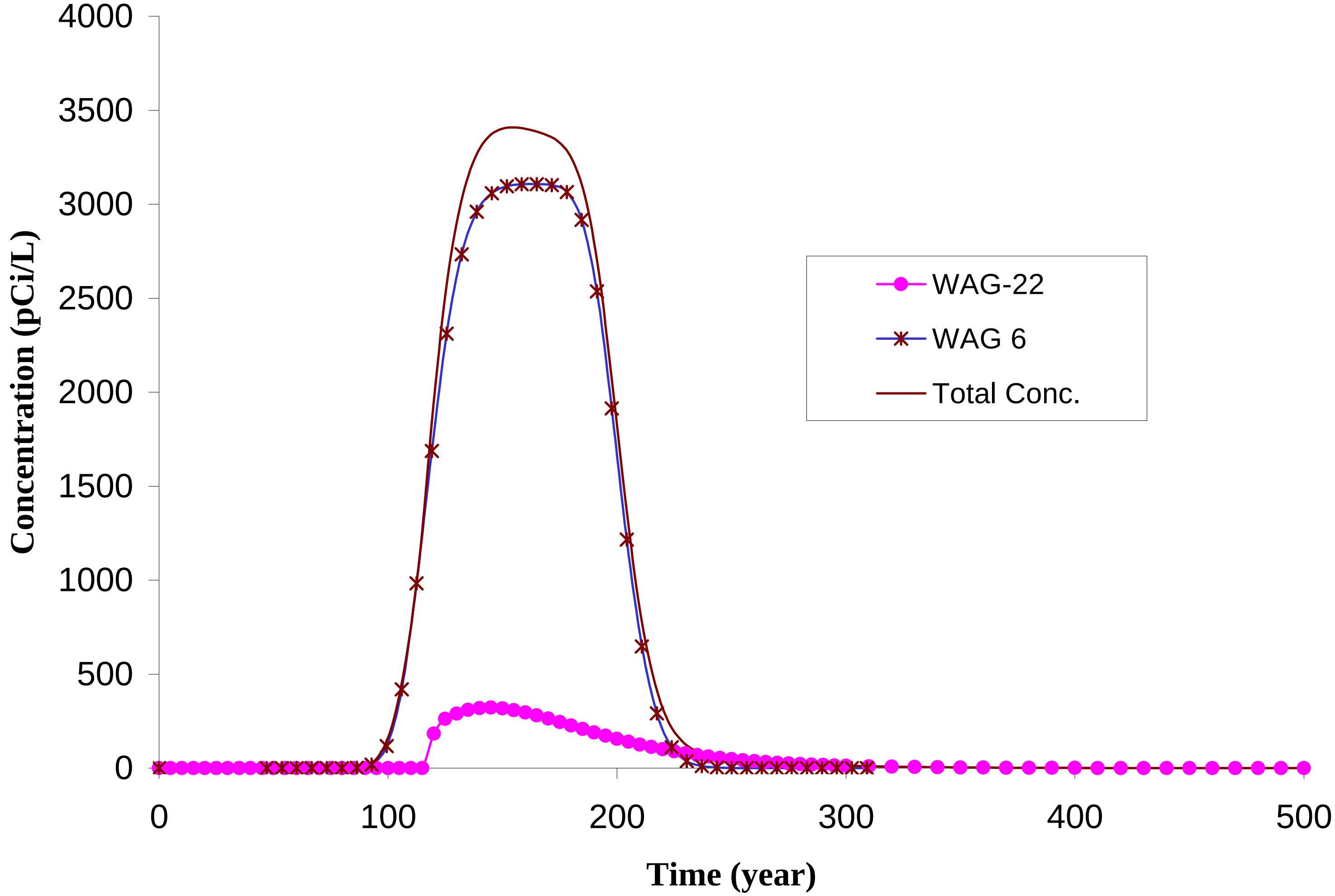


Fig. C3.22. Predicted Tc-99 Activity Concentrations at the Ohio River due to Loading from PGDP Source Areas

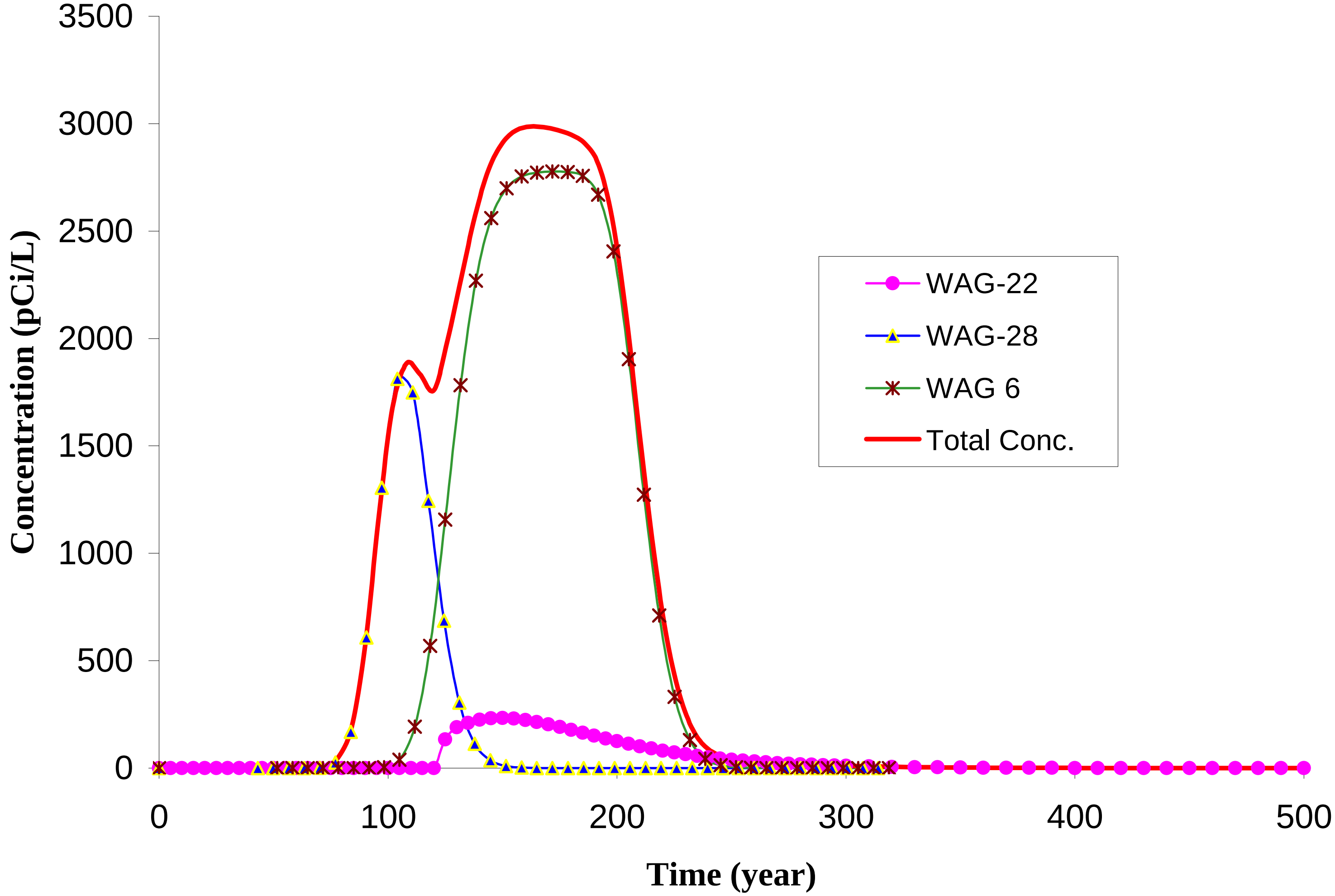


Fig. C3.23. Predicted TCE Concentrations at the Fenceline due to loading from PGDP Source Areas

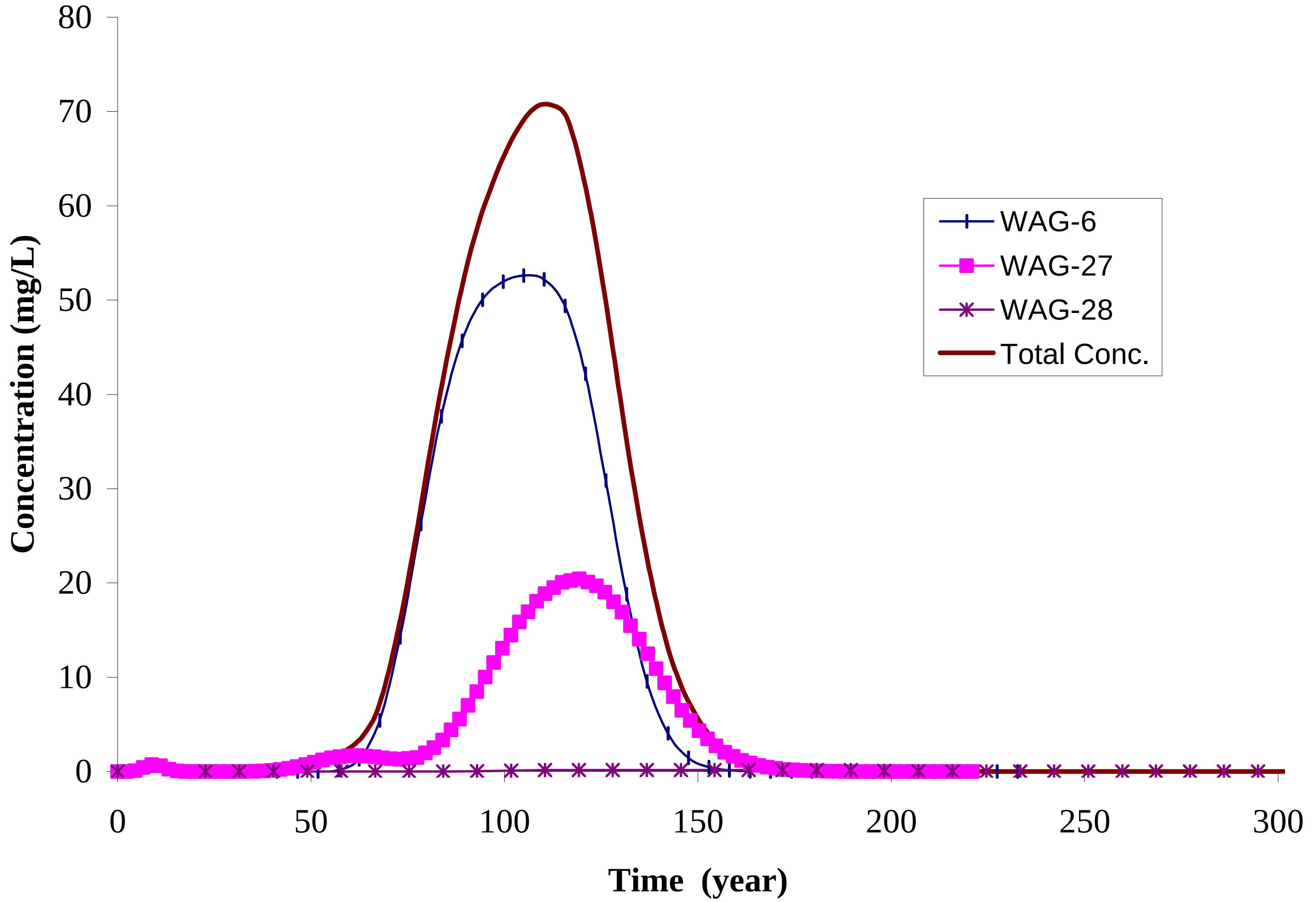


Fig. C3.24. Predicted TCE Concentrations at the Property Boundary due to loading from PGDP Source Areas

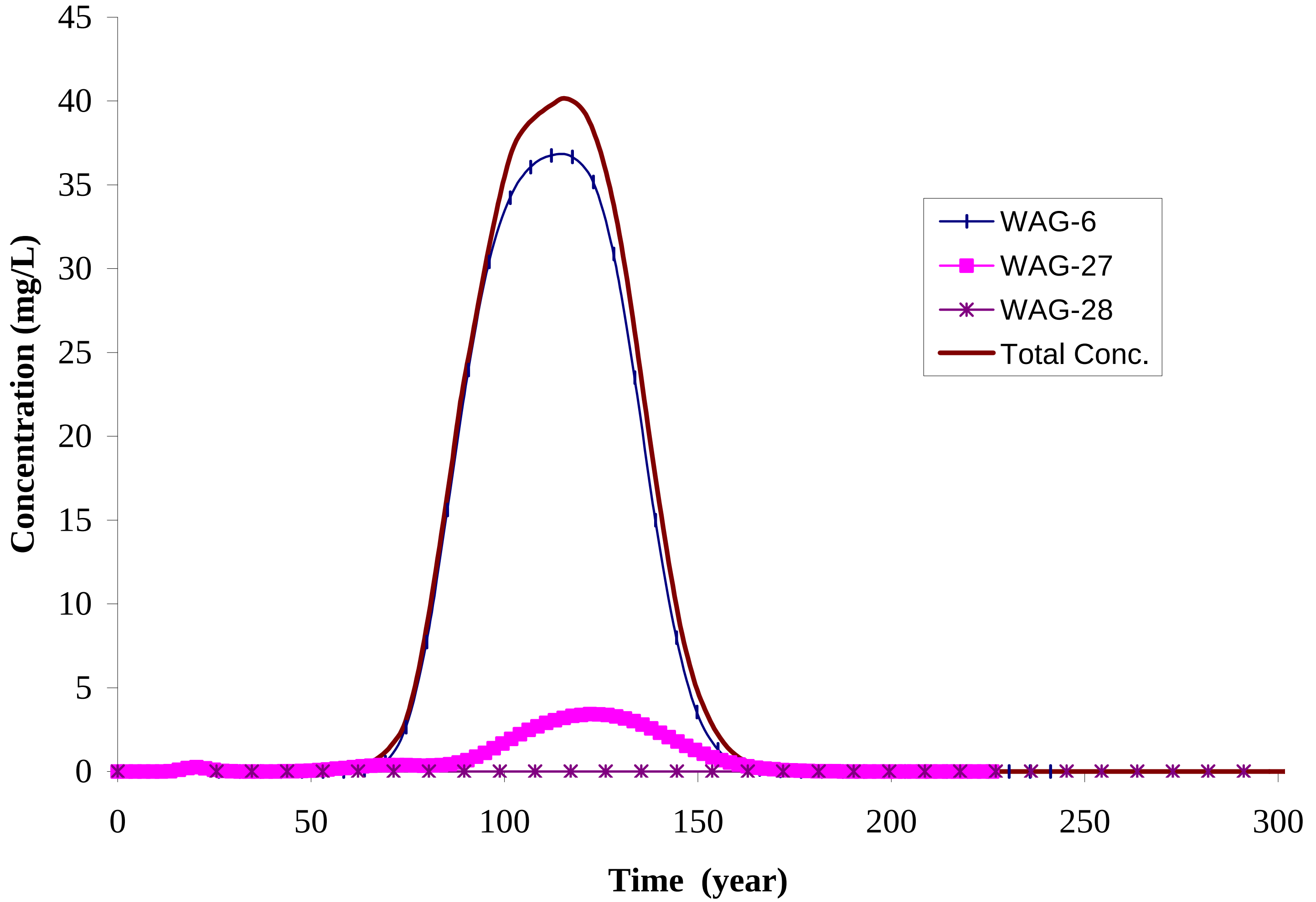


Fig. C3.25. Predicted TCE Concentrations at the Bayou Creek due to loading from PGDP Source Areas

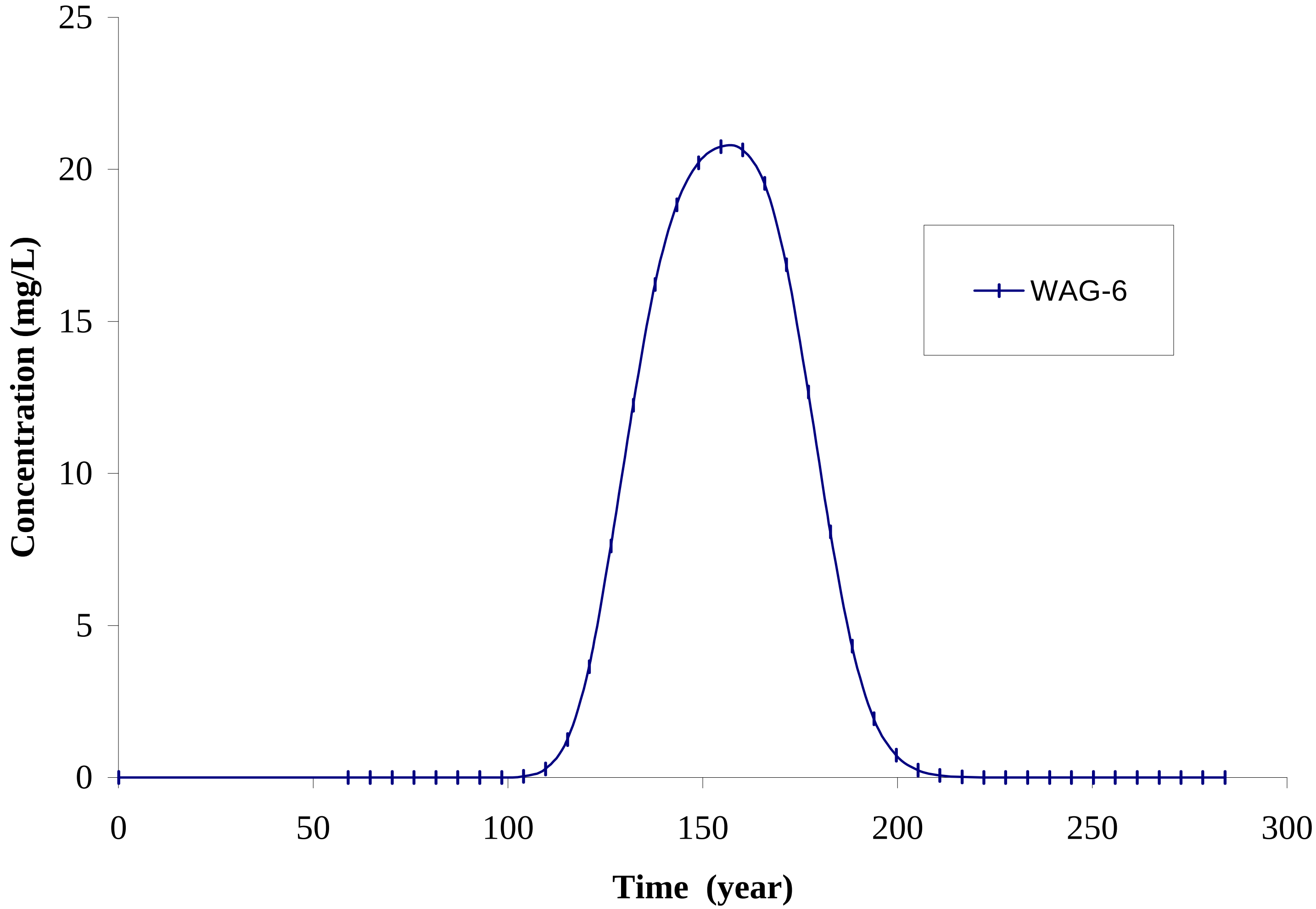


Fig. C3.26. Predicted TCE Concentrations at the Ohio River due to loading from PGDP Source Areas

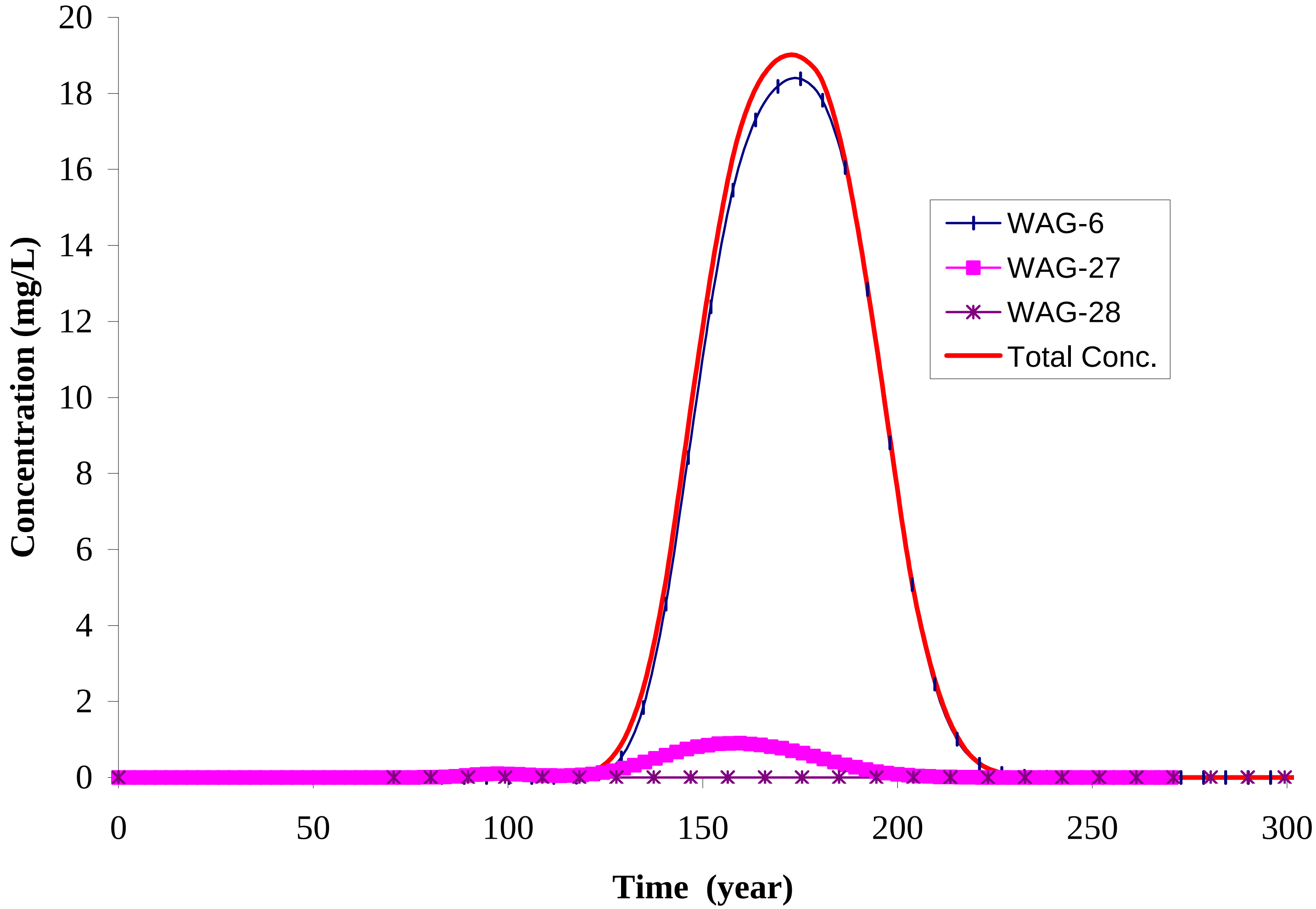


Fig. C3.27. Predicted Vinyl Chloride Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

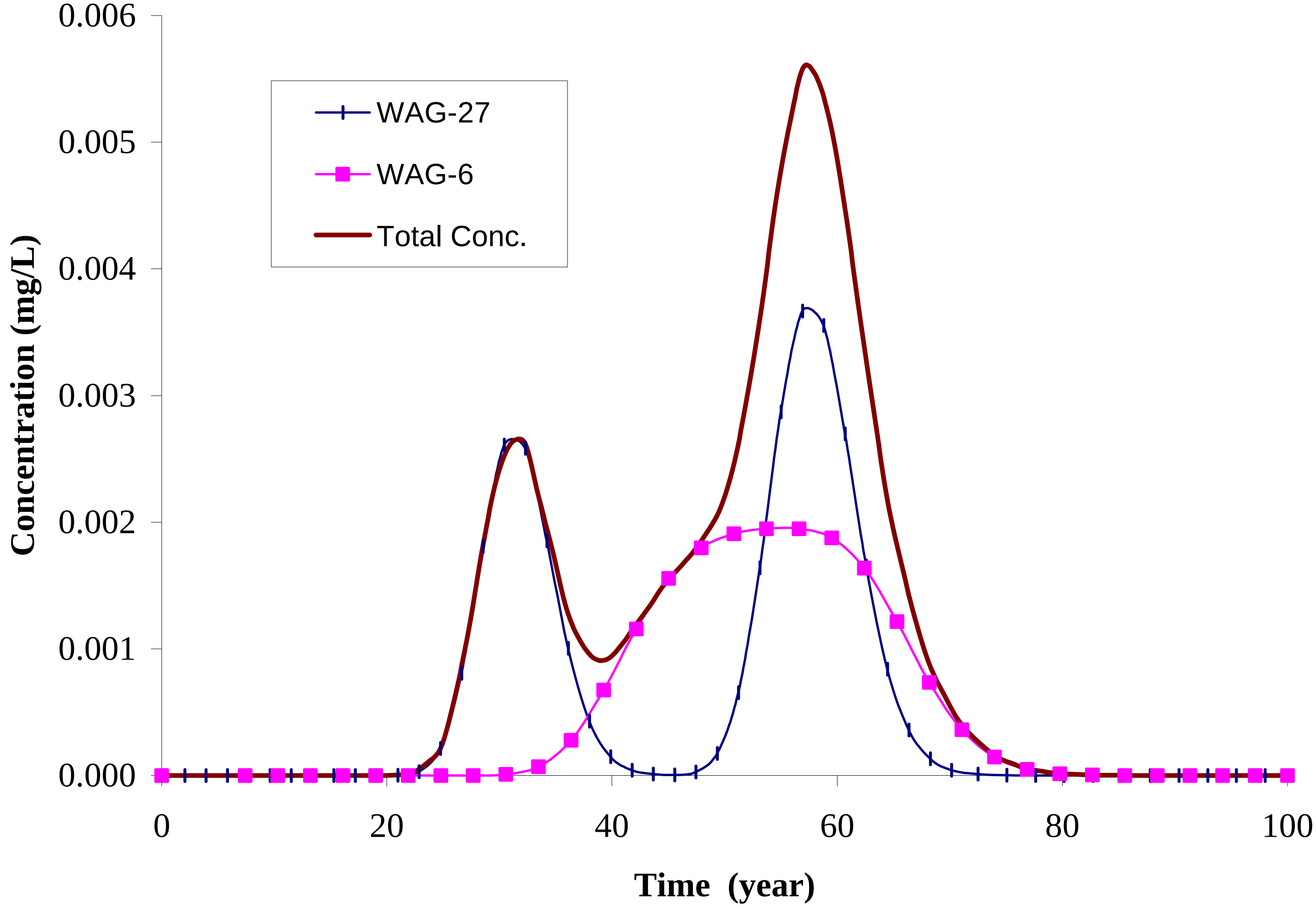


Fig. C3.28. Predicted Vinyl Chloride Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

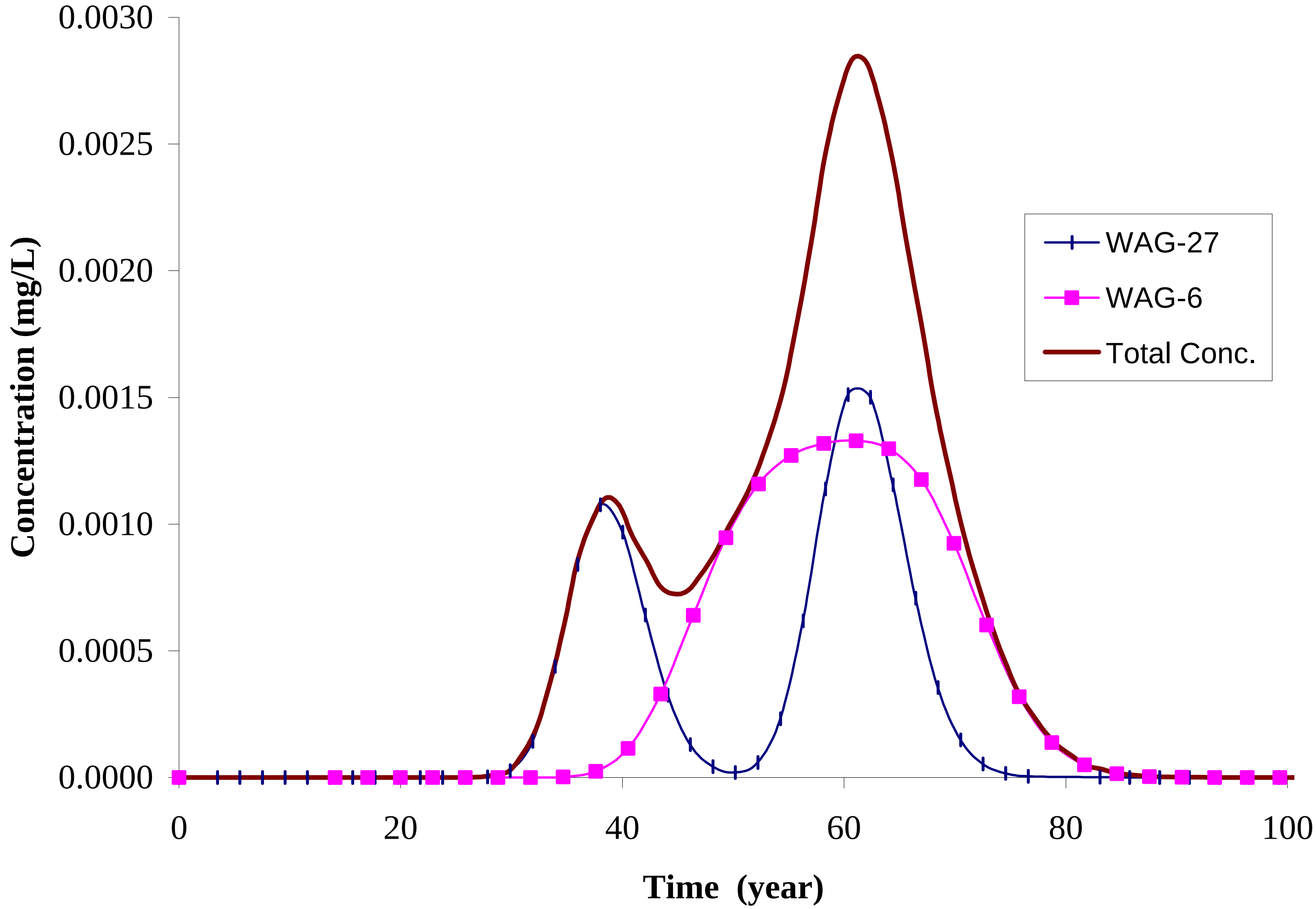


Fig. C3.29. Predicted Vinyl Chloride Concentrations at the Bayou Creek due to loading from PGDP Source Areas

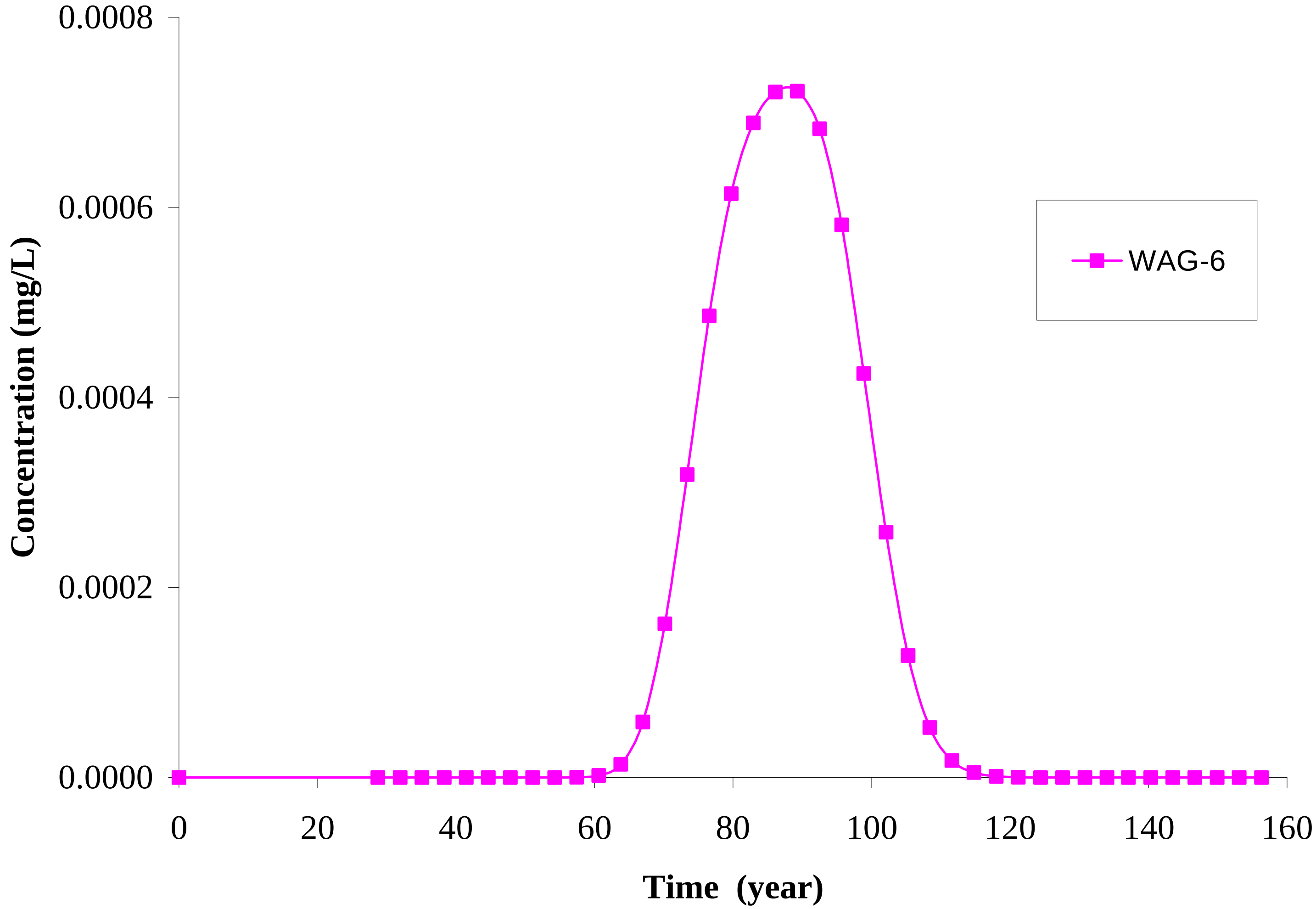


Fig. C3.30. Predicted Vinyl Chloride Concentrations at the Ohio River due to loading from PGDP Source Areas

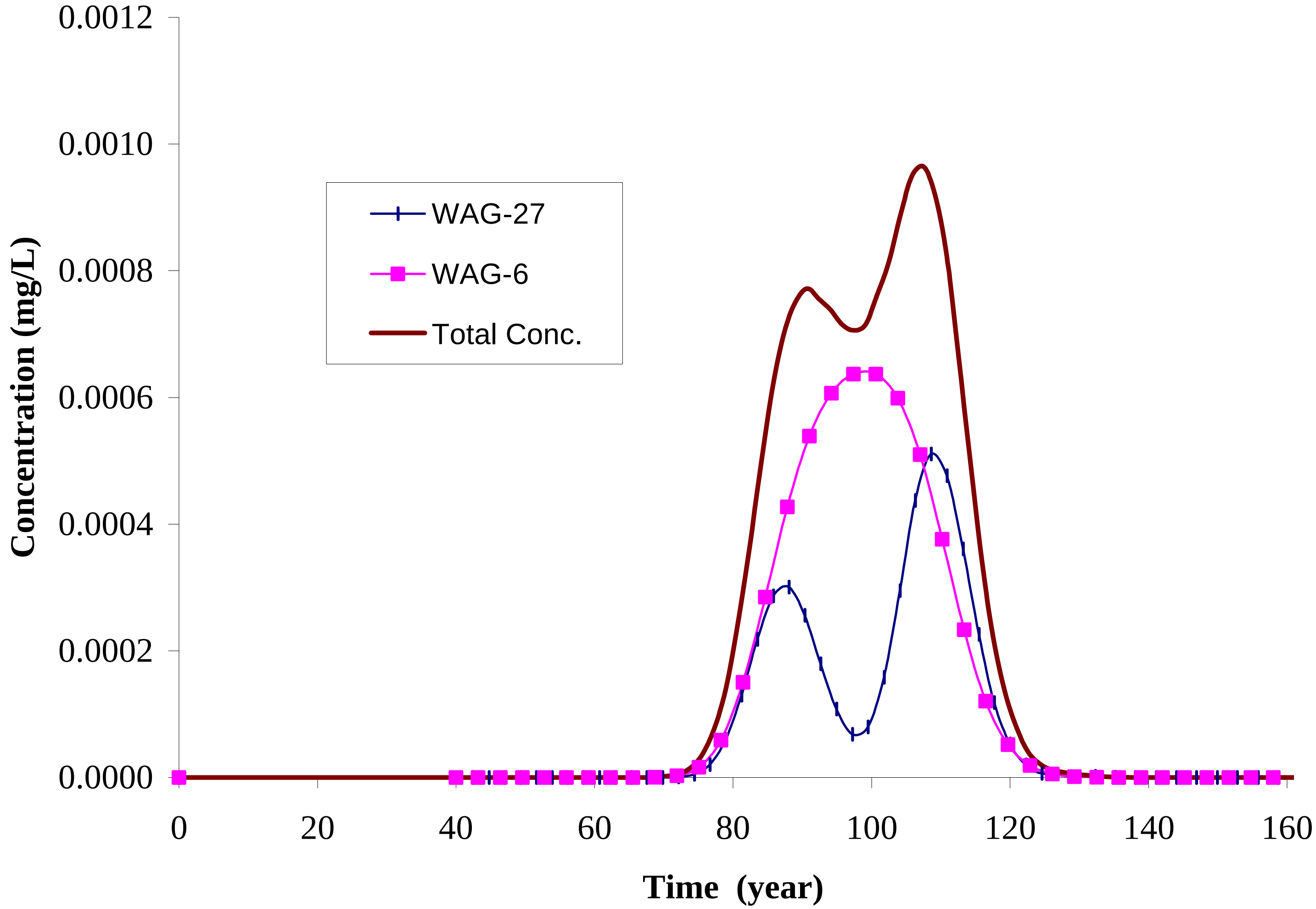


Fig. C3.31. Predicted Antimony Concentrations in the RGA Groundwater at the PGDP Fenceline due to loading from PGDP Source Areas

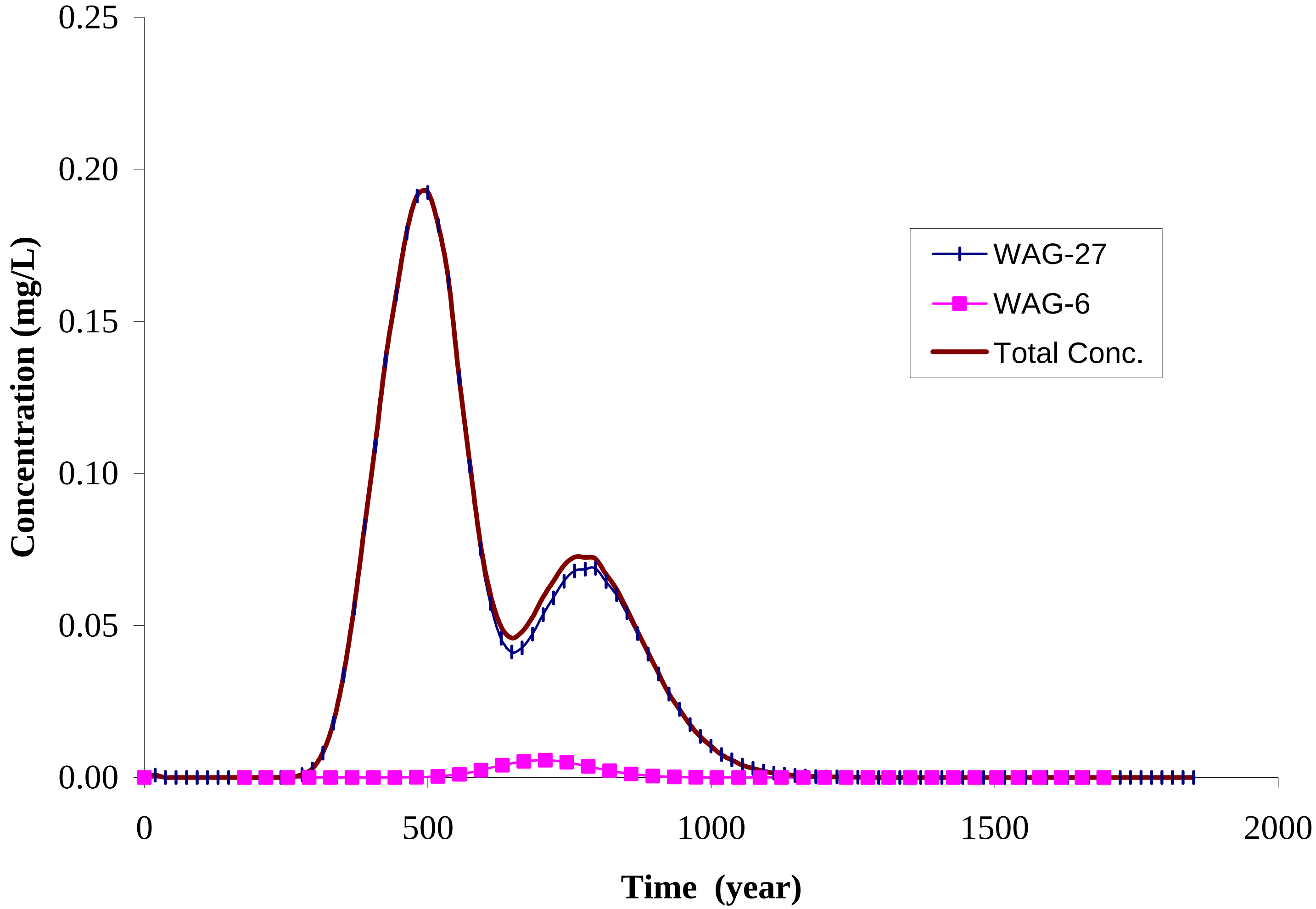


Fig. C3.32. Predicted Antimony Concentrations in the RGA Groundwater at the DOE Property Boundary due to Loading from PGDP Source Areas

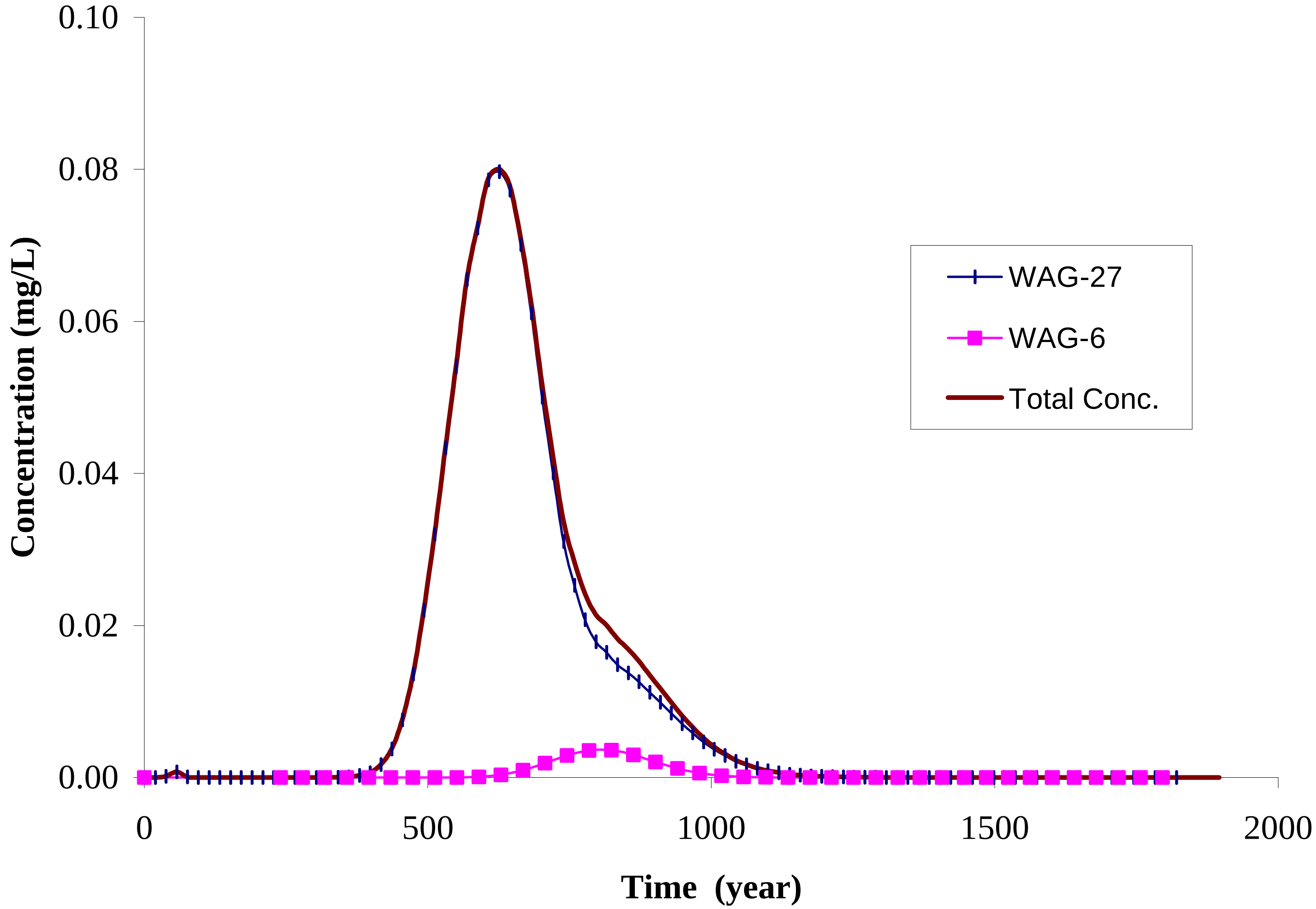


Fig. C3.33. Predicted Antimony Concentrations in the RGA Groundwater at the Bayou Creek Boundary due to Loading from PGDP Source Areas

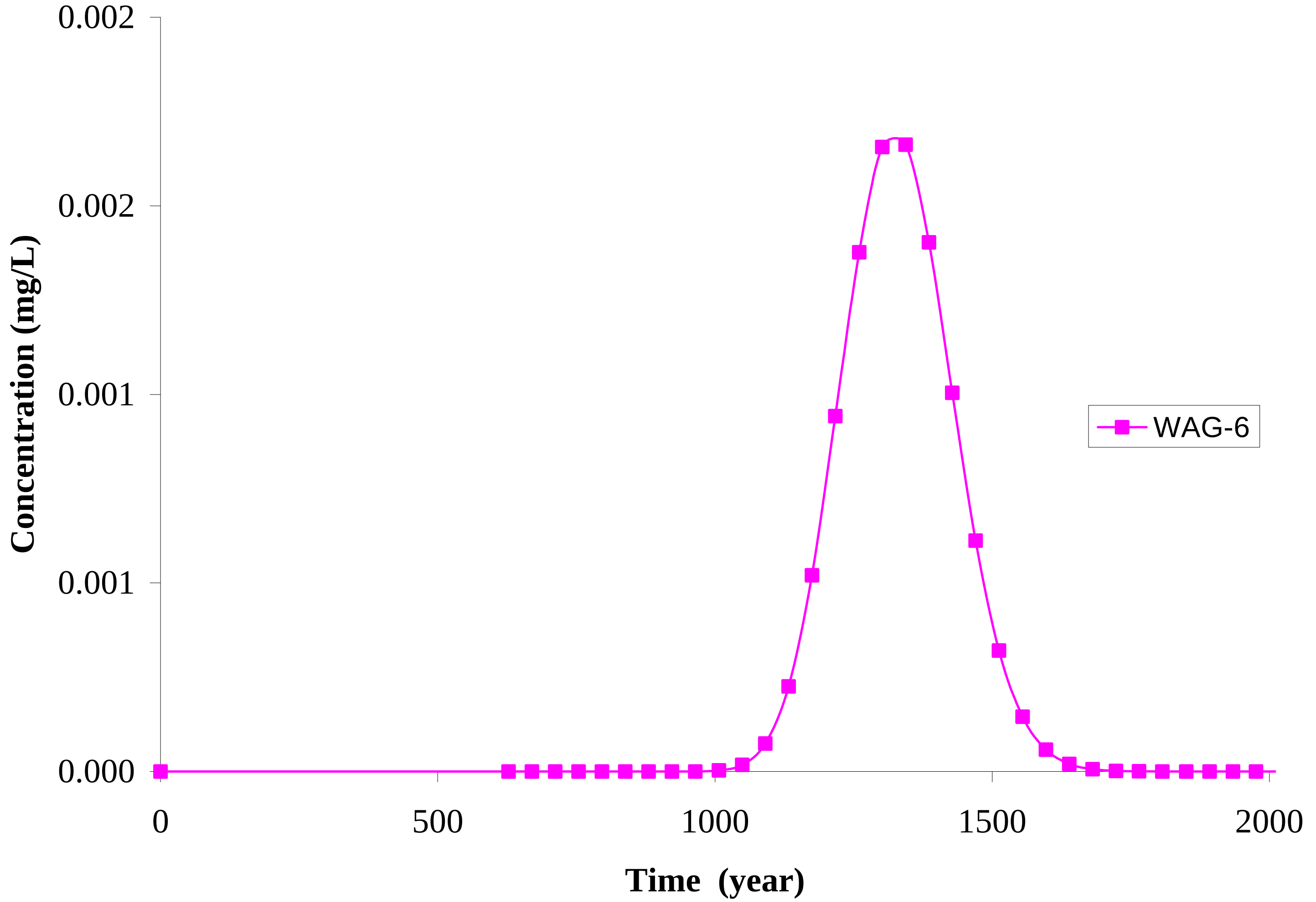


Fig. C3.34. Predicted Antimony Concentrations in the RGA Groundwater at the Ohio River due to Loading from PGDP Source Areas

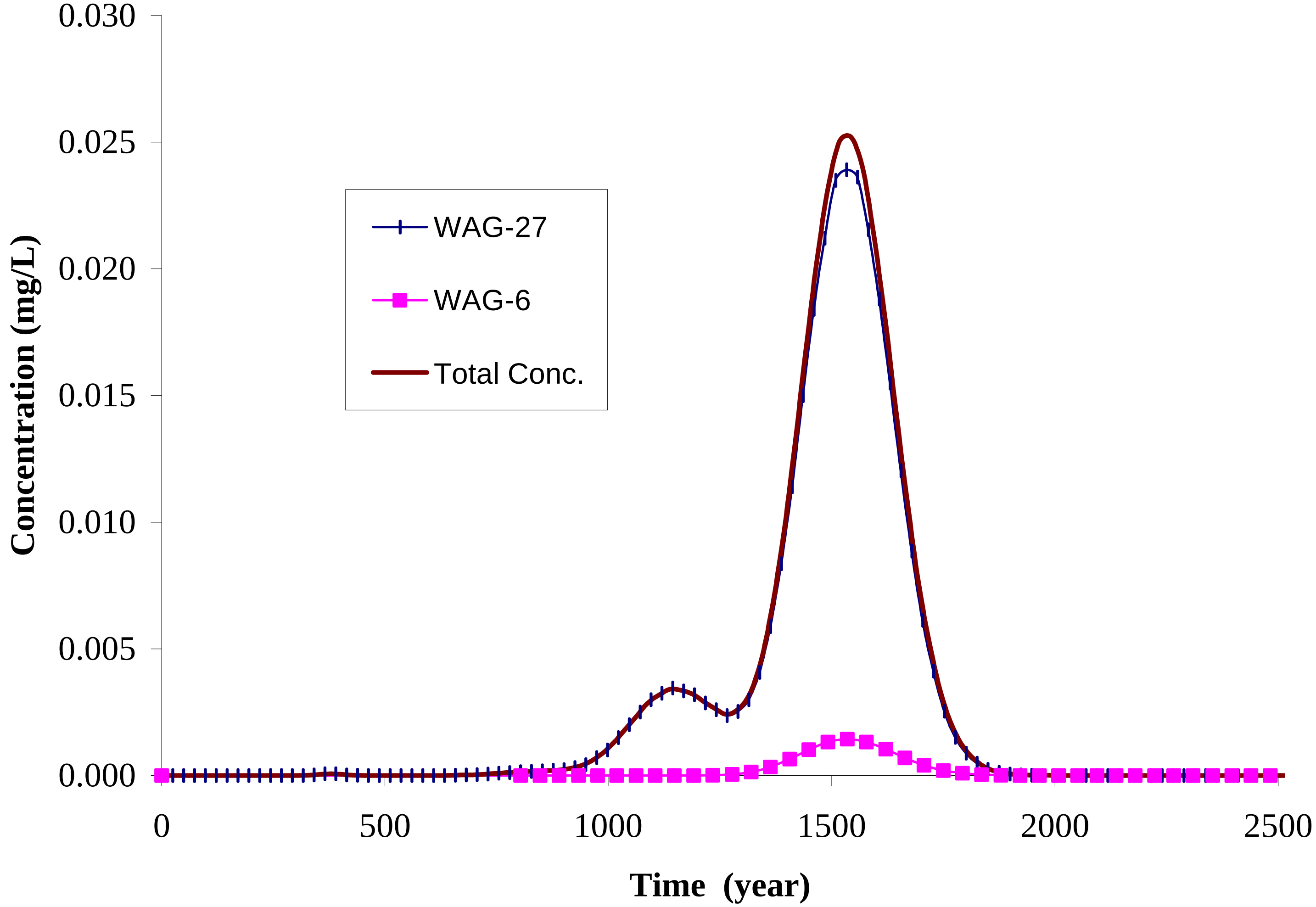


Fig. C3.35. Predicted Chromium Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

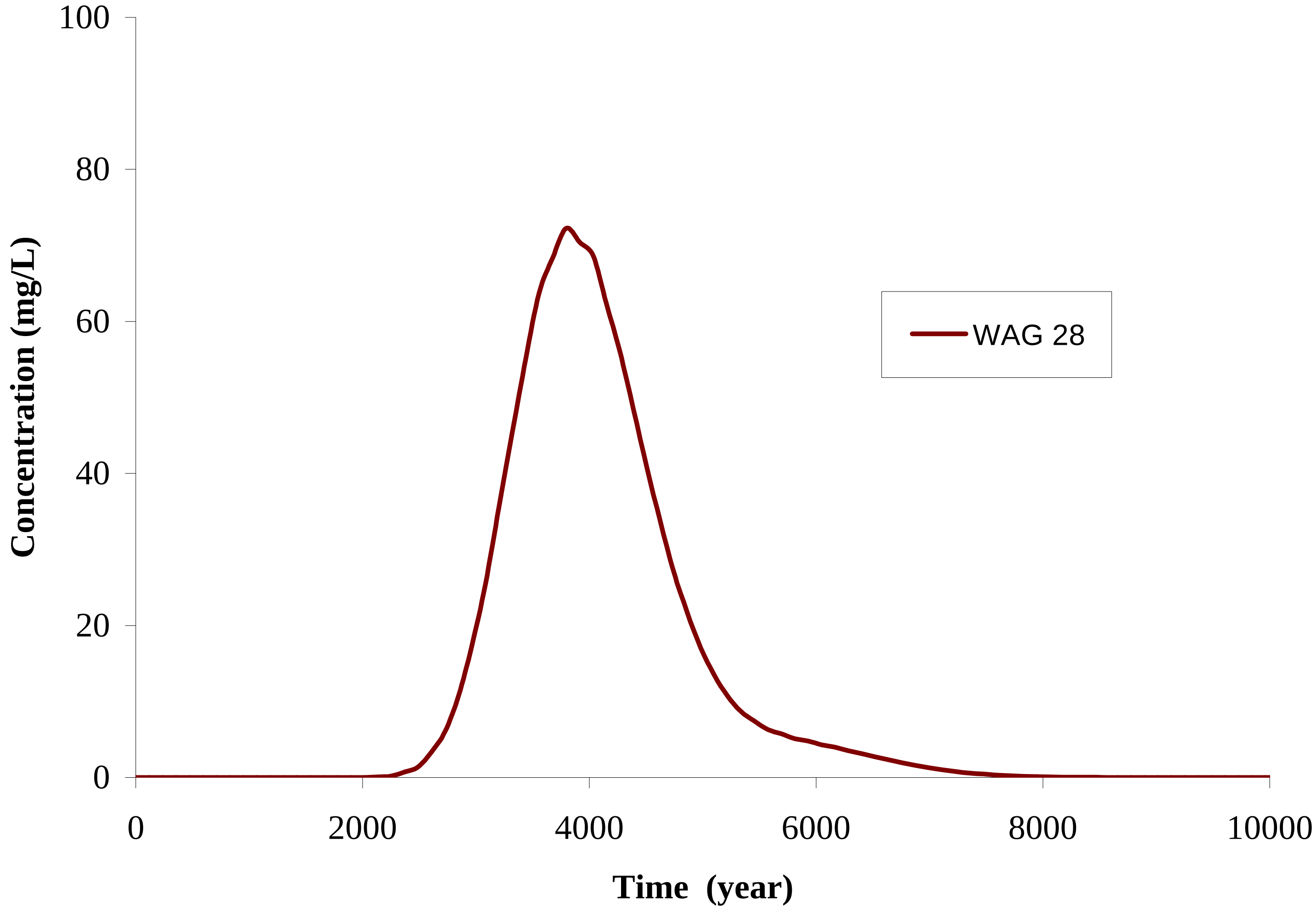


Fig. C3.36. Predicted Chromium Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

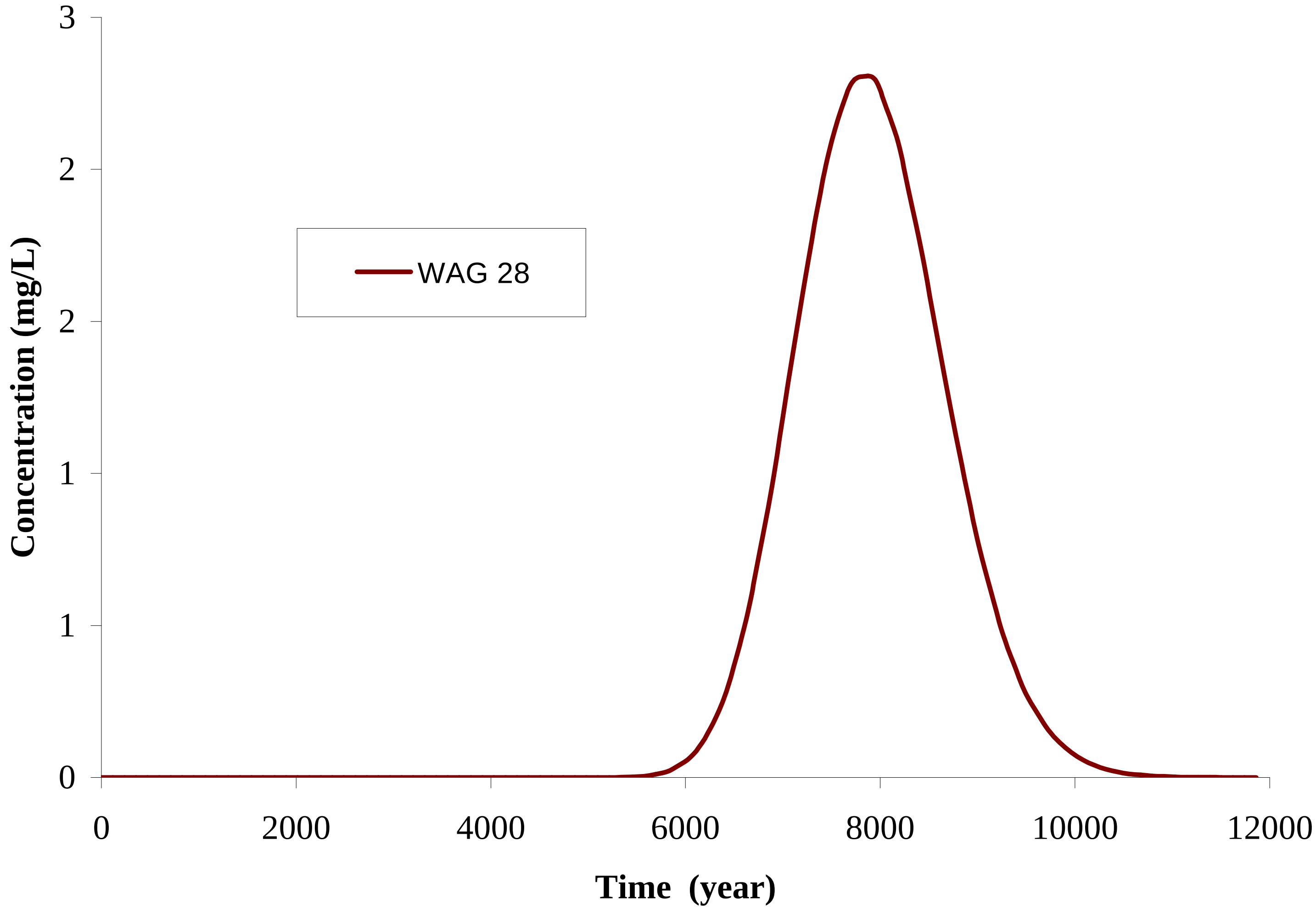


Fig. C3.37. Predicted Chromium Concentrations at the Ohio River due to loading from PGDP Source Areas

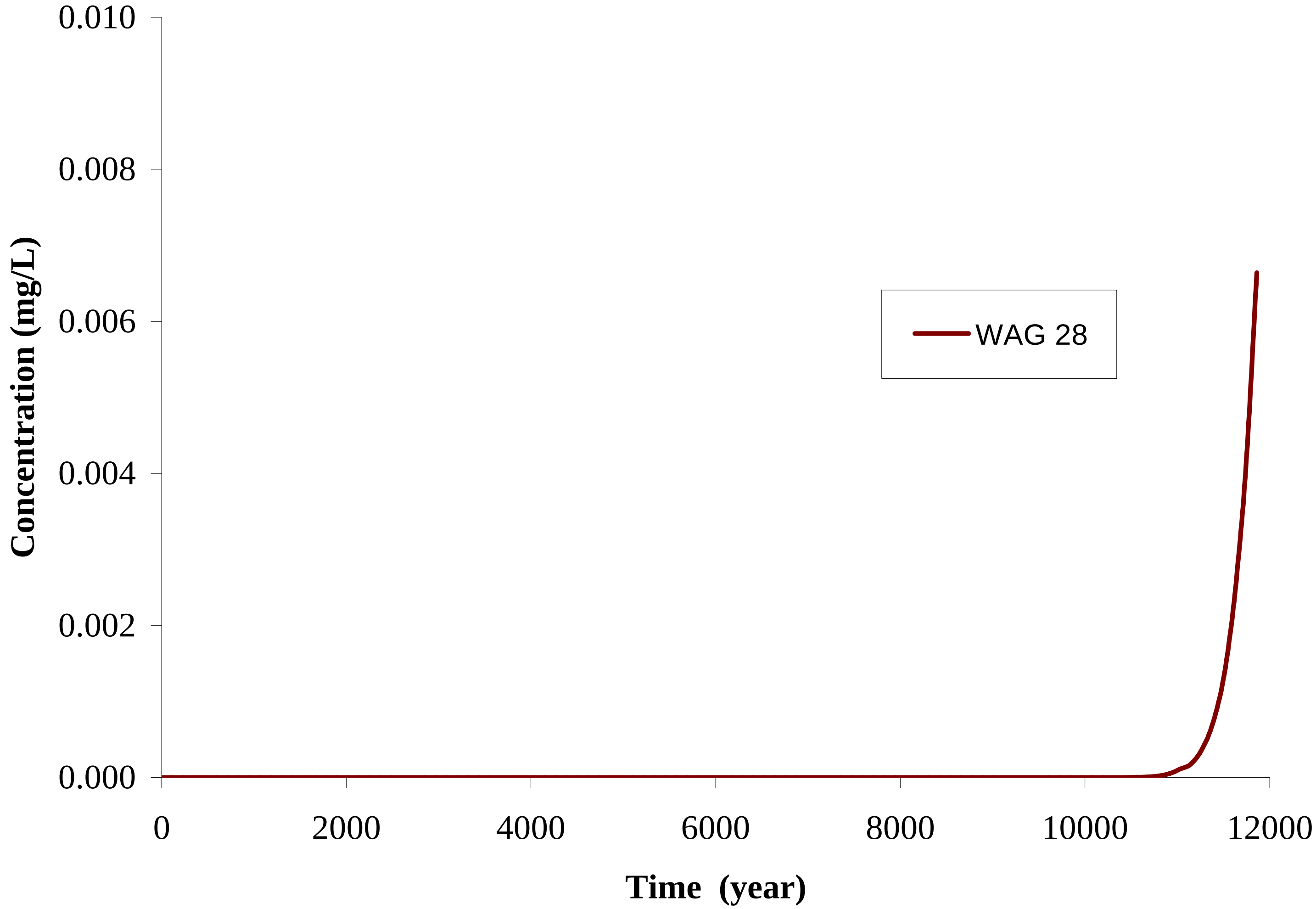


Fig. C3.38. Predicted Lithium Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

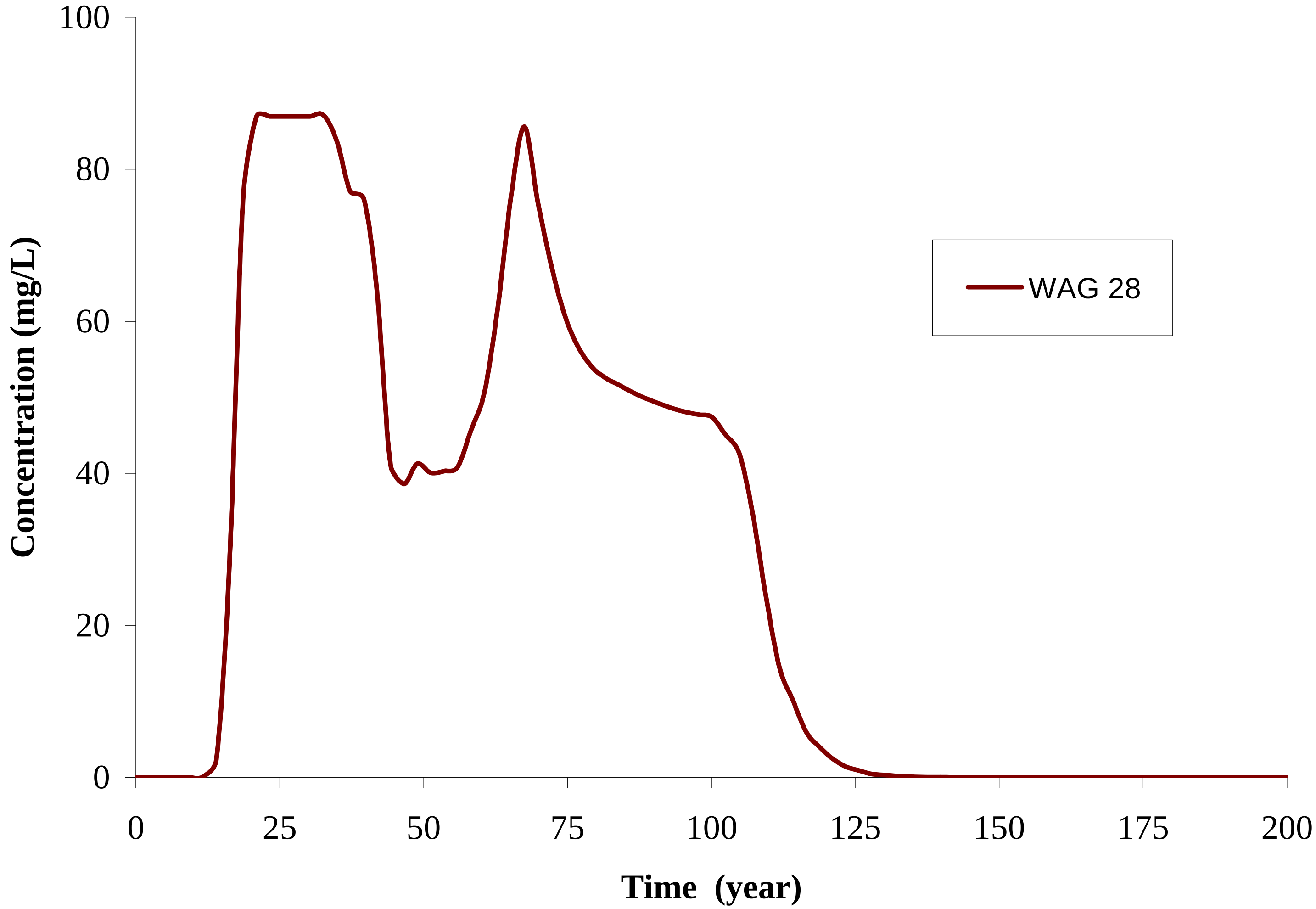


Fig. C3.39. Predicted Lithium Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

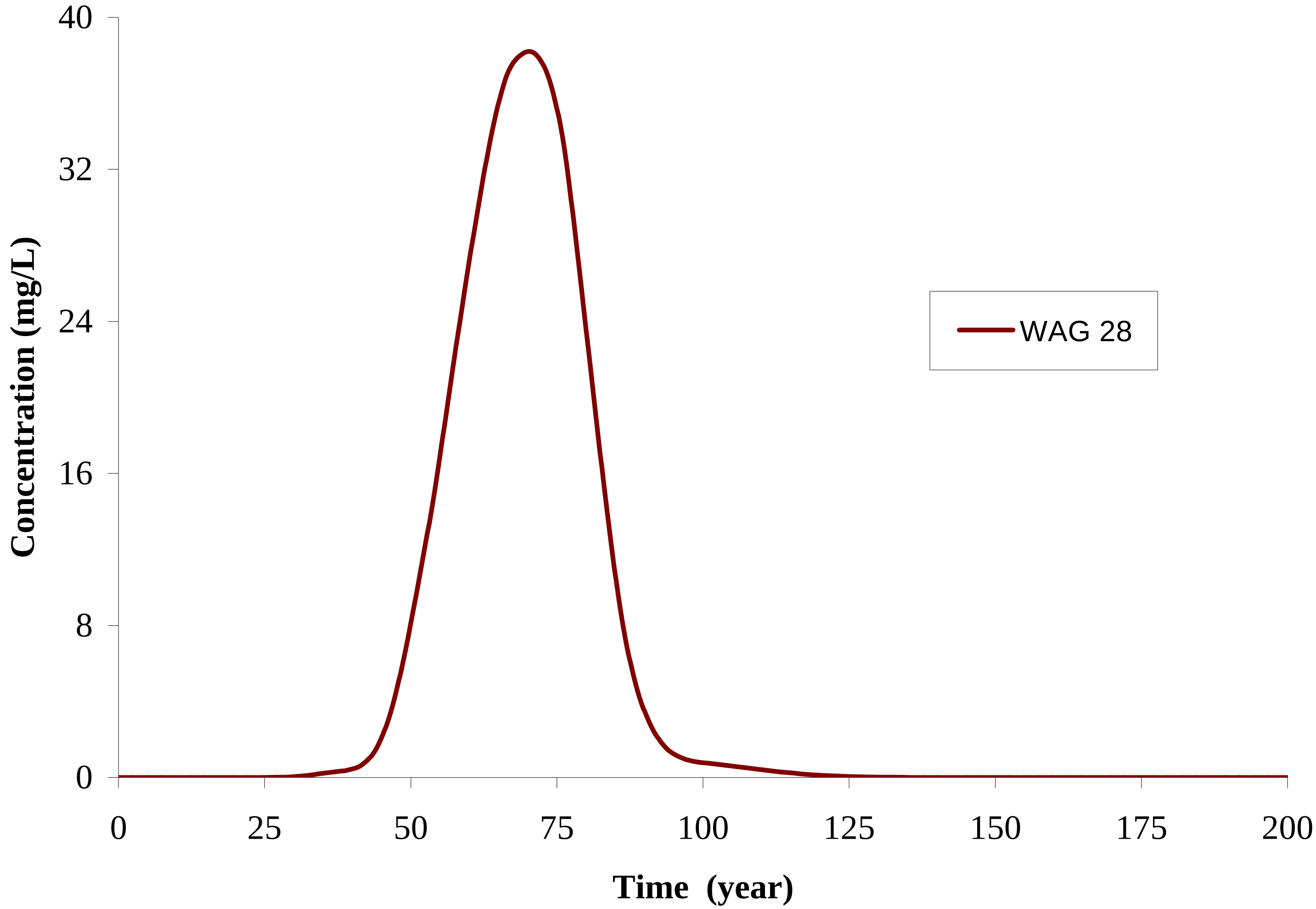


Fig. C3.40. Predicted Lithium Concentrations at the Ohio River due to loading from PGDP Source Areas

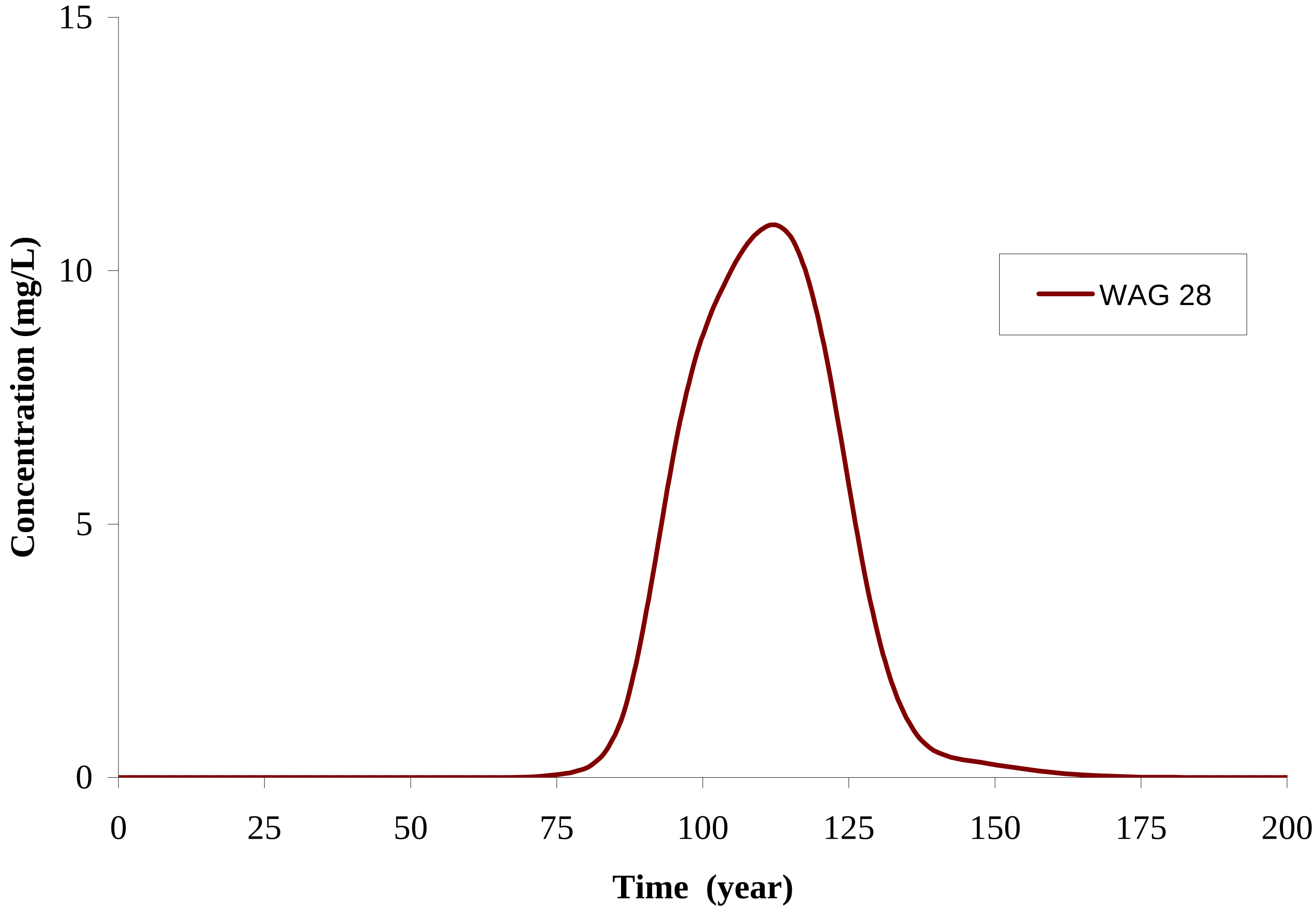


Fig. C3.41. Predicted Manganese Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

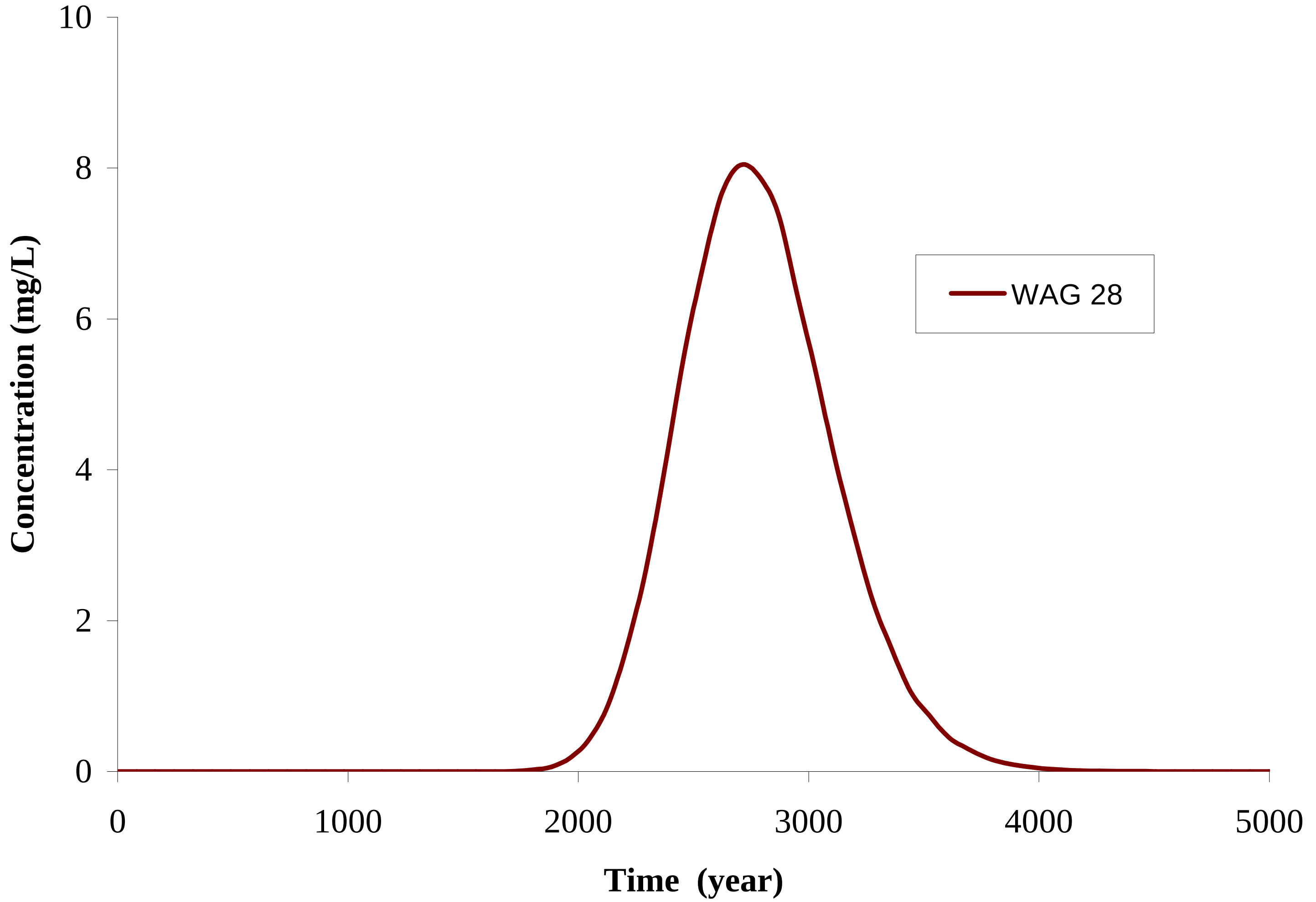


Fig. C3.42. Predicted Manganese Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

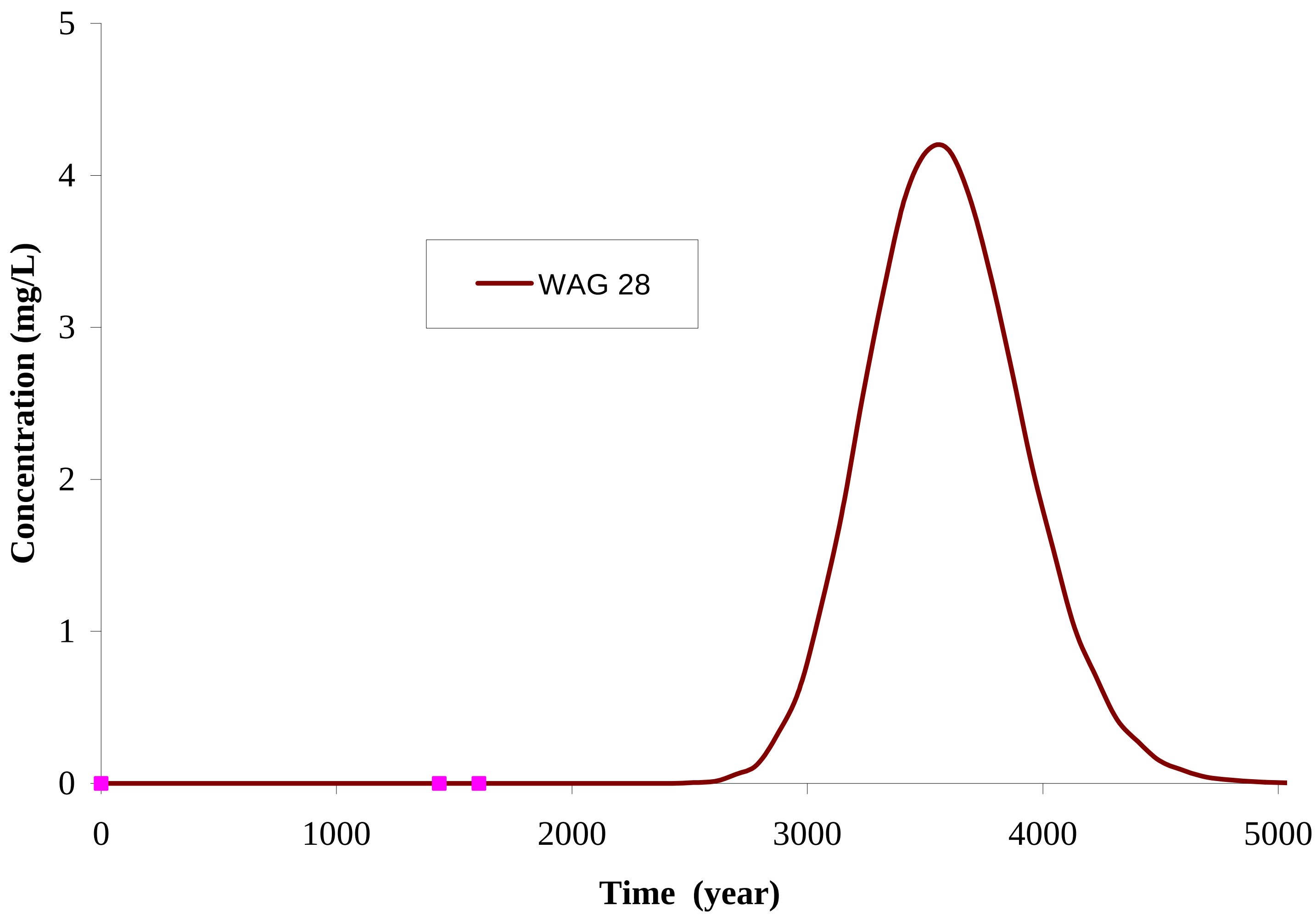


Fig. C3.43. Predicted Manganese Concentrations at the Ohio River due to loading from PGDP Source Areas

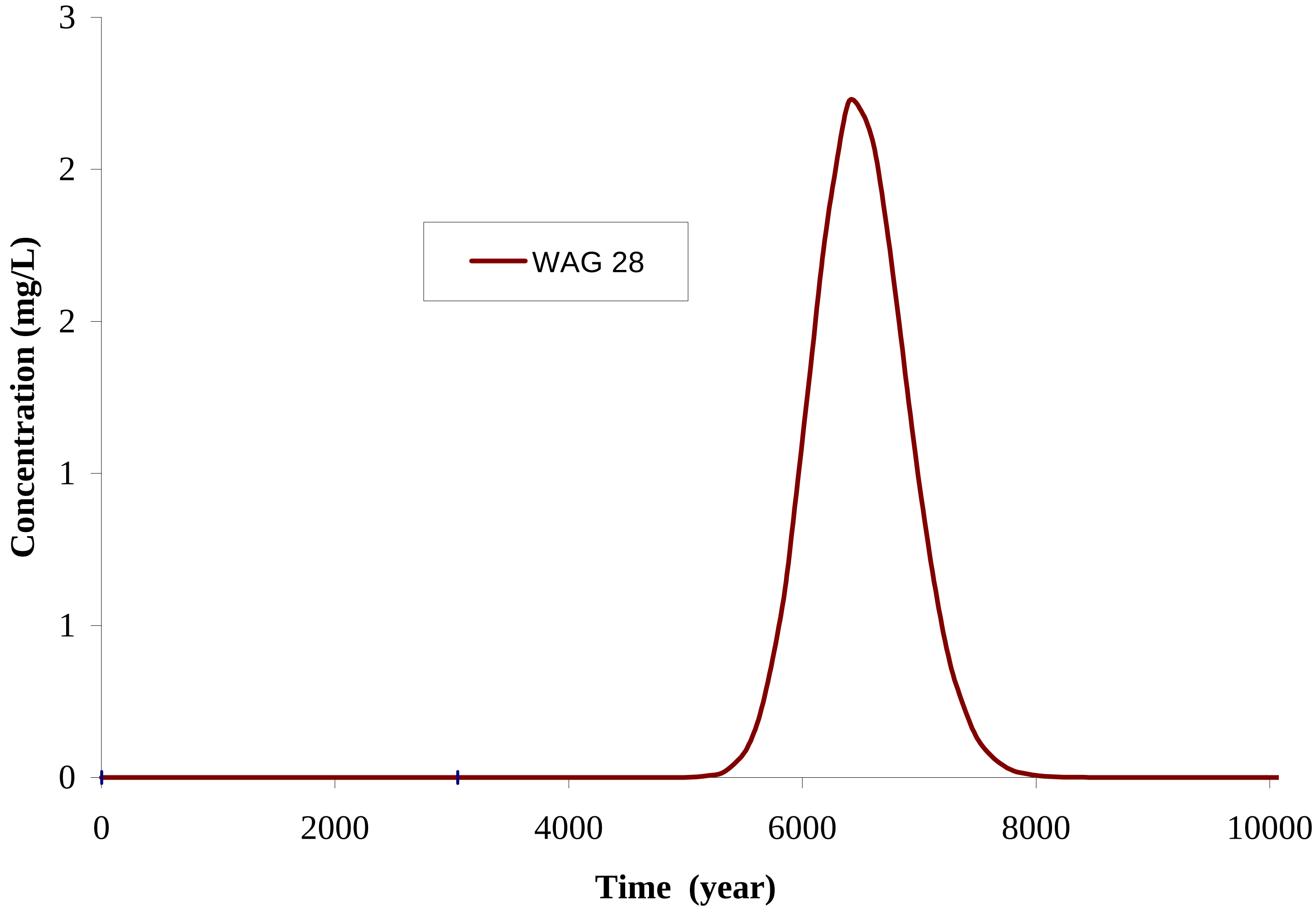


Fig. C3.44. Predicted Strontium Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

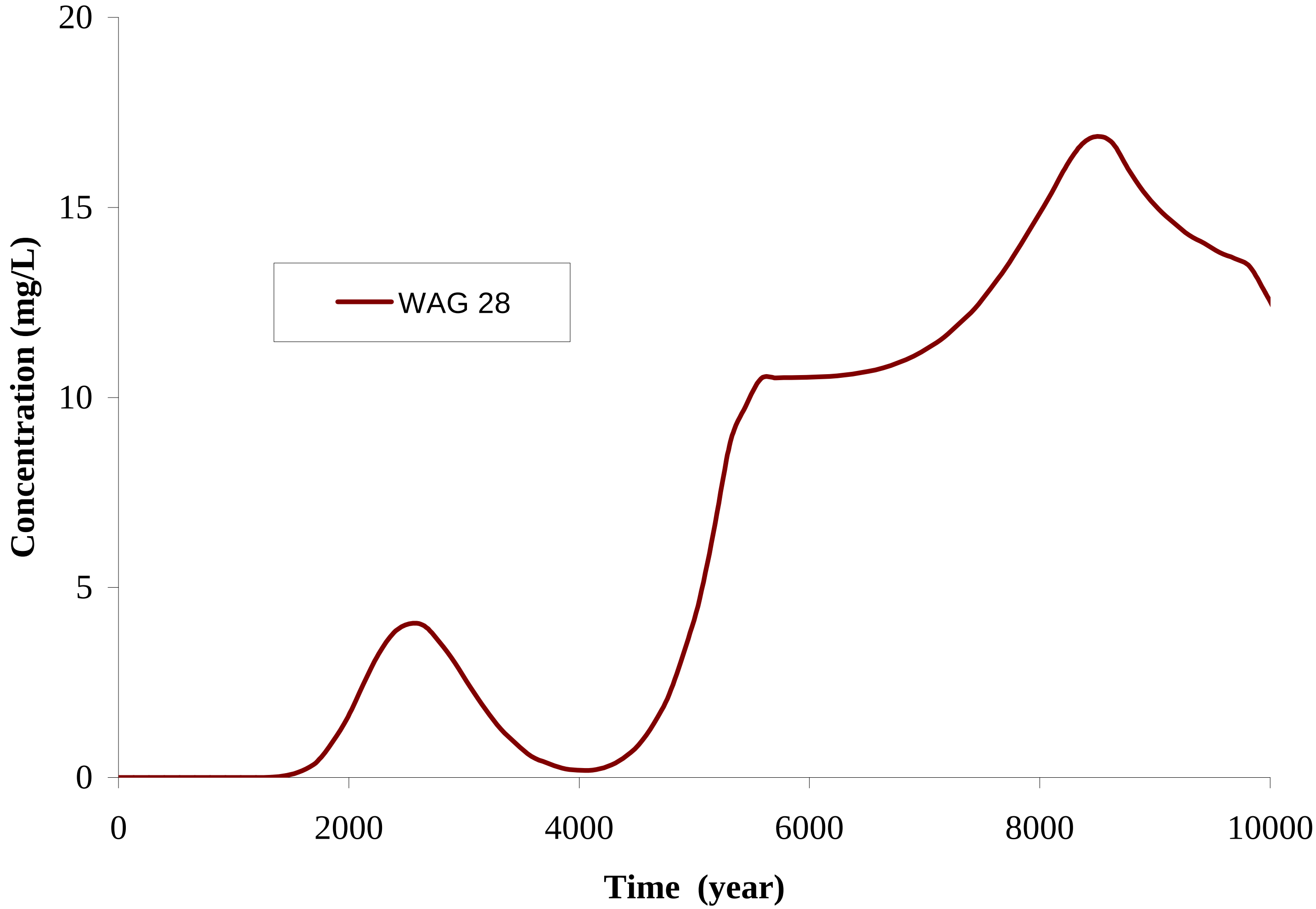


Fig. C3.45. Predicted Strontium Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

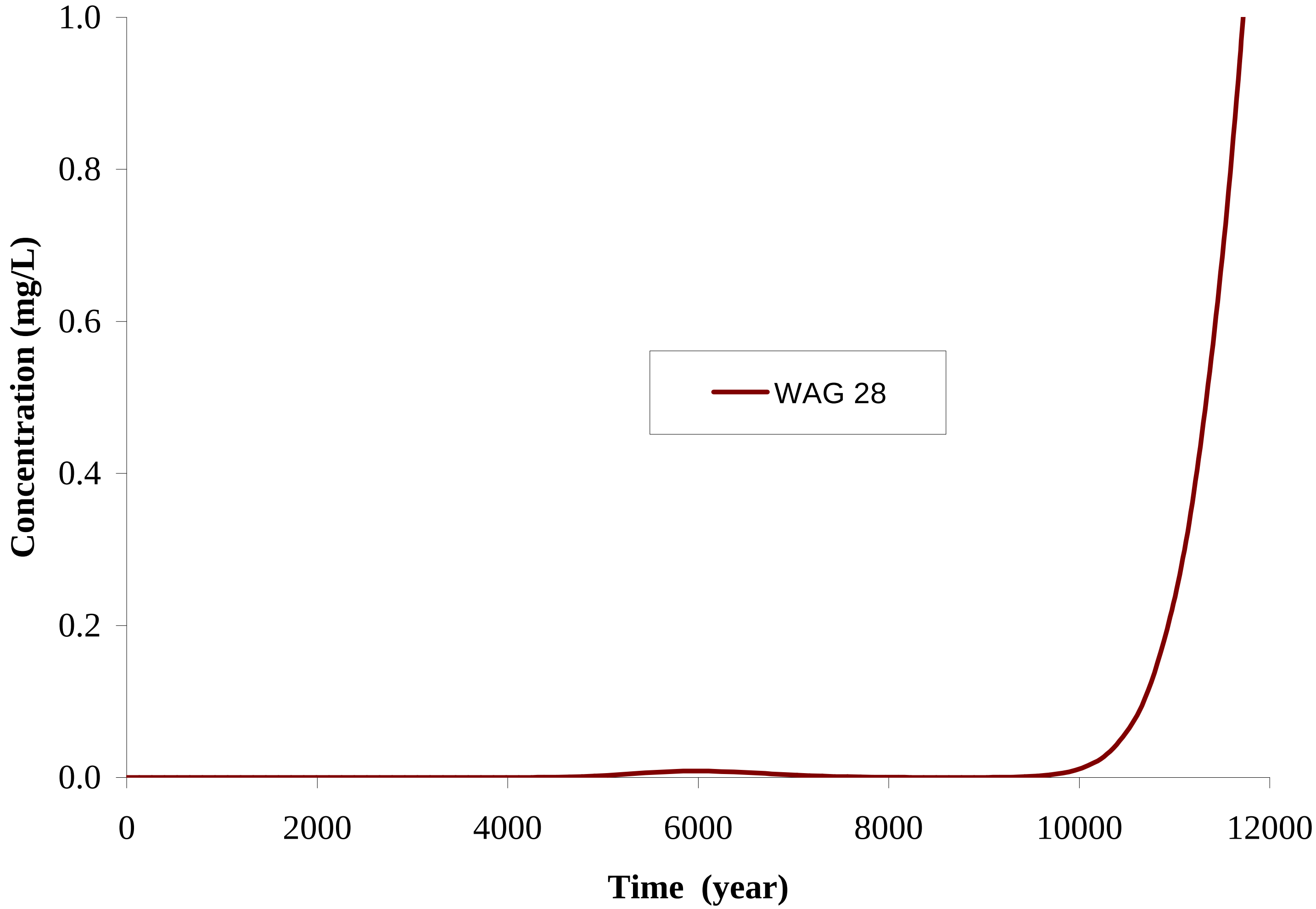


Fig. 3.46. Predicted Uranium-234 Activity Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

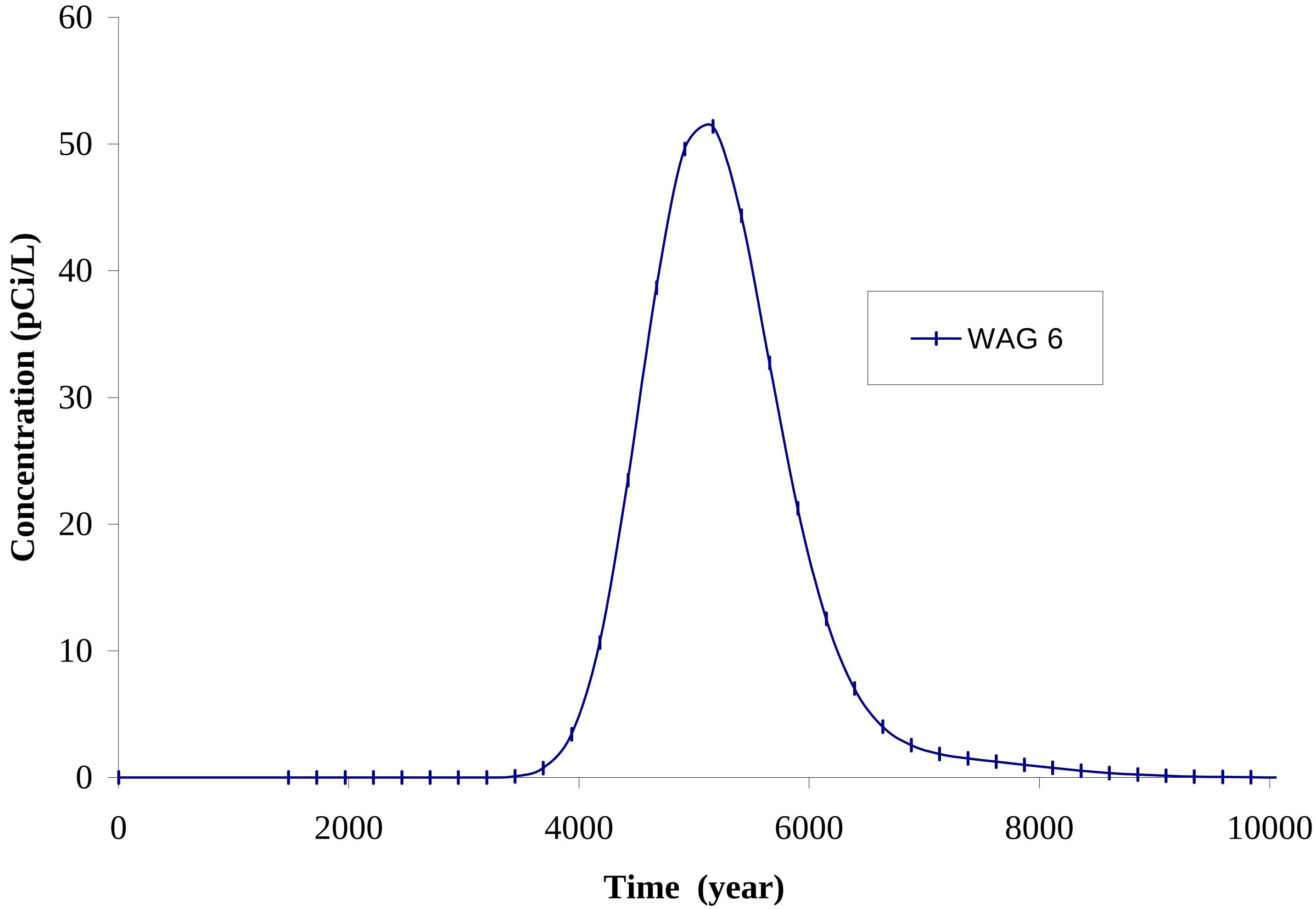


Fig. C3.47. Predicted Uranium-234 Activity Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

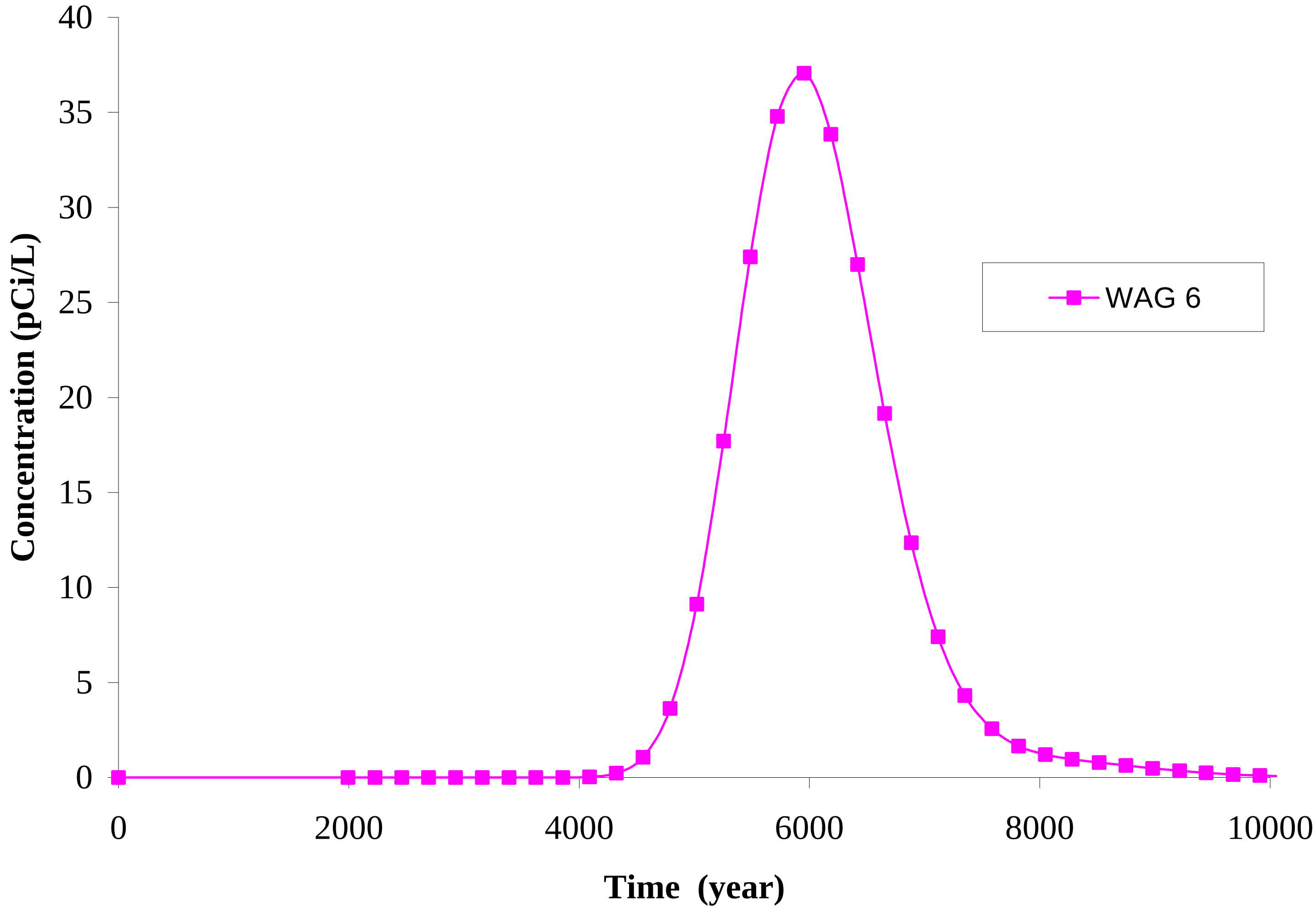


Fig. C3.48. Predicted Uranium-234 Activity Concentrations at the Bayou Creek due to loading from PGDP Source Areas

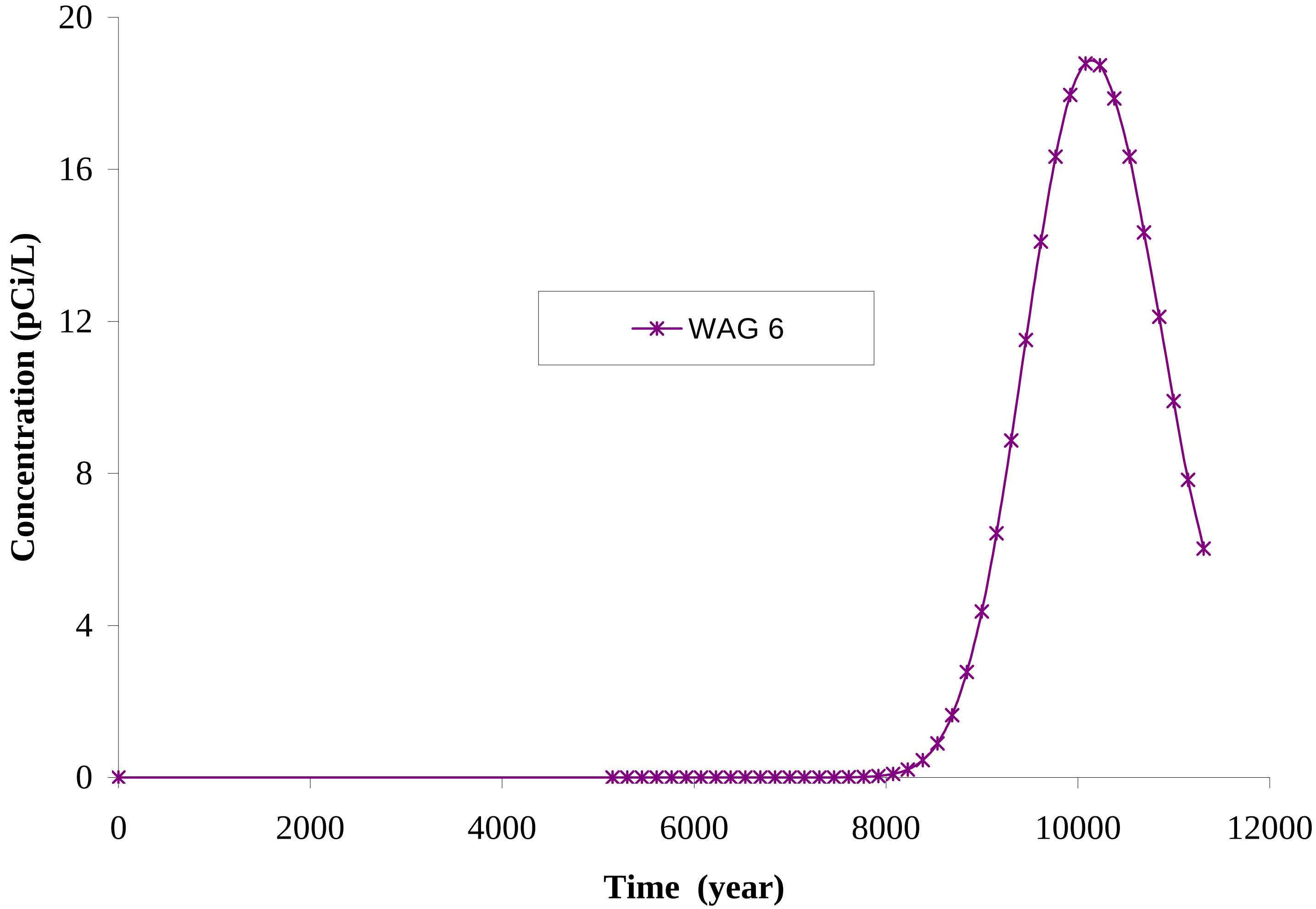


Fig. C3.49. Predicted Uranium-234 Activity Concentrations at the Ohio River due to loading from PGDP Source Areas

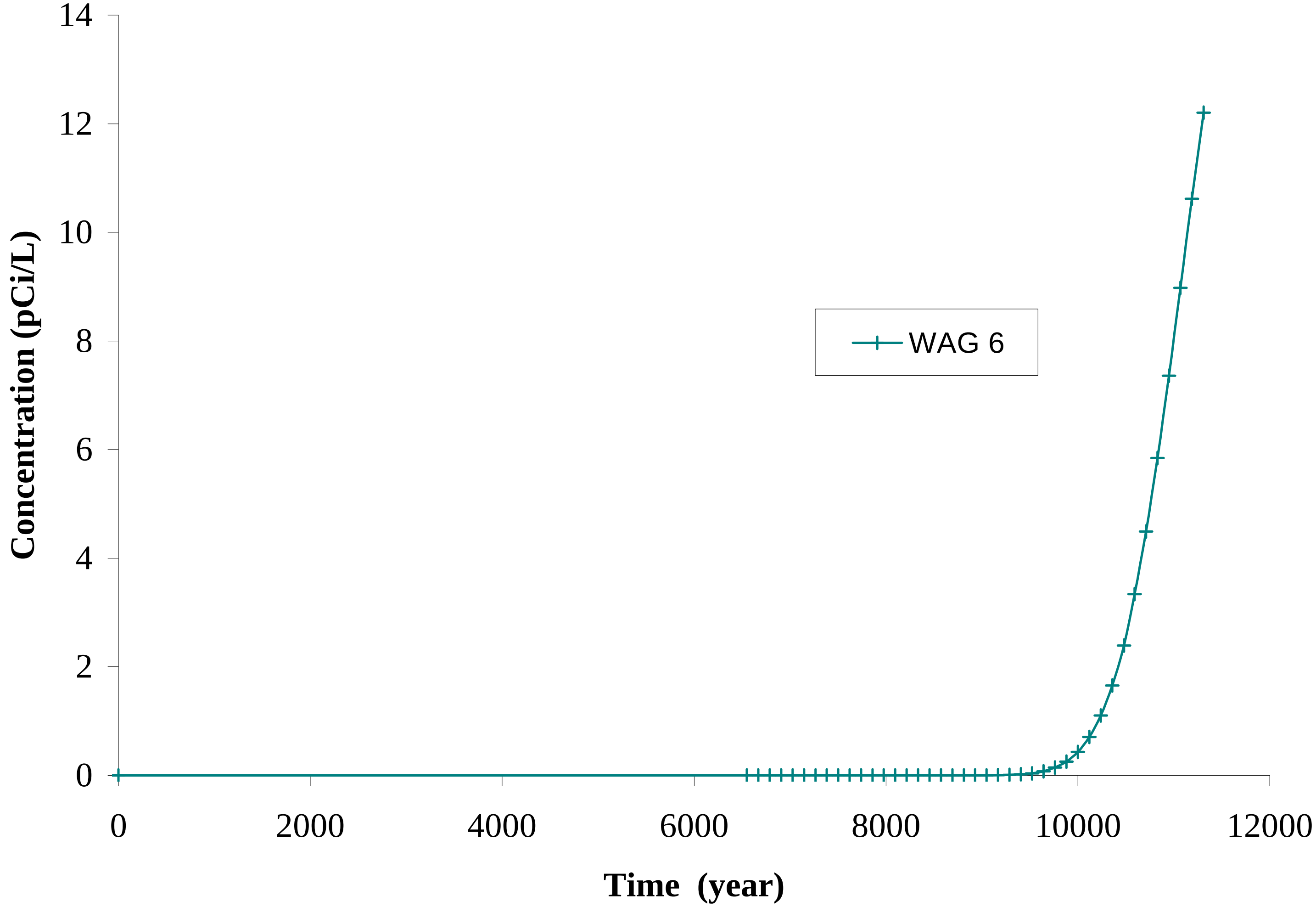


Fig. C3.50. Predicted Uranium-235 Activity Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

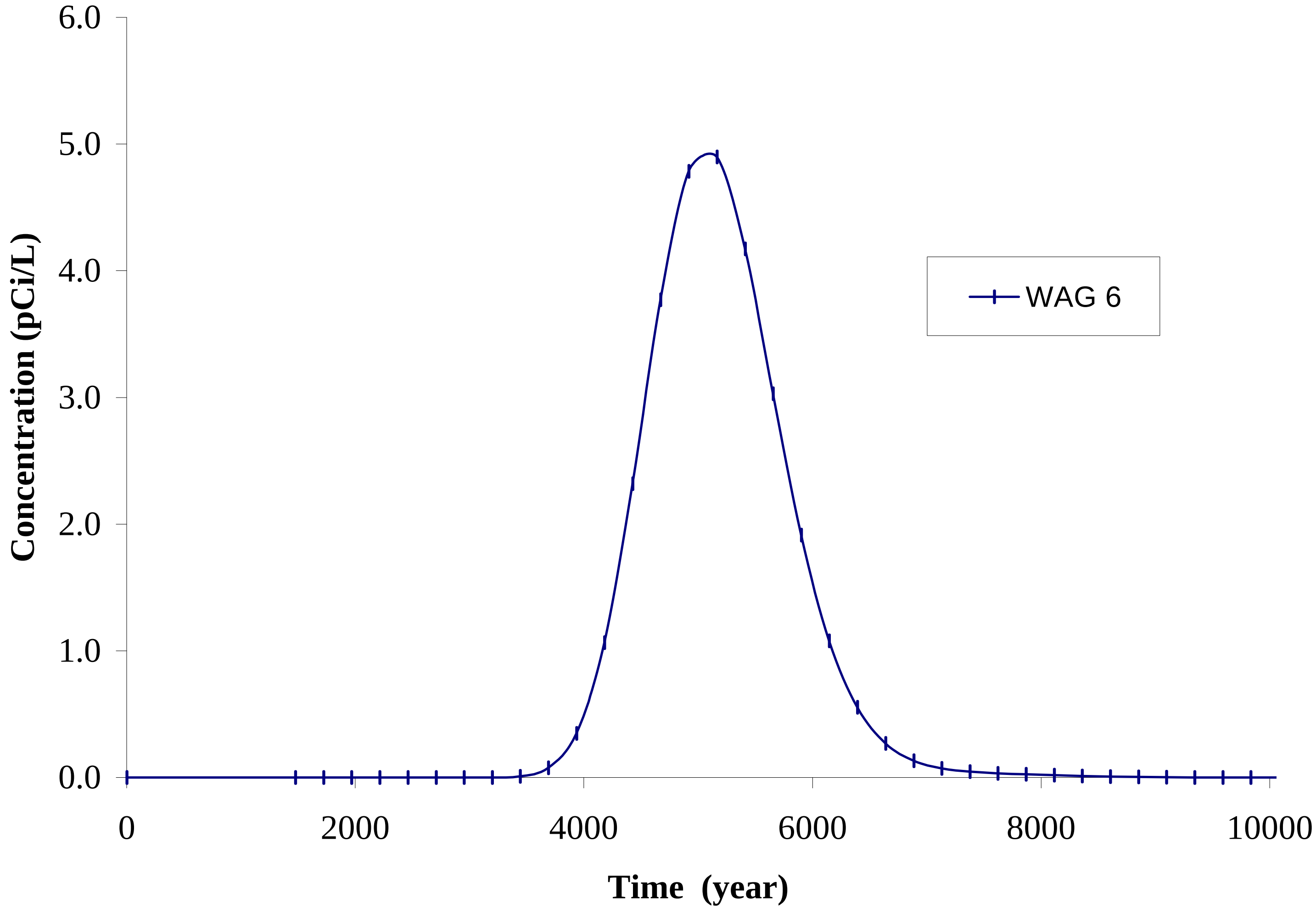


Fig. C3.51. Predicted Uranium-235 Activity Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

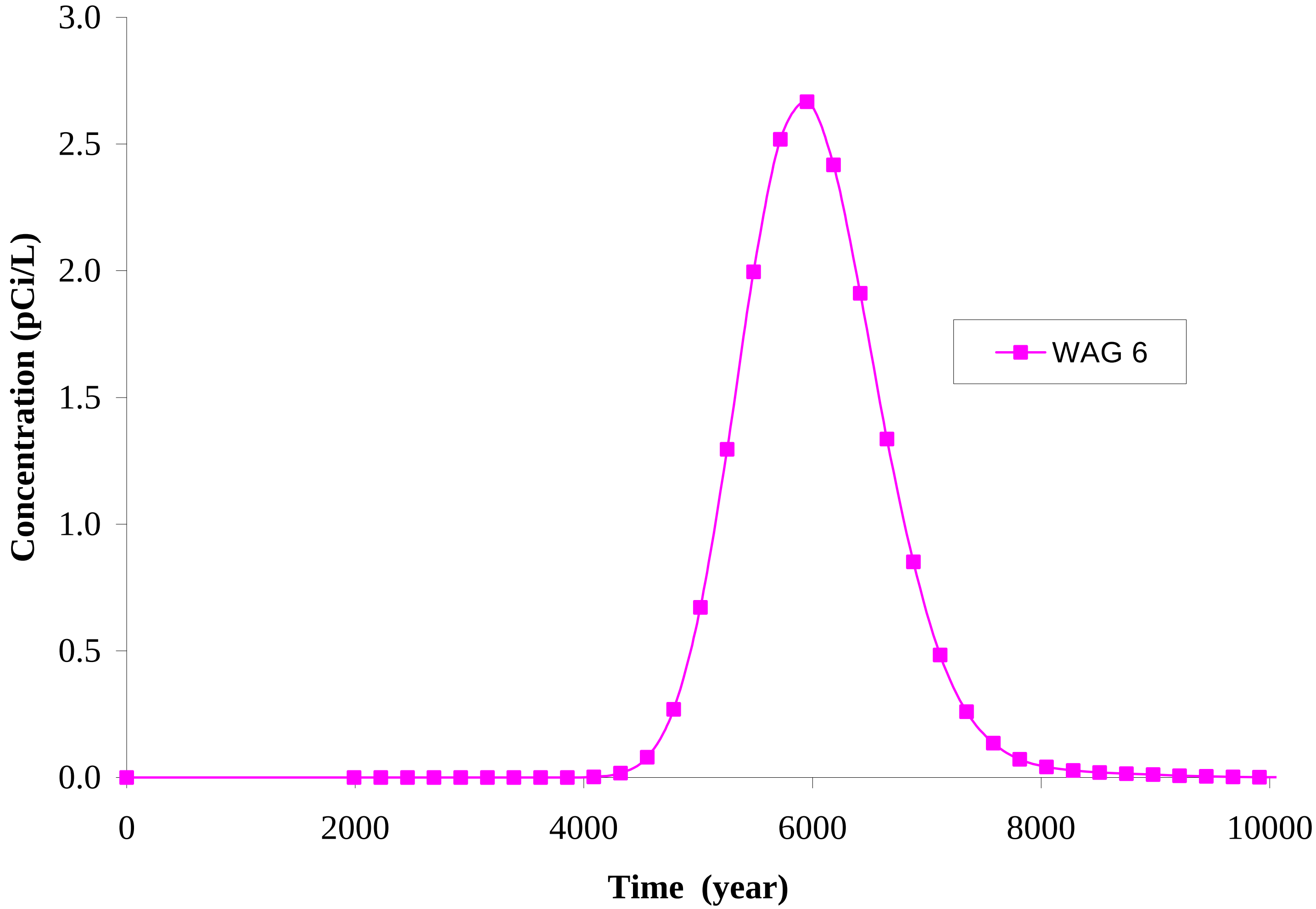


Fig. C3.52. Predicted Uranium-235 Activity Concentrations at the Bayou Creek due to loading from PGDP Source Areas

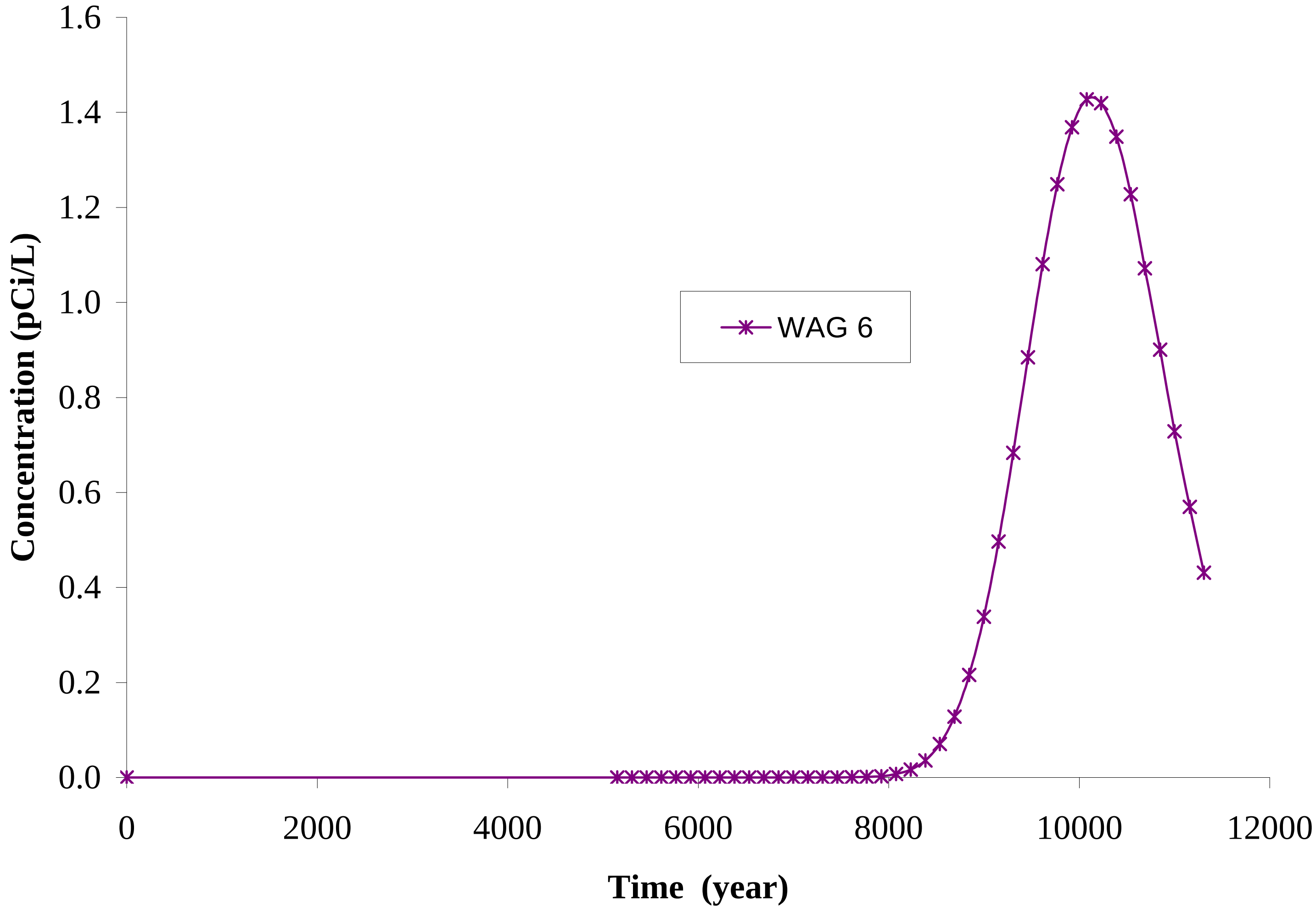


Fig. C3.53. Predicted Uranium-235 Activity Concentrations at the Ohio River due to loading from PGDP Source Areas

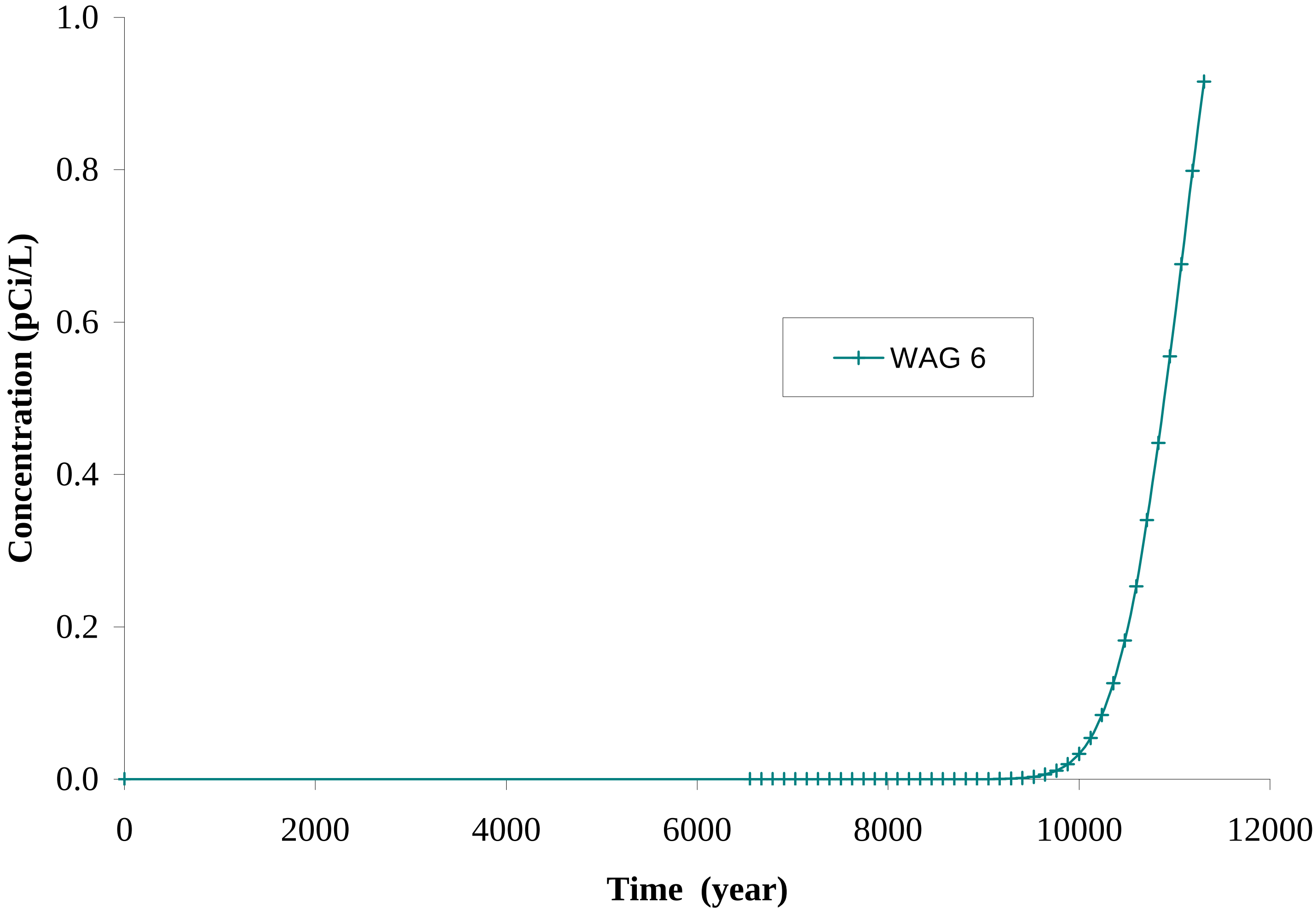


Fig. C3.54. Predicted Uranium-238 Activity Concentrations at the PGDP Fenceline due to loading from PGDP Source Areas

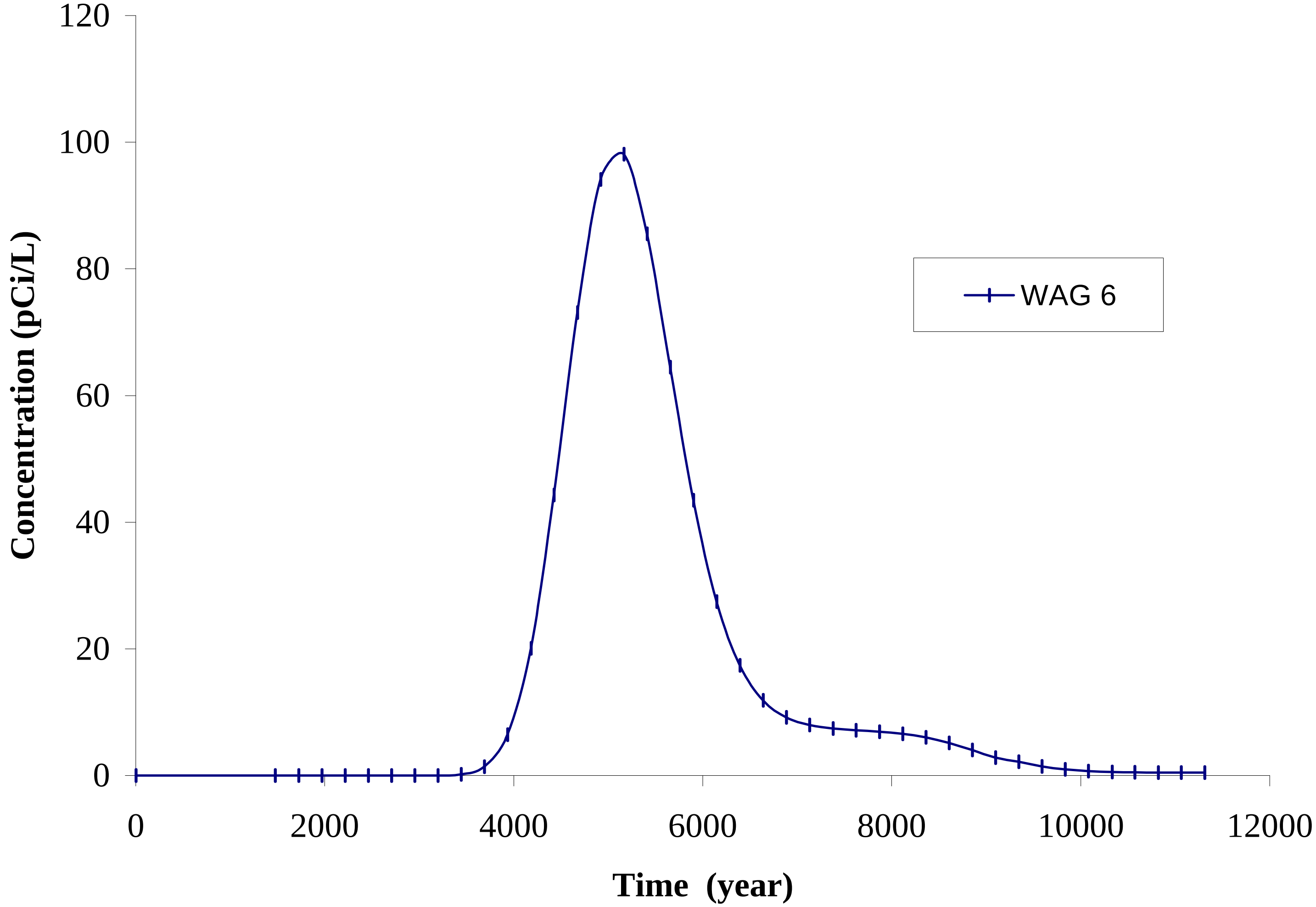


Fig. C3.55. Predicted Uranium-238 Activity Concentrations at the DOE Property Boundary due to loading from PGDP Source Areas

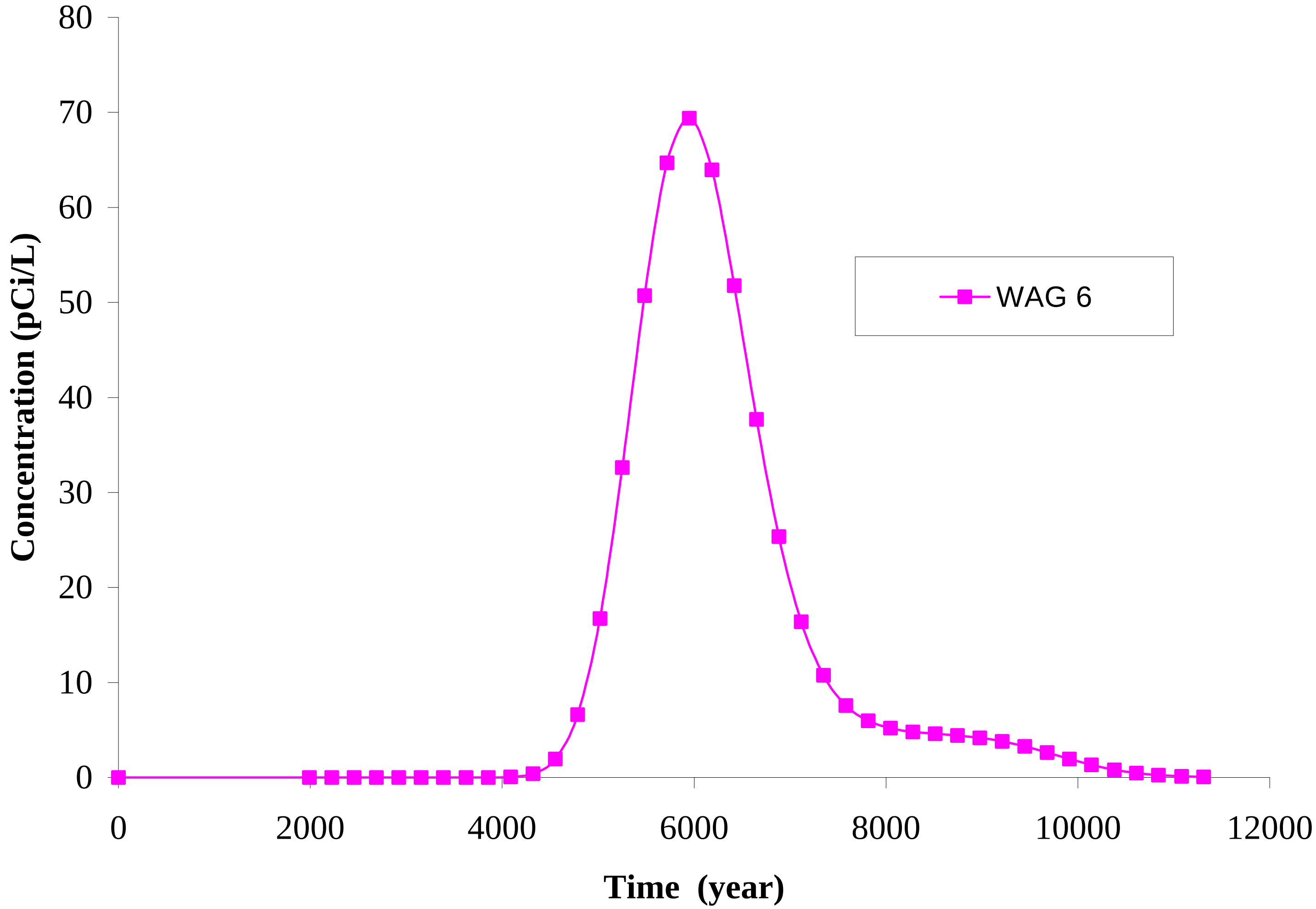


Fig. C3.56. Predicted Uranium-238 Activity Concentrations at the Bayou Creek due to loading from PGDP Sources

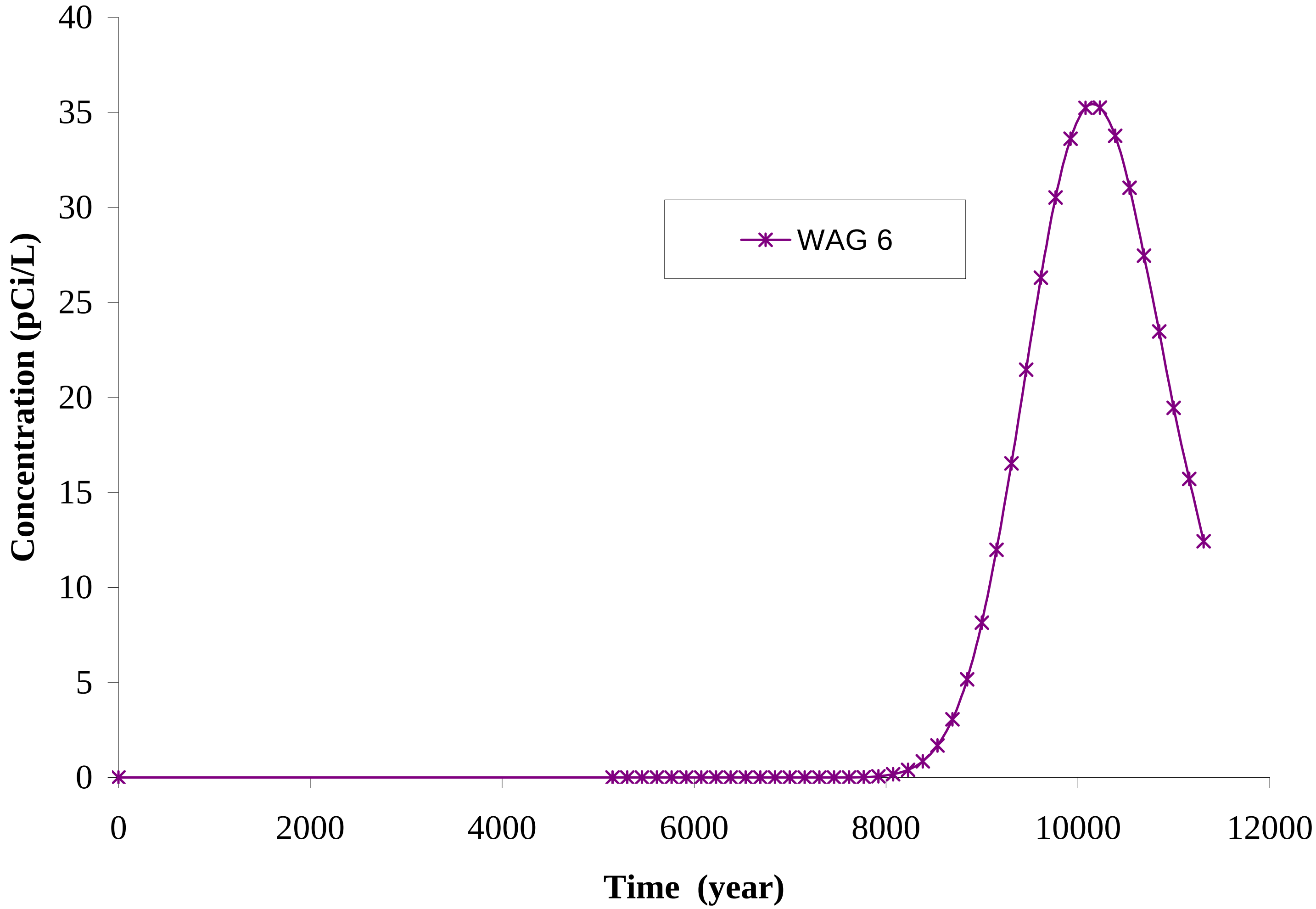


Fig. C3.57. Predicted Uranium-238 Activity Concentrations at the Ohio River due to loading from PGDP Sources

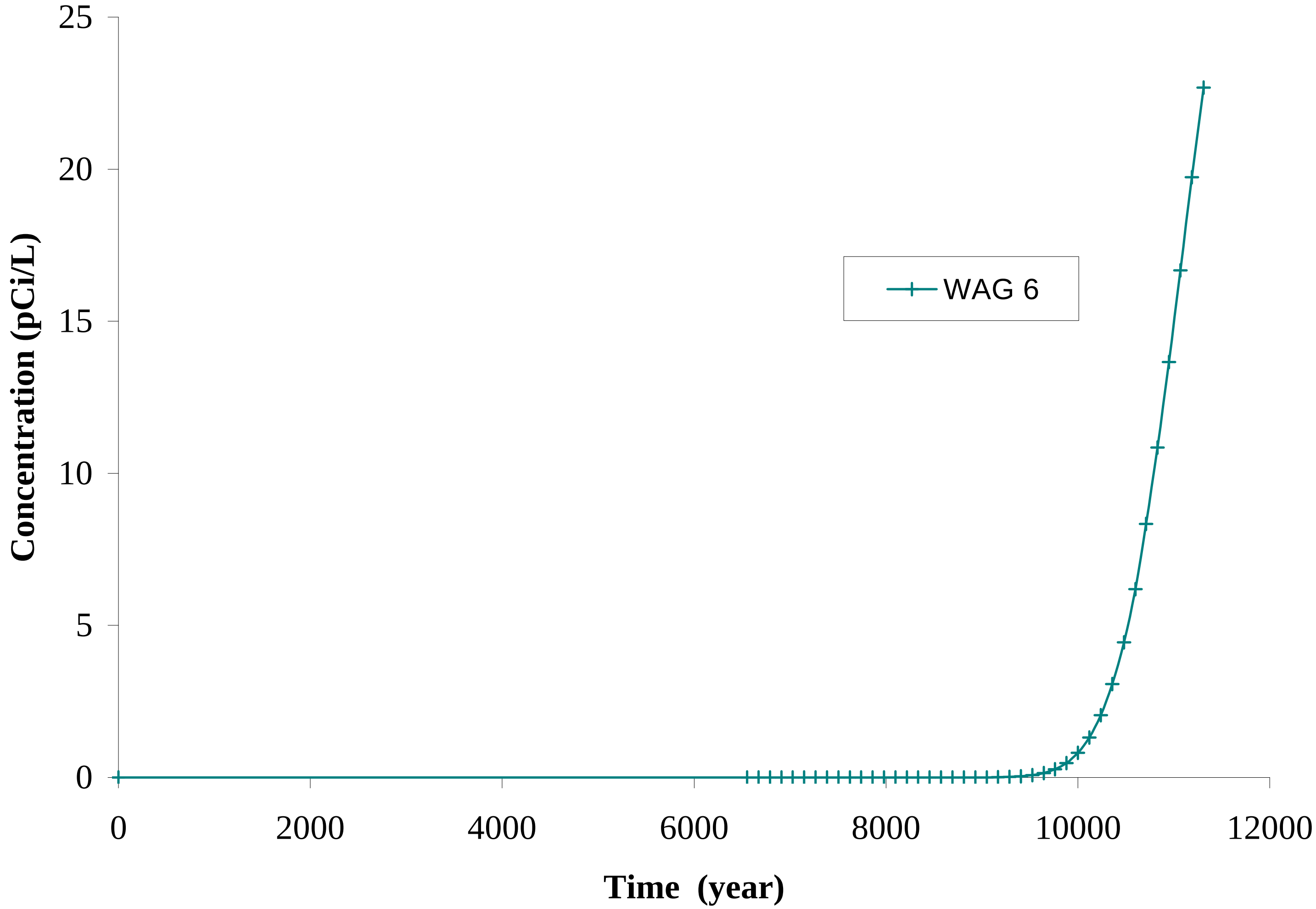


Fig. C3.58. Predicted TCE Concentrations in the Surface Air due to Contaminated Soil in the WAG 6 (Sector 4)

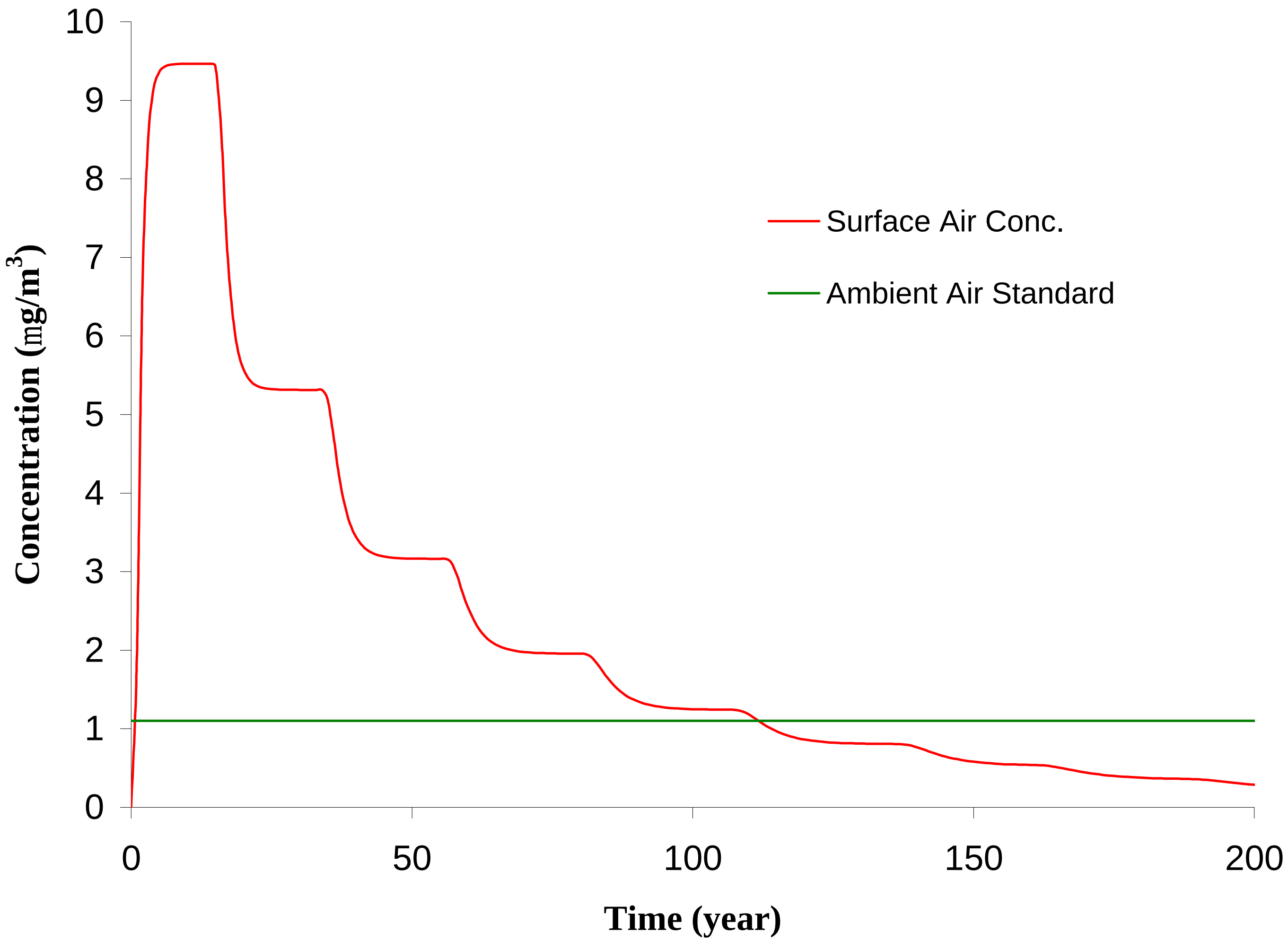
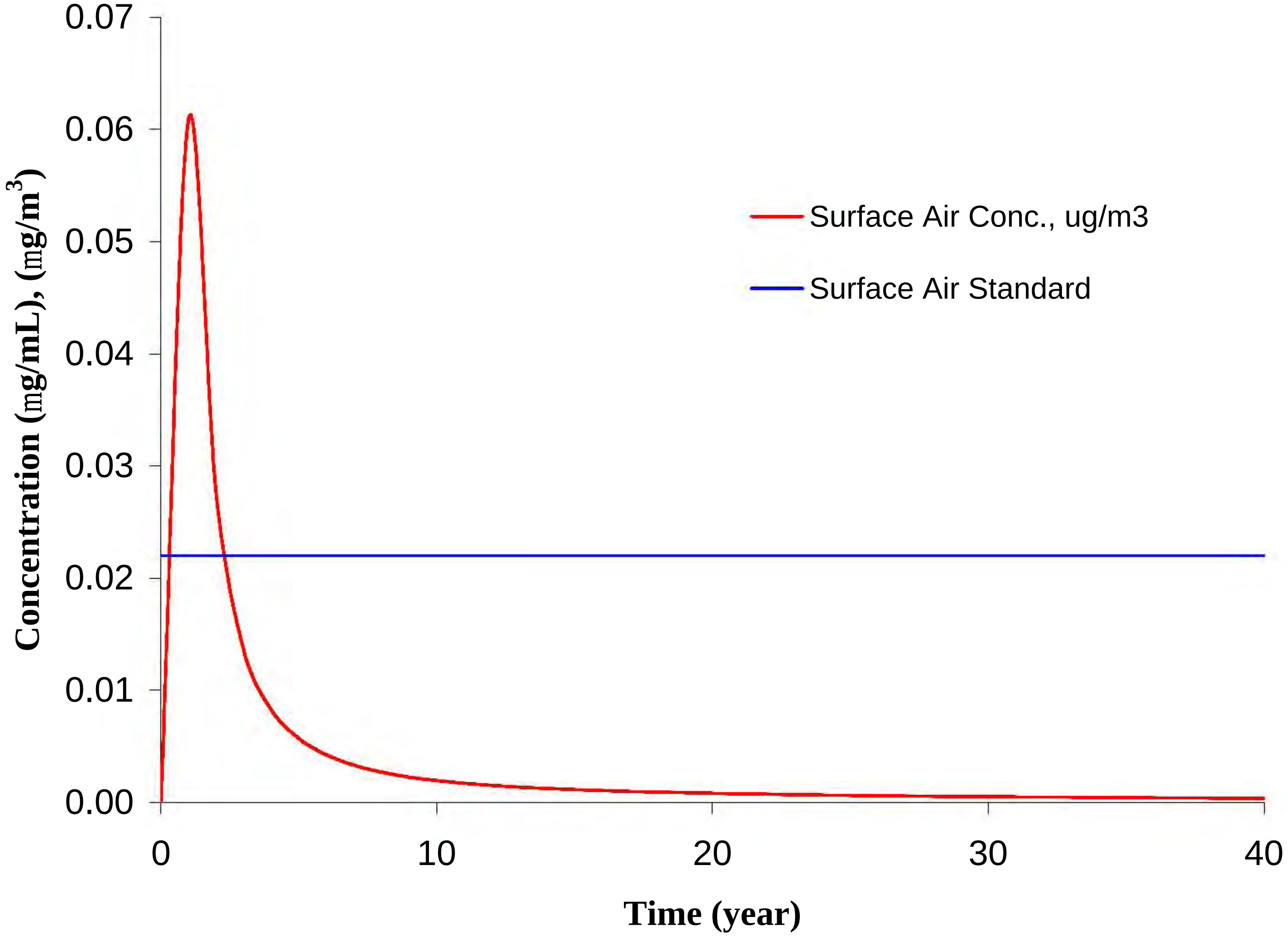


Fig. C3.59. Predicted Vinyl Chloride Concentrations in the Atmosphere due to Contaminated Soil in the WAG 6 (Sector 4)



APPENDIX C4

Table C4-1. Identification of Remedial Technologies and Process Options For Upper Continental Recharge System Vadose Zone Soils (0 to 15 ft deep)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
No Action	None	Not Applicable	No further action to address contaminated media.	Required for consideration by the NCP and NEPA.
Institutional Actions	Access Restrictions	Deed Restrictions	Restrictions on property in the deed and title.	Could be implemented as a component of the ROD or on a site-wide basis.
		Site Protection/Security	Guards to restrict and monitor plant access.	Currently conducted for the PGDP as an operating facility.
		Physical Barriers/ Restrictions	Fencing, warning signs, permits, etc.	Potentially applicable; the PGDP currently is fenced, and “no trespassing” signs are posted. Additional barriers could be located at isolated areas within the PGDP security fence to protect workers, and PGDP permitting could be required before working at the SWMU.
	Monitoring	Surface Soil and Water Monitoring	Periodic monitoring of site conditions through environmental sampling.	Surface-soil monitoring could be enacted as a component of the ROD. Groundwater and surface water monitoring already is conducted routinely at the PGDP on a site-wide basis.
Containment Actions	Capping	Clay/Soil or Asphalt/Concrete	Single or multi-layered soil, clay, and/or pavement (concrete, asphalt) cap designed to minimize dermal contact, exposure, or re-entrainment and/or to provide some reduction of infiltration/vertical movement of precipitation or contaminants into the subsurface.	Potentially applicable as a barrier to mitigate direct contact to COCs. Potentially applicable for reducing infiltration of precipitation since surface water could be directed to storm sewers.
		Multimedia	Multi-layered cap with low permeability, designed for highest degree of reduction of infiltration/ vertical movement of precipitation into contaminated soil.	Potentially applicable as a barrier to mitigate direct contact to COCs. Potentially applicable for reducing infiltration of precipitation, since surface water could be directed to storm sewers.
		Lead Shield	Cap containing lead to reduce exposure to radioactive contamination (gamma-emitting particles).	Potentially applicable to protect workers by reducing radioactivity from surface soils.
	Surface Controls	Grading	Reshaping the topography to manage surface water runoff, control erosion, and reduce infiltration.	Potentially applicable, especially in combination with other technologies.
		Revegetation	Re-vegetating soil can assist with reducing infiltration and erosion control.	Potentially applicable to manage surface water runoff, control erosion, and reduce infiltration.
		Flow Diversion	Collection and diversion systems can divert storm water and runoff to prevent erosion and reduce contaminant migration (infiltration).	Potentially applicable as compatible with other medium technologies to reduce infiltration of precipitation to lower media.
	Bottom Barriers	Jet grouting; Slanted Grout columns; cryogenics	An impermeable layer is placed below the contaminated area to prevent vertical migration/ leaching of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.

Table C4-1. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Containment Actions (Continued)	Vertical Barriers	Slurry Walls	Slurry walls are constructed around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Grout Curtains	Grout curtains are constructed around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Sheet Piles/Vibrating Beam	Pilings or beams are driven around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Cryogenic Walls	Liquid nitrogen or other cryogenic fluids are used to construct a frozen barrier around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
Removal	Water Collection	Wells and Subsurface Drains	Wells and/or subsurface drains can be installed to collect perched water or water leaking from utilities.	Potentially applicable depending upon each SWMU's specific conditions.
	Excavation	Solids and Semisolids Excavation	Contaminated solids and semisolids can be excavated by ordinary construction equipment (backhoes, trackhoes, bulldozers).	Potentially applicable to the surface soils, especially those contaminated with radiological contamination. Various *ex situ* treatment technologies are available, depending on the contaminants present. (See *Ex Situ* Treatment).
		Solidify and Mine (Freeze and Mine)	Cryogenic fluids are used to freeze or immobilize contaminants within the contaminated area to allow excavation.	Potentially applicable to soils containing a number of contaminants, including DNAPLs or radioactive liquids.
	Site Equipment/ Debris Removal	Equipment/Debris Removal and Decontamination	Equipment and/or structures along with debris may require removal and decontamination before surface soils can be removed.	Potentially applicable depending upon each particular SWMU's rate and extent of contamination and the type of contamination.
	Bulk Liquid Removal	Drain or Pump Tanks/Pits and Lines Containing Liquids	Liquids would be drained or pumped from tanks/pits and lines that require removal and treatment/disposal prior to surface soil remediation.	Potentially applicable if liquids are located within tanks/pits and lines prior to remediation of surface soils and other media.
	Bulk Solid/ Liquid Removal	Vacuum Loader	Vacuum system used to pneumatically collect and load solid, semi-solid, sludge, and/or liquid wastes.	Potentially applicable to remove contaminated surface soil and sludge.
In Situ Treatment	Physical/ Chemical Treatment	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Potentially applicable to inorganically contaminated soils.

Table C4-1. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
In Situ Treatment (Continued)	Physical/ Chemical Treatment (Continued)	Chemical Mixing (Deep Soil Mixing)	Remediation agents are added to contaminated soil and physically mixed into soil at varying depths. A wide range of treatment agents may be used, including solvents, precipitating and neutralizing chemicals, hot air, steam, and stabilizing agents.	Potentially applicable to physical mix surface soil contamination. Use of solvents or surfactants preferred.
		Soil Vapor Extraction/Soil Venting	Vacuum is applied through piping to create a pressure gradient that induces gas-phase volatiles to diffuse through soil to extraction wells. This technology also is known as in situ soil venting, in situ volatilization, enhanced volatilization, or soil vacuum extraction.	Potentially applicable to soils contaminated with VOCs. Not effective for PCBs, dioxins/furans, inorganics, or radionuclides.
	Thermal Treatment	Vitrification	Contaminated soils and wastes are melted at a high temperature using electrodes to form a large glass monolith with very low leaching characteristics.	Potentially applicable to inorganic-contaminated soil.
	Biological Treatment	Bioventing/ Barometric Venting	Oxygen is delivered to contaminated unsaturated soils by forces air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation. The system also may include the injection of contaminated gases, using the soil system for remediation.	Potentially applicable to soils contaminated by VOCs, SVOCs, and PCBs.
		Enhanced Bioremediation	Naturally occurring microbes are stimulated by circulating water-based solutions through contaminated soils to enhance *in situ* biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and contaminant desorption from subsurface materials.	Potentially applicable to soils contaminated by VOCs, SVOCs, and PCBs.
		Phytoremediation	Plants are selected, planted, and managed to uptake contaminants for digestion or degradation.	Potentially applicable to shallow soils contaminated by VOCs, SVOCs, PCBs, and radionuclides.
Ex Situ Treatment	Refer to Table C-4 for identification of *ex situ* treatment technologies.			
Disposal Actions	Refer to Table C-6 for identification of disposal actions.			

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-2. Identification of Remedial Technologies and Process Options For Upper Continental Recharge System Subsurface Saturated Soils

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
No Action	None	Not Applicable	No further action to address contaminated media.	Required for consideration by the NCP and NEPA.
Institutional Actions	Access Restrictions	Deed Restrictions	Restriction on property in the deed and title.	Could be implemented as a component of the ROD or on a site-wide basis.
		Site Protection/Security	Guards to restrict and monitor plant access.	Currently conducted for the PGDP as an operating facility.
		Physical Barriers/Restrictions	Fencing, warning signs, permits, etc.	Potentially applicable; the PGDP currently is fenced and "no trespassing" signs are posted. Additional barriers could be located at isolated areas within the PGDP security fence to protect workers and PGDP permitting could be required before working at the SWMU.
	Monitoring	Groundwater Monitoring	Periodic monitoring of site conditions through environmental sampling.	Soil monitoring could be enacted as a component of the ROD. Groundwater and surface water monitoring already is conducted routinely at PGDP on a site-wide basis.
Containment Actions	Bottom Barriers	Jet Grouting; Slanted Grout Columns; Cryogenics	An impermeable layer is placed below the contaminated area to prevent vertical migration/ leaching of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
	Vertical Barriers	Slurry Walls	Slurry walls are constructed around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Grout Curtains	Grout curtains are constructed around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Sheet Piles/Vibrating Beam	Pilings or beams are driven around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
		Cryogenic Walls	Liquid nitrogen or other cryogenic fluids are used to construct a frozen barrier around the contaminated area to prevent horizontal migration of contaminants.	Potentially applicable for containment of wastes or in conjunction with process options that could mobilize vapors.
Removal	Groundwater Collection	Wells and Subsurface Drains	Wells and/or subsurface drains can be installed to collect perched water or water leaking from utilities.	Potentially applicable depending upon the saturated zone of concern.

Table C4-2. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Removal (Continued)	Groundwater Collection (continued)	Vacuum Enhanced Recovery (2 Phase or Dual Phase)	Vacuum enhanced recover is an enhancement of soil vapor extraction, although groundwater and soil vapor are both extracted. The 2-Phase system uses a high-vacuum pump to extract both groundwater and vapor. The Dual Phase system uses a vacuum pump for vapors and a submersible or pneumatic pump for groundwater.	Potentially applicable.
	Excavation	Solids and Semisolids Excavation	Contaminated solids and semi-solids can be excavated by ordinary construction equipment (backhoes, trackhoes, bulldozers).	Potentially applicable to some of the saturated soils. The depth capacity of conventional excavation equipment [~9 meters (30 feet)] is limited.
		Solidify and Mine (Freeze and Mine)	Patented process in which waste is immobilized for excavation by cryogenic freezing methods.	Potentially applicable to excavate contaminated soil.
In Situ *Treatment*	Physical/ Chemical Treatment	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Potentially applicable to inorganically-contaminated soils.
		Hydrous Pyrolysis Oxidation (used in conjunction with *in situ* steam stripping)	Steam and possible oxygen are injected together, building a heated oxygenated zone in the subsurface. When the injection is stopped, the steam condenses and contaminated groundwater returns to the heated zone and mixes with the condensate and oxygen, destroying any dissolves contaminants.	Unable to treat the full UCRS. Limited to 30 feet -- technically unfeasible.
		Oxidation	Oxidants are injected to treat/destroy organic contaminants.	Cannot inject oxidant due to low permeability.
		Electroosmosis (Lasagna™)	The Lasagna™ technology was developed to remediate soils and groundwater contaminated with TCE and is especially suited to sites with low-permeability soils. The process uses electro-osmosis to move soil contaminants by flushing multiple pore volumes of water through treatment zones where the TCE can be captured or chemically altered to nontoxic products.	Potentially applicable.

Table C4-2. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
In Situ *Treatment* (continued)	Physical/ Chemical Treatment (continued)	Air Sparging and Vacuum Extraction	Air sparging and vacuum extraction rely on the air-stripping mechanism to remove volatile contaminants from the saturated zone. The injection of air into the saturated zone is coupled with vacuum extraction to recover volatile contaminants within the vadose zone.	Potentially applicable.
		In Situ Aeration in the Saturated Zone (Air Sparging and UVB Wells)	Volatile contaminants below the water table can be stripped by injecting air through wells (Air Sparging). Vaporized volatiles move with the air to the unsaturated zone and are recovered using a vacuum extraction system. Another *in situ* groundwater stripping process is known as the Underpressure-Vaporizer-Well (UVB) method in which contaminated groundwater is stripped by air at negative pressures in a special filtered well. The contaminated gas is collected and treated at the well head.	Potentially applicable.
		Permeable Treatment Zones (Horizontal or Vertical)	*In situ* treatment zones are permeable and reactive structures using conventional installation technologies. The walls are constructed of granular material or a slurry that permits groundwater flow through the structure under ambient gradients. Treatment is achieved by the contaminant coming in contact with the reactive media (i.e., iron nutrients, bacteria, redox controls carbon) as it passes through wall.	Potentially applicable for sand lenses; however, an induced gradient likely would be required.
		Chemical Mixing (Deep Soil Mixing)	Remediation agents are added to contaminated soil and physically mixed into soil at varying depths using augers. A wide range of treatment agents my be used, including solvents, precipitating chemicals, neutralizing chemicals, hot air, steam, oxidizing agents, and stabilizing agents, depending upon the contaminants of concern.	Potentially applicable to physical mix soil, providing surface and subsurface locations/conditions do not obstruct operation.
	Thermal Treatment	Vacuum/Steam Extraction	Similar to vapor extraction with steam injected for heating the formation. Steam drives the soil, (clay) which increases the permeability of the formation and volatilizes organic contaminants. Vapors re extracted for treatment/storage. The process includes systems for handling offgases.	Potentially applicable to soils contaminated with VOCs. Not effective for PCBs, dioxins/ furans, inorganics, or radionuclides.

Table C4-2. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
In Situ Treatment (Continued)	Thermal Treatment (Continued)	Vitrification	Contaminated soils and wastes are melted at a high temperature using electrodes to form a large glass monolith with very low leaching characteristics.	Potentially applicable to inorganically contaminated soil.
		EM/RF or Six-Phase Soil Heating	Heats the soil by splitting conventional three-phase electricity into six separate phases, producing a heated environment. Each phase is delivered to a single electrode place din a hexagonal pattern. Heat dries the soil, (clay) which increases the permeability of the formation and volitalizes organic contaminants. Vapors are extracted for treatment, storage, or disposal. The process includes systems for handling offgases.	Potentially applicable to soils contaminated with VOCs. Not effective for PCBs, dioxins/furans, inorganics, or radionuclides.
	Biological Treatment	Monitored Natural Attenuation	Naturally-occurring process in soil and groundwater environments that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media. These *in situ* processes include biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization or destruction of contaminants. Sampling and analysis are required throughout the process.	Potentially applicable to soils contaminated by VOCs, some SVOCs, and PCBs.
		Bioventing/ Barometric Venting	Oxygen is delivered to contaminated saturated soils by forced air movement (either extraction or injection of air) to increase oxygen concentrations and stimulate biodegradation. The system also may include the injection of contaminated gases, using the soil system for remediation.	Potentially applicable to soils contaminated by VOCs, SVOCs, and PCBs.
		Enhanced Bioremediation	Naturally occurring microbes are stimulated by circulating water-based solution through contaminated soils to enhance *in situ* biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and contaminant desorption from subsurface materials.	Potentially applicable to soils contaminated by VOCs, some SVOCs, and PCBs.
		Phytoremediation	Plants are selected, planted, and managed to uptake contaminants for digestion or degradation.	Potentially applicable to shallow groundwater contaminated by VOCs, SVOCs, PCBs, and radionuclides.

Table C4-2. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Ex Situ Treatment	Refer to Table C-4 for identification of *ex situ* treatment technologies.			
Disposal Actions	Refer to Table C-6 for identification of disposal actions.			

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-3. Identification of Remedial Technologies and Process Options For Regional Gravel Aquifer (60 to 100 feet deep) and McNairy (> 100 feet deep) Groundwater

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
No Action	None	Not Applicable	No further action to address contaminated media.	Required for consideration by the NCP and NEPA.
Institutional Actions	Access Restrictions	Deed Restrictions	Restrictions on property in the deed and title.	Potentially applicable as one component of a remedial alternative.
		Site Protection/Security	Guards to restrict and monitor plant access.	Potentially applicable as one component of a remedial alternative. As an operating facility, full-time security measures are conducted at the PGDP.
		Physical Barriers/ Restrictions	Fencing, warning signs, permits, etc.	Potentially applicable as one component of a remedial alternative. The PGDP currently is fenced and "no trespassing" signs are posted.
	Administrative Options	Alternate Concentration Limits (ACLs)	Involves establishing ACLs for groundwater under CERCLA or RCRA in lieu of existing groundwater standards (e.g., MCLs).	Potentially applicable as one component of a remedial alternative.
		Technical Impracticability (TI) Waivers	A waiver under CERCLA or RCRA that may be imposed when remediation of contaminants is agreed to be technically impracticable.	Potentially applicable as one component of a remedial alternative. Presence of NDAPL may increase justification for A TI waiver.
	Monitoring	Water Monitoring	Periodic monitoring of site condition through environmental sampling of surface water and/or groundwater.	Potentially applicable as one component of a remedial alternative. Periodic groundwater and surface water monitoring is conducted at PGDP on a site-wide basis.
Groundwater Containment Actions	Subsurface Vertical Barriers	Slurry/Grout Walls	Low permeability, underground barriers constructed to contain or divert groundwater flow. Slurry/grout material is pumped into a trench or injected into soil voids to form a continuous subsurface barrier. Slurry and grout mixtures vary, but generally include fine clays (e.g., bentonite) or cementeous compounds (e.g., Portland cement). Many installation techniques exist, including trenching, vibrating beam, high-pressure injection, low-pressure (permeation) injection, hydromill, and deep soil mixing. Horizontal, low-permeability subsurface barriers have been constructed using slurry/grouting through innovative installation techniques.	Potentially applicable t contaminated groundwater in the RGA and/or McNairy.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Groundwater Containment Actions (Continued)	Subsurface Vertical Barriers (Continued)	Sheet Piling	A steel pile wall is constructed by driving (with an impact or vibratory hammer) individual steel panels through the soil. Various methods exist to from an interlock between panels and help maintain integrity along the sidewalls of the steel sections. This technology has been used for conventional excavations that require support of side slopes and some degree of hydraulic control.	Potentially applicable to contaminated groundwater in the RGA and/or McNairy.
		Polyethylene Wall	Polyethylene walls are fixed, subsurface barriers formed by either insertion of continuous polyethylene liner into an excavated trench or vibration of panels into place with an insertion plate. Polyethylene and other polymer materials are chemically resistant and can be manufactured to exhibit extremely low permeabilities (i.e., on the order of 10^{-13} cm/s).	Potentially applicable to contaminated groundwater in the RGA and/or McNairy.
		Cryogenic Barriers	A refrigerant (e.g., aqueous ammonia, propylene glycol, liquid nitrogen) is used to freeze a soil layer to form a continuous, low-permeability wall that provides geotechnical stabilization and hydraulic control. Theoretically, horizontal cryogenic barriers may be constructed utilizing innovative installation techniques (e.g., horizontal drilling and casing).	Potentially applicable to contaminated groundwater in the RGA and/or McNairy.
		Bio-barrier	Starved microorganisms are mixed into a slurry and injected into a porous media. Through monitored injection of nutrients, the micro-organisms flourish and form a "slime" wall within the pores of the soil matrix. As the nutrient supply is diminished and the microorganisms go dormant, the low-permeability "slime" wall remains.	Potentially applicable to contaminated groundwater in the RGA and/or McNairy.
	Hydraulic Containment	Hydraulic Containment	Hydraulic containment of dissolved chemicals may be achieved by pumping groundwater from wells and/or grains. Fluid flow control can be augmented by injecting water through wells and/or drains and by the installation of physical barriers (cut-off) walls. Monitoring wells are utilized to determine whether or not the specified hydraulic gradients have been obtained and chemical migration has been arrested. (Methods may include hydraulic bypass, hydraulic isolation, hydraulic manipulation, or aquifer leveling.)	Potentially applicable to contaminated groundwater in the RGA and/or McNairy.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Removal Actions (Groundwater and/or Contaminant)	Extraction	Soil Vapor Extraction (SVE)	A vacuum is applied through piping to create a pressure gradient that induces gas-phase volatiles to diffuse through permeable media to extraction wells. This technology also is known as *in situ* soil venting, *in situ* volatilization, enhanced volatilization, or soil vacuum extraction. (One passive form of SVE is titled barometric pumping.)	Not applicable to the RGA or McNairy since they are aquifers.
		Vacuum-Enhanced Recovery (Dual Phase or 2-Phase)	This option is an enhancement of soil vapor extraction, although groundwater and soil vapor both are extracted. The 2-Phase system uses a high-vacuum pump to extract both groundwater and vapor. The Dual Phase system uses a vacuum pump to extract vapors and a submersible pneumatic pump to extract groundwater.	Soil vapor extraction, with or without enhancements, is not applicable to the RGA or McNairy since they are aquifers.
		In-well Stripping **[includes: UVB; No VOCs]**	Air is injected into the saturated zone, which causes volatile contaminants to be mobilized from the saturated zone by the air-stripping mechanism, and vacuum extraction is used to recover volatile contaminants within the vadose zone. (Bio-sparging may be added to enhance air sparging.)	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs, but either would require installation of a recovery mechanism at depth (instead of in the vadose zone).
			A significant, *in situ* variation, known as the Underpressure-Vaporizer-Well (UVB) method, utilizes air at negative pressures to strip volatile contaminants from the groundwater inside specially designed wells. As the groundwater flows through the wells, the volatilized contaminants are recovered at the surface for treatment/disposal and the groundwater remains in the saturated zone(s).	Potentially applicable to groundwater in the RGA contaminated with dissolved VOCs. Not applicable to the McNairy due to the low hydraulic conductivity.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Removal Actions (Groundwater and/or Contaminant) (Continued)	Extraction (Continued)	Electrokinetics (including Lasagna^{TM})	An electric potential is established between electrodes in contaminated groundwater to cause contaminant ions to move to the electrodes. The contaminant can be recovered as plating on a solid electrode or, in the case of liquid electrodes, contaminants in the electrolysis fluids.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with metals or radionuclides.
			The LasagnaTM technology was developed to remediate soils and groundwater contaminated with TCE and is especially suited to sites with low-permeability soils. The process uses electro-osmosis to move soil contaminants by flushing multiple pore volumes of water through treatment zones where the TCE can be captured or chemically altered to nontoxic products.	Not applicable to the McNairy due to large pore size. Potentially applicable to groundwater in the McNairy contaminated with dissolved VOCs.
		"Pump and Treat"	Contaminated groundwater is pumped from wells or drains, followed by *ex situ* treatment. Recovery rates can be optimized by fine-tuning pumping rates, well locations, etc. Extraction wells may be installed vertically or horizontally.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved contaminants.
		In Situ Steam Injection/Vacuum Extraction (including Dynamic Underground Stripping)	Similar to soil vapor extraction with steam injected for heating the formation. Steam dries the soil, increases the permeability of the formation, decreases the viscosity and surface tension of liquids, and volatilizes organic contaminants. Vapors are extracted for treatment.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with VOCs (dissolved or DNAPL).
		Radio Frequency Heating (RFH)	This method involves heating soil with electromagnetic energy in the radio frequency band. Using a modified radio transmitter, the zone of interest is targeted for heating via electrodes placed in an array of boreholes. This energy heats the soil to temperatures between 150°C and 300°C.	Not applicable for use in saturated media, such as the RGA or McNairy.
		Six-Phase Soil Heating	This method involves heating soil by splitting conventional three-phase electricity into six separate phases, producing a heated environment. Each phase is delivered to a single electrode placed in a hexagonal pattern. Heat dries the soil, which increases the permeability of the formation and volatilizes organic contaminants.	Potentially applicable as an enhancement to some other groundwater remediation system in the RGA and/or McNairy, where heating of a low-permeability area needs to be targeted.

00-001(doc)/041301

C4-15

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Removal Actions (Groundwater and/or Contaminant) (Continued)	Extraction (Continued)	Microwave	Microwave energy is used to heat the contaminated groundwater, causing it to volatilize. Contaminant and groundwater vapors are extracted for treatment/disposal.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with VOCs (dissolved or DNAPL).
	Secondary/ Enhanced Recovery	Waterflooding or Injection	Referred to as secondary recovery by the oil industry, waterflooding involves the injection of water into strategically-placed wells or drains to move DNAPL hydraulically toward extraction wells. The injection/extraction systems (i.e., line-drive and five spot systems) enhance recovery by allowing development and sustenance of increased hydraulic gradients and flow rates, elimination of dead zones, and overall improved flow control management. This option may be used in combination with other process options (e.g., injected water may include oxidants as an enhancement).	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved contaminants.
		Surfactant Flooding and Pumping	A surfactant solution is injected as a slug in a flooding sequence to decrease the interfacial tension between DNAPL and water by several orders of magnitude. Ultra-low interfacial tension and higher capillary numbers improve the DNAPL displacement efficiency of a flood, promote the coalescence of DNAPL ganglia and development of a DNAPL bank in front of the surfactant slug, and result in increased DNAPL recovery and reduced DNAPL residual saturation. Surfactant flooding also can enhance DNAPL recovery by causing increased wetting, solubilization, and emulsification. (Some surfactants used in operations by the oil industry include petroleum surfactants, synthetic surfactants, ethoxylated surfactants, and ethoxylated alcohols. Environmental surfactants may include beta-cyclodextrins.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved contaminants.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Removal Actions (Groundwater and/or Contaminant) (Continued)	Secondary/ Enhanced Recovery (Continued)	Polymer Waterflooding and Pumping	Polymers are large molecules that can be dispersed in a waterflood to increase the viscosity of the flood, thereby reducing the mobility ratio and improving the volumetric sweep efficiency (DNAPL recovery). The mobility ratio is defined as the mobility of the displacing fluid (effective permeability/viscosity for water) divided by the mobility of the displaced fluid (effective permeability/viscosity for DNAPL). Lower mobility ratios favor DNAPL displacement and recovery. An effective polymer will impart a high viscosity at low concentration. In operation, polymer flooding often is used as part of a phased injection sequence consisting of the following: a preflush to adjust the pH and salinity (if required), surfactants and/or alkaline agents to reduce interfacial tension, a polymer solution to increase viscosity and improve the displacement efficiency, and the waterflood to displace the mobilized contaminant solutions.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved contaminants.
		Chemically Enhanced Dissolution and Pumping (Cosolvents)	Co-solvents are injected into a contaminated zone via wells or drains to increase the dissolution of DNAPLs and adsorbed chemicals. Continued flooding of the contamination zone with co-solvents or another flood (water, polymers, etc.) drives the contaminants to extraction wells or drains.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved contaminants.
In Situ Groundwater Treatment	Physical/ Chemical Treatment	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Methods for solidification/ stabilization include deep soil mixing, grout injection, hydromill, permeation grouting; and materials include bentonite, epoxy, thermplastic, or cementious materials.	Potentially applicable to the RGA and/or McNairy.
		Hydrous Pyrolysis/ Oxidation	Steam and possibly oxygen are injected together, building a heated, oxygenated zone in the subsurface. When the injection is stopped, the steam condenses and contaminated groundwater returns to the heated zone and mixes with the condensate and oxygen, destroying any dissolved contaminants.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
In Situ Groundwater Treatment (Continued)	Physical/ Chemical Treatment (Continued)	Permeable Treatment Walls	Subsurface walls are constructed using reactive granular material or a reactive slurry that permits groundwater flow through the structure under ambient or induced gradients. The contaminant is treated as it comes into contract with the reactive media (i.e., iron, nutrients, bacteria, redox control agent, carbon, humic acids, or other sorptive or reactive materials) as it passes through the wall.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs or metals.
		In Situ Chemical Treatment (Oxidation)	Oxidizing agents are injected into the contaminated groundwater, resulting in chemical oxidation of targeted contaminants. A wide range of treatment agents may be used, including solvents or precipitating, oxidizing, or stabilizing agents.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs.
		Ozone Injection (C-Sparge)	Ozone is injected into the contaminated groundwater, resulting in chemical oxidation of targeted VOC contaminants. C-Sparge uses a patented process for small bubble injection, which allows for deeper penetration laterally into the aquifer than normal sparging. This increases efficiency and prevents plugging.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs
		Sodium Dithionate Injection	The injection of the reducing agent produces a highly reduced treatment zone which can cause dehalogenation of CVOC contaminants. Continued agent addition is needed to maintain the zone.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs
	Biological Treatment	Monitored Natural Attenuation	Naturally-occurring processes in soil and groundwater environments that act to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media. These *in situ* processes include biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization or destruction of contaminants. Sampling and analysis are required throughout the process.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs, some SVOCs, PCBs, and possibly with metals and/or radionuclides.

Table C4-3. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
In Situ Groundwater Treatment (Continued)	Biological Treatment (Continued)	*In Situ* Biodegradation	The activity of naturally-occurring microbes is stimulated by circulating water-based solutions through contaminated soils to enhance *in situ* biological degradation of organic contaminants. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and contaminant desorption from subsurface materials. Process options may include co-metabolic, nitrate enhancement, or oxygen enhancement.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs, SVOCs, and PCBs.
		Bio-sparging	Amendments may be added to air sparging options to stimulate or enhance biodegradation.	Potentially applicable to groundwater in the RGA and/or McNairy contaminated with dissolved VOCs and possibly with metals and/or radionuclides.
	Thermal Treatment	Vitrification (*in situ*)	Contaminated soils and wastes are melted at a high temperature using electrodes to form a large glass monolith with very low leaching characteristics.	Potentially applicable to inorganically contaminated soil.
Ex Situ Groundwater Treatment	Refer to Table C-5 for identification of *ex situ* groundwater treatment technologies			
Disposal Action	Refer to Table C-6 for identification of disposal actions.			

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked processes does not signify endorsement.

Table C4-4. Identification of Remedial Technologies and Process Options for *Ex Situ* Treatment Technologies for Soils and Solids

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Ex Situ Treatment	Solids Handling	Magnetic Processes, Crushing and Grinding, Shredding and Chipping, and Screening	Solids handling equipment is used to screen magnet and non-magnet waste, prepare brittle and non-brittle waste, and segment solids for further treatment or disposal.	Potentially applicable to process excavated solids for treatment or storage.
	Solids Dewatering	Gravity Settling, Filter Press, Dewatering Beds, Belt Filters, Vacuum Filtration, Centrifuges	All methods are used to dewater solids prior to further treatment or storage.	Potentially applicable to process excavated soil for treatment, storage, or disposal.
	Physical Separation	Screening, Classification, Gravity Concentration, Magnetics	*Ex situ* volume reduction process used to segregate waste streams into components for further treatment, storage, or disposal.	Potentially applicable to extracted groundwater prior to further treatment or storage.
	Physical/ Chemical Separation	Solidification/ Stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Potentially applicable to inorganic soils.
		Chemical Extraction (Solvent Extraction)	Waste and solvent are mixed in an extractor, dissolving the organic contaminant into the solvent. The extracted organics and solvent are then placed in a separator, where the contaminants and solvent are separated for treatment and further use.	Potentially applicable to excavated surface soils contaminated with VOCs, SVOCs, PCBs, dioxins/furans, and radiological contaminants.
		Electrokinetic Removal	Electrical current is past through soil to separate contaminants.	Potentially applicable to excavated soils contaminated with chlorinated VOCs, SVOCs, or metals.
		Soil Washing/Leaching	Contaminants sorbed onto soil particles are separated from soil in an aqueous-based system. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	Potentially applicable to excavated soils contaminated with VOCs, PCBs, and dioxins/furans; some techniques may be applicable to uranium and other radionuclides.

Table C4-4. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Ex Situ Treatment (Continued)	Physical/ Chemical Separation (Continued)	Dechlorination: Glycolate/Base-catalyzed	An alkaline polyethylene glycolate (APEG) reagent is used to dehalogenate halogenated aromatic compounds in a batch reactor. Potassium polyethylene glycolate (KPEG) is the most common APEG reagent. Contaminated soils and the reagent are mixed and heated in a treatment vessel. In the APEG process, the reaction causes the polyethylene glycolate to replace halogen molecules and render the compound nonhazardous. For example, the reaction between chlorinated organics and KPEG causes replacement of a chlorine molecule and results in a reduction in toxicity.	Potentially applicable to excavated soils contaminated with halogenated VOCs, PCBs, and dioxins/furans. Not effective for radionuclides.
			Contaminated soil is screened, processed with a crusher and pug mill, and mixed with sodium bicarbonate. The mixture is heated in a rotary reactor to decompose and partially volatilized the contaminants.	Potentially applicable to excavated soils contaminated with halogenated VOCs, PCBs, and dioxins/furans. Not effective for radionuclides.
		Neutralization	Acids are added to an alkaline waste or base added to an acidic water to adjust the pH.	Not applicable for remediation since the majority of the soils do not need pH adjustment.
		Chemical Reduction-Oxidation	Reduction/oxidation chemically converts hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. The reducing/oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, potassium permanganate chlorine, and chlorine dioxide.	Potentially applicable to excavated souls contaminated with TCE, PCBs, or radionuclides.
	Biological Treatment	Biodegradation: Composting (Land-farming)	Contaminated soils are mixed with soil amendments and placed in aboveground enclosures that have leachate collection systems and some form of aeration. Processes include prepared treatment beds, biotreatment cells, soil piles, and composting. Moisture, heat, nutrients, oxygen, and pH may be controlled to enhance biodegradation.	Potentially applicable to excavated soils contaminated with VOCs, SVOCs, or PCBs.
			Contaminated soils are applied onto the soil surface or an above grade system and periodically tilled into the soil or turned over to aerate the waste and microbes.	Potentially applicable to some excavated soils contaminated with VOCs, SVOCs, or PCBs.

Table C4-4. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Ex Situ Treatment (Continued)	Biological Treatment (Continued)	Biodegradation: Slurry-Phase Treatment	An aqueous slurry is created by combining soil or sludge with water and other additives. The slurry is mixed to keep solids suspended and microorganisms in contact with the soil contaminants. Nutrients, oxygen and pH in the bioreactor may be controlled to enhance biodegradation. Upon completion of the process, the slurry is dewatered and the treated soil is disposed of.	Potentially applicable to some excavated soils contaminated with VOCs, SVOCs, or PCBs.
	Thermal Treatment	Incineration	High temperatures, 871°C to 1,204°C (1,600°F to 2,200 °F), are used to volatilized and combust (in the presence of oxygen) organic constituents.	Potentially applicable to excavated soils contaminated with VOCs, SVOCs, or PCBs.
		Pyrolysis	Chemical decomposition is induced in organic material by heat in the absence of oxygen. Organic materials are transformed into gaseous components and a solid residue (coke) containing fixed carbon and ash.	Potentially applicable to excavated organic soils and some excavated wastes.
		Thermal Desorption	Wastes are heated to 93°C to 538°C (200°F to 4,000°F), are used to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized vapors to the treatment system.	Potentially applicable to excavated soils contaminated with VOCs, SVOCs, PCBs, and dioxins/furans. Not effective for radionuclides and inorganics.
		Vitrification (*ex situ*)	Contaminated soil and sludge are melted at a high temperature to form a glass with very low leaching characteristics.	Potentially applicable to excavated inorganic soils and some excavated wastes.

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-5. Identification of Presumptive Technologies for Treatment of Extracted Groundwater

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Comments
Ex Situ Treatment Actions	Physical/ Chemical/ Biological Treatment	Air Stripping	A separation process in which volatile contaminants are partitioned to the gas phase process and rate are a function of the difference in contaminant concentration in each phase. Aeration methods include packed towers, diffused aeration, try aeration, and spray aeration.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved organic contaminants (e.g., VOCs, halogenated SVOCs). (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.)
		Granular Activated Carbon	A separation process in which groundwater contaminants are sorbed onto activated carbon. Periodic replacement or regeneration of saturated carbon is required.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved organic contaminants (e.g., VOCs, SVOCs). (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance,* EPA 540/R-96/023, October 1996.
		Chemical/UV Oxidation	A treatment process in which chemicals (e.g., oxygen, ozone, hydrogen peroxide, chlorine) and/or ultraviolet (UV) radiation are used to oxidize organic contaminants as water flows into a treatment tank. An ozone destruction unit is used to treat off-gases from the treatment tank.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved organic contaminants (e.g., VOCs, SVOCs). Also may be applicable to cyanides. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.)
		Aerobic Biological Reactors	A treatment process in which contaminated groundwater is treated using fixed or suspended microbiological systems, In fixed or attached systems, such as rotating biological contactors and tricking filters, microorganism are established on an inert support matrix to aerobically degrade groundwater contaminants. In suspended systems, such as activated sludge, contaminated groundwater is circulated in an aeration basin where a microbial population aerobically degrades organic matter and produces new cells.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved organic contaminants (*e.g., VOCs SVOC). (EPA, 1996. Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance,* EPA 540/R-96/023, October 1996.)
		Chemical Precipitation	A separation technology in which chemicals are added to encourage dissolved metals and suspended particles to form insoluble (or precipitated) metal hydroxides, sulfides, carbonates, or other salts.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved metals. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.

Table C4-5. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Comments
Ex Situ Treatment Actions (Continued)	Physical/ Chemical/ Biological Treatment (Continued)	Ion Exchange/Adsorption	A separation technology in which a resin media adsorbs, or removes, contaminants from groundwater or leachate. Cation resins, anion resins, or chelating resins may be used, depending upon the contaminant(s). The resins are contained in a pressurized vessel and may require regeneration.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved metals. Also, potentially applicable for sulfates, nitrates, and radionuclides. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.
		Electrochemical Methods	A separation technology in which direct electrical current is placed between two immersed electrodes to drive chemical oxidation-reduction reactions in an aqueous solution. Dissolved metals (e.g., hexavalent chromium, arsenic, cadmium, molybdenum, aluminum, zinc, copper) either deposit on the cathode or precipitate from the solution. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved metals. Also, potentially applicable for sulfates, nitrates, and radionuclides. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.
		Aeration of Background Metals	A separation technology in which aeration removes some metals (e.g., iron, manganese) from water by promoting chemical oxidation and the formation of insoluble hydroxides that precipitate from the water. The precipitants then may be removed by flocculation, sedimentation, and/or filtration. Methods of aeration include aeration tanks, aeration basins, or cascade aeration. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.)	Presumptive technology for treatment of extracted groundwater; potentially applicable for treatment of dissolved metals. Also, potentially applicable for sulfates, nitrates, and radionuclides. (EPA, 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996.
		Membrane Separation	A selective semipermeable membrane is used to separate, or remove, dissolved solids from water. Types of membrane separation include the following processes: microfiltration, ultrafiltration, reverse osmosis, dialysis, and electrodialysis. (McGraw-Hill, 1988. *The NALCO Water Handbook*, 2nd edition.)	Potentially applicable for treatment of radionuclides.

Table C4-5. (continued)

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Comments
Pretreatment Actions	Solids Dewatering	Gravity Settling, Filter Press, Dewatering Beds, Belt Filters, Vacuum Filtration, Centrifuges, *In Situ* Dewatering	Separation methods which are used to dewater solids prior to further treatment or storage.	Potentially applicable to support other treatment technologies.
	Physical Separation	Screening, Classification, Gravity Concentration, Coagulation/Flocculation, Magnetic separation	Separation methods which are used to segregate waste streams into components for further treatment, storage, or disposal.	Potentially applicable to support other treatment technologies.
	Physical/Chemical Treatment	Neutralization	Treatment method in which either an acid is added to an alkaline waste or a base is added to an acidic water to adjust the pH.	Potentially applicable to support other treatment technologies.
		Solidification/ Stabilization	Contaminants are bound Physically or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Potentially applicable to process sludge.

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-6. Identification of Remedial Technologies and Process Options for Disposal Actions

General Response Actions	Remedial Technology Types	Process Options	Descriptions	Screening Comments
Disposal Actions	On-Site Disposal	Permitted Facility	Wastes placed in an approved DOE-owned facility at the PGDP.	Potentially applicable for excavated soil/waste or treatment residuals. The C-746-U Contained Landfill is limited to 49 ppm PCBs and <30 pCi/g radionuclides (average total uranium).
		Constructed Disposal Cell	Excavate and place the generated wastes in a disposal cell specifically constructed for this purpose.	Depending upon the availability of a suitable location, potentially applicable for excavated soil.
	Off-Site Disposal	RCRA Facility	RCRA-hazardous wastes transported to a permitted, commercial RCRA disposal facility.	Potentially applicable to process residuals identified as hazardous waste. Must meet facility's waste acceptance criteria and land disposal restrictions.
		TSCA Facility	TSCA wastes transported to a permitted, commercial TSCA disposal facility.	Potentially applicable to soil and/or process residuals containing >50 ppm PCBs. (Currently limited to DOE-owned facilities if material contains radionuclides.) Must meet facility's waste acceptance criteria.
		(Low-Level) Radioactive Waste Facility	Low-level radioactive wastes transported to a DOE-approved facility.	Potentially applicable to soil and/or process residuals identified as low-level radioactive waste. Currently limited to DOE-owned facilities. Must meet facility's waste acceptance criteria.
		Mixed-Waste Facility	Mixed waste (RCRA-hazardous waste plus low-level radioactive waste) transported to a DOE-approved facility.	Potentially applicable to process residuals identified as mixed waste. Currently limited to DOE-owned facilities (due to radioactive component). Must meet facility's waste acceptance criteria.
	Interim Storage	On-Site Storage	Interim storage for an indefinite period in a DOE-owned facility at the PGDP.	Potentially applicable, but PGDP currently does not have such a facility available.

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-7. Evaluation of Remedial Technologies and Process Options for Upper Continental Recharge System Vadose Zone Soils (0 to 15 ft deep)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
No Action	None	Not Applicable	○	●	NA	●	●	●	●
			Option does not achieve RAOs. Option poses no short-term risks.			No action involved with this option; therefore, it is technically and administratively feasible to implement.		Option requires minimal (“baseline”) or no cost.	
Institutional Actions	Access Restrictions	Deed Restrictions	●	●	●	●	●	●	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access.			Option is technically and administratively feasible to implement.		Option requires relatively little capital to implement and little or no O&M, compared to other access restriction technologies.	
		Site Protection/ Security	●	●	●	●	●	⌖	○
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access.			Option is technically and administratively feasible to implement. A full security program already is implemented at the PGDP.		Option requires moderate capital to implement and significant O&M, compared to other access restriction technologies.	
		Physical Barriers/ Restrictions	●	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts. Option is proven and reliable for restricting access.			Option is technically and administratively feasible to implement. Physical barriers are already implemented at the PGDP (i.e., a security fence surrounds the entire PGDP).		Option requires moderate capital to implement and moderate O&M, compared to other access restriction technologies.	
	Monitoring	Surface Soil and Water Monitoring	●	●	●	●	●	●	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts, depending upon the level of construction required. Option is proven and reliable for evaluating groundwater and/or surface water characteristics, contaminants, and trends.			Option is technically and administratively feasible to implement. Routine groundwater and surface- water monitoring is conducted at the PGDP.		Option may require relatively moderate to low capital to implement and moderate O&M. Costs are dependent upon the number of samples and analyses conducted.	

Table C4-7. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	**Short-term Impacts**	**Provenness & Reliability**	**Technical Feasibility**	**Administrative Feasibility**	**Capital Cost**	**O&M Cost**
Containment Actions	Capping	Clay/Soil or Asphalt/Concrete	●	●	⌖	●	●	●	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce short-term impacts, depending upon the level of construction required. Option is proven and reliable for reducing exposure potential and reducing infiltration/vertical movement of contaminants into the subsurface. These types of caps require regular maintenance to ensure effectiveness.			Option is technically and administratively feasible to implement in most areas. Could include using existing floor slabs in developed areas.		Option requires moderate costs to implement. Costs for soil cover are low. O&M costs are moderate for cap inspection and maintenance.	
		Multimedia	●	●	●	●	●	⌖	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce short-term impacts, depending upon the level of construction required. Option is proven and reliable for reducing exposure potential and reducing infiltration/vertical movement of contaminants into the subsurface.			Option is technically and administratively feasible to implement in most areas.		Option requires moderate costs to implement. O&M costs are moderate for cap inspection and maintenance.	
		Lead Shield	⌖	⌖	●	●	●	○	⌖
			Option applicable to gamma-emitting radionuclides only. Probably applies to smaller areas only. Provides no contaminant reduction. Option would produce some short term impacts, especially in developed areas.			Option is technically and administratively feasible to implement.		Option is costly to implement and maintain.	
	Surface Controls	Grading	⌖	●	⌖	●	●	●	●
			Option available to all volumes, media, and contaminants, but provides no contaminant reduction. May produce short term impacts if surficial soils are contaminated. Could increase soil erosion. Option is proven and reliable for reducing infiltration/vertical movement of contaminants. Option does not limit surface exposure.			Option is technically and administratively feasible to implement.		Option is of low cost with little O&M.	

Table C4-7. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Containment Actions (Continued)	Surface Controls (Continued)	Revegetation	⌖	●	●	●	●	●	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce short-term impacts, depending upon the level of grading and required and degree of site development. Could cause increased erosion of surface contamination and short term exposure to workers during implementation. Option is proven and reliable for reducing infiltration/vertical movement of contaminants into the subsurface. Option does not limit surface exposure.			Option is technically and administratively feasible to implement.		Option is of low cost with little O&M.	
		Flow Diversion	⌖	●	●	●	●	●	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option produces few short-term impacts, depending upon the degree of construction required. Should cause minimal worker exposure. Option is proven and reliable for reducing infiltration/vertical movement of contaminants into the subsurface. Option does not limit surface exposure.			Option is technically and administratively feasible to implement. Could be incorporated as improvements to existing stormwater drainage network.		Option is of low cost with little O&M.	
	Bottom Barriers	Jet grouting; Slanted Grout columns; cryogenics	●	●	○	●	●	○	⌖
			Option available for all volumes and media. Grout may be degraded in presence of high concentrations of VOCs. Few short-term impacts or exposure risks. Options are neither proven or known to be reliable at PGDP.			Option is technically and administratively feasible to implement in most areas.		Options are high in capital costs. O&M costs are comparable to other containment options.	
	Vertical Barriers	Slurry Walls	⌖	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings. Use of vertical barrier in vadose zone limited to perched matter systems.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	

Table C4-7. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Containment Actions (Continued)	Vertical Barriers (Continued)	Grout Curtains	⊕	●	●	●	●	⊕	⊕
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings. Use of vertical barrier in vadose zone limited to perched matter systems.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	
		Sheet Piles/ Vibrating Beam	⊕	●	⊕	●	●	●	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces no short-term impacts. May be limited by site conditions. Use of vertical barrier in vadose zone limited to perched matter systems.			Option is technically and administratively feasible to implement		Option requires relatively low capital and O&M, compared to vertical barriers.	
		Cryogenic Walls	⊕	●	●	●	●	⊕	⊕
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings. Use of vertical barrier in vadose zone limited to perched matter systems.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	
Removal	Water Collection	Wells and Subsurface Drains	⊕	●	⊕	●	●	●	●
			Option available for areas of high recharge, leaking utilities, or perched groundwater, otherwise not effective for vadose zone contaminants. Would cause minimal to moderate short-term impacts or worker exposure. Generally unproven to remediate vadose contaminants.			Option is technically and administratively feasible to implement.		Option requires relatively low capital to implement and low to moderate O&M compared to other collection technologies.	
	Excavation	Solids and Semisolids Excavation	⊕	⊕	●	●	●	●	●
			Option applicable to shallow (< 30 ft.) volumes, media, and contaminants only. Relies on *ex situ* means of treatment or disposal. Option produces short-term impacts, of worker exposure and other construction-related impacts. Option is proven and reliable for contaminant mass reduction.			Option is readily implementable but not feasible beneath permanent buildings/structures. Option is administrative feasible.		Capital costs generally low depending on amount of worker protection required and method of disposal or treatment. Little O&M is required.	

Table C4-7. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Removal (Continued)	Excavation (Continued)	Solidify and Mine (Freeze and Mine)	⊕	●	○	⊕	⊕	⊕	●
			Option available for rather homogeneous, specialized wastes. Most applicable for explosive or reactive wastes. Minimal worker exposure and site impacts. Option is proven only for controlled environments. It is unproven for large scale applications.			Technology unproven for many of these applications. Handling highly toxic or dangerous material could result in permitting issues.		Capital costs are moderate to high, while O&M can be quite low compared to other *ex situ* separation technologies.	
	Site Equipment/ Debris Removal	Equipment/Debris Removal and Decontamination	⊕	⊕	●	●	●	⊕	⊕
			Option limited only to removable equipment, structures and debris of material emitting <200mR/hr. Relies on *ex situ* decontamination and disposal. Potential for short-term exposures to workers. Option is proven effective and reliable.			Option is technically and administratively feasible to implement.		Costs are highly variable due to ease of removal and nature and degree of contamination.	
	Bulk Liquid Removal	Drain or Pump Tanks/Pits and Lines Containing Liquids	●	⊕	●	●	●	●	●
			Option limited to containment structures and their appurtenances. Could cause short-term impacts depending on location of containment structure and nature of material.			Location of containment structure could impede removal actions. Option is administratively feasible.		Capital costs are low providing easy access to containment structure. O&M costs are comparable to or lower than other removal options.	
	Bulk Solid/ Liquid Removal	Vacuum Loader	⊕	●	●	●	●	●	●
			Option limited to containment structures and their appurtenances. May not be effective on all sludges. Should cause minimal worker exposure. Generally proven for liquids and semi-solids.			Option is technically and administratively feasible to implement.		Low cost compared to other removal options.	
In Situ Treatment	Physical/ Chemical Treatment	Solidification/ Stabilization	⊕	●	●	●	●	⊕	●
			Option uses several methods to that could be applied to all volumes, all media and all contaminants. NAPL could limit effectiveness. Carbonate-based gravels could mobilize radionuclides (e.g., uranium). Possible limitations in areas of buried materials. Produces little opportunity for worker exposure. Most methods are proven and reliable.			Technology is technically and administratively feasible.		Capital costs are variable with the technology employed but overall similar to other *in situ* technologies. Generally moderate to low O&M.	
		Chemical Mixing (Deep Soil Mixing)	●	⊕	⊕	⊕	⊕	⊕	●
			Option available to all volumes, all media and most contaminants. Possible limitations in areas of buried materials. Produces some opportunity for worker exposure. Most methods are proven and reliable.			Must use care not to mix incompatible wastes or introduce reactive substances. Accessibility is problematic in areas of dense infrastructure. Option is administratively feasible.		Capital costs are comparable to low compared to other *in situ* technologies. O&M costs are low.	

Table C4-7. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
In Situ	Physical	Soil Vapor Extraction/Soil Venting	⌖	●	●	●	●	●	●
			Option available for all volumes and media. Applicable to VOCs and some SVOCs only. Produces few short-term impacts. Method is proven and reliable.			Technology is technically and administratively feasible.		Capital and O&M costs are low compared to other *in situ* technologies.	
	Thermal Treatment	Vitrification	●	⌖	○	●	⌖	○	⌖
			Option available for most volumes, media and contaminants, but generally not feasible below ~ 25ft. Releases hot gases and potential for contaminant release. Has not proven to be reliable in field demonstrations.			Technology is technically feasible. Potential administrative difficulties based on perceived safety concerns.		High capital costs compared to other *in situ* technologies. O&M is moderate to high during operations. Long- term O&M is very low.	
	Biological Treatment	Bioventing/ Barometric Venting	⌖	●	●	●	●	⌖	●
			Option available for all volumes and media. Applicable to VOCs and some SVOCs. Produces few short-term impacts. Method is proven and reliable. Not applicable to radionuclides.			Technology is technically and administratively feasible.		Capital costs are low to moderate and O&M costs are comparable to other biological treatment technologies.	
	Biological	Enhanced Bioremediation	⌖	●	●	⌖	⌖	⌖	⌖
			Option available for all volumes and media. Applicable to VOCs and some SVOCs. Produces few short-term impacts. Method is proven and reliable.			Technology is technically difficult in vadose zone. Addition of amendments (e.g., toluene) for co-metabolic reactions may cause permitting problems.		High costs compared to other biological treatment technologies.	
		Phytoremediation	⌖	⌖	⌖	●	●	⌖	⌖
			Option is applicable to shallow to moderate depths and many contaminants in soil. Could produce vegetation containing radionuclides. Largely proven and reliable, but not for all applications.			Technology is technically and administratively feasible.		Capital and O&M costs are moderate compared to other biological treatment technologies.	
Ex Situ Treatment	Refer to Table C-10 for evaluation of *ex situ* treatment technologies.								
Disposal Actions	Refer to Table C-12 for evaluation of disposal actions.								

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-7. (continued)

Legend					
Effectiveness		**Implementability**		**Cost**	
●	Satisfies effectiveness criteria	●	Feasible to implement	●	Low cost compared to other options within the same technology type
⌖	Satisfies some, but not all, criteria	⌖	May be feasible to implement	⌖	Moderate cost compared to other options within the same technology type
○	Does not satisfy effectiveness criteria	○	Unfeasible to implement	○	High cost compared to other options within the same technology type

<u>Explanation of Evaluation Criteria</u>

- Effectiveness (primary focus) includes:
  - — Potential effectiveness in handling the areas/volumes of media or recovering contaminated media and meeting remediation goals,
  - — Potential impacts to human health and environment during construction and implementation phase, and
  - — How proven and reliable the process is with respect to site contaminants and conditions.

- Implementability includes:
  - — Technical feasibility (e.g., availability of TSD and adequate capacity, availability of equipment and workers) and
  - — Administrative feasibility (e.g., ability to obtain permits).

- Cost includes:
  - — Capital cost and
  - — O&M cost.

Table C4-8. Evaluation of Remedial Technologies and Process Options
For Upper Continental Recharge System Subsurface Saturated Soils (15 to 60 ft deep)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
No Action	None	Not Applicable	○	●	NA	●	●	●	●
			Evaluation of this alternative is required by the NCP. Option does not achieve RAOs. Option poses no short-term risks.			No action involved with this option; therefore, it is technically and administratively feasible to implement.		Option requires minimal (“baseline”) or no cost.	
Institutional Actions	Access Restrictions	Deed Restrictions	●	●	●	●	●	●	●
			Option applicable to all volumes and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access to groundwater.			Option is technically and administratively feasible to implement. Option may require approval by the public.		Option requires relatively little capital to implement and little or no O&M, compared to other access restriction technologies.	
		Site Protection/ Security	●	●	●	●	●	⌖	○
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access.			Option is technically and administratively feasible to implement. A full security program already is implemented at the PGDP.		Option requires moderate capital to implement because existing system in place, but significant O&M, compared to other access restriction measures.	
		Physical Barriers/ Restrictions	●	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts. Option is proven and reliable for restricting access.			Option is technically and administratively feasible to implement. Physical barriers is already implemented at the PGDP (i.e., a security fence surrounds the entire PGDP).		Option requires some expenditures capital to implement and moderate O&M, compared to other access restriction technologies.	
	Monitoring	Groundwater Monitoring	●	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts, depending upon the level of construction required. Option is proven and reliable for evaluating groundwater characteristics, contaminants, and trends.			Option is technically and administratively feasible to implement. Routine groundwater monitoring is conducted at the PGDP.		Option may require additional wells to implement and moderate O&M. Costs are dependent upon the number of samples and analyses conducted.	
Containment Actions	Bottom Barriers	Jet Grouting; Slanted Grout Columns; Cryogenics	●	●	○	⌖	●	○	⌖
			Option available for all volumes and media. Grout may be degraded in presence of high concentrations of VOCs. Few short term impacts or exposure risks. Options are not proven at PGDP.			Option is technically and administratively feasible to implement in most areas.		Options are high in capital costs. O&M costs are comparable to other containment options.	

Table C4-8. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Containment Actions (Continued)	Vertical Barriers	Slurry Walls	⌖	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	
		Grout Curtains	⌖	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	
		Sheet Piles/ Vibrating Beam	⌖	●	⌖	●	●	●	●
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces no short-term impacts. May be limited by site conditions.			Option is technically and administratively feasible to implement		Option requires relatively low capital and O&M compared to vertical barriers.	
		Cryogenic Walls	⌖	●	●	●	●	⌖	⌖
			Option applicable to all volumes, media and contaminants, but provides no contaminant reduction and is not effective in limiting vertical migration. Option produces few short-term impacts. Technology is proven and reliable in many settings.			Option is technically and administratively feasible to implement		Costs are moderate compared to other vertical barriers.	
Removal	Groundwater Collection	Wells and Subsurface Drains	⌖	●	⌖	●	●	⌖	⌖
			Available to all volumes and saturated media. However, only that portion of UCRS with appreciable permeability would cause minimal short-term impacts or worker exposure. Technology is proven and reliable, but extraction may not be effective in low permeability material of the UCRS.			Option is technically and administratively feasible to implement.		Option requires moderate to low capital to implement and moderate to low O&M compared to other removal technologies.	
		Vacuum Enhanced Recovery (2 Phase or Dual Phase)	●	●	●	●	●	⌖	⌖
			Available to all volumes and media only. Minimal short-term impacts or worker exposure. Technology is proven and reliable. Low permeability of UCRS may limit effectiveness but is more effective than simple extraction.			Option is technically and administratively feasible to implement.		Option requires moderate capital to implement and moderate O&M compared to other removal technologies.	

Table C4-8. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	**Short-term Impacts**	**Provenness & Reliability**	**Technical Feasibility**	**Administrative Feasibility**	**Capital Cost**	**O&M Cost**
Removal (Continued)	Excavation	Solids and Semisolids Excavation	⌖	⌖	●	⌖	●	●	●
			Option applicable to shallow (< 30 ft.) volumes, media, and contaminants only. Limited to only those areas with limited infrastructure. Relies on *ex situ* means of treatment or disposal. Option produces short-term impacts, of worker exposure and other construction-related impacts. Option is proven but difficult in saturated zone.			Option is readily implementable but not feasible beneath permanent buildings/structures. Option is administratively feasible.		Capital costs generally low depending on amount of worker protection required and method of disposal or treatment. Little O&M is required.	
		Solidify and Mine (Freeze and Mine)	⌖	⌖	○	⌖	⌖	⌖	●
			Option available for rather homogeneous, specialized wastes. Most applicable for explosive or reactive wastes. Minimal worker exposure and site impacts. Option is proven only for controlled environments. It is unproven for large-scale applications.			Technology is implementable. Handling highly toxic or dangerous material could result in permitting issues.		Capital costs are moderate to high, while O&M can be quite low compared to other *ex situ* separation technologies.	
In Situ Treatment	Physical/ Chemical Treatment	Solidification/ Stabilization	⌖	⌖	●	●	●	⌖	●
			Option uses several methods to that could be applied to all volumes, all media and all contaminants. NAPL could limit effectiveness. Carbonate-based gravel could mobilize certain radionuclides (e.g., uranium). Possible limitations in areas of buried materials. Produces some opportunity for worker exposure. Most methods are proven and reliable.			Technology is technically and administratively feasible.		Capital costs are variable with the technology employed but overall similar to other *in situ* technologies. Generally moderate to low O&M.	
		Electroosmosis (Lasagna™)	⌖	●	⌖	⌖	●	⌖	⌖
			Option available for all volumes and media. Applicable to VOCs and some SVOCs only. Produces some off-gas but relatively few short-term impacts. Method is proven and reliable for limited applications at PGDP.			Technology is not as effective below 30 ft, but is administratively feasible.		Capital and O&M costs are comparable to other *in situ* technologies.	
		Air Sparging and Vacuum Extraction	⌖	●	●	⌖	●	●	●
			Option available for all volumes and media. Applicable to VOCs only. Produces few short-term impacts. Method is proven and reliable.			Technology is technically and administratively feasible. Technology must be used in conjunction with hydraulic fracturing.		Capital and O&M costs are low to moderate compared to other *in situ* physico-chemical technologies.	
		In Situ Aeration in the Saturated Zone (Air Sparging and UVB Wells)	⌖	●	⌖	⌖	●	●	●
			Option is available to VOCs only, probably limited to gravel zones in UCRS. Few short- term impacts. Air sparging technology is widely proven and reliable, but UVB wells are not widely used. Not proven in low-permeability materials.			Technology is technically and administratively feasible.		Capital and O&M costs are low to moderate compared to other *in situ* physico-chemical technologies.	

Table C4-8. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
In Situ Treatment (Continued)	Physical	Permeable Treatment Zones (Horizontal or Vertical)	●	●	⊕	●	●	⊕	⊕
			Option available to all groundwater volumes and many contaminants. Few short-term impacts. Technology is proven and generally reliable, but some problems with long-term effectiveness.			Technology is technically and administratively feasible.		Capital and O&M costs are comparable to other *in situ* physio-chemical technologies.	
		Chemical Mixing (Deep Soil Mixing)	●	⊕	⊕	⊕	⊕	⊕	●
			Option available to all volumes, all media and most contaminants. Possible limitations in areas of buried materials. Produces little opportunity for worker exposure. Most methods are proven and reliable.			Must use care not to mix incompatible wastes or introduce reactive substances. Accessibility limited in some areas with in intricate intrastructive. Option is administratively feasible.		Capital costs are comparable to low compared to other *in situ* technologies. O&M costs are low.	
	Thermal Treatment	Vacuum/Steam Extraction	⊕	⊕	⊕	●	●	⊕	⊕
			Option available for all volumes and media. Potential for surface expulsion at these depths. Applicable to VOCs and some SVOCs only. Produces few short-term impacts. Method is proven and reliable.			Technology is technically and administratively feasible. Will require hydraulic fracturing to be implemented in low permeability zones.		Capital and O&M costs are comparable to other *in situ* technologies.	
		Vitrification	⊕	⊕	○	⊕	○	○	●
			Option available for all volumes, media and contaminants, but generally not feasible below ~25 ft. Releases hot gases and potential for contaminant release. Has not proven to be reliable in field demonstrations.			Technology is technically feasible but only at shallow portions of UCRS. Potential administrative difficulties based on perceived safety concerns.		High capital costs compared to other in situ technologies. O&M is moderate to high during operations. Long term O&M is very low.	
		EM/RF or Six-Phase Soil Heating	⊕	●	⊕	⊕	●	⊕	⊕
			Option available for VOCs and some SVOCs only. Few short-term impacts except for completion and operation of off-gas treatment system. Not a widely used technology. Not proven in this environment.			Technology is technically difficult in areas with substantial debris or structures. Administratively feasible.		Costs are comparable with other thermal technologies.	
	Biological Treatment	Monitored Natural Attenuation	⊕	●	●	⊕	●	●	●
			Option available to VOCs and many radionuclides. Produces few short-term impacts, proven and reliable for many constituents. May require long time frames.			Technology is technically and administratively feasible.		Capital and O&M costs are low compared to other biological treatment technologies.	
		Bioventing/ Barometric Venting	⊕	●	●	●	●	⊕	●
			Option available for all volumes and media. May require co-metabolic processes, (ex. addition of chemicals). Applicable to VOCs and some SVOCs. Produces few short-term impacts. Method is proven and reliable.			Technology is technically and administratively feasible.		Capital costs are low to moderate and O&M costs are comparable to other biological treatment technologies.	

Table C4-8. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	Short-term Impacts	Provenness & Reliability	Technical Feasibility	Administrative Feasibility	Capital Cost	O&M Cost
In Situ (Continued)	Biological Treatment (Continued)	Enhanced Bioremediation	⊕	●	●	●	●	⊕	⊕
			Option available for all volumes and media. Applicable to VOCs and some SVOCs. Produces few short-term impacts. Method is proven and reliable.			Technology is technically and administratively feasible.		Capital and O&M costs are comparable to other biological treatment technologies.	
		Phytoremediation	⊕	●	⊕	●	●	⊕	⊕
			Option is applicable to shallow to moderate depths and many contaminants in soil and shallow groundwater. Produces few short-term impacts and is largely proven and reliable, but not for all applications.			Technology is technically and administratively feasible.		Capital and O&M costs are moderate compared to other biological treatment technologies.	
Ex Situ Treatment	Refer to Table 3-J for evaluation of ex situ treatment technologies.								
Disposal Actions	Refer to Table 3-L for evaluation of disposal actions.								

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Effectiveness		Implementability		Cost	
●	Satisfies effectiveness criteria	●	Feasible to implement	●	Low cost compared to other options within the same technology type
⊕	Satisfies some, but not all, criteria	⊕	May be feasible to implement	⊕	Moderate cost compared to other options within the same technology type
○	Does not satisfy effectiveness criteria	○	Unfeasible to implement	○	High cost compared to other options within the same technology type

Explanation of Evaluation Criteria

- Effectiveness (primary focus) includes:
  - — Potential effectiveness in handling the areas/volumes of media or recovering contaminated media and meeting remediation goals,
  - — Potential impacts to human health and environment during construction and implementation phase, and
  - — How proven and reliable the process is with respect to site contaminants and conditions.
- Implementability includes:
  - — Technical feasibility (e.g., availability of TSD and adequate capacity, availability of equipment and workers) and
  - — Administrative feasibility (e.g., ability to obtain permits).
- Cost includes:
  - — Capital cost and
  - — O&M cost.

Table C4-9. Evaluation of Remedial Technologies and Process Options
For Regional Gravel Aquifer (60 to 100 feet deep) and McNairy (> 100 feet deep) Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	Short-term Impacts	Provenness & Reliability	Technical Feasibility	Administrative Feasibility	Capital Cost	O&M Cost
No Action	None	Not Applicable	○ Option does not achieve RAQ. Option poses no short-term risks.	●	NA	● No action involved with this option; therefore, it is technically and administratively feasible to implement.	●	● Option requires minimal (“baseline”) or no cost.	●
Institutional Actions	Access Restrictions	Deed Restrictions	● Option applicable to all volumes and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access.	●	●	● Option is technically and administratively feasible to implement. Option may require approval by the public.	●	● Option requires relatively little capital to implement and little or no O&M, compared to other access restriction technologies.	●
		Site Protection/Security	● Option applicable to all volumes and contaminants, but provides no contaminant reduction. Option produces no short-term impacts. Option is proven and reliable for restricting access.	●	●	● Option is technically and administratively feasible to implement. A full security program is already implemented at the PGDP.	●	⌖ Option requires relatively high capital to implement and significant O&M, compared to other access restriction technologies.	○
		Physical Barriers/Restrictions	● Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts. Option is proven and reliable for restricting access.	●	●	● Option is technically and administratively feasible to implement. Physical barriers are already implemented at the PGDP (i.e., a security fence surrounds the entire PGDP).	●	○ Option requires relatively high capital to implement and moderate O&M, compared to other access restriction technologies.	⌖
	Administrative Options	Alternate Concentration Limits (ACLs)	⌖ ● Option applicable to limited volumes of dissolved phase contamination. Option may produce limited short-term impacts. Provenness and reliability may be questionable for use in the RGA; prospects may be better in the McNairy.	⌖		● Option does not appear to be technically implementable throughout the RGA; may be technically implementable in the McNairy. Option should be administratively implementable.		⌖ Will require groundwater monitoring.	⌖
		Technical Impracticability (TI) Waivers	● Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option would not provide short-term impacts during “implementation.” Option is proven and reliable.	●	●	● Option likely to be used only as a contingency action.	⌖	⌖ Will require groundwater monitoring.	⌖

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Institutional Actions (Continued)	Monitoring	Water Monitoring	●	●	●	●	●	⊕	⊕
			Option applicable to all volumes, media, and contaminants, but provides no contaminant reduction. Option may produce minimal short-term impacts, depending upon the level of construction required. Option is proven and reliable for evaluating groundwater and/or surface water characteristics, contaminants, and trends.			Option is technically and administratively feasible to implement. Routine groundwater and surface water monitoring is conducted at the PGDP.		Option may require relatively moderate to high capital to implement and moderate to high O&M. Cost is dependent upon the number of samples and analyses conducted.	
Groundwater Containment Actions	Subsurface Vertical Barriers	Slurry/Grout Walls	●	⊕	⊕	●	●	○	●
			Option applicable to all volumes, media, and contaminants. Various installation methods exist; installation of a vertical barrier into the RGA/McNairy could produce significant short-term impacts, depending upon the installation method. Although this option is proven and reliable for reducing horizontal migration of groundwater and dissolved contaminants, this option is unproven at depths > 60 feet, and the continuity of a deep installation may be questionable.			Option is technically and administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Option is commercially available from several vendors that may be capable of installation to depths > 100 feet.		Capital costs may range from \$15 to \$300/ft^2 (*DOE, 1993a, ORNL Technology Logic Diagram, Vol 1, Pt B, ORNL Technology Logic Diagram, Vol 1, Pt B*). Costs are likely to be greater for depths > 60 feet. Option may generate wastes that require additional handling and disposal. Other than use of groundwater monitoring to evaluate effectiveness, this option requires minimal O&M.	
		Sheet Piling	⊕	⊕	○	○	⊕	○	●
			Option applicable to all volumes, media, and contaminants. Installation of a vertical barrier into the RGA/McNairy using pile driving or vibratory hammer methods will produce less waste than installation of slurry/grout walls. Although this option is proven and reliable for reducing horizontal migration of groundwater and dissolved contaminants, this option is unproven at depths > 60 feet, and the hydraulic integrity of joints in a deep installation may be of concern.			Option is administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Option is commercially available from several vendors that may be capable of installation to depths > 100 feet, however, installation of sheet piling into/through the RGA has proven nearly impossible.		Capital costs may range from \$30 to \$40/ft^2 (*DOE, 1993a, ORNL Technology Logic Diagram, Vol 1, Pt B, ORNL Technology Logic Diagram, Vol 1, Pt B*). Costs are likely greater for depths > 60 feet. Other than use of groundwater monitoring to evaluate effectiveness, this option requires minimal O&M.	

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Groundwater Containment Actions (Continued)	Subsurface Vertical Barriers (Continued)	Polyethylene Wall	⌖	⌖	●	⌖	●	○	●
			Option applicable to all volumes, media, and contaminants. Installation requires use of trenching/excavation techniques; installation of a vertical barrier into the RGA/McNairy could produce significant short-term impacts, depending upon the installation method. Although this option is proven and reliable for reducing horizontal migration of groundwater and dissolved contaminants, this option is unproven at depths > 40 feet. Continuity of poly walls may be better than other subsurface barriers.			Option is technically and administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Option is commercially available from vendors that may be capable of installation to depths > 100 feet. Option may require a bottom seal (e.g., bentonite) to minimize underflow.		Capital costs may range from \$12 to \$45/ft^2 *(Gundwall)*. Costs are likely to be greater for depths > 40 feet. Option may generate wastes that require additional handling and disposal. Other than use of groundwater monitoring to evaluate effectiveness, this option requires minimal O&M.	
		Cryogenic Barriers	⌖	⌖	●	●		○	○
			Option applicable to all volumes, media, and contaminants. Installation requires use of augering/excavation techniques and high electrical power usage; installation of a barrier into the RGA/McNairy could produce significant short-term impacts, depending upon the installation method. Although this option is proven and reliable for reducing horizontal migration of groundwater and dissolved contaminants, this option is unproven at depths > 40 feet.			Option is technically and administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Option is commercially available from vendors that may be capable of installation to depths > 100 feet. May be more effective as an interim action.		Capital costs may be higher than other containment walls. Costs are likely to be greater for depths > 40 feet. Active operation requires relatively high O&M costs which are greaer than all other alternatives.	

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Groundwater Containment Actions (Continued)	Subsurface Vertical Barriers (Continued)	Bio-barrier	⌖	●	○	○	⌖	○	○
			Option may be applicable to all volumes, media, and contaminants. Requires installation of injection system for implementation, which may generate wastes and could produce minimal short-term impacts. Although this option is effective for reducing horizontal migration of ground water and dissolved contaminants, this option is unproven at depths > 20 feet. Microbes susceptible to high concentrations of VOCs. Option may not be effective in the RGA.			Option has not been installed > 20 feet deep, and high VOC or metals may affect microorganisms adversely; therefore, option may not be technically feasible; therefore, option may not be technically feasible to implement. Option may be considered administratively feasible to implement. Option is commercially available from vendors that may be capable of installation to depths > 100 feet. Option may be better suited for formations with smaller pore sizes and lower flow velocities (e.g., UCRS). Option has not been utilized for environmental applications (i.e., oil field use only).		Capital costs may be higher than all except the cryogenic barrier due to preliminary – engineering requirements. Costs are likely to be greater for depths > 20 feet. Installation may generate wastes that require additional handling and disposal. Active operation requires relatively high O&M costs. Other than use of groundwater monitoring to evaluate effectiveness, this option requires minimal O&M.	
	Hydraulic Containment	Hydraulic Containment	●	⌖	●	●	●	⌖	○
			Option applicable to all volumes, media, and contaminants. With the exception of installing additional groundwater extraction wells or monitoring wells, no significant short-term impacts expected. Proven effective at controlling migration of groundwater and dissolved phase contaminants using pump and treat technology. Effectiveness in the McNairy Formation is less certain due to the low hydraulic conductivity of the formation. The overall effectiveness depends on the design and operation of the system (injection wells can be utilized to enhance effectiveness).			Option is technically and administratively feasible to implement (in the RGA using pump and treat technology). Option may be operated indefinitely or until contaminant sources are removed/depleted. Materials necessary for implementation are readily available.		Typically low to moderate capital cost and high O&M cost due to the long-term operations needed to maintain and verify containment.	

Table C4-9. (continued)

			Effectiveness			Implementability		Cost	
General Response Actions	**Remedial Technology Types**	**Process Options**	**Volumes, Media, & Rem. Goals**	**Short-term Impacts**	**Provenness & Reliability**	**Technical Feasibility**	**Administrative Feasibility**	**Capital Cost**	**O&M Cost**
Removal Actions (Groundwater and/or Contaminant)	Extraction	In-well Stripping [includes: UVB; No VOCs]	⊕	⊕	⊕	●	●	⊕	⊕
			Option applicable to all volumes and media. Option applicable to VOCs; option not effective for metals or radionuclides. With the exception of installing additional groundwater extraction wells or monitoring wells, no significant short-term impacts expected. Option has been used at several sites, but is less-proven than P&T.			Option is technically and administratively feasible to implement. (Installation near underground utilities should not require significant design modifications.) Option is commercially available from vendors. May be useful for source control, but not source (DNAPL) removal.		Capital costs may range from \$50K to 120K per well (*EG&G*). Operations may generate wastes during installation that require additional handling and disposal. Operations require moderate O&M (including electricity to power the pumps). O&M may be less than for pump-and-treat.	
		Electrokinetics (including Lasagna™)	⊕	○	○	○	●	○	⊕
			Option applicable to all volumes. Option effective for moving groundwater with dissolved contaminants in fine-grained soil such as the McNairy Formation; technology would be ineffective in the RGA. Option applicable to VOCs (including DNAPL), metals, and/or radionuclides. Some short-term impacts expected; degree of impact is dependent upon installation methods. The Lasagna™ electroosmosis technology has been demonstrated at the PGDP in the UCRS (i.e., < 50 feet deep).			Although implementability in shallow soils (< 50 ft deep) is proven, installation in the McNairy Formation may require fracturing technologies to emplace electrodes and in the situ treatment zones (for Lasagna™ Standard electroosmosis may be implementable by installing electrodes in well bores that allow contaminated groundwater to be pumped to the surface for treatment. Therefore, this option is believed to be technically feasible to implement. Option may be considered administratively feasible to implement. Standard electroosmosis is commercially available.		Option requires low to moderate capital and low O&M costs, but costs are dependent on the energy supply and duration of remediation time. Costs may range from \$20 to \$225/yd^3 (GWRTAC, Electrokinetics, TO-97-03, July 1997; also Draft *Rapid Commercialization Initiative Verification Statement for Lasagna™*, undated). Option may generate wastes during installation that require additional handling and disposal.	

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	Short-term Impacts	Provenness & Reliability	Technical Feasibility	Administrative Feasibility	Capital Cost	O&M Cost
Removal Actions (Groundwater and/or Contaminant) (Continued)	Extraction (Continued)	"Pump and Treat"	⌖	⌖	●	●	●	⌖	○
			Option applicable to all volumes and contaminants (including DNAPL). Minimal short-term impacts expected during implementation. Extensive time may be required to achieve remedial goals. Option proven and utilized at > 90% of Superfund sites with groundwater contamination, including two interim actions at the PGDP.			Option is technically and administratively feasible to implement. Option may be operated indefinitely or until contaminant sources are removed/depleted. Materials necessary for implementation are readily available. Two pump and treat projects are being conducted at the PGDP. Option useful for source control, but source (DNAPL) removal.		Capital costs may range from < $50 to $100 *(Evaluation of Technologies for In-situ cleanup of DNAPL Contaminated Sites, EPA/600/R-94/120, August 1994)*. Costs are likely to be greater for depths > 60 feet. Installation of this option may generate wastes that require additional handling and disposal. Current pump and treat O&M costs at the PGDP range from $5/1,000 gal water treated (Northeast Plume facility) to $16/1,000 gal water treated (Northwest Plume facility) *(B. Ford 4/19/99 telephone call to D. Jolly, BJC)*.	
		In Situ Steam Injection/Vacuum Extraction (including Dynamic Underground Stripping)	⌖	⌖	⌖	⌖	●	⌖	⌖
			Option applicable to all volumes, dissolved contaminants, and DNAPL. Option effective in permeable zones, and it may achieve remedial objectives in clay zones, also. Option may achieve remedial action objectives quicker than other options. Moderate short-term impacts related to use of steam are expected during implementation. Option demonstrated at three to four sites with favorable results on dissolved phase and NAPL contaminants.			Option is technically and administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Steam injection option is commercially available for several vendors; DUS option is available from two licensed vendors. Most appropriate for source zone reduction; may not be cost-effective for dissolved-phase plumes.		Option may require relatively high capital and O&M costs, but the high costs may be offset by a shorter remediation time frame. Costs may range from $46 to $166/yd^3 (EPA, 1997, *Analysis of Selected enhancements for SVE*). Option may generate wastes during installation that require additional handling and disposal.	

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Removal Actions (Groundwater and/or Contaminant) (Continued)	Extraction (Continued)	Six-Phase Soil Heating	⊕	⊕	○	○	●	⊕	⊕
			Option applicable to all volumes. Option is effective for extraction of VOCs from low-permeability zones, but ineffective for metals and radionuclides. Moderate short-term impacts may be expected during implementation due to safety concerns associated with use of high voltages. Option has been demonstrated in unsaturated and saturated soils. Option may be used in a flowing aquifer, but cost-effectiveness is reduced as the depth below the water table is increased.			Option may be technically and administratively feasible to implement; however, installation near underground utilities may require significant design consideration. Option is commercially available from one licensed vendor. Option has not been installed to depths > 40 ft.		Low to moderate capital and O&M costs, but may be offset by a shorter remediation time frame. Costs may range from \$40 to \$99 yd^3, including treatment of secondary wastes (*Initiatives Online*, Vol. 5, Spring 1998), but may increase with depth. Option likely is not cost effective in the RGA or McNairy, since it would involve high energy requirements to adequately heat the aquifer and contaminants.	
		Microwave	Option unproven, and effectiveness is unknown. Option is not available commercially.			Vendor, equipment, and experts are unavailable.		Cost information is unavailable.	
	Secondary/ Enhanced Recovery	Waterflooding or Injection	⊕	⊕	⊕	●	●	⊕	⊕
			Option applicable to all volumes and contaminants except DNAPL. Minimal short-term impacts expected during implementation, but extensive O&M period may be required. Option likely incapable of achieving remedial goals. Hydraulic conductivity of the RGA may be too great for this option to be effective. Option considered proven and reliable.			Option is technically and administratively feasible to implement. Materials necessary for implementation are readily available.		Capital costs may range from \$75 to \$125 (*Evaluation of Technologies for In-situ cleanup of DNAPL Contaminated Sites*, EPA/600/R-94/120, August 1994). This option may generate wastes that require additional handling and disposal.	

Table C4-9. (continued)

			Effectiveness			Implementability		Cost	
General Response Actions	**Remedial Technology Types**	**Process Options**	**Volumes, Media, & Rem. Goals**	**Short-term Impacts**	**Provenness & Reliability**	**Technical Feasibility**	**Administrative Feasibility**	**Capital Cost**	**O&M Cost**
Removal Actions (Groundwater and/or Contaminant) (Continued)	Secondary/ Enhanced Recovery (Continued)	Surfactant Flooding and Pumping	⊕ Option applicable to al columns. Pumping applicable for all contaminants, but surfactant flooding is specific to VOCs (including DNAPL). Minimal short-term impacts expected during implementation. Option not fully proven. Treatability testing may be required to ensure that the selected surfactant does not react adversely with the McNairy Formation.	⊕	⊕	⊕ Option is technically and administratively feasible to implement. Option is commercially available from a limited number of vendors. Option requires permits for inject for surfactants.	⊕	⊕ Capital costs may range from $75 to $125 (*Evaluation of Technologies for In-situ cleanup of DNAPL Contaminated Sites*, EPA/600/R-94/120, August 1994). This option may generate wastes that require additional handling and disposal.	○
		Polymer Waterflooding and Pumping	⊕ Option applicable to all volumes and media (including DNAPL). Minimal short-term impacts expected during implementation. Option not fully proven; it appears to have been demonstrated at only one environmental project.	⊕	○	○ Option not commercially available from vendors may be limited. Option is administratively feasible to implement. Option requires permits for injection of polymer(s).	⊕	⊕ Costs are unavailable. This option may generate wastes that require additional handling and disposal.	○
		Chemically Enhanced Dissolution and Pumping (Cosolvents)	⊕ Option applicable to all volumes. Pumping applicable for all contaminants, but cosolvents are effective only for VOCs (including DNAPL). Minimal short-term impacts expected during implementation. Option not fully proven. Treatability testing is suggested.	⊕	○	⊕ Option not commercially available; vendors may be limited. Option is administratively feasible to implement. Option requires permits for injection of cosolvents.	⊕	⊕ Capital costs may range from $75 to $125 (*Evaluation of Technologies for In-situ cleanup of DNAPL Contaminated Sites*, EPA/600/R-94/120, August 1994). This option may generate wastes that require additional handling and disposal.	○
In Situ Groundwater Treatment	Physical/ Chemical Treatment	Solidification/ Stabilization	⊕ Option uses several methods that could be applied to all contaminants. NAPL could limit effectiveness. Carbonate-based gravel could mobilize certain radionuclides (e.g., uranium). Possible limitations in areas of buried materials. Produces some opportunity for worker exposure. Most methods are proven and reliable. May not be effective in the RGA.	⊕	⊕	⊕ Technical feasibility in RGA is questionable. Option is administratively feasible.	●	⊕ Greater than $70/m^3 (DOE, 1993b, ORNAL Technology Logic Diagram, Vol 2, Pt b) to $150/yd^3 (DOE, 1993a, ORNL Technology Logic Diagram, Vol 1, Pt B, ORNL Technology Logic Diagram, Vol 1, Pt B).	●

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
In Situ Groundwater Treatment (Continued)	Physical/ Chemical Treatment (Continued)	Hydrous Pyrolysis/ Oxidation	●	⊕	⊕	⊕	●	●	●
			Requires installation of injection network and electrodes; potential for generation of contaminated wastes. Case study indicates very high effectiveness for removing residual contamination. Option used at only two sites.			Innovative technology which has only be assessed empirically. Has not been evaluated without implementing DUS at same site. Requires a relatively dense strata to ensure thermal acceleration of media and entrapment of condensate.		< $20 per cubic yard (Faster Cleanup of Contaminated Soil and Groundwater, *Science & Technology Review*, May 1998); potential for no O&M costs. Option patented by LLNL.	
		Permeable Treatment Walls	●	●	⊕	●	●	⊕	●
			Option available to all groundwater volumes and many contaminants. Few short-term impacts. Technology is proven and generally reliable, but some problems with long-term effectiveness may exist. Geochemical and biological concerns may limit effectiveness. TS is being conducted in FY 2000 at Southwest Plume site.			Technology is technically and administratively feasible.		Capital and O&M costs are comparable to other *in situ* physico-chemical technologies. Costs have wide range from < $2/SF to > $30/SF	
		In Situ Chemical Treatment (Oxidation)	⊕	⊕	⊕	⊕	⊕	⊕	⊕
			Effective for dissolved phase TCE. Not effective for DNAPL. Not effective for ^{99}Tc. Potential concern regarding possible reactions with organic carbon in the McNairy.			Requires injection of oxidant into aquifer(s).		Low Capital and intensive O&M.	
		Ozone Injection (C-Sparge)	⊕	●	●	●	●	●	●
			Effective for dissolved phase TCE. Not effective for DNAPL. Not effective for ^{99}Tc, vendor claims add-on option can treat ^{99}Tc.			Technically and administratively feasible.		Low capital and O & M	
		Sodium Dithionate Injection	⊕	○	○	⊕	○	⊕	○
			Effective for ^{99}Tc, but unproven. Not applicable for DNAPL. Reaction may be reversible.			Option believed to be technically feasible. Option requires permits for injection of reducing agent.		Option patented by PNNL. Commercial costs unavailable.	
	Biological Treatment	Monitored Natural Attenuation	⊕	●	⊕	⊕	⊕	⊕	●
			Ineffective for ^{99}Tc or DNAPLs. Not effective for removing VOCs from the RGA. Additional site characterization would be required to determine if it is able to address low concentrations of TCE in the McNairy .			Implementable. Requires additional groundwater monitoring data to define decay rates and to monitor effectiveness. MNA accepted by EPA, but never used in Kentucky.		Low capital and low to moderate O&M costs associated with long-term groundwater monitoring. Extensive monitoring and modeling required.	

Table C4-9. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
In Situ Groundwater Treatment (Continued)	Biological Treatment (Continued)	*In Situ* Biodegradation	● Both co-metabolic and anaerobic biodegradation are effective in removing TCE from the groundwater. UCRS without DNAPL is a prime target, but RGA or McNairy could be another target. Anaerobic bioremediation will require larger quantities of electron donor to render RGA anaerobic and provide environment for degradation of TCE. Technology will not remove metals and or radioactive contaminants.	●	⊕	● Technology is implementable with appropriate approvals and UIC permits or approvals.	●	● Costs are uncertain due to limited information on Anaerobic Bioremediation. Costs for similar operations at Dover AFB and INEEL TEN North Site are not yet published.	⊕
		Bio-sparging	⊕ Co-metabolic, see above for TCE.	●	⊕	⊕ See above	⊕	⊕ See above	⊕
Ex Situ Groundwater Treatment	Refer to Table 3-E for identification of *ex situ* groundwater treatment technologies								
Disposal Action	Refer to Table 3-L for evaluation of disposal actions.								

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Effectiveness		Implementability		Cost	
●	Satisfies effectiveness criteria	●	Feasible to implement	●	Low cost compared to other options within the same technology type
⊕	Satisfies some, but not all, criteria	⊕	May be feasible to implement	⊕	Moderate cost compared to other options within the same technology type
○	Does not satisfy effectiveness criteria	○	Unfeasible to implement	○	High cost compared to other options within the same technology type

Table C4-9. (continued)

Explanation of Evaluation Criteria

- Effectiveness (primary focus) includes:
  - — Potential effectiveness in handling the areas/volumes of media or recovering contaminated media and meeting remediation goals,
  - — Potential impacts to human health and environment during construction and implementation phase, and
  - — How proven and reliable the process is with respect to site contaminants and conditions.

- Implementability includes:
  - — Technical feasibility (e.g., availability of TSD and adequate capacity, availability of equipment and workers) and
  - — Administrative feasibility (e.g., ability to obtain permits).

- Cost includes:
  - — Capital cost and
  - — O&M cost.

Table C4-10. Evaluation of Remedial Technologies and Process Options for *Ex Situ* Treatment Technologies for Soils and Solids

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Ex Situ Treatment	Solids Handling	Magnetic Processes, Crushing and Grinding, Shredding and Chipping, and Screening	⌖	○	⌖	●	●	⌖	⌖
			Option available for soils and other solids in conjunction with excavation. Worker exposure could result during handling; erosion of material could occur. Waste segregation elsewhere has increased waste volumes. Option not proven for most waste areas.			Option is technically and administratively feasible. Would require a large, secure area as a staging and processing area.		Capital costs for equipment and labor; O&M on equipment and residual material are comparable or higher compared to other *ex situ* treatment technologies.	
	Solids Dewatering	Gravity Settling, Filter Press, Dewatering Beds, Belt Filters, Vacuum Filtration, Centrifuges	⌖	⌖	●	⌖	●	⌖	⌖
			Option available for soils and semisolids in conjunction with excavation to segregate saturated wastes. Worker exposure could result during handling. Option requires long time intervals in clayey soils.			Option is technically feasible. May be difficult for large waste volumes. Option is administratively feasible.		Moderate capital costs. O&M costs are comparable to other *ex situ* treatment technologies.	
	Physical Separation	Screening, Classification, Gravity Concentration, Magnetics	⌖	⌖	●	●	●	●	⌖
			Option available for saturated soils and solids and most contaminants. Also applicable for NAPL in groundwater. Worker exposure could occur for manual methods. Option is proven and effective for most material.			Option is technically and administratively feasible to implement.		Capital costs are low compared to other *ex situ* technologies. Labor intensive operation results in moderate O&M costs.	
	Physical/ Chemical Separation	Solidification/ Stabilization	⌖	●	●	●	●	⌖	⌖
			Option available for most volumes, media, and many contaminants; however there is no volume reduction. Option is largely proven but long-term effectiveness is uncertain.			Option is technically and administratively feasible for most applications.		Capital and O&M costs comparable to other *ex situ* separation technologies.	
		Chemical Extraction (Solvent Extraction)	⌖	⌖	●	⌖	⌖	⌖	⌖
			Option available for most small to medium volumes, some media, and certain contaminants. Could increase waste volumes. Possible worker exposure and site impacts. Option is proven and reliable for some wastes.			Technology unproven for many of these applications. Technology may be administratively difficult due to permitting.		Capital costs are moderate to high, while O&M also could be high compared to other *ex situ* separation technologies.	
		Electrokinetic Removal	⌖	⌖	○	⌖	●	⌖	●
			Option available for most small to medium volumes some media, and certain contaminants. Possible worker exposure and site impacts. Option is not proven or known to be reliable in this environment.			Technology unproven for many of these applications. Technology is administratively feasible.		Capital costs are moderate to high, while O&M can be quite low compared to other *ex situ* separation technologies.	

Table C4-10. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness			Implementability		Cost	
			Volumes, Media, & Rem. Goals	Short-term Impacts	Provenness & Reliability	Technical Feasibility	Administrative Feasibility	Capital Cost	O&M Cost
Ex Situ Treatment (Continued)	Physical/ Chemical Separation (Continued)	Soil Washing/Leaching	⌖	⌖	●	⌖	●	⌖	⌖
			Option available for small to medium volumes, and the most critical media (soil, sediment and some sludges). Could result in increased waste volumes. Could result in worker exposure. Operation is proven and reliable.			Technology is not proven for all materials, but is feasible. Option is administratively feasible but leachate may have permitting issues.		Capital costs and O&M are comparable to or lower than other *ex situ* separation technologies. O&M costs can be high due to long processing times.	
		Dechlorination: Glycolate/Base-catalyzed	⌖	⌖	⌖	⌖	⌖	⌖	⌖
			Option available for small to medium volumes, and most media. Applicable only to constituents that benefit from dehalogenation (i.e., solvent-related organics, PCBs, dioxin, etc.). Could result in worker exposure. Option is unproven for large volumes.			Technology is feasible for limited applications. Handling of highly toxic material could generate permitting issues.		Capital and O&M costs are comparable to other *ex situ* separation technologies.	
		Chemical Reduction-Oxidation	⌖	⌖	●	●	⌖	⌖	⌖
			Option available for small to medium volumes, most media. Typically used for organics. Could result in worker exposure.			Technology is technically feasible. Permitting may be problematic.		Capital and O&M costs are comparable to other *ex situ* separation technologies.	
	Biological Treatment	Biodegradation: Composting (Land-farming)	⌖	⌖	⌖	●	●	●	⌖
			Option available for small to medium volumes of some soils/sludges contaminated with organics. Option not proven or reliable for all wastes.			Technology is technically and administratively feasible.		Capital costs are relatively low compared to other biological treatment technologies. Moderate O&M costs due to long time frames.	
		Biodegradation: Slurry-Phase Treatment	⌖	⌖	⌖	●	●	⌖	⌖
			Option available for small to medium volumes of some soils/sludges contaminated with organics. Option not proven or reliable for all wastes.			Technology is technically and administratively feasible.		Capital and O&M costs are comparable with other *ex situ* biological technologies.	
	Thermal Treatment	Incineration	⌖	⌖	●	●	⌖	⌖	⌖
			Option available for most volumes of soils/sludges contaminated with organics, metals, and radionuclides. Could cause worker exposure. Option is proven and reliable.			Technology is technically and administratively feasible. Permitting may be difficult.		Capital costs are moderate compared to other *ex situ* thermal technologies. O&M high due to fuel costs and monitoring requirements.	
		Pyrolysis	⌖	⌖	●	●	⌖	⌖	⌖
			Option available for small to medium volumes of some soils/sludges contaminated with organics. Option is proven and reliable.			Technology is technically and administratively feasible. Permitting may be difficult.		Capital and O&M costs are comparable with other *ex situ* thermal technologies.	

Table C4-10. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Ex Situ Treatment (Continued)	Thermal Treatment (Continued)	Thermal Desorption	⌖	●	●	●	●	●	●
			Option available for most volumes of soils and sludges contaminated with organics and volatile metals. Option is proven and reliable.			Technology is technically and administratively feasible.		Capital and O&M costs are lower compared to other *ex situ* thermal technologies.	
		Vitrification (*ex situ*)	⌖	⌖	●	●	●	○	●
			Option available for smaller volumes, solid or semisolid media, and all contaminants. NAPL could limit effectiveness. Carbonate-based gravel could release certain radionuclides (e.g., uranium). Technology produces manageable short-term impacts and is proven and reliable.			Technology is technically and administratively feasible.		High capital and O&M costs compared to other *ex situ* thermal technologies. O&M includes power consumption and disposal/ storage of monoliths.	

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Effectiveness		Implementability		Cost	
●	Satisfies effectiveness criteria	●	Feasible to implement	●	Low cost compared to other options within the same technology type
⌖	Satisfies some, but not all, criteria	⌖	May be feasible to implement	⌖	Moderate cost compared to other options within the same technology type
○	Does not satisfy effectiveness criteria	○	Unfeasible to implement	○	High cost compared to other options within the same technology type

Explanation of Evaluation Criteria

- Effectiveness (primary focus) includes:
  — Potential effectiveness in handling the areas/volumes of media or recovering contaminated media and meeting remediation goals,
  — Potential impacts to human health and environment during construction and implementation phase, and
  — How proven and reliable the process is with respect to site contaminants and conditions.

- Implementability includes:
  — Technical feasibility (e.g., availability of TSD and adequate capacity, availability of equipment and workers) and
  — Administrative feasibility (e.g., ability to obtain permits).

- Cost includes:
  — Capital cost and
  — O&M cost.

Table C4-11. Evaluation of Presumptive Technologies for Treatment of Extracted Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness, Implementability, and Cost Screening Comments
Ex Situ Treatment Actions	Physical/Chemical/ Biological Treatment	Air Stripping	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Granular Activated Carbon	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Chemical/UV Oxidation	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Aerobic Biological Reactors	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Chemical Precipitation	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Ion Exchange/Adsorption	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Electrochemical Methods	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Aeration of Background Metals	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.
		Membrane Separation	This is a presumptive technology for treatment of extracted groundwater. The *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance*, EPA 540/R-96/023, October 1996, constitutes this phase of the screening for this process option.

Table C4-11. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness, Implementability, and Cost Screening Comments
Pretreatment Actions	Solids Dewatering	Gravity Settling, Filter Press, Dewatering Beds, Belt Filters, Vacuum Filtration, Centrifuges, *In Situ* Dewatering	These pre-treatments are retained as-needed to support other ex situ treatment process options.
	Physical Separation	Screening, Classification, Gravity Concentration, Coagulation/Flocculation, Magnetic separation	These pre-treatments are retained as-needed to support other ex situ treatment process options.
	Physical/Chemical Treatment	Neutralization	This pre-treatment is retained as-needed to support other ex situ treatment process options.
		Solidification/Stabilization	This pre-treatment is retained as-needed to support other ex situ treatment process options.

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Table C4-12. Evaluation of Remedial Technologies and Process Options for Disposal Actions

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Admini-strative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Disposal Actions	On-Site Disposal	Permitted Facility	⌖	●	●	●	●	●	●
			The only on-site permitted disposal facility at PGDP is the C-746-U Landfill. Only non-RCRA hazardous and low-level waste containing less that 30 pCi/g uranium are allowed to be disposed. May not be applicable for media with ≥ 30 pCi/g radionuclides.			Disposal at this facility is technically and administratively feasible. But applicable only to a narrow range on contaminant concentrations.		Low cost compared to other disposal actions.	
		Constructed Disposal Cell	⌖	●	●	○	⌖	○	○
			Effective for all volumes, media, and contaminants (depending on construction). Construction should have few short-term impacts if located outside main plant area. Constructed cells are proven and reliable.			Facility does not exist. Could be implementable but will require extensive permitting. Public opposition may delay or halt construction of facility. May not be cost effective.		High cost compared to other disposal actions.	
	Off-Site Disposal	RCRA Facility	⌖	⌖	●	●	●	○	NA
			Effective for disposal of RCRA Hazardous Waste. Not suitable for most radionuclides or TSCA wastes. May cause worker or public exposure from transport. RCRA landfills are proven and reliable.			Technologically and administratively feasible. Transport requires additional permitting.		High cost compared to other disposal actions.	
		TSCA Facility	⌖	⌖	●	●	⌖	○	NA
			Applies only to TSCA wastes. Threat of worker or public exposure during loading and transport. Technology is proven and reliable.			Technologically and administratively feasible. Transport requires additional permitting.		High cost compared to other disposal actions.	
		(Low-Level) Radioactive Waste Facility	⌖	⌖	●	●	⌖	⌖	NA
			Effective disposal for low-level wastes comprising most media. Worker and public exposure is possible during transport. Technology is proven and reliable.			Substantial waste volumes could be disposed of in such a facility. Transport requires additional permitting.		Moderately high cost compared to other disposal actions.	
		Mixed-Waste Facility	●	⌖	●	●	●	○	NA
			Effective for disposal of waste containing TCE, PCBs, and low-level constituents. This includes solids, stabilized sludges, soils, building rubble, concrete, ash, and asbestos. Potential worker/public exposure during transport. Proven and reliable option.			Substantial waste volumes could be disposed of in such a facility. Transport requires permits from all affected states.		Very high cost compared to other disposal actions.	

Table C4-12. (continued)

General Response Actions	Remedial Technology Types	Process Options	Effectiveness: Volumes, Media, & Rem. Goals	Effectiveness: Short-term Impacts	Effectiveness: Provenness & Reliability	Implementability: Technical Feasibility	Implementability: Administrative Feasibility	Cost: Capital Cost	Cost: O&M Cost
Disposal Actions (Continued)	Interim Storage	On-Site Storage	⌖	⌖	●	⌖	●	⌖	⌖
			Does not provide final disposition of wastes. Large volumes could produce perception problems. Potential for worker exposure during implementation. Option is proven and reliable.			Interim storage facility currently unavailable. May require additional permitting.		Capital costs are comparable to other options. O&M includes inspection/ monitoring requirements.	

Notes:
Shaded process options have been screened out.
Identification of copyrighted, patented, or trademarked names does not signify endorsement.

Effectiveness		Implementability		Cost	
●	Satisfies effectiveness criteria	●	Feasible to implement	●	Low cost compared to other options within the same technology type
⌖	Satisfies some, but not all, criteria	⌖	May be feasible to implement	⌖	Moderate cost compared to other options within the same technology type
○	Does not satisfy effectiveness criteria	○	Unfeasible to implement	○	High cost compared to other options within the same technology type

Explanation of Evaluation Criteria

- Effectiveness (primary focus) includes:
  — Potential effectiveness in handling the areas/volumes of media or recovering contaminated media and meeting remediation goals,
  — Potential impacts to human health and environment during construction and implementation phase, and
  — How proven and reliable the process is with respect to site contaminants and conditions.

- Implementability includes:
  — Technical feasibility (e.g., availability of TSD and adequate capacity, availability of equipment and workers) and
  — Administrative feasibility (e.g., ability to obtain permits).

- Cost includes:
  — Capital cost and
  — O&M cost.

APPENDIX C5

ERRATTA SHEET

1) On page 8, paragraph 2, change

> "As an approximation, it is assumed that the mass of TCE is 190 l (50 gal)."
>
> to
>
> "As an approximation, it is assumed that the volume of TCE is 190 l (50 gal)."

2) On page 42, paragraph 1, change

> "The upgradient 100 mg/L (ppm) TCE isoconcentration contour appears to map the DNAPL source zones of the RGA. Moreover, the US Environmental Protection Agency recommends the use of 1% of the solubility of DNAPL (1% of the solubility of TCE is 110 mg/L) as an indication of DNAPL presence (EPA, 1992)."
>
> to
>
> "The upgradient 100 mg/L (ppm) TCE isoconcentration contour appears to map the DNAPL source zones of the RGA. Moreover, the US Environmental Protection Agency recommends the use of 1% of the solubility of DNAPL (1% of the solubility of TCE is 11 mg/L) as an indication of DNAPL presence (EPA, 1992)."

JACOBS ENGINEERING

Engineers and Constructors

Jacobs Engineering Group Inc.

MEMORANDUM

DATE: November 18, 1999 JE/PAD/99-0019

TO: Bryan Clayton, Bechtel Jacobs Company LLC

FROM: Bruce M. Ford Bruce Ford

SUBJECT: Task 116 — Waste Area Group 27 Trichloroethene Source Estimates

Attached is the final version of the *Waste Area Group 27 Trichloroethene Source Estimates*. These estimates were developed in support of the Groundwater Operable Unit (GWOU) Feasibility Study (FS) and incorporate comments from the GWOU FS team.

If you have any questions please contact me at (270) 462-2550.

Attachment

cc: Bruce Phillips, SAIC
Sarah Maudlin, SAIC
Document Control

SM:ams/g:prod:lts/T116/00001 9

THIS PAGE INTENTIONALLY LEFT BLANK

Waste Area Group 27 Trichloroethene Source Estimates

The Paducah Gaseous Diffusion Plant (PGDP) performed a remedial investigation (RI) of Waste Area Group (WAG) 27 during 1998. Waste Area Group 27 consists of the following: the C-720 Complex, the C-747-C Former Oil Landfarm, the UF_6 Cylinder Drop Test Area, and the C-746-A Septic Systems. Previous investigations at the UF_6 Cylinder Drop Test Area documented the presence of a shallow dense nonaqueous phase liquid (DNAPL) zone of trichloroethene (TCE). High dissolved TCE levels in water collected during other investigations and environmental surveillance programs in the areas of the C-720 Building and the C-747-C Former Oil Landfarm were suggestive of DNAPL presence. The WAG 27 RI was able to identify general source zone areas. This paper reviews both the WAG 27 RI data and previous data to support the development of conceptual source zone models and then applies those models to the specific settings of WAG 27 to identify the probable location and extent of the DNAPL source zones.

Conceptual Models: C-720 Building Area

Dissolved TCE levels in the Regional Gravel Aquifer (RGA) groundwater of the C-720 Area are indicative of an area DNAPL source zone(s). The highest dissolved TCE levels in the upper RGA have been observed in water samples form two boreholes located near the northeast corner of the C-720 complex: Boring 720-018 and Boring P4-H7 (see attached Figure 4.21 from the WAG 27 RI Report for a map of area boreholes). Elevated dissolved TCE levels are restricted to the upper RGA at Boring P4-H7 but extend throughout most of the thickness of the RGA at Boring 720-018 (Figure 1). Trichloroethene levels in water samples of Boring 720-018 from the underlying McNairy Formation were below detection limits.

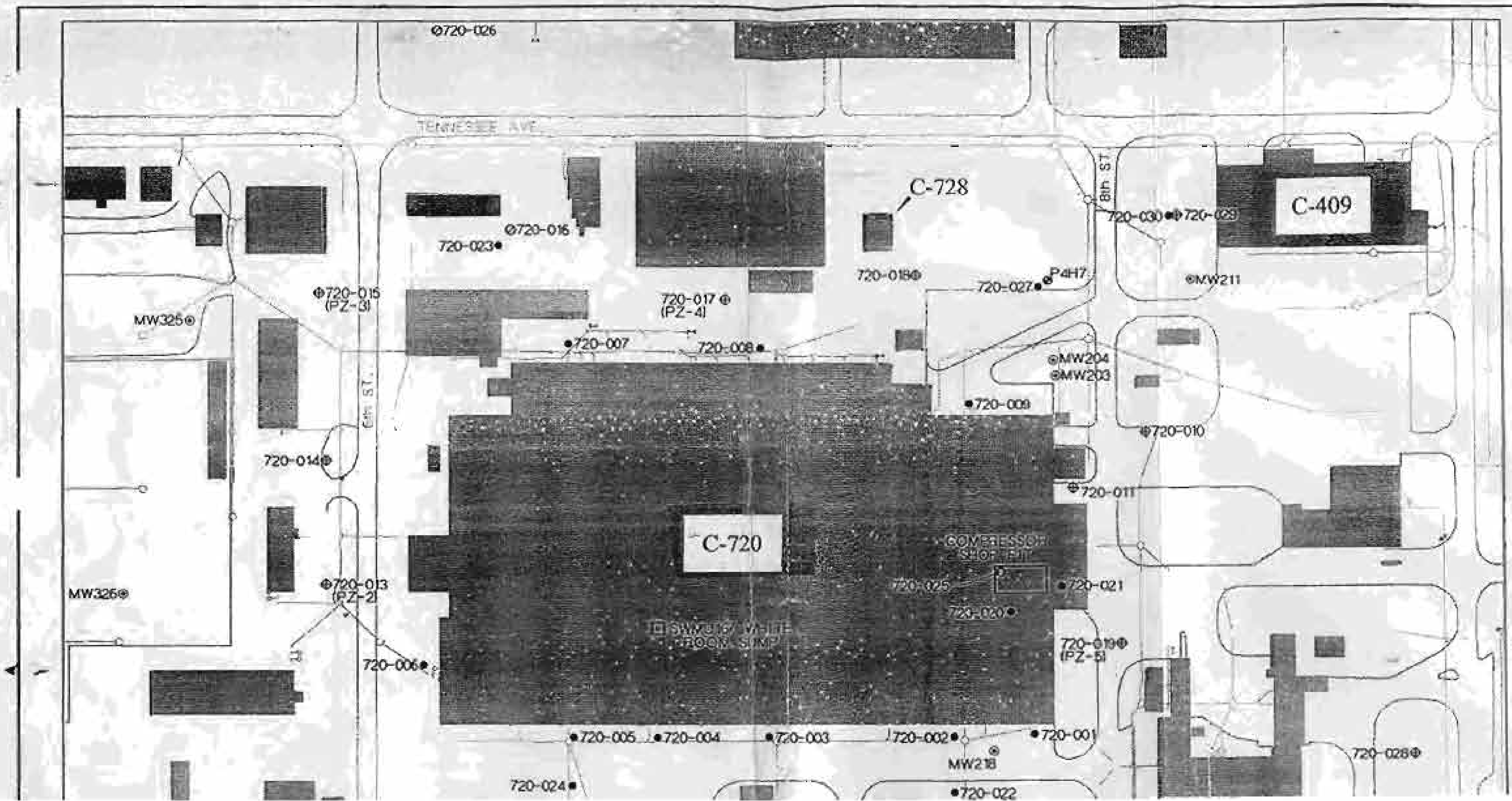
Despite the proximity of the two boreholes [separation of approximately 47 m (155 ft)], the three-dimensional distribution of dissolved TCE in the RGA suggests two distinct source zones in the overlying Upper Continental Recharge System (UCRS) are responsible for the observed contaminant plume. In addition, the potentiometric surface of the RGA, as mapped in the WAG 27 RI, suggests the borings are located cross-gradient to each other. Thus, dissolved contamination present at Boring P4-H7 should pass north of Boring 720-018.

Boring P4-H7: P4-H7 was installed in September 1994 as part of the Northeast Plume Preliminary Characterization (Phase IV) Investigation. Water samples were recovered from the upper, middle, and lower RGA [elevations 94.5, 89.9, and 86.9 m (310, 295, and 285 ft) amsl]. Table 1 presents the results of the TCE analyses.

Table 1. Trichloroethene Analyses (µg/l) for Boring P4-H7

Location	Fixed Base Laboratory	Field Laboratory
Upper RGA	12,000	6,329
Middle RGA	87	99
Basal RGA	35	36

The areal extent of elevated dissolved TCE in the upper RGA is very limited. Other than in Boring 720-018, no other locations are known in the C-720 area where TCE levels of 1,000 µg/l or greater are encountered in the upper RGA. The limited lateral and vertical



720-026
TENNESSEE AVE.
C-728
C-409
8th ST.
720-030
720-029
720-016
720-023
720-018
P4H7
720-027
MW211
720-015
(PZ-3)
MW325
720-017
(PZ-4)
720-007
720-008
MW204
MW203
720-009
6th ST.
720-010
720-014
720-011
C-720
COMPRESSOR SHOP PIT
720-025
720-021
720-020
720-013
(PZ-2)
MW326
SWU 7 WHITE ROOM SUMP
720-019
(PZ-5)
720-006
720-005
720-004
720-003
720-002
720-001
MW218
720-028
720-024
720-022

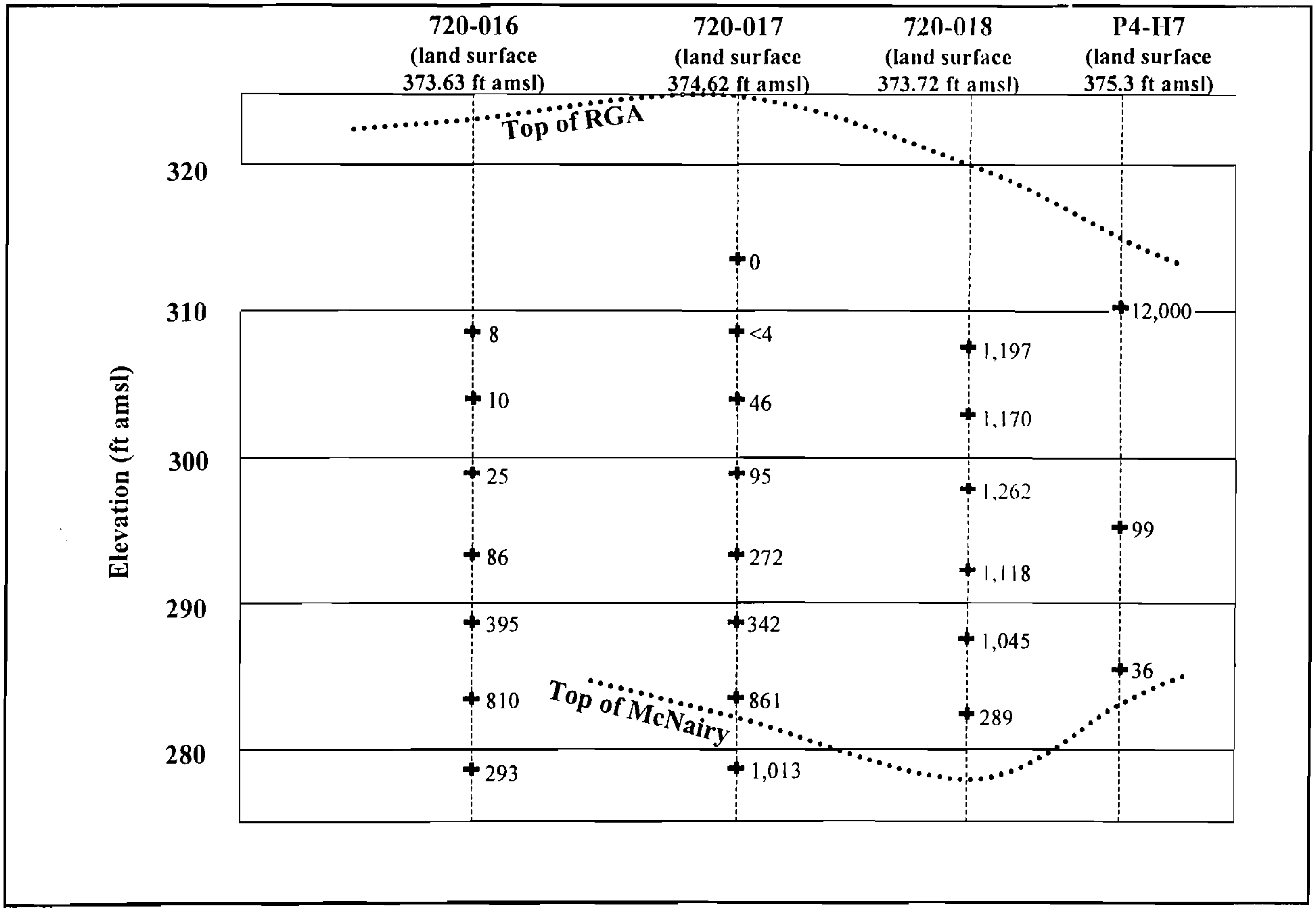


Figure 1. Trichloroethene Levels (μg/l) in the Regional Gravel Aquifer on the North Side of the C-720 Building

extent of elevated dissolved TCE levels indicates the DNAPL source zone is relatively small and restricted to the UCRS. (Similar trends associated with UCRS source zones occur at the C-400 Building.) Three process areas in the vicinity of Boring P4-H7 must be considered initially as the potential original source of the TCE DNAPL: C-409, C-720, and C-728.

The C-409 Stabilization Building is located approximately 68.6 m (225 ft) northeast of Boring P4-H7. C-409 Building activities included testing of waste handling processes. A TCE recovery system was housed in the building (but experienced little use). The building is designed to retain any spills from process leaks.

The WAG 27 RI Borings 720-029 and 720-030 are located immediately west of the C-409 Building. Soil and water samples from the borings indicate that only low concentrations of TCE exist in the subsurface of the C-409 area. Trichloroethene levels in all UCRS soil samples are less than the WAG 27 RI laboratory detection limits and the maximum dissolved TCE level in RGA water samples is 33 µg/l. Moreover, the RGA potentiometric surface in the C-720 Building area, as measured during the WAG 27 RI, shows the C-409 Building is cross-gradient to Boring P4-H7. Thus, the C-409 Building does not appear to be the source of TCE observed in Boring P4-H7.

The C-728 Motor Cleaning Facility is approximately 53.3 m (175 ft) northwest of Boring P4-H7. No use of TCE is reported in descriptions of C-728 facility processes. Mineral spirits were used as the cleaning agent; thus, it is unlikely that the C-728 Building is the source of TCE to an area DNAPL zone.

Boring P4-H7 is adjacent to an outside concrete pad that is contiguous with the C-720 Building. Anecdotal evidence suggests that machinery/equipment being brought into the C-720 Building for repair occasionally was cleaned (degreased) on the concrete pad prior to entry into C-720. Runoff of TCE, used as the degreasing agent, is a likely source of DNAPL in the vicinity of Boring P4-H7.

As part of the WAG 27 RI, Boring 720-027 sampled UCRS soils to a depth of 14.6 m (48 ft) [elevation 99.4 m (326 ft) amsl] adjacent to Boring P4-H7 [0.84 m (2.8 ft) to the west]. Sample analyses reveal elevated TCE levels beginning at a depth of 6.1 m (20 ft) that range up to 8,100 µg/kg. Well MW204 is screened in the UCRS and located approximately 30.5 m (100 ft) to the south. Analyses of dissolved TCE levels in MW204 range up to 320 µg/l. These data suggest that Boring P4-H7 is near the DNAPL source zone but not located within it. Soil concentrations within the heart of the DNAPL zone can be expected to be approximately 65,000,000 µg/kg (assuming 30% DNAPL saturation), declining to 10,000 µg/kg and less within a distance of 3 to 6.1 m (10 to 20 ft) (refer to Attachments 1 and 2). The dissolved TCE levels observed in MW204 are much less than expected of a UCRS DNAPL source zone. Characterization sampling of the Cylinder Drop Test DNAPL zone, for comparison, commonly revealed TCE concentrations of 300,000 µg/l in UCRS water samples.

For the purposes of estimating a source volume, the conceptual model of the DNAPL source is a small volume of TCE runoff from an undocumented degreasing operation on the C-720 concrete pad. In the conceptual model, the TCE runoff infiltrated over a small area at the edge of the concrete pad to the base of the HU2 horizon sands in the UCRS, where the interface with the underlying HU3 clay horizon would halt further migration.

Boring 720-018: 720-018 is located at the northwest corner of the same concrete pad. Table 2 presents the results of TCE analyses of water samples from the boring. The consistent dissolved TCE level throughout most of the RGA is difficult to interpret.

Contaminant trends in Boring P4-H7 and at the southwest and northeast corners of Building C-400 show that a UCRS DNAPL typically will result in elevated dissolved TCE levels only in the uppermost RGA. However, a DNAPL source distributed throughout most of the thickness of the RGA would be expected to result in much higher levels of dissolved TCE. The sample density in the C-720 area, and downgradient to the northwest, appears to be sufficient to rule out the occurrence of an undetected core of much higher dissolved TCE levels.

Table 2. Trichloroethene Analyses for Boring 720-018

Location	Elevation (m amsl)	Elevation (ft amsl)	TCE (μg/l)
Upper RGA	93.9	308	1197
Upper RGA	92.4	303	1170
Middle RGA	90.8	298	1262
Middle RGA	89.3	293	1118
Lower RGA	87.8	288	1045
Lower RGA	86.3	283	289

This apparent contradiction of source effects can be resolved in the context of the hydrology of the C-720 area. The subcrop of the Porters Creek Clay, which defines the southern extent of the RGA, occurs nearby and south of the C-720 Building. Most of the area south of the C-720 Building that overlies the RGA is paved. Thus, little area recharge to the RGA is realized south of the C-720 Building (upgradient of Boring 720-018) and little lateral throughflow is developed. In consequence, sources of recharge south of the C-720 Building "fan" across the thickness of the RGA.

The conceptual model to account for the dissolved TCE levels in Boring 720-018 is a DNAPL zone located in the UCRS and upgradient (via flow in the RGA) of the boring. This potential DNAPL source is restricted to the east side of the C-720 Building and most likely occurs south of the building.

The WAG 27 RI report identified a storm sewer exiting near the southeast corner of the C-720 building as a likely DNAPL source, based on TCE-in-soil levels observed in Boring 720-002. For the dissolved TCE contamination found in Boring 720-018, the conceptual model of the DNAPL source is a leak in the storm sewer system servicing the C-720 Compressor Shop Pit area, at the point where the storm sewer passes from beneath the building (adjacent to Boring 720-002). Because dissolved TCE concentrations in the RGA at Boring 720-018 do not approach levels that would be expected to be derived from an RGA source zone, it is assumed that the DNAPL migrated downward no further than the base of the HU2 sand horizon in the UCRS.

DNAPL Source Zone Volumes: C-720 Area

Boring P4-H7 Area: WAG 27 Boring 720-027, located adjacent to Boring P4-H7, sampled TCE levels in soils through the UCRS. Trichloroethene levels were highest in HU2 sandy silt and silty sandy gravel layers to a depth of 10.7 m (35 ft), elevation 103.6 m (340 ft) amsl. Table 3 summarizes the lithologic log and TCE analyses from Boring 720-027.

Two lines of evidence suggest the DNAPL mass is relatively small. The lack of significant TCE-in-soil levels at the Boring 720-027 location, adjacent to Boring P4-H7 (the presumed source area), demonstrates little lateral extent of the DNAPL zone. TCE-in-soil levels and the limited extent of the dissolved-phase plume indicate the DNAPL source is restricted to the UCRS. Apparently inadequate DNAPL mass was available to penetrate beyond a depth of 10.7 m (35 ft). The available data is insufficient to derive a mass or volume of the DNAPL source zone.

Table 3. Lithology and Trichloroethene Levels in Boring 720-027

DEPTH		ELEVATION		LITHOLOGY SUMMARY	TCE LEVELS (μg/kg)
(m)	(ft)	(m)	(ft)		
1.5-5.5	5-18	108.5-112.5	356-369	Silty clay	<900; <900; <900
6.1-7.0	20-23	107.0-107.9	351-354	Gravely clay	5,000
7.0-7.9	23-26	106.1-107.0	348-351	Sandy gravel	500
7.9-8.5	26-28	105.5-106.1	346-348	Gravely sand	not sampled
8.5-9.4	28-31	104.5-105.5	343-346	Clay	not sampled
9.4-10.1	31-33	103.9-104.5	341-343	Silty, clayey sand	8,100
10.1-10.7	33-35	103.3-103.9	339-341	Gravely sand	not sampled
10.7-14.6	35-48	99.4-103.3	326-339	Clay	1,800; 300; <900

As an approximation, it is assumed that the mass of TCE is 190 l (50 gal). The average TCE saturation for the UCRS DNAPL source zones at WAG 6 (including both the high-saturation core and the surrounding soils with greater than 0.1% TCE saturation) was found to be 5.7%. Using a DNAPL saturation of 5.7%, the DNAPL zone would encompass 9.2 m^3 (326 ft^3) (assuming a soil porosity of 36%). If distributed evenly over the 10.7 m (35 ft) depth, the plan view area of the DNAPL zone would be 0.8 m^2 (9 ft^2).

<u>Southeast C-720 Storm Sewer</u>: WAG 27 Borings 720-022 and 720-002 define the lithology and TCE levels in the area of the Southeast C-720 storm sewer. Table 4 summarizes the data for this area:

Table 4. Lithology and Trichloroethene Levels Near the Southeast C-720 Storm Sewer

DEPTH		ELEVATION		LITHOLOGY SUMMARY (720-022)	TCE LEVELS (720-002) (μg/kg)
(m)	(ft)	(m)	(ft)		
1.5-3.7	5-12	109.7-111.9	360-367	Silty clay	37; 17,000
3.7-5.5	12-18	107.9-109.7	354-360	Gravely clay	19,000
6.1-10.1	20-33	103.3-107.3	339-352	Gravely sand	32,000; 68,000
10.1-15.2	33-50	98.1-103.3	322-339	Silty clay	not sampled

The following assumptions are used to estimate the volume of the DNAPL source zone.

(1) The TCE leak occurred at the point where the storm sewer passes from beneath the building [4.0 m (13 ft) from Boring 720-002].

(2) The source begins at a depth of 2.6 m (8.5 ft) (depth of the area storm sewers).

(3) The depth to water table is 5.8 m (19 ft) (based on a conceptual water table map for the PGDP).

(4) The base of the DNAPL zone coincides with the base of the HU2 sand horizon.

For the purpose of estimating the volume of the vadose DNAPL zone, the DNAPL zone is assumed to approximate a cylinder with height of 3.2 m (10.5 ft) [depth to water table/5.8 m (19 ft), less depth to source zone/2.6 m (8.5 ft)] and radius of 4.0 m (13 ft) (distance from Boring 720-002 to assumed leak source). This cylinder (the vadose DNAPL zone) has a volume of 157.9 m^3 (5,575 ft^3).

The DNAPL zone below the water table will again be assumed to approximate a cylinder. The height of the cylinder is 4.3 m (14 ft) [depth to base of the HU2 sand horizon/10.1 m (33 ft), less depth to the water table/5.8 m (19 ft)] and the radius remains 4.0 m (13 ft). Thus, the saturated DNAPL zone has a volume of 210.5 m^3 (7,433 ft^3).

The following assumptions are used to determine the mass of TCE and the average DNAPL saturation of the DNAPL zone.

(1) The average DNAPL saturations of the vadose and saturated zones are different.

(2) The vadose zone has an average water saturation of 50%.

(3) TCE levels of 18,000 µg/kg characterize the vadose DNAPL zone and 68,000 µg/kg characterize the saturated DNAPL zone at Boring 720-002.

(4) The DNAPL saturation of the center of the DNAPL zone (where vertical migration occurred) is 30%

(5) The zone of vertical migration has minimal width.

Attachment 1 presents the calculation of the TCE-in-soil level for water saturations of 10%, 30%, 50%, and 70% and a DNAPL saturation of 30%. The TCE concentration for a 50% water saturated soil is 66,992,964 µg/kg. A soil with DNAPL saturation of 30% occurring below the water table (water saturation of 70%) has a TCE-in-soil level of 61,746,186 µg/kg. By assuming that the decline in DNAPL saturation (and TCE concentration) with distance from the zone of vertical migration is similar to dispersion, the DNAPL saturation (TCE concentration) at a given location can be determined through application of a fixed multiplier per unit distance. Attachment 2 documents the multiplier (derived through iteration) required to match TCE concentrations in the core of the DNAPL zone and at Boring 720-002 for both above and below the water table. The total distance used in these calculations is the radius of the DNAPL zone [4.0 m (13 ft)]. The average TCE concentration of the DNAPL zone is derived by averaging the TCE concentrations over all of the unit distances [0.3 m (1 ft) increments] and an average DNAPL saturation is determined, based on the TCE level. Table 5 presents the average derived DNAPL saturation and, assuming a UCRS soil porosity of 36%, the volume of DNAPL present above and below the water table.

Table 5. Dense Nonaqueous Phase Liquid Volume in the Southeast C-720 Storm Sewer Source

	ELEVATION		DNAPL SATURATION	DNAPL VOLUME			
	(m)	(ft)	(%)	(m^3)	(ft^3)	(l)	(gal)
Vadose Zone	107.6-110.8	353-363.5	3.7	2.1	74	2,103	556
Saturated Zone	103.3-107.6	339-353	4.2	3.2	112	3,183	841

<u>Other DNAPL Zones</u>: WAG 27 soil borings at other locations proximal to the storm sewer system around the C-720 Building sampled soils with TCE-in-soil levels less than 20,000 µg/kg. The above DNAPL source zones and their dissolved-phase plume do not account for additional occurrences of dissolved TCE in the upper RGA (up to 10 µg/l). TCE has not been used in a plant process at the PGDP for over five years. Thus, these occurrences likely attest to other DNAPL occurrences. It is anticipated that the storm sewer network around the C-720 Building, in general, is a DNAPL source zone with very low DNAPL saturation.

Conceptual Model: C-747-C Former Oil Landfarm

The WAG 27 investigation of the C-747-C Former Oil Landfarm included seven soil borings yielding soil samples with 10,000 µg/kg TCE or greater (see attached Figure 4.4 from the WAG 27 RI Report for a map of area boreholes). These soil borings define a "hotspot" area with greater than 10,000 µg/kg TCE of up to 471.5 m^2 (5,075 ft^2). By assuming these TCE occurrences result from DNAPL presence, a DNAPL (liquid) volume of 56.4 m^3 (1,991 ft^3 or 56,379 1/14,895 gal) can be derived using the same procedures as above. However, there is no evidence, otherwise, of mass disposal of TCE at C-747-C. More likely, the TCE release was the disposal of a single drum of spent solvent.

As a conceptual model, the TCE release has been assumed to occur into a single plow "lane" of the former landfarm. Highest TCE-in-soil concentrations were routinely found in Boring 001-065. Thus, the route of vertical DNAPL migration appears to have occurred near Boring 001-065.

DNAPL Source Zone Volume Assessment: C-747-C Former Oil Landfarm

The Cylinder Drop Test Area, a nearby TCE spill site with adequate characterization, provides a useful comparison for the Former Oil Landfarm. At the Cylinder Drop Test Area, dissolved-phase TCE concentrations are 300,000 µg/l or greater in the DNAPL source zone. For water saturated soil with 36% porosity and 300,000 µg/l TCE in the water, the TCE-in-soil concentration would be 52,000 µg/kg (assuming no sorbed TCE is present).

With one exception, [a soil sample from Boring 001-065, at 4.7 m (15.5 ft) depth, with 400,000 µg/kg TCE] the highest TCE-in-soil levels in the "hot spot" ranged between 10,000 and 87,000 µg/kg. These levels are easily accounted for by dissolved phase contamination derived from a small DNAPL source zone. For the lone sample outlier with 400,000 µg/kg, the DNAPL saturation may have been as much as 0.13%, assuming a dry soil. The TCE mass represented in the WAG 27 samples from the Former Oil Landfarm is diminishingly small.

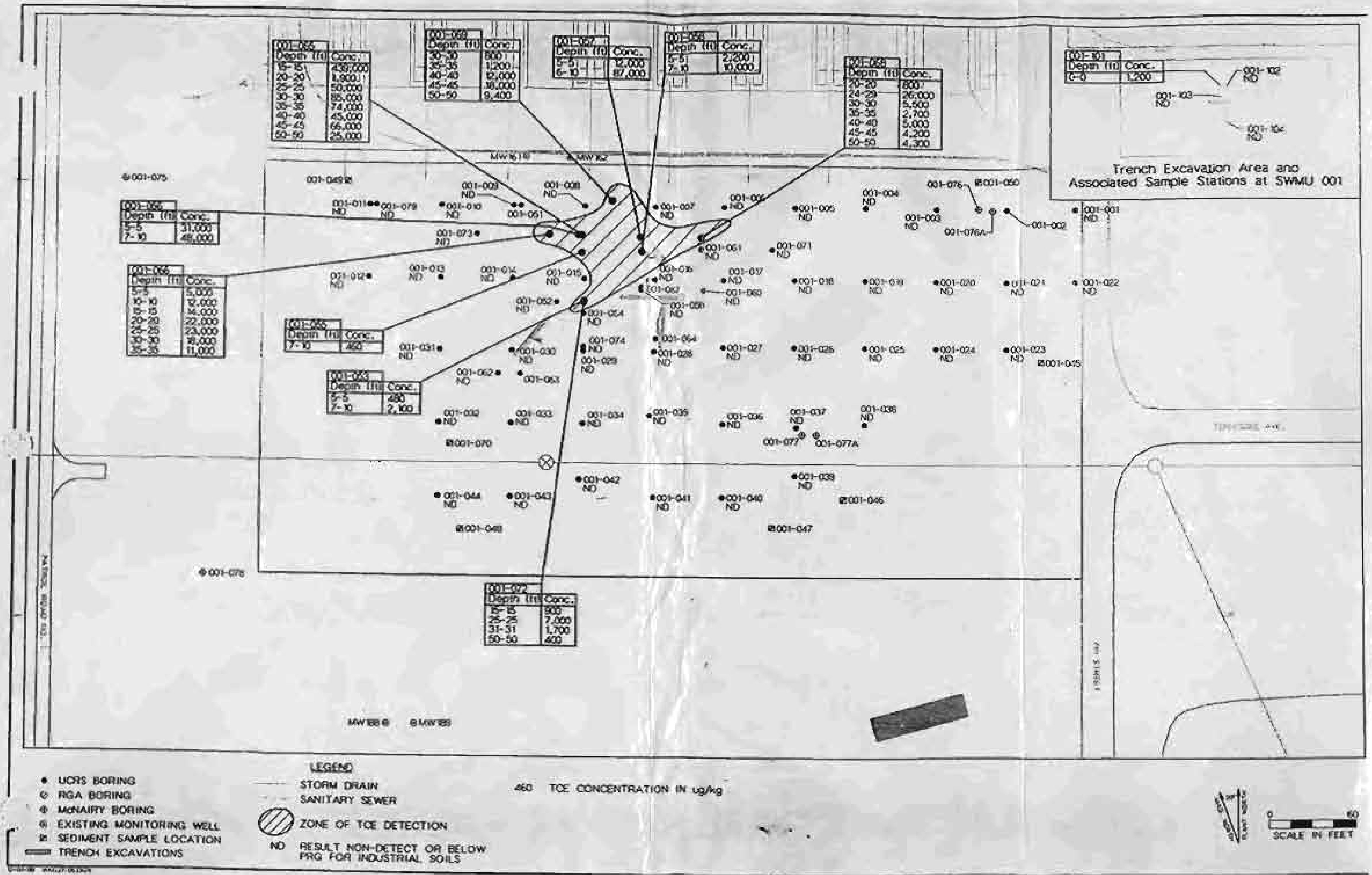


Fig. 4.4 Distribution of TCE in UCRS soil at SWMU 001.

Area and vertical trends of TCE contamination in soil and water are consistent with a small DNAPL source zone located in the upper 6.1 m (20 ft) of clayey silt underlying C-747-C. The greatest density of soil data is available for the shallowest depth intervals, elevations 111.2 to 113.2 m (365.0 to 371.5 ft) amsl and 109.7 to 111.2 m (360.0 to 364.9 ft) amsl (see Attachment 3). Soil boring data define a "hot spot" area containing greater than 10,000 µg/kg TCE of 46.5 and 83.6 m^2 (500 and 900 ft^2), respectively, for these two shallowest depth intervals. The data are insufficient to outline a discrete "hot spot" zone between 106.6 and 109.7 m (349.9 and 360.0 ft) amsl. Below 106.6 m (349.9 ft) amsl, the zone of elevated TCE detections ranges from 220.6 to 471.5 m^2 (2,375 to 5,075 ft^2) in area.

Waste Area Group 27 Boring 001-077b provides definition of the geology of the "hot spot" vicinity. Table 6 summarizes the lithologies with depth. The contaminant distribution is consistent with a conceptual model in which a well-defined "hot spot" zone in the HU1 clay interval is disseminated by lateral dispersion of dissolved phase contamination in the HU2 gravel horizon. Because flow is primarily vertical in the lower UCRS, the "hot spot" zone retains the larger dimensions with depth.

Table 6. Lithology of the "Hot Spot" Area of the Former Oil Landfarm

DEPTH		ELEVATION		LITHOLOGY SUMMARY (001-077b)	HYDROGEOLOGIC UNIT
(m)	(ft)	(m)	(ft)		
0-6.1	0-20	107.9-114.0	354-374	Clay	HU1
6.1-9.8	20-32	104.2-107.9	342-354	Sandy and clayey gravel	HU2
9.8-16.8	32-55	97.2-104.2	319-342	Clay	HU3
16.8-29.6	55-97	84.1-97.2	276-319	Gravel and sand	HU4&5 (RGA)

A water sample from Boring 001-073 of the WAG 27 RI characterizes contaminant levels in the upper RGA immediately downgradient of the "hot spot" zone in the Former Oil Landfarm. The TCE-in-water concentration is 312 µg/l. This contaminant level is consistent with a shallow DNAPL source zone. A deep UCRS or RGA DNAPL source would be expected to yield higher dissolved-phase contaminant levels in the RGA downgradient of the DNAPL zone.

Following the above logic, the DNAPL volume is expected to be on the order of 19 to 190 l (5 to 50 gal). Using an average DNAPL saturation of 5.7% (the derived DNAPL saturation for a UCRS DNAPL zone at the C-400 Building), a 190 l (50 gal) spill would occupy an area of 1.5 m^2 (16 ft^2) down to a depth of 6.1 m (20 ft). This size source zone is consistent with lateral and vertical trends of TCE contamination at the C-747-C Former Oil Landfarm.

ATTACHMENT 1

Derivation of TCE in soil (µg/kg) for 30% DNAPL Saturation (expected only in the core of the DNAPL source zone)

Assumptions:

- Soil grain density = 2.65 g/cm^3
- TCE specific gravity = 1.46 g/cm^3
- Water specific gravity = 1.00 g/cm^3
- Soil porosity = 36%

Water Saturation (%)	Total Density (g/cm^3)	TCE* (g/cm^3)	TCE (µg/kg)
10	1.95	0.16	80,709,226
30	2.15	0.16	73,214,219
50	2.35	0.16	66,992,964
70	2.55	0.16	61,746,186

*TCE (g/cm^3) = specific gravity x (porosity x DNAPL saturation)
=1.46 x (0.36 x 0.30) = 0.157

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT 2

Derivation of TCE in soil (µg/kg) for the DNAPL Zones

Boring 720-002 Area

Depth to water = 5.8 m (19 ft)

Distance to presumed source = 4.0 m (13 ft)

Sample Data Summary

Depth		TCE
(m)	(ft)	(µg/kg)
2.1	7	37
3.0	10	17,000
4.3	14	19,000
6.7	22	68,000
6.7	22	32,000

Vadose Zone Saturation = 50% Multiplier = 0.531283			Saturated Zone Multiplier = 0.5921803		
Distance		TCE	Distatnce		TCE
(m)	(ft)	(µg/kg)	(m)	(ft)	(µg/kg)
0.0	0	66,992,964	0.0	0	61,746,186
0.3	1	35,592,223	0.3	1	36,564,875
0.6	2	18,909,543	0.6	2	21,652,999
0.9	3	10,046,319	0.9	3	12,822,479
1.2	4	5,337,438	1.2	4	7,593,220
1.5	5	2,835,690	1.5	5	4,496,555
1.8	6	1,506,554	1.8	6	2,662,771
2.1	7	800,407	2.1	7	1,576,841
2.4	8	425,242	2.4	8	933,774
2.7	9	225,924	2.7	9	552,963
3.0	10	120,030	3.0	10	327,454
3.4	11	63,770	3.4	11	193,912
3.7	12	33,880	3.7	12	114,831
4.0	13	18,000	4.0	13	68,000
Average =		10,207,713	Average =		10,807,633
DNAPL Saturation =		3.7%	DNAPL Saturation =		4.2%

* The multiplier is an approximation of the percentage of DNAPL mass remaining with unit distance (1 ft interval, in this case) from the core of the DNAPL zone.

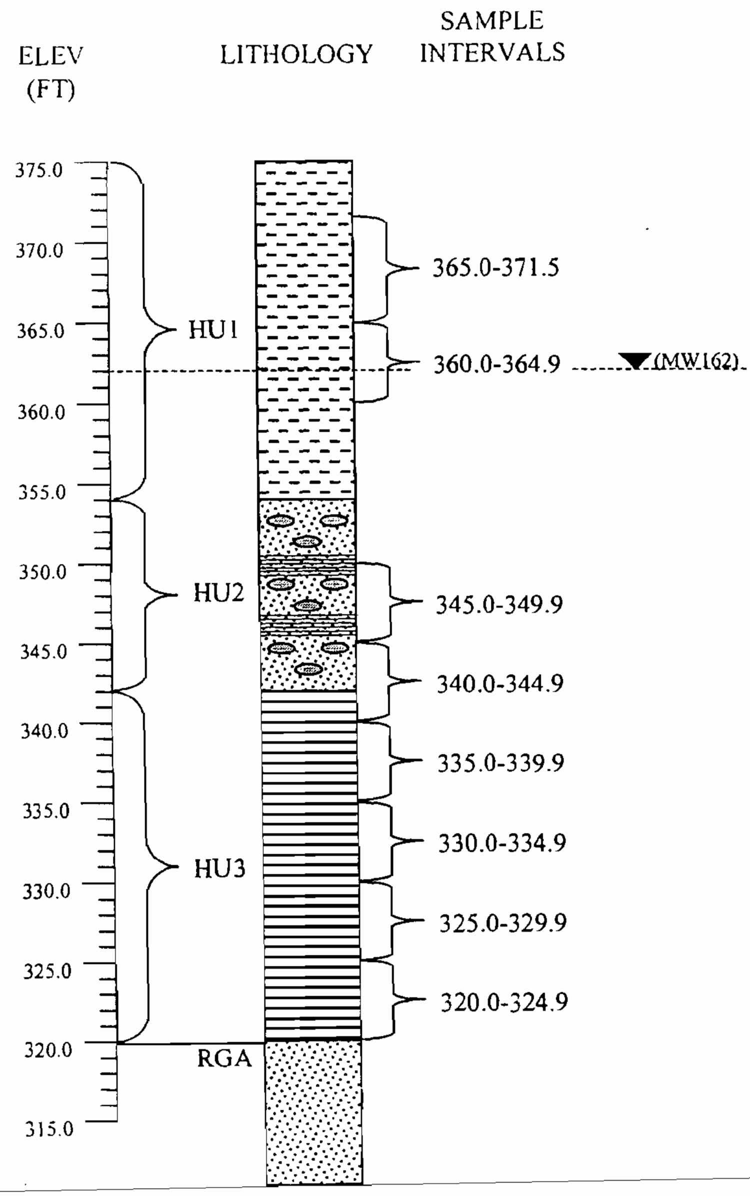
THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT 3

TCE in Soil (μg/kg) at the C-747-C Former Oil Land Farm

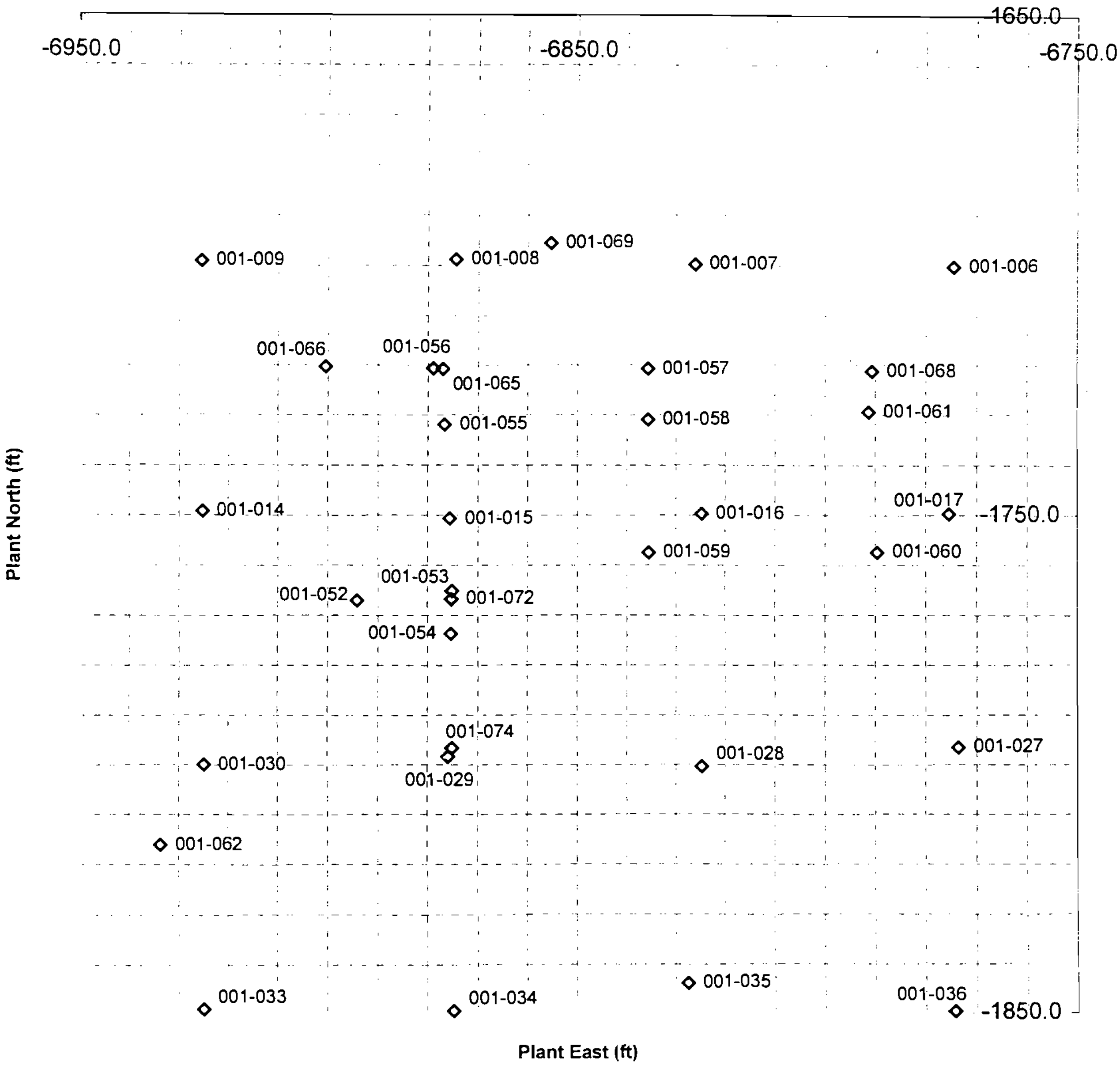
(contour intervals are 1,000 and 10,000 μg/kg)

⚹ without a value = non detect

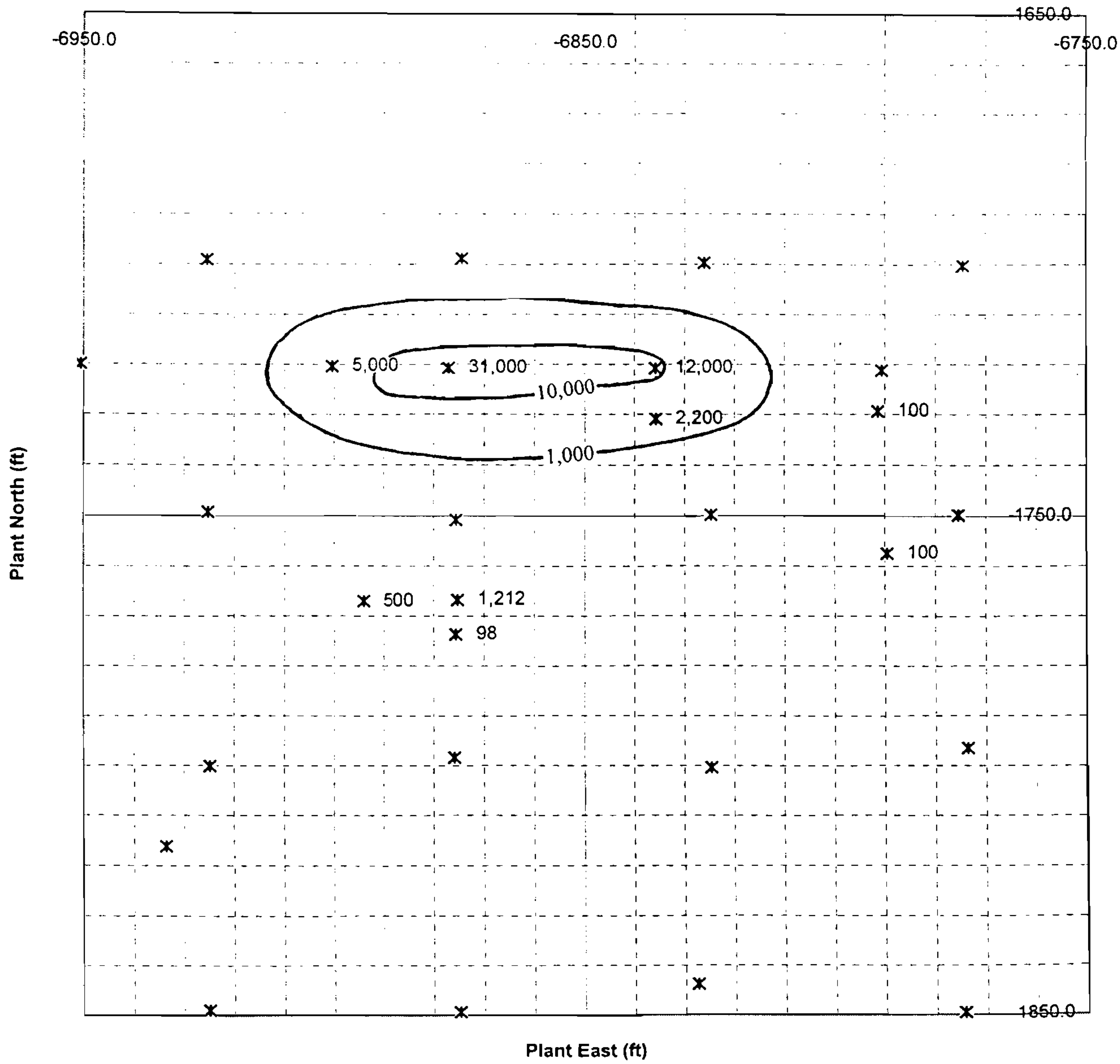


THIS PAGE INTENTIONALLY LEFT BLANK

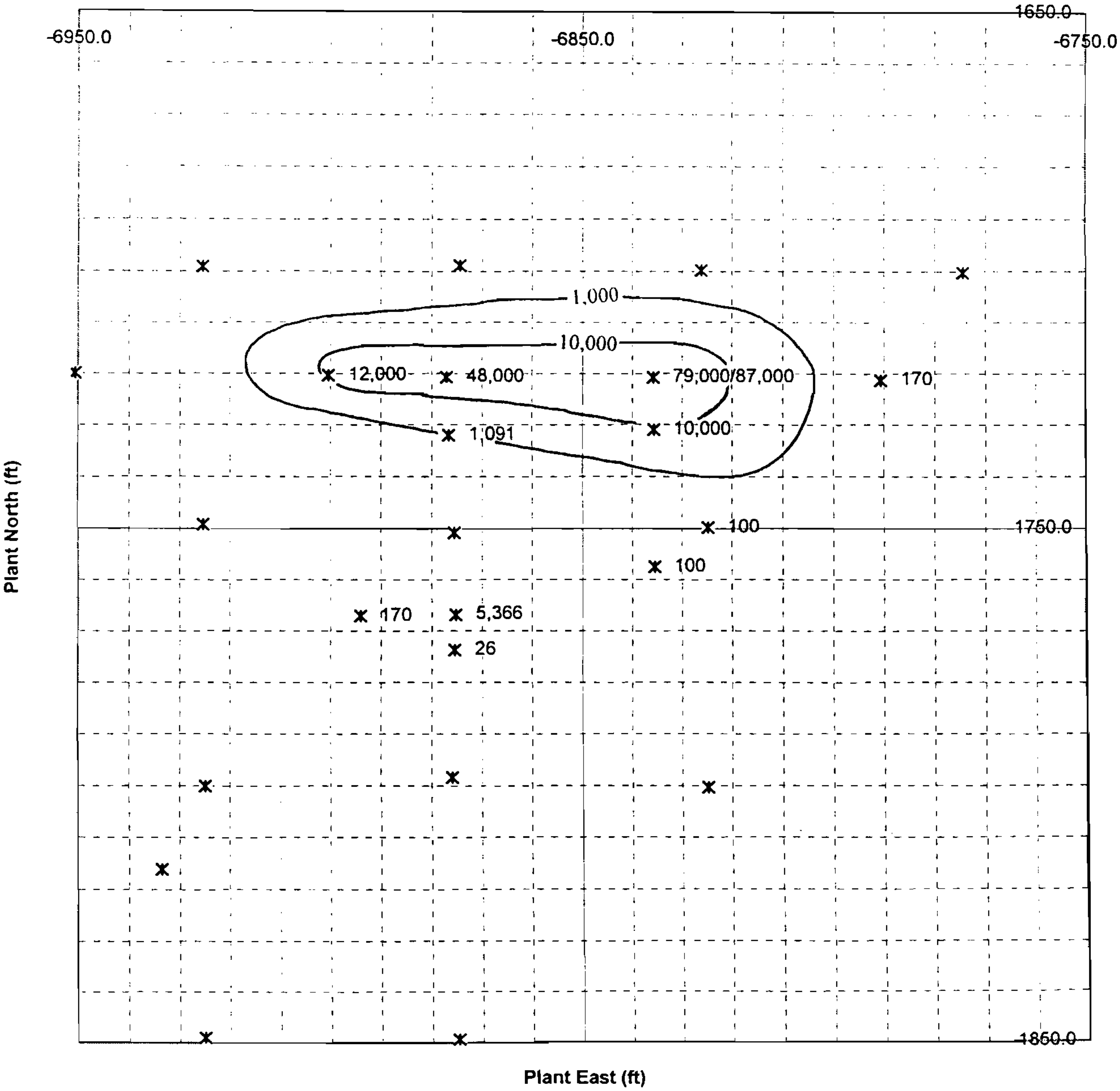
C-747-C "HOT SPOT" SOIL BORINGS



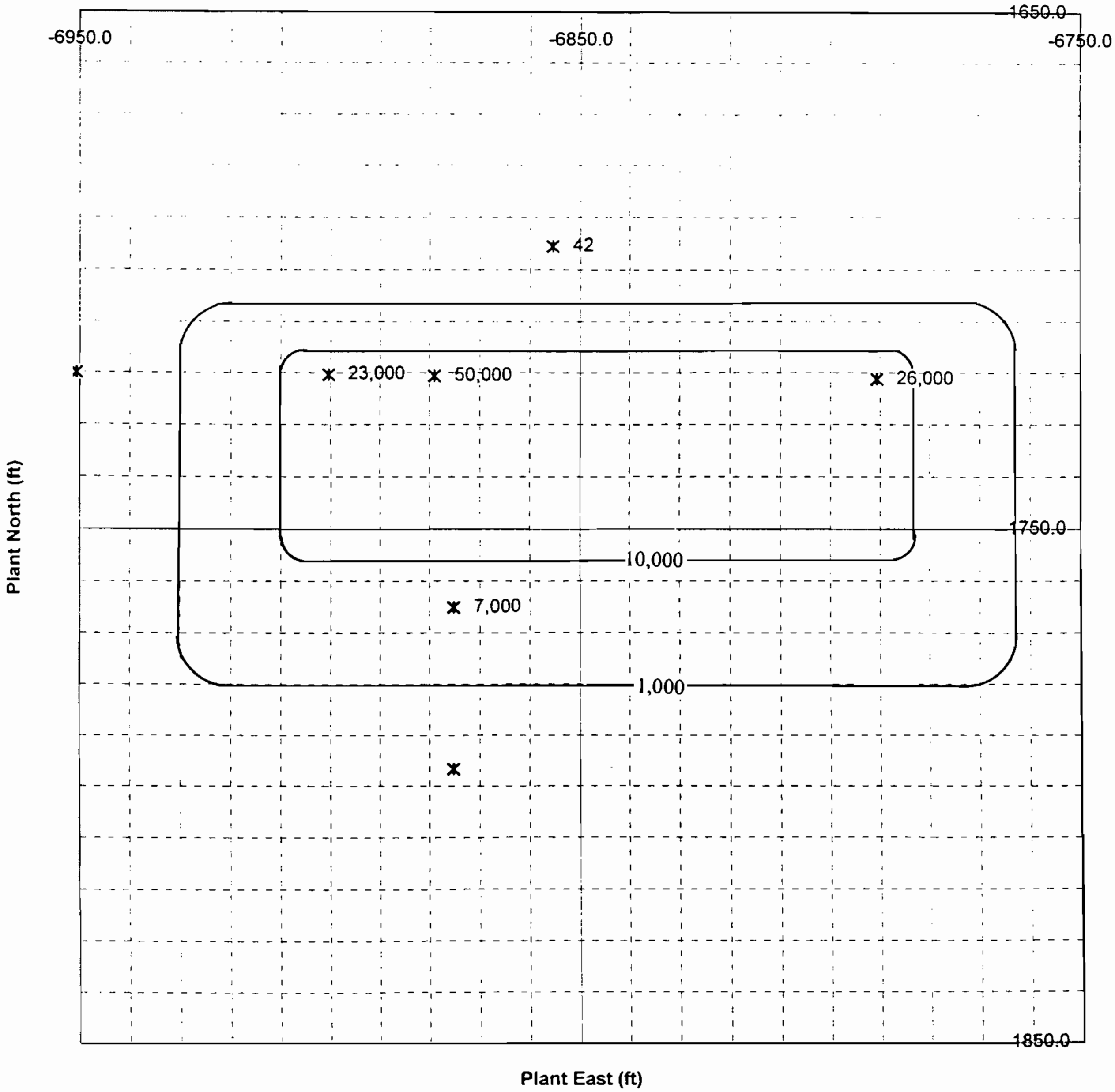
TCE LEVEL (365.0 - 371.5)



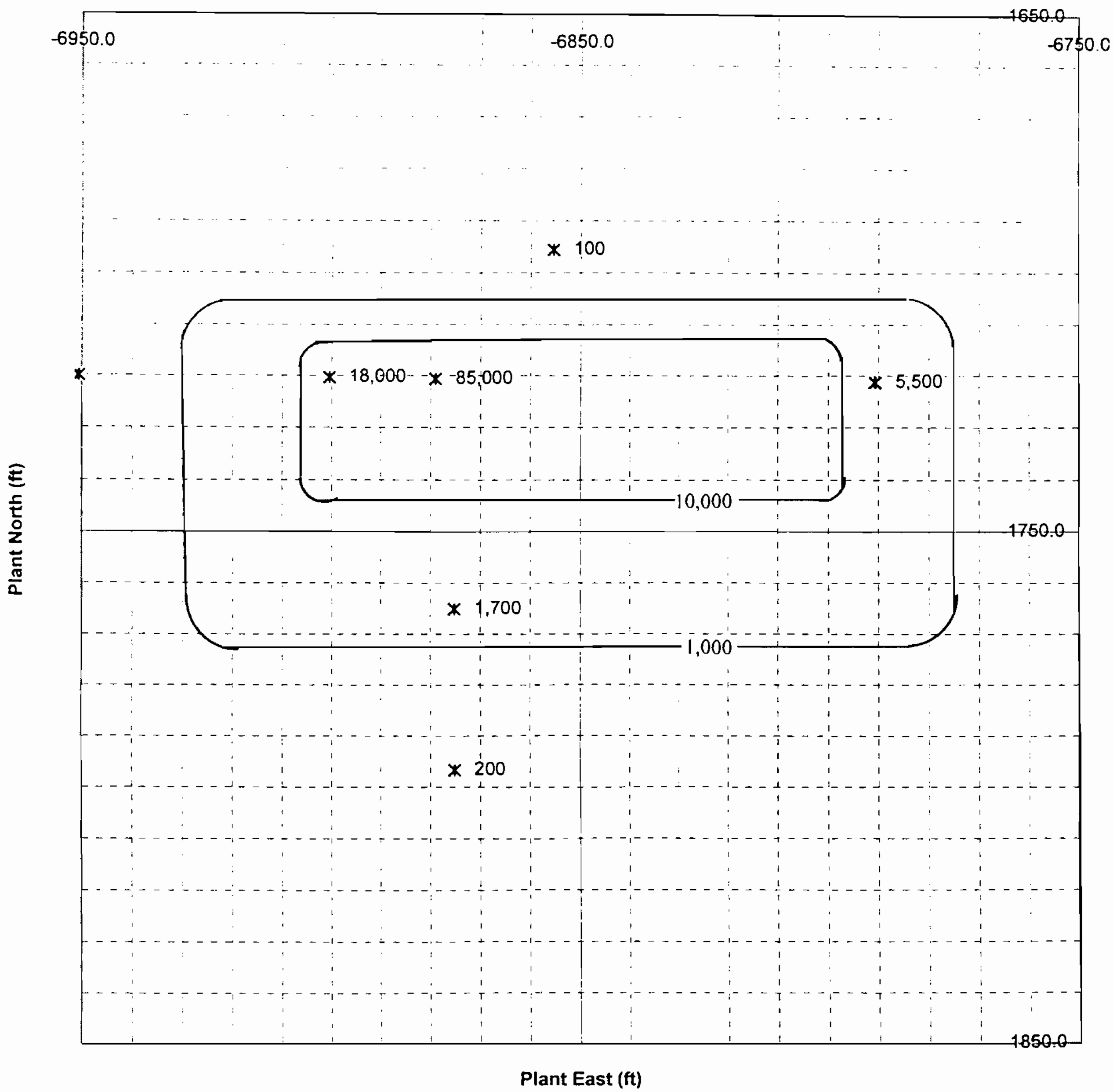
TCE LEVEL (360.0 - 364.9)



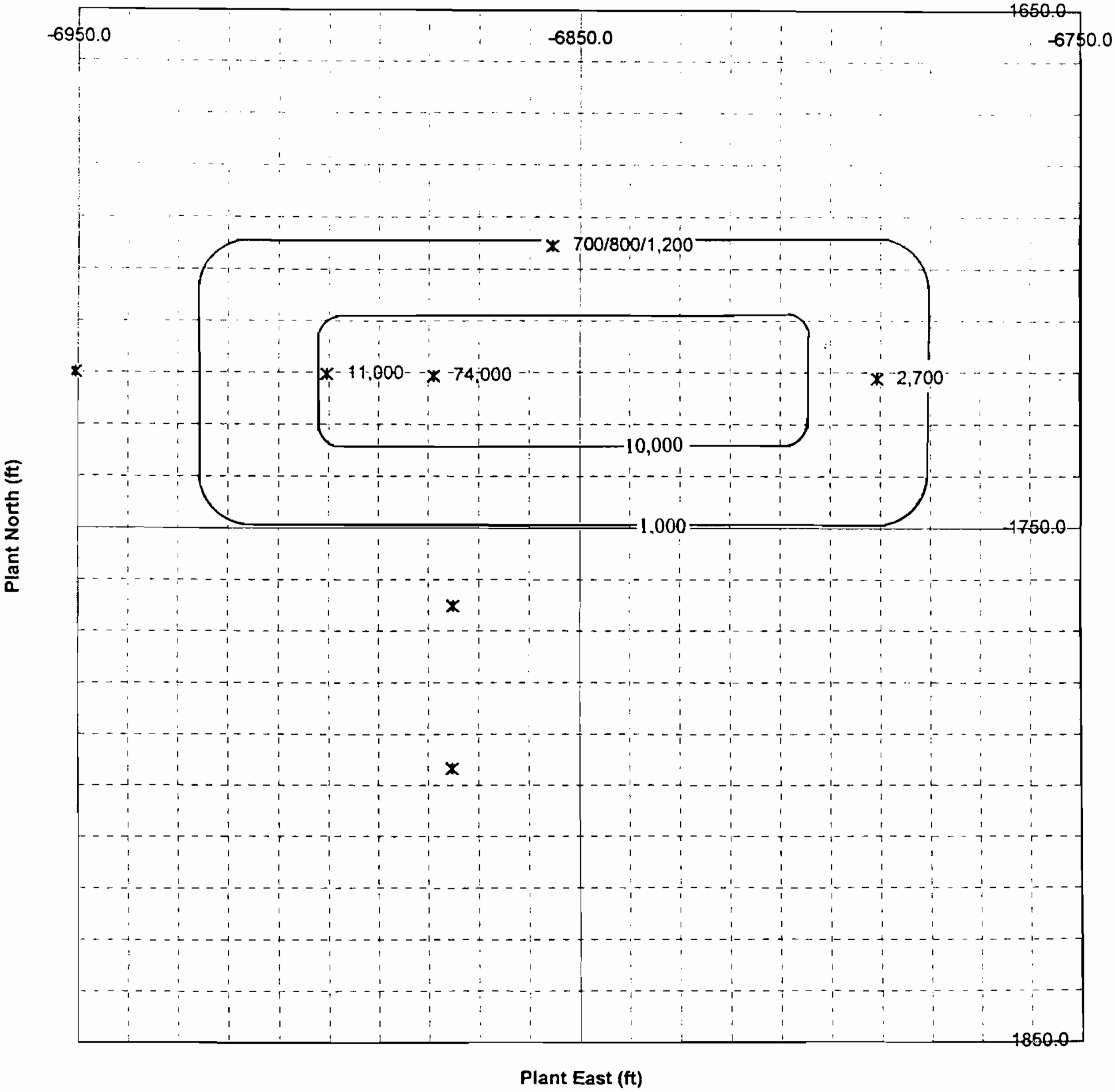
TCE LEVEL (345.0 - 349.9)



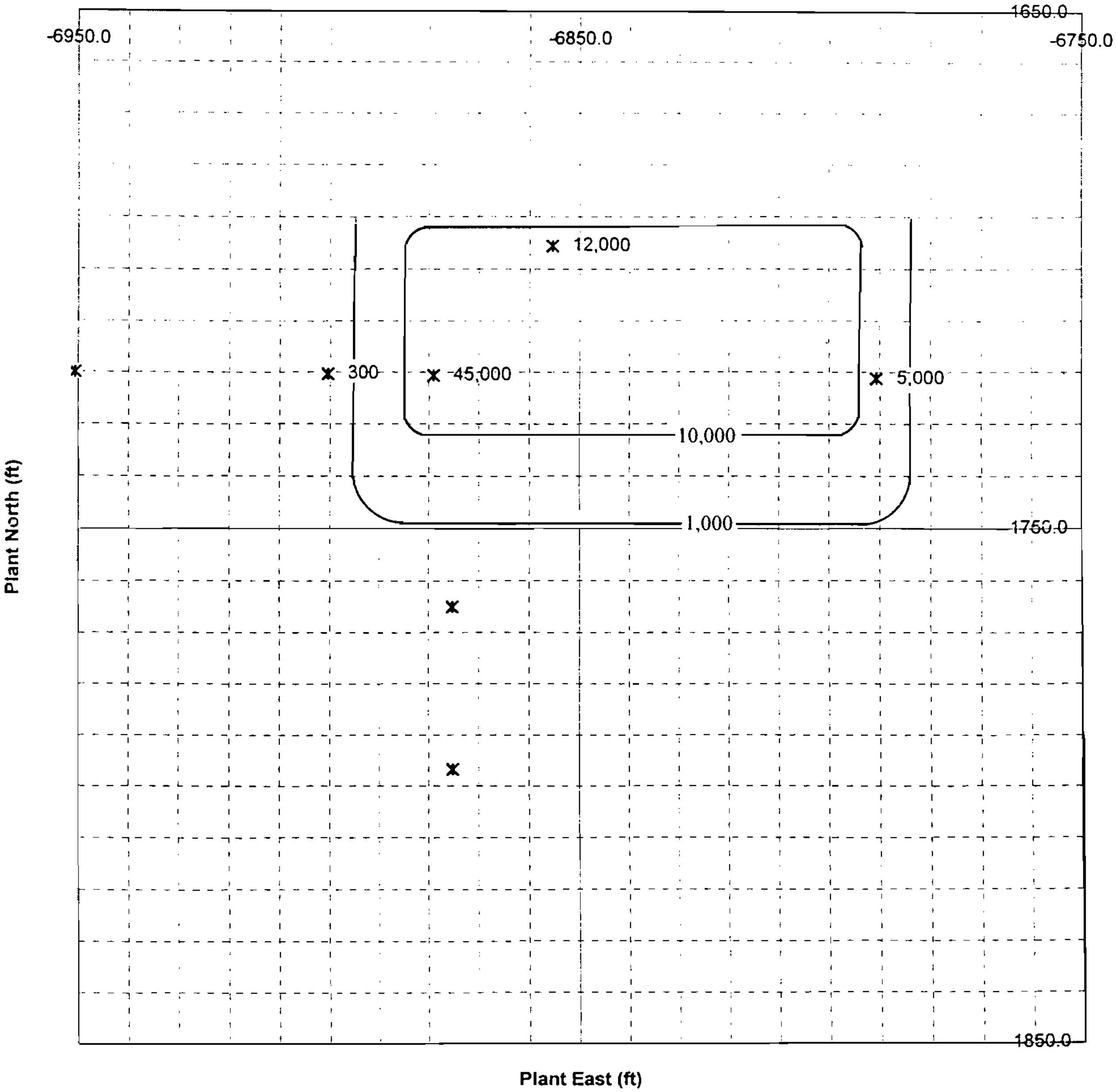
TCE LEVEL (340.0 - 344.9)



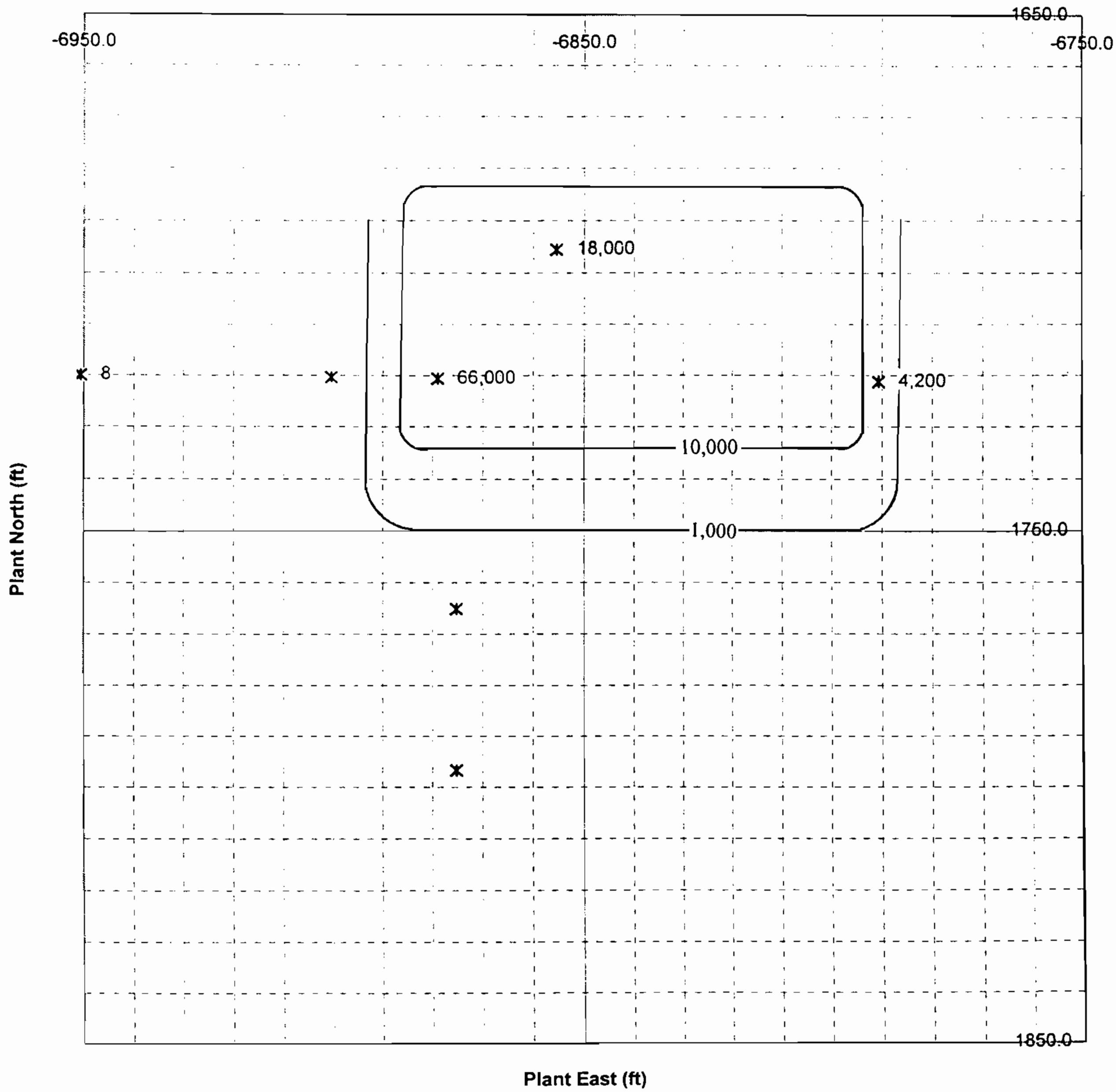
TCE LEVEL (335.0 - 339.9)



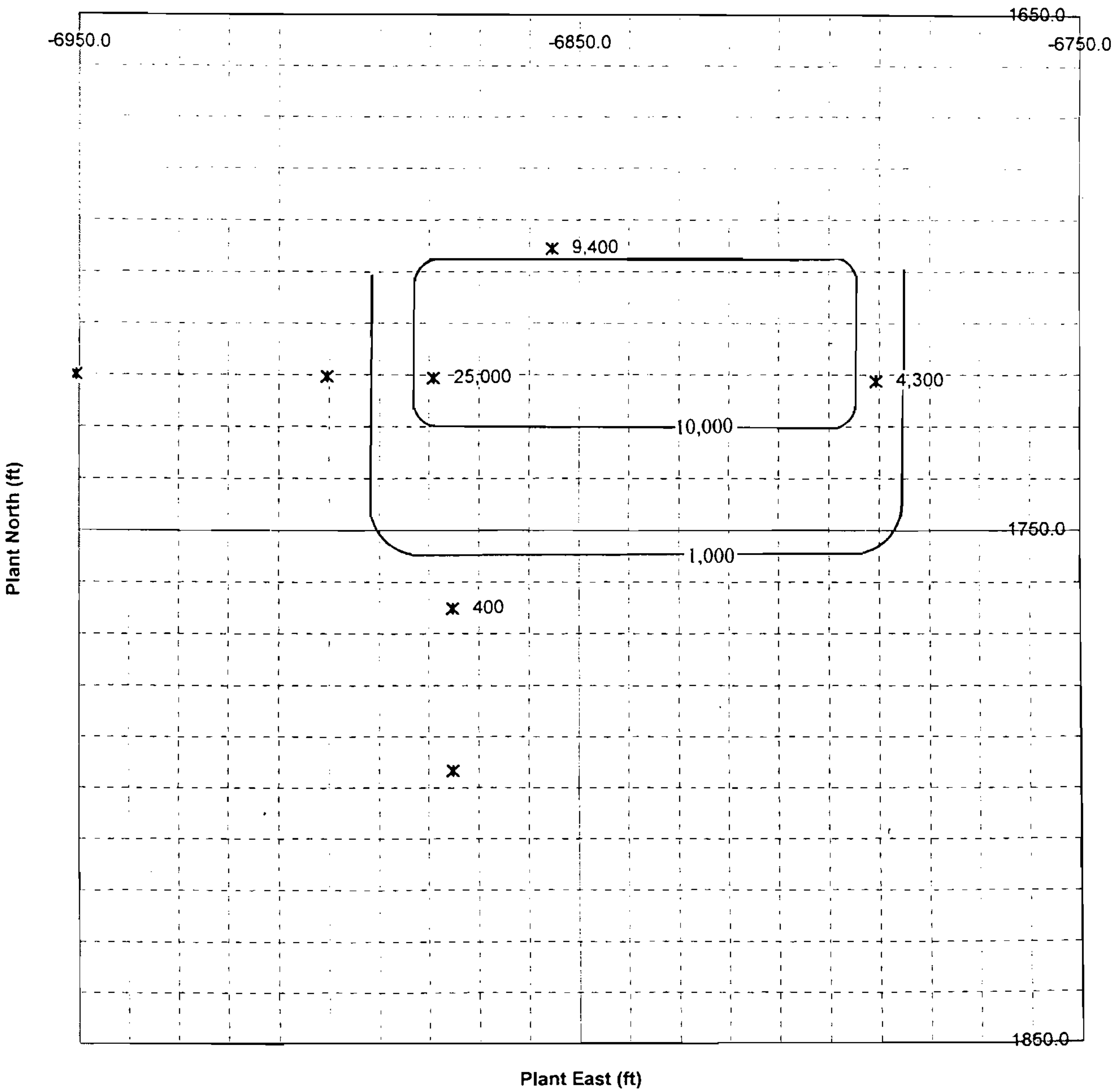
TCE LEVEL (330.0 - 334.9)



TCE LEVEL (325.0 - 329.9)



TCE LEVEL (320.0 - 324.9)



THIS PAGE INTENTIONALLY LEFT BLANK

DERIVATION OF

TRICHLOROETHENE AND ^{99}TECHNETIUM

SOURCE ZONE VOLUMES

FOR THE WAG 6 AREA

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

TABLES

FIGURES

DERIVATION OF SOURCE ZONE VOLUMES

INTRODUCTION

The WAG 6 Remedial Investigation (RI) collected subsurface soil and water samples from 133 boreholes within and adjacent to the C-400 block. As anticipated and documented in this calculation package, the data confirm that the C-400 area contains the primary sources of trichloroethene (TCE) and ^{99}technetium (^{99}Tc) to the Northwest Plume and a plume trending east from the north corner of the C-400 block. Useful characterization data are largely derived from soil samples in the UCRS and water samples within the RGA.

Taken together, the data indicate the presence of four discrete sources of TCE and two discrete sources of ^{99}Tc near C-400. In addition, there is a diffuse source of ^{99}Tc on the east side of the C-400 building and an undefined source of ^{99}Tc south of the C-400 block that impacts water quality in the lower RGA on the east side of the C-400 Building.

TCE DNAPL SOURCE ZONES

This analysis of the WAG 6 data infers the presence of four TCE DNAPL source zones located: 1) at the site of a former TCE transfer pump (southeast C-400 block), 2) along the storm sewer at the C-400 Leak Site/SWMU 11 (southeast C-400 block), 3) along the storm sewer exiting the south end of the C-400 Building (southwest C-400 block), and 4) beneath the C-403 Neutralization Pit/SWUM 40 (northeast corner C-400 block).

Only the southeast corner of the C-400 block is sufficiently sampled in 3-dimensions to map/model TCE levels within the UCRS DNAPL zone. Because no meaningful data regarding TCE levels in RGA soils could be collected by the WAG 6 RI, the depth and width of the RGA source zone must be inferred from the dimensions and vertical trends of the resulting dissolved-phase plumes and conceptual models. Appendix A presents isoconcentration maps of TCE in soil for the southeast C-400 block.

For the DNAPL source zone associated with the C-400 Building southwest storm sewer, the UCRS soil data define TCE in soil concentrations near the edge of the DNAPL zone and a perimeter of very low to nondetect levels of TCE in soil. Appendix B presents the TCE-in-soil analyses for this area. The presence of DNAPL at the C-403 Neutralization Pit (SWMU 40) is inferred solely from levels of dissolved-phase TCE, both in the RGA and in water that collected within the C-403 Neutralization Pit during the RI.

^{99}TECHNETIUM SOURCE ZONES

The dimensions of the ^{99}Tc source zones in the UCRS are based on conceptual models. Too few ^{99}Tc analyses resulted from the WAG 6 RI. However, the plot of dissolved beta activity to ^{99}Tc activity shows a strong, near 1:1, relationship (Figure 1). The RI provides sufficient analyses of dissolved beta activity to map the primary ^{99}Tc source to the Northwest Plume in the northwest corner of the C-400 block. This source zone is south of the Waste Discard Sump/SWMU 203 (located at the northwest corner of the C-400 Building). The former Technetium Storage Tank/SWMU 47 appears to be the likely remaining candidate spill source. Elevated ^{99}Tc activity in soil was detected in soil borings at the former tank location.

Dissolved beta activity suggests a second discrete source of ^{99}Tc exists at the northeast corner of the C-400 Building. The C-403 Neutralization Pit/SWMU 40 appears to be the ^{99}Tc source. High dissolved ^{99}Tc activity has been reported from a shallow well adjacent to C-403. The water that collected in the C-403 Pit during the RI had high beta activity.

The upper RGA on the east side of the C-400 Building has a near uniform beta activity of 100-200 pCi/L. This activity appears to be derived from a diffuse source. The fan room plenum basement on the east side of the building is a potential release mechanism with appropriate size to generate an UCRS source with low activity.

Much higher dissolved beta activity, 800-900 pCi/L appears near the base of the RGA on the east side of the C-400 Building. This increase in beta activity appears to be due to a separate plume flowing into the C-400 area from the south. The source of this plume remains undefined.

DISSOLVED PHASE PLUMES

Appendix C provides TCE isoconcentration contour maps and beta isoactivity contour maps of the RGA in the C-400 area. Previous interpretations of the groundwater contaminant plumes at PGDP, consistent with the present interpretation, indicate significant lateral and vertical development of the plumes. Consequently, the data set was discretized vertically to generate 'slice' maps. As determined by the sampling frequency, the dissolved phase contaminant levels are grouped for mapping in five ft thick intervals between the elevations of 285 ft and 315 ft above mean sea level.

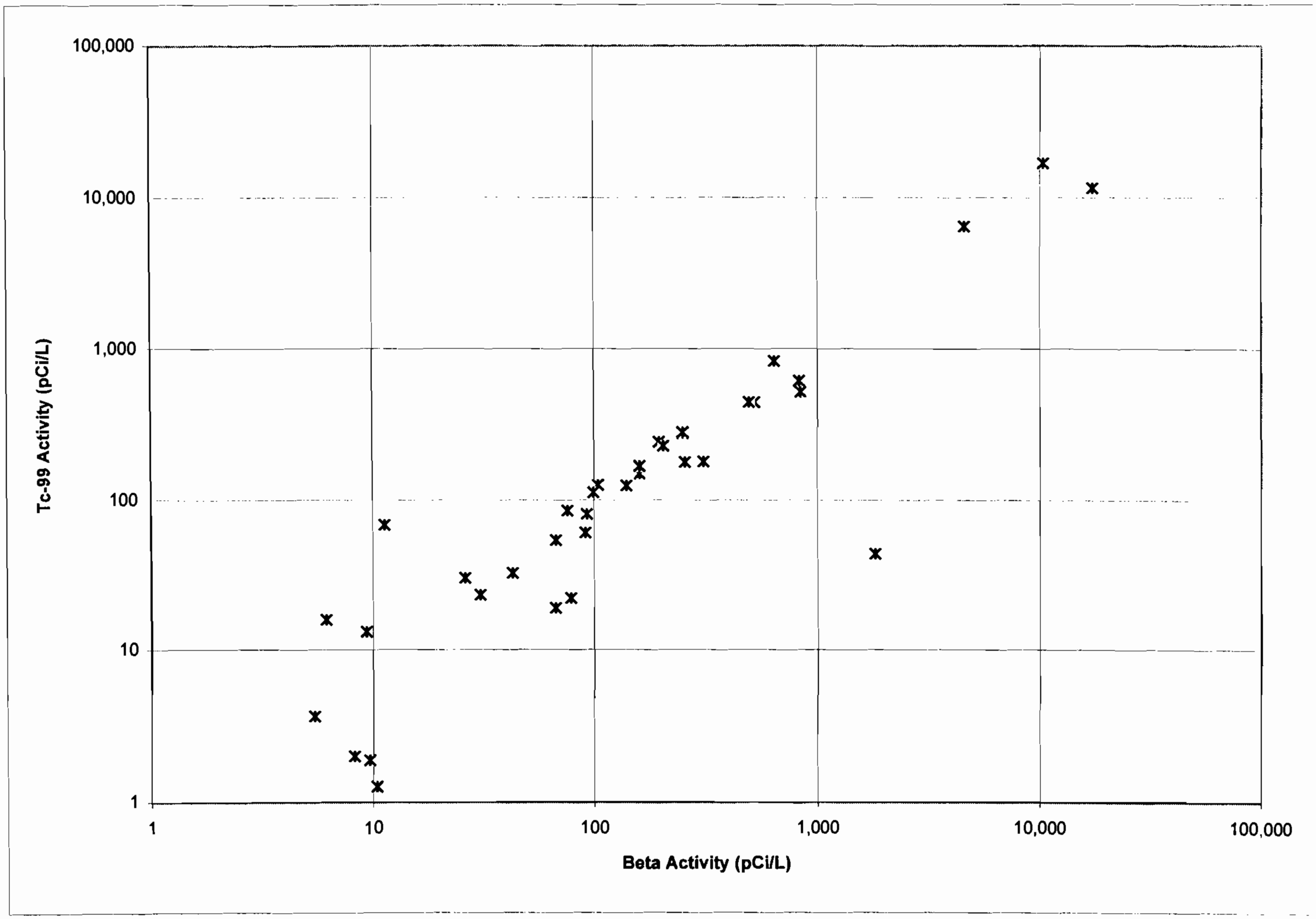


Figure 1. Plot of Dissolved Beta Activity Versus Dissolved Technetium-99 Activity from the WAG 6 Data Base

To constrain the possibilities regarding the number and locations of source areas and location and orientation of plumes, these maps have been contoured to be compatible (flow directions inferred from dissolved TCE trends match flow directions inferred from dissolved ^{99}Tc trends). An additional constraint placed on the contour maps was that the inferred flow direction could not significantly change between adjacent depth intervals. Thus, data from adjacent depth intervals biases the contour interpretation, maximizing the use of the available data.

Vertical flow predominates in the UCRS and has significant impact in the uppermost RGA, where the sediments typically are finer grained than the middle and lower RGA (interpreted to mean the upper RGA has a lower hydraulic conductivity than the middle and lower RGA). Thus, the high contaminant levels in the top 'slice' interval mark the entry point of the DNAPL or core of dissolved contamination into the RGA and help to point to the spill location.

Lateral trends of the main contaminant plumes sourced in the C-400 area are well developed in the next lower interval, 305.0 - 309.9 ft. With increasing depth, the impact of the shallow DNAPL sources are diminished and the areal extent of the high concentration TCE core of the plume becomes smaller.

DEPTH OF MIGRATION OF TCE DNAPL

As interpreted by these vertical trends, the C-403 DNAPL source is constrained to the UCRS. (This site impacts dissolved phase TCE levels only down to an elevation of 310 ft). It appears that the DNAPL source zones associated with the TCE Leak Site/ SWMU 11 and the south-end storm sewer penetrate to the upper RGA. (These sites influence dissolved phase TCE levels down to an elevation of 300 ft.) TCE, as DNAPL, from the TCE transfer pump appears to have migrated to the base of the RGA where a small DNAPL pool has formed. (TCE levels in nearby boring 400-037 increase at the base of the RGA.)

DEPTH OF ^{99}TECHNETIUM SOURCE

Dissolved-phase beta activity is limited to the upper RGA beneath C-403, suggestive of a source term in the UCRS. This is consistent with the expected behavior of ^{99}Tc. The high solubility of ^{99}Tc in oxidized water, such as the RGA, would tend to inhibit the development of a secondary source in the RGA.

The depth of penetration of the ^{99}Tc source tentatively associated with the Technetium Storage Tank (SWUM 47) remains uncertain.

Here, the dissolved-phase beta activity penetrates to the base of the RGA. One possible interpretation is that the oil containing the ^{99}Tc concentrate (a mixture of polyaromatic hydrocarbons) also was a DNAPL that has penetrated to the base of the RGA. No indications of a polyaromatic hydrocarbon source are known from the northwest C-400 Building area. Presumably, these oils have very low solubilities that would not result in an appreciable dissolved-phase plume of polyaromatic hydrocarbons.

DNAPL VOLUME CALCULATION IN THE UCRS

Southeast C-400 Block (TCE Transfer Pump and TCE Leak Site/ SWMU 11 Source Zones

Table 1 summarizes the soil textures described from boring 400-207. This boring is being used to represent the geology of the UCRS for the source zones in the southeast C-400 area. The assumed porosity for the UCRS sediments is the mean of measurements from 16 UCRS samples collected for the WAG 6 RI.

Table 1. Summary of UCRS Properties in the Southeast C-400 Area

Depth Interval (ft)	Elevation of Base of Interval (ft)	Representative Lithology	Assumed Porosity (%)
0-33	346	silt to silty clay	36
33-45	334	gravely sand	36
45-57	322	silty sand to fine sand	36

For the purpose of calculating a TCE DNAPL volume in the UCRS for the southeast C-400 block, the maps of Appendix A have been used to define the area containing soil with 100 µg/g or greater TCE. Assuming the density of the TCE DNAPL is 1.46 g cm^3, the specific gravity of the UCRS soil grains is 2.65 g/cm^3, and the soil has a porosity of 36% with a 0.1% DNAPL saturation, the associated soil TCE concentration is 308,948 µg/Kg or 309 µg/g. Thus, the maps define the area containing soils with approximately 0.1% saturation and greater.

Note: In *Estimating Potential for Occurrence of DNAPL at Superfund Sites* (EPA, 1992), a DNAPL saturation of 1% in soil is presented as an indication of DNAPL presence. The use of a 0.1% saturation level to define the DNAPL zone is due to the limits of resolution capable with the data set. The WAG 6 RI analyzed soils from the southeast C-400 block with greater than 1% DNAPL saturation.

The approximate area for each depth interval slice is presented in Table 2.

Table 2. Area and Volume of the TCE DNAPL Zone in the UCRS in the Southeast C-400 Area

Depth Interval (ft)	Area Containing 100 PPM TCE or Greater (ft^2)	Thickness Represented (ft)	Volume Represented (ft^3)
365.0 - 369.9	4,000	14*	56,000
360.0 - 364.9	3,400	5	17,000
355.0 - 359.9	5,070	5	25,350
350-0 - 354.9	3,730	5	18,650
345.0 - 349.9	2,500	5	12,500
340.0 - 344.9	3,560	5	17,800
335.0 - 339.9	2,130	5	10,650
330.0 - 334.9	3,330	8**	26,640

* Land surface to subsurface elevation 365.0 ft.
** Elevation 334.9 ft to top of the RGA at 327 ft elevation.

Characterization data from the original SWMU 11 investigation and the WAG 6 and WAG 27 RIs all suggest the DNAPL migration pathways through the UCRS are essentially straight down. This is consistent with the general texture of the UCRS silts and clays which have no observable lateral-to-vertical anisotropy. Thus, the 'footprint' of the leak source is the width of the source zone with highest DNAPL saturation.

The distribution of TCE levels in the southeast C-400 block suggests the TCE concentration declines near-logarithmically with distance from the DNAPL migration pathway. Several assumptions have been made to derive a representative DNAPL saturation of the source zone:

- The DNAPL volume in the area containing less than 100 µg/g (~0.1% saturation) of TCE in soil is insignificant.
- The vertical migration pathway of the DNAPL has an insignificant width.
- The residual TCE saturation of the vertical DNAPL migration pathway (center of the DNAPL zone) is 30% (the maximum residual saturation suggested for the PGDP site by Dr. B. H. Kueper, 1991).
- DNAPL levels decline at a uniform percentage per unit distance from the source zones (similar to dispersion effects). Thus, for a DNAPL zone with a 30% saturation at the center and a 0.1 % saturation at the edge, the average DNAPL saturation in soil is 5.7% (Figure 2).

The calculation of volume of TCE DNAPL is the product of the volume of the TCE DNAPL source zone, the porosity, and the saturation. Table 3 documents the calculation of volume of DNAPL for the southeast C-400 block.

Unit Factor = 0.751872

Unit Distance	DNAPL Saturation (%)
0	30.00
1	22.56
2	16.96
3	12.75
4	9.59
5	7.21
6	5.42
7	4.08
8	3.06
9	2.30
10	1.73
11	1.30
12	0.98
13	0.74
14	0.55
15	0.42
16	0.31
17	0.24
18	0.18
19	0.13
20	0.10
Avg. DNAPL Saturation:	**5.74**

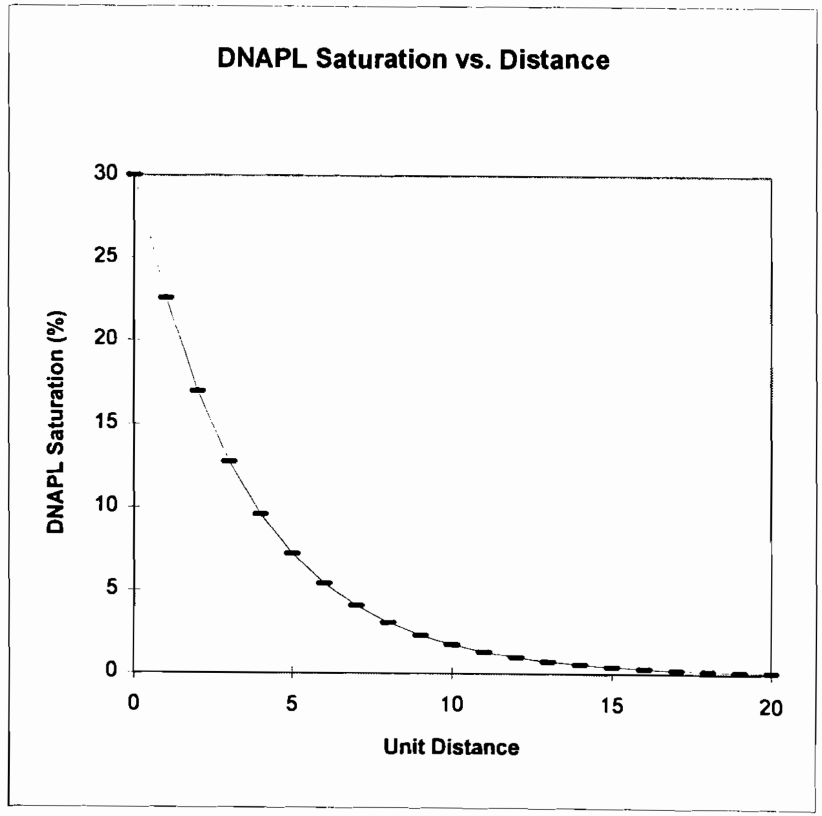


Figure 2. Average DNAPL Saturation of UCRS DNAPL Source Zone

Table 3. Calculation of TCE DNAPL for the Southeast C-400 Block

Depth Interval (ft)	Volume Represented (ft^3)	Assumed Porosity (%)	Assumed Saturation (%)	TCE DNAPL Volume (ft^3)
322 - 379	184,590	36	5.7	3,788

A volume of 3,788 ft^3 is equal to 28,338 gallons (107,259 liters).

South-End C-400 Building Storm Sewer and C-403 Neutralization Pit/SWMU 40 Source Zones

Soil characterization data are sufficient for the south-end C-400 Building storm sewer to determine that a DNAPL source zone exists at the point where the storm sewer exits from beneath the building. However, the data are inadequate to define the TCE DNAPL levels in three dimensions. The inference that a DNAPL source zone exists at the C-403 Neutralization Pit is based only on dissolved TCE levels, in the upper RGA and in the fill water that collected within the pit during the RI.

As previously discussed, the DNAPL source zone associated with the south-end storm sewer apparently extends to the RGA whereas the C-403 source zone is constrained within the UCRS. Borings 400-045 and 400-042 will be used to represent the geology of the UCRS for the south-end storm sewer and C-403 DNAPL source zones, respectively.

Table 4. Summary of UCRS Properties in the Southwest C-400 Area and the North C-400 Area

Depth Interval (ft)	Elevation of Base of Interval (ft)	Representative Lithology	Assumed Porosity (%)
Boring 400-045 (Southwest C-400 Area)			
0-16	360.5	silt to silty clay	36
16-47	329.5	silty sand and gravel?	36
47-52	324.5	silt and clay	36
Boring 400-042 (North C-400 Area)			
0-20	358.5	silt to silty clay	36
20-42	336.5	silty sand and gravel	36
42-62	316.5	silty clay with sand and gravel	36

It will be assumed that the UCRS DNAPL zone extends the full 52 ft depth of the UCRS soils in the southwest C-400 block but is limited to a depth of 42 ft beneath C-403.

The width of these TCE DNAPL zones remains largely undefined.

South-End Storm Sewer Source

Boring density is sufficient to determine that the width of the south-end sewer system DNAPL zone does not extend 100 ft from the source. If we assume that 100 µg/g (~0.1% saturation) of TCE in soil defines the DNAPL source zone, only one WAG 6 boring was completed in the source zone. The TCE levels (94 and 200 µg/g) suggest the boring, located approximately 30 ft south of the C-400 Building, is near the edge of the source zone.

Following calculations of the south-end storm sewer source will be based on the assumption that the DNAPL leak occurred at the edge of the building footprint and that the source zone is symmetrical. Thus, the south-end storm sewer source will be a cylinder with a 30 ft radius, centered on the south end of the C-400 Building where the storm sewer exits from beneath the building.

C-403 Source

WAG 6 borings around the perimeter of the C-403 Neutralization Pit did not return soil samples with TCE levels approaching 100 µg/g. As a default value, the following calculations of the C-403 source zone will be based on the assumption that the source zone (defined by TCE levels in soil greater than 100 µg/g) extends half the width of C-403. The C-403 Neutralization Pit measures 25 ft square in plan view. The C-403 Neutralization Pit source zone will be approximated as a cylinder centered below C-403, with a radius of 6.25 ft.

Table 5. Calculation of TCE DNAPL for the South-End Storm Sewer and C-403 Sources

Height (ft)	Radius (ft)	Volume Represented (ft^3)	Assumed Porosity (%)	Assumed Saturation* (%)	TCE DNAPL Volume (ft^3)
South-End Storm Sewer Source (324.5-376.5 ft elevation)					
52	30	147,027	36	5.7	3,017
C-403 Neutralization Pit Source (336.5-378.5 ft elevation)					
42	6.25	5,154	36	5.7	106

* From the derived saturation of the southeast C-400 area source zones.

The 3,017 ft^3 of DNAPL in the south-end storm sewer source is equal to 22,570 gallons (85,427 liters)and the 82 ft^3 of DNAPL in the C-403 source is equal to 793 gallons (3,002 liters).

DNAPL VOLUME CALCULATION IN THE RGA

The upgradient 100 mg/L (ppm) TCE isoconcentration contour appears to map the DNAPL source zones of the RGA. Moreover, the US Environmental Protection Agency recommends the use of 1% of the solubility of DNAPL (1% of the solubility of TCE is 110 mg/L) as an indication of DNAPL presence (EPA, 1992). Table 6 presents the assumptions used to define the area of the DNAPL source zones in the upper RGA (based on the TCE isoconcentration contour map for the elevation interval 310.0 - 314.9 ft).

Table 6. Upper RGA DNAPL Source Zone Assumptions

TCE DNAPL Source Zone	Areal Extent Assumption	Area (ft^2)
TCE Transfer Pump	cylinder with radius of 90 ft	25,447
TCE Leak Site (SWMU 11)	line source 200 ft long by 5 ft wide	1,000
South-End Storm Sewer	cylinder with radius of 25 ft	1,963

The geologist's logs and geophysical logs of WAG 6 borings 400-038 and 400-207 provide the most detailed description of soil properties for the south end of the C-400 Building. These borings will be used to represent the RGA DNAPL source zones. In both borings, an upper fine to medium grained sand horizon (base at elevation 323 ft in boring 400-038 and elevation 322 ft in boring 400-207) overlies a thick interval of coarse sand and gravel.

As previously discussed, the slice maps of dissolved-phase TCE levels suggest different depths of penetration for the DNAPL source zones. All three of the RGA source zones are represented in the slice map for the elevation range 310.0 - 314.9 ft. The influence of the south-end storm sewer diminishes rapidly with depth. For the approximation of the south-end storm sewer DNAPL zone, the base of the DNAPL zone will be assumed to be the base of the upper sand horizon at 322 ft.

The influence of the TCE Leak Site (SWMU 11) DNAPL source zone is evident down to an elevation of approximately 305 ft in the slice maps of dissolved-phase TCE levels. This depth closely corresponds to the depth (307 ft elevation) of an anomaly on the neutron porosity log of boring 400-207 and the depth (302 ft elevation) of an abrupt decline in field measurements of volatile organic compound levels (FID) in the soil core of boring 400-207. The base of the TCE Leak Site DNAPL zone will be assigned an elevation of 305 ft.

TCE isoconcentration contours indicate a DNAPL source zone extends to the base of the RGA near the location of the TCE transfer pump. Moreover, an increase in dissolved-phase TCE levels from boring 400-207 at the base of the RGA may signify the presence of a DNAPL pool at the base of the RGA. For the estimate of the DNAPL source zone below 305 ft elevation, the source zone will be assumed to approximate a cylinder measuring 25 ft in radius (based on the TCE isoconcentration contour map for the elevation interval 290.0 - 294.9 ft) and to extend to the base of the RGA, at an elevation of 286 ft.

Table 7. Calculation of the Volume of the RGA DNAPL Source Zones

TCE DNAPL Source Zone	Areal Dimensions (ft)	Area (ft^2)	Thickness (ft)	Volume (ft^3)
TCE Transfer Pump (305-327 ft elevation)	radius = 90	25,447	22	559,834
TCE Transfer Pump (286-305 ft elevation)	radius = 25	1,963	19	37,297
TCE Leak Site/SWMU 11 (305-327 ft elevation)	length = 200 width = 5	1,000	22	22,000
South-End Storm Sewer (322-324.5 ft elevation)	radius = 25	1,963	2.5	4,908

The WAG 6 RI characterized soil properties around the C-400 Building. The mean of 26 measurements of porosity of RGA soils is 40%. An average TCE saturation level is required for the calculation of DNAPL volume. Unfortunately, no suitable samples for measurement of TCE levels in soil have been recovered from the coarse sand and gravel of the RGA.

The only available data related to DNAPL saturation in the RGA are the dissolved-phase levels of TCE. These limited measurements cannot be directly linked to a saturation level. However, the decline of dissolved-phase TCE levels with lateral distance from the center of the DNAPL source zone (with the exception of the direction of groundwater flow) may be a model of decrease of DNAPL saturation.

The following derivation of average DNAPL saturation for the source zone (upgradient area with dissolved-phase TCE levels greater than 100 mg/L) assumes that the profile of dissolved-phase TCE levels in a direction normal to groundwater flow is a direct measure of the distribution of DNAPL saturation. Dispersion will also reduce dissolved-phase TCE levels away from the source zone. For this derivation, the effect of DNAPL distribution is assumed to be dominant.

This derivation is based on a conceptual model of a narrow pathway of vertical migration at the center of the DNAPL source zone. The coarse sand and gravel of the RGA is assumed to retain a DNAPL saturation of 20% (33% less than expected in the UCRS) in the core of the DNAPL source zone. As in the UCRS, DNAPL saturation in the RGA soils is assumed to decrease away from the center of the source zone by a uniform factor per unit distance.

The profile of dissolved-phase TCE levels for this derivation is taken east of the location of the former TCE transfer pump from the elevation slice 310.0 - 314.9 ft. Table 8 summarizes the relevant data from this transect.

Table 8. Distance to TCE Isoconcentration Contours Along Transect

Dissolved-Phase TCE Level (mg/L)	Lateral Distance From TCE Transfer Pump (ft)
1,100	0
100	60
10	120
1	160

Table 9 demonstrates the fit of the chosen unit factor (multiplier to derive the decline in dissolved-phase TCE levels for unit distance) for the transect. The unit distance arbitrarily has been selected as 10 ft.

Table 9. Fit of Unit Factor (0.67) to Transect Data

Lateral Distance From TCE Transfer Pump (ft)	Derived Dissolved-Phase TCE Level (mg/L)	Transect Dissolved-Phase TCE Level (mg/L)
0	1,100.0	1,100
10	737.0	
20	493.8	
30	330.8	
40	221.7	
50	148.5	
60	99.5	100
70	66.7	
80	44.7	
90	29.9	
100	20.1	
110	13.4	
120	9.0	10
130	6.0	
140	4.0	
150	2.7	
160	1.8	1

By assuming the decline in TCE concentration is directly related to decrease in DNAPL saturation and that the residual DNAPL saturation of the center of the source zone is 20%, the derived unit factor is a multiplier to calculate DNAPL saturation in the source zone along the transect. Table 10 presents the calculated saturation levels.

Table 10. Derived DNAPL Saturation of the Source Zone

Lateral Distance From TCE Transfer Pump (ft)	Derived DNAPL Saturation (%)
0	20.0
10	13.4
20	9.0
30	6.0
40	4.0
50	2.7
60	1.8
Average DNAPL Saturation	**8.1**

By applying this derived average saturation to all RGA DNAPL zones, Table 11 presents the calculation of DNAPL volume in the RGA.

Table 11. Calculation of the Volume of DNAPL in the RGA Source Zones

TCE DNAPL Source Zone	Volume (ft^3)	Assumed Porosity (%)	Assumed Saturation (%)	TCE DNAPL Volume (ft^3)
TCE Transfer Pump (305-327 ft elevation)	559,834	40	8.1	18,139
TCE Transfer Pump (286-305 ft elevation)	37,297	40	8.1	1,208
TCE Leak Site (SWMU 11) (305-327 ft elevation)	22,000	40	8.1	713
South-End Storm Sewer (322-324.5 ft elevation)	4,908	40	8.1	159

Table 12. Volume of DNAPL in the RGA Source Zones

TCE DNAPL Source Zone	TCE DNAPL Volume (ft^3)	TCE DNAPL Volume (gallons)	TCE DNAPL Volume (liters)
TCE Transfer Pump (305-327 ft elevation)	18,139	135,698	513,696
TCE Transfer Pump (286-305 ft elevation	1,208	9,037	34,210
TCE Leak Site (SWMU 11) (305-327 ft elevation)	713	5,334	20,189
South-End Storm Sewer (322-324.5 ft elevation)	159	1,189	4,503

NOTES ON CALCULATION OF DNAPL VOLUMES

The above calculations ignore the presence of pooled DNAPL. Where pooled DNAPL occurs, the DNAPL volume will be significantly greater than the derived volumes. Dissolved-phase TCE levels in WAG 6 boring 400-207 increase at the base of the RGA, suggesting a DNAPL pool may be present at the base of the RGA. The WAG 6 data are insufficient to quantify the dimensions or volume of pooled DNAPL.

DNAPL pools tend to develop at the interface of permeability barriers. The base of the sand and gravel horizon in the UCRS is another horizon where significant DNAPL pools should be expected.

^{99}TECHNETIUM SOURCE ZONE CALCULATION IN THE UCRS

Technetium Storage Tank/SWMU 47 Source Zone

The lithologic log of the soil boring for well MW175 will be used to represent the soil textures of the Technetium Storage Tank source zone. Table 13 summarizes the dominant UCRS textures with depth.

Table 13. Summary of UCRS Soil Textures for the Former Location of the Technetium Storage Tank

Depth Interval (ft)	Elevation of Base of Interval (ft)	Representative Lithology
0-20	358	clay
20-30	348	gravely sand
30-32	346	sandy clay
32-39	339	gravely sand
39-49	329	clay and sandy silt

The WAG 6 RI found the UCRS soils were unsaturated in the vicinity of the Technetium Storage Tank location down to an elevation of approximately 335 ft. Because ^{99}Tc has a high solubility in oxidized waters (approximately 4,300 pCi/L), this calculation assumes that the only soils retaining ^{99}Tc are in the unsaturated zone. Thus, the base of the ^{99}Tc source zone is at an elevation of 335 ft, a depth of 43 ft.

All of the seven surface soil samples collected within and adjacent to the bermed area that marks the former location of the Technetium Storage Tank exhibit high ^{99}Tc activity. The surface soil ^{99}Tc activity ranges from 4.5 to 53 pCi/g. The only subsurface soil ^{99}Tc activity data comes from analysis of samples from boring 047-002. Table 14 presents the ^{99}Tc analyses for subsurface soil samples of 047-002.

Table 14. ^{99}Technetium in Subsurface Soil Analyses for Boring 047-002

Depth Interval (ft)	^{99}Technetium Activity (pCi/g)
1.0-4.5	8.1
8.5-12.0	0.5
15.5-19	2.2
26-29.5	0.4
Average ^{99}Technetium Activity	**2.8**

The average ^{99}Tc activity of soils from boring 047-002 will be used as the measure of ^{99}Tc activity of the source zone soils.

The three-dimensional distribution of data is insufficient to define the limits of the Technetium Storage Tank source zone. As a default value, the area enclosed by the berm will be used to define the lateral dimensions of the source zone. The basis for this assumption is that spills or leaks from the storage tank are not expected to spread beyond the berm at the land surface and groundwater flow (the likely mechanism for ^{99}Tc migration) is predominately vertical in the UCRS.

The bermed area has a surface area of approximately 625 ft^2. Thus, approximately 26,875 ft^3 of soil is contained within the ^{99}Tc source area. At an average ^{99}Tc activity of 2.8 pCi/g and a bulk density of approximately 1.70 g/cm^3 (specific gravity of 2.65 g/cm^3 and porosity of 36%), the total ^{99}Tc activity of the source zone is:

$$26{,}875\ \text{ft}^3 \times 28{,}317\ \text{cm}^3/\text{ft}^3 \times 1.70\ \text{g/cm}^3 \times 2.8\ \text{pCi/g} = \mathbf{3.62 \times 10^9\ pCi}$$

C-403 Neutralization Pit/SWMU 40 Source Zone

The lithologic logs of the soil boring for well MW178 and boring 040-008 represent the soil textures of the C-403 Neutralization Pit source area. Table 15 presents a summary of the area geology.

Table 15. Summary of UCRS Textures for the Area of the C-403 Neutralization Pit

Depth Interval (ft)	Elevation of Base of Interval (ft)	Representative Lithology
0-17	359	fill (clayey gravel)
17-24	352	clayey silt
24-38	338	gravely sand
38-52	324	clayey silt

One soil boring sampling the backfill of the C-403 Neutralization Pit found water at shallow depth. However, nearby piezometers document the depth of the UCRS saturated zone to be much deeper, at an elevation of approximately 341 ft. Apparently, the depth to water in the saturated backfill of the C-403 pit represents a localized perched water table. For the purposes of approximating a ^{99}Tc source zone, the source zone will be assumed to extend between the base of the C-403 Neutralization Pit (elevation 351 ft) and an elevation of 341 ft.

The only ^{99}Tc in soil analyses for the source zone depths at SWMU 40 are for single samples taken from the east and west sides of the C-403 pit. In both samples, the ^{99}Tc activity was minimal (0.1 and 0.4 pCi/g). For the purposes of defining a source zone volume for the C-403 Neutralization Pit, it will be assumed that the source zone approximates a cylinder with a diameter extending one half of the width of the pit (the pit is 25 ft wide).

For lack of better data, it will also be assumed that the average ^{99}Tc activity in soil and the bulk density of the soil is the same as the average for the Technetium Storage Tank area, 2.8 pCi/g and 1.70 g/cm^3, respectively. The total ^{99}Tc activity of the source zone is:

$$1{,}227 \text{ ft}^3 \times 28{,}317 \text{ cm}^3/\text{ft}^3 \times 1.70 \text{ g/cm}^3 \times 2.8 \text{ pCi/g} = \mathbf{1.65 \times 10^8 \text{ pCi}}$$

MASS OF ^{99}TECHNETIUM IN THE UCRS SOURCE ZONES

Table 16 summarizes the volume and total activity of the two discrete UCRS ^{99}Tc source zones as well as the mass of ^{99}Tc present, assuming a specific activity of 0.017 Ci/g (Shleien, 1992).

Table 16. Summary of UCRS ^{99}Technetium Source Zones

^{99}Tc Source Zone	^{99}Tc Source Zone Volume (ft^3)	Total ^{99}Tc Activity in ^{99}Tc Source Zone (Ci)	Total ^{99}Tc Mass in ^{99}Tc Source Zone (g)
Technetium Storage Tank (SWMU 47)	26,875	3.62×10^{-3}	2.13×10^{-1}
C-403 Neutralization Pit (SWMU 40)	1,227	1.65×10^{-4}	9.71×10^{-3}

REFERENCES

EPA, 1992. *Estimating Potential for Occurrence of DNAPL at Superfund Sites*, Publication 9355.4-07FS, United States Environmental Protection Agency, R.S. Kerr Environmental Research Laboratory, January, 1992.

Kueper, B.H., 1991. *The Occurrence of Dense, Non-Aqueous Phase Liquids in the Subsurface at the Paducah Gaseous Diffusion Plant*, KY/ER/Sub/0815-1015/91/2, Queens University, Kingston, Canada, November, 1991.

Shleien, 1992. Shleien, Bernard, ed., *The Health Physics and Radiological Health Handbook*, Scinta, Inc., Silver Springs, MD, 1992.

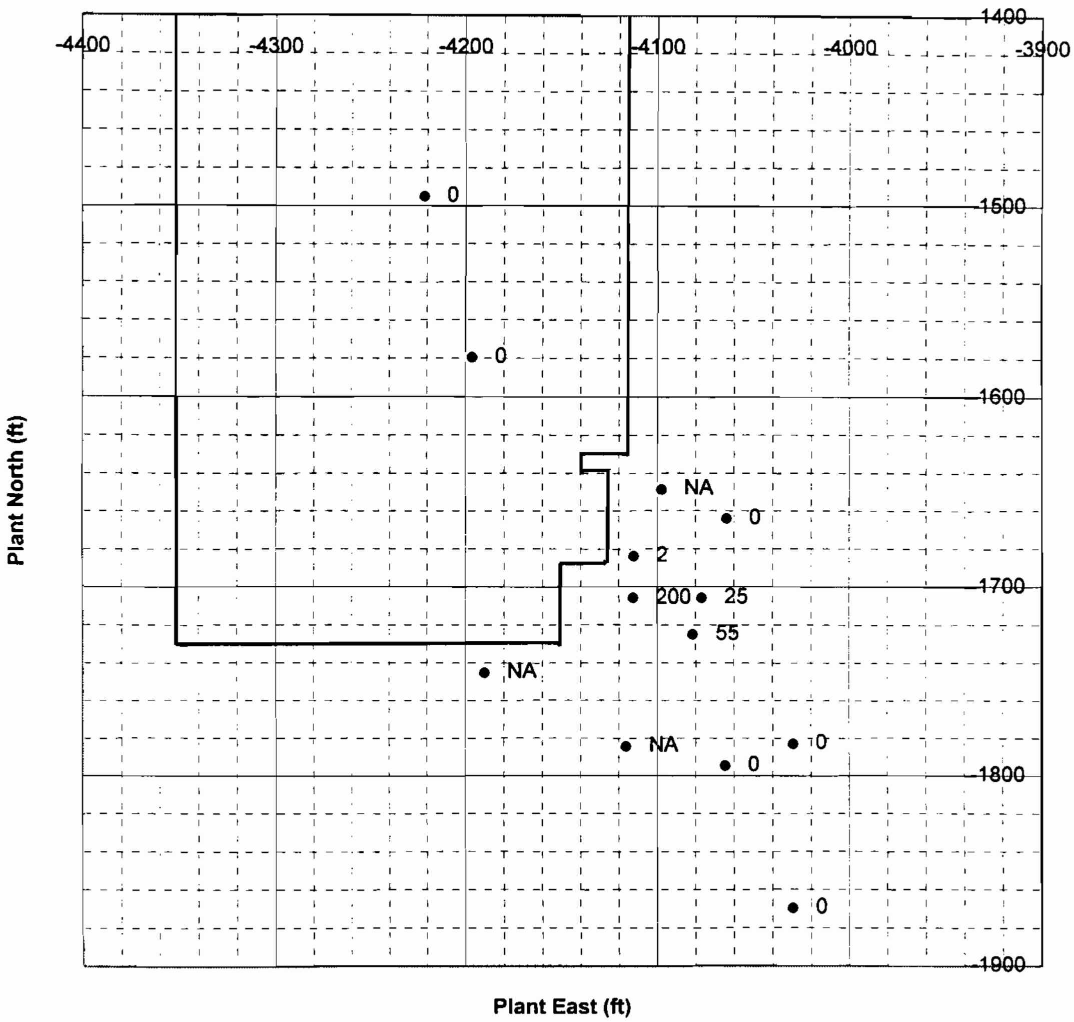
THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A
Isoconcentration Maps of TCE in Soil (µg/g *or ppm*)
for the Southeast C-400 Block

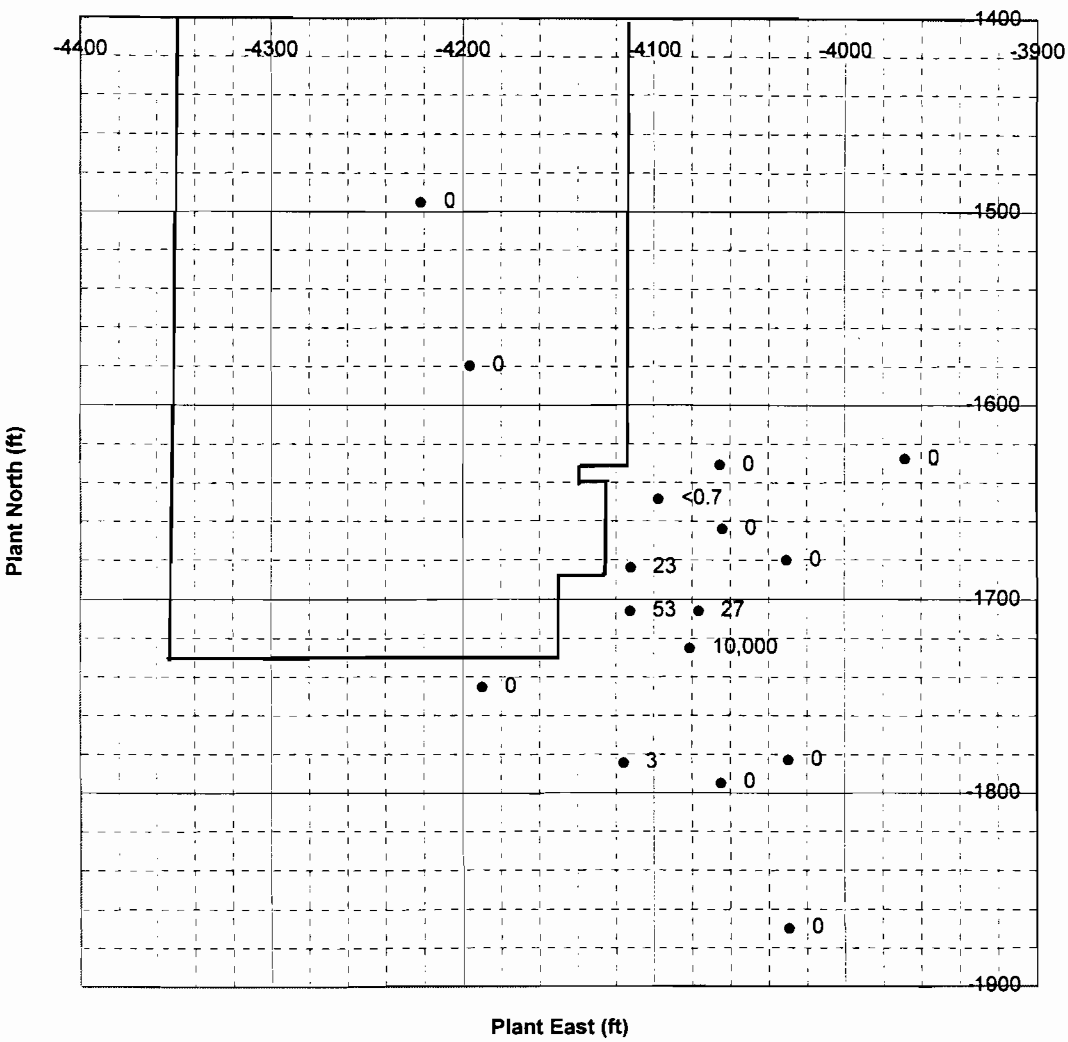
- • soil sample
- Ж water sample

THIS PAGE INTENTIONALLY LEFT BLANK

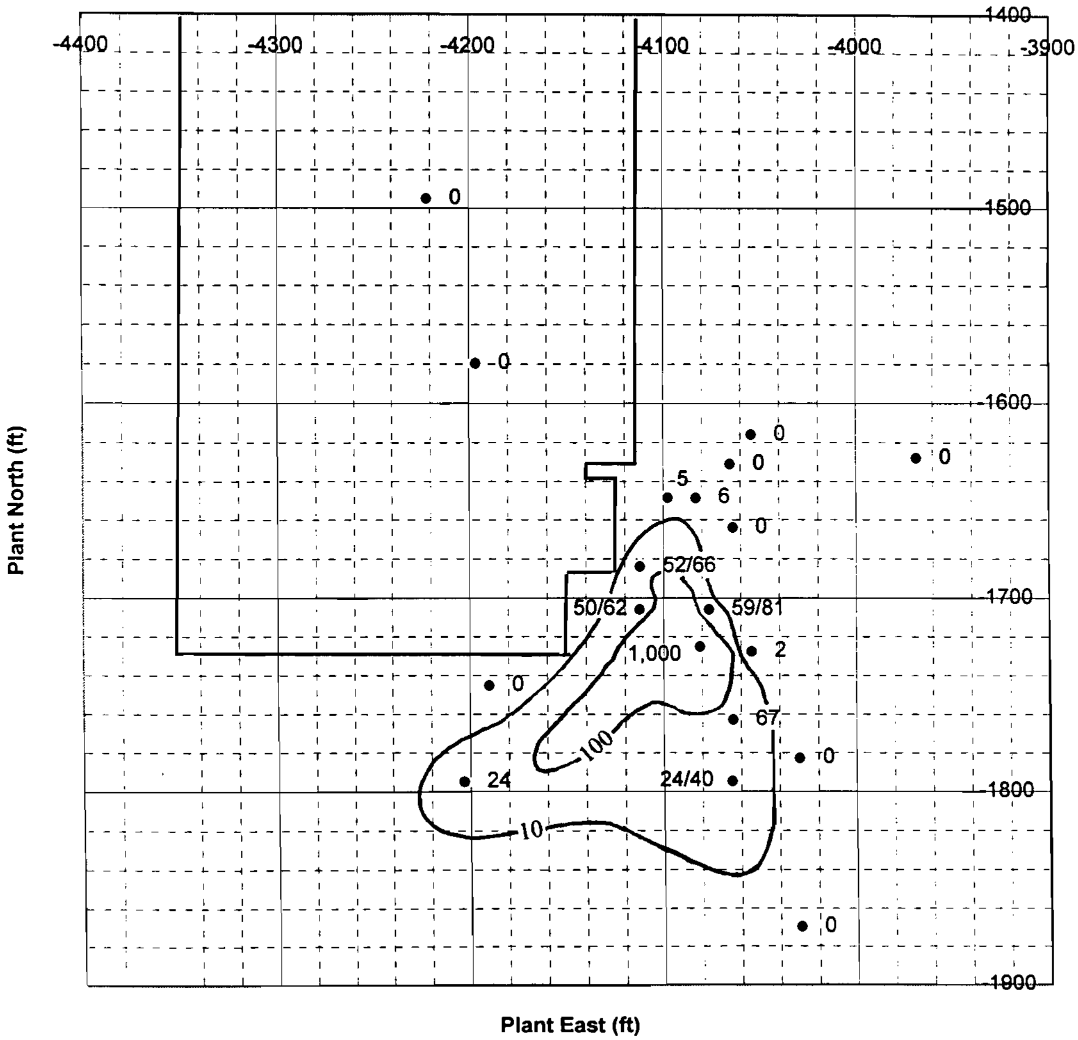
TCE LEVEL (375.0 - 379.9)



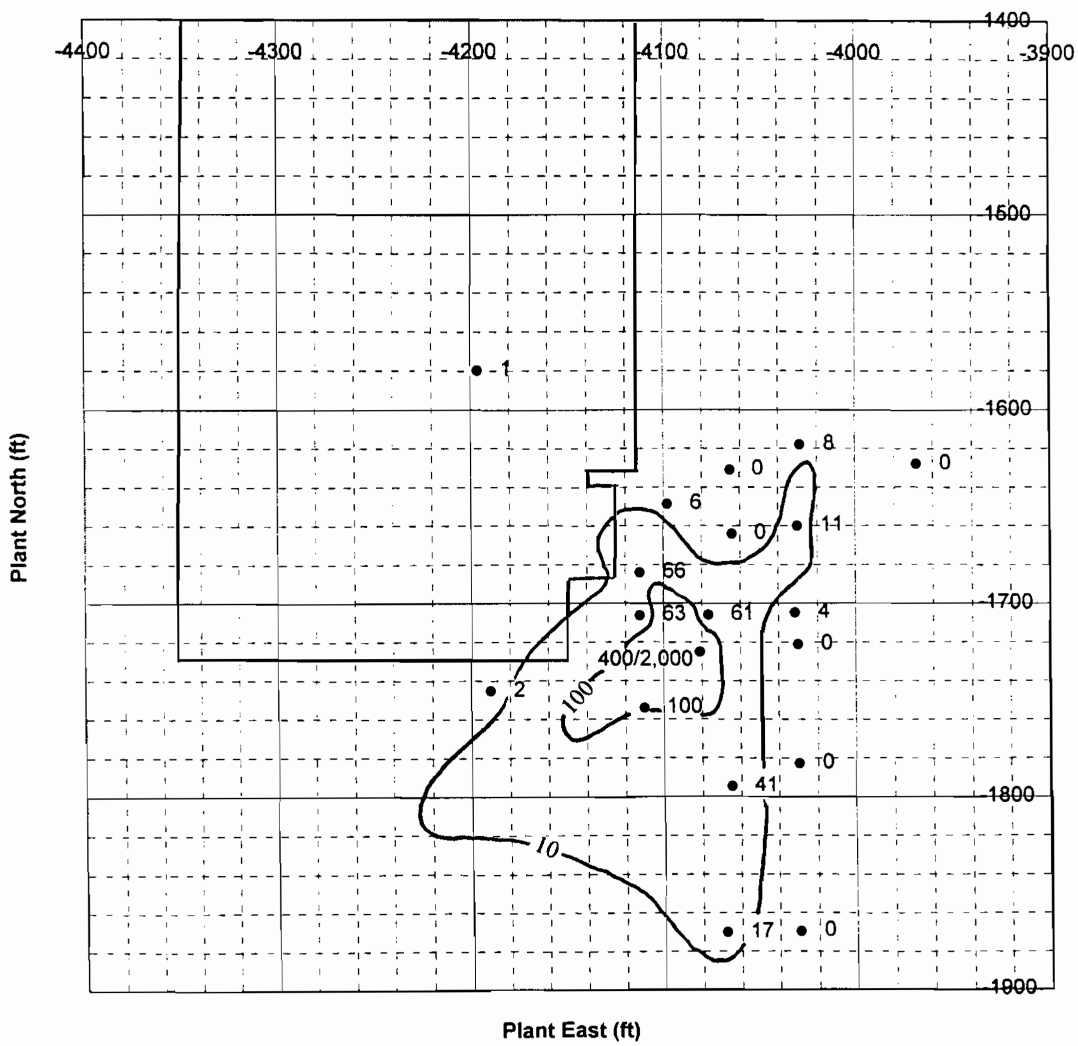
TCE LEVEL (370.0 - 374.9)



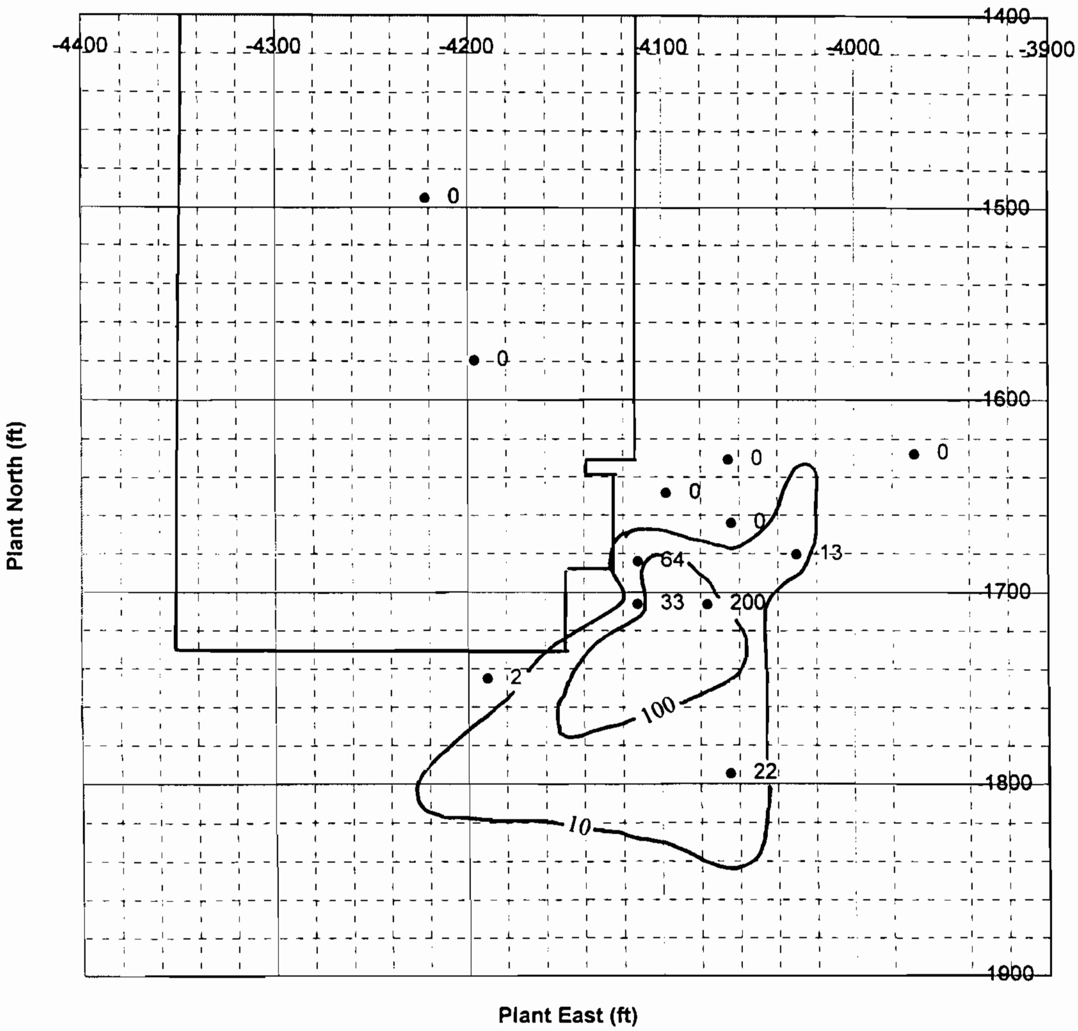
TCE LEVEL (365.0 - 369.9)

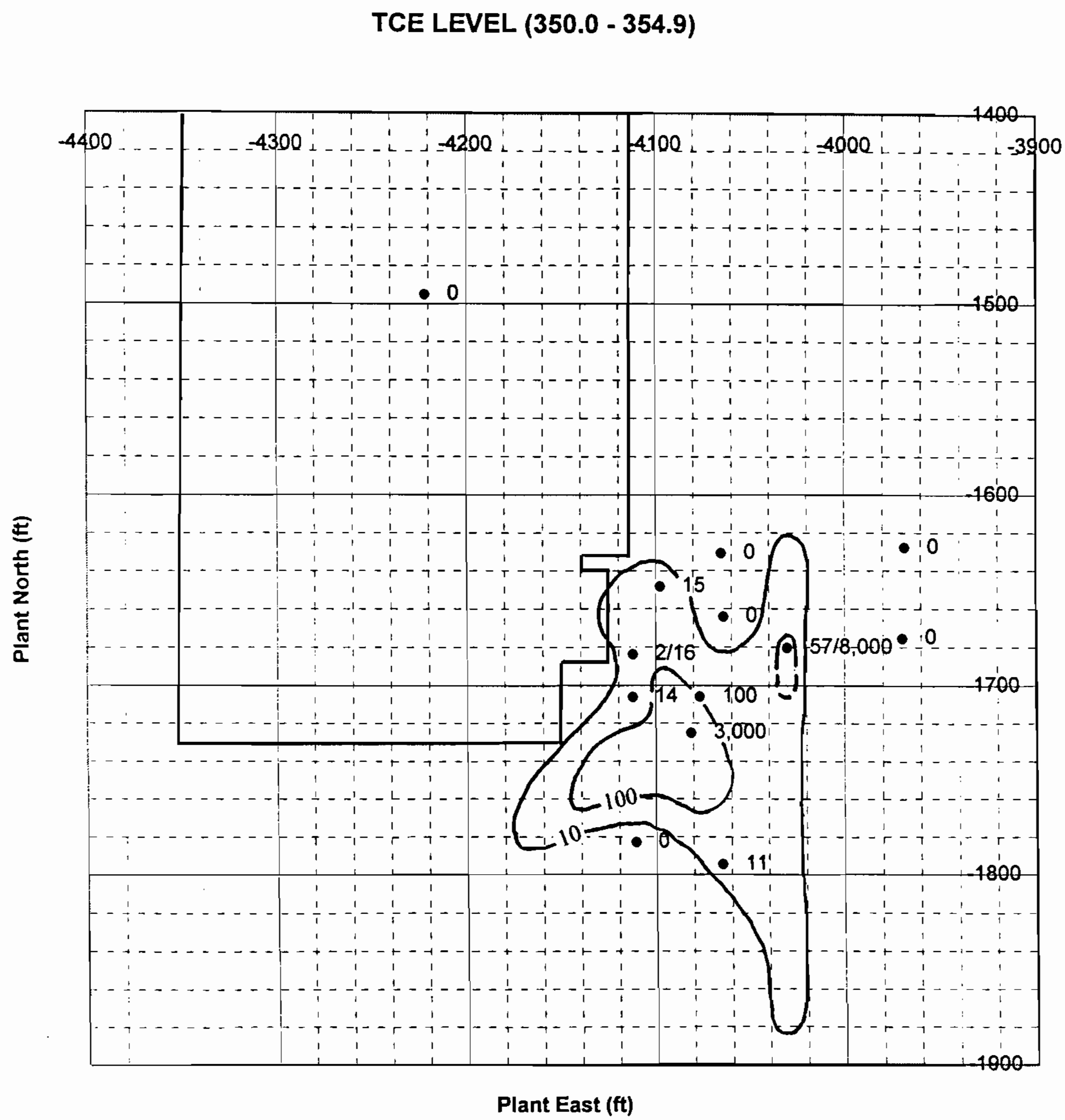


TCE LEVEL (360.0 - 364.9)



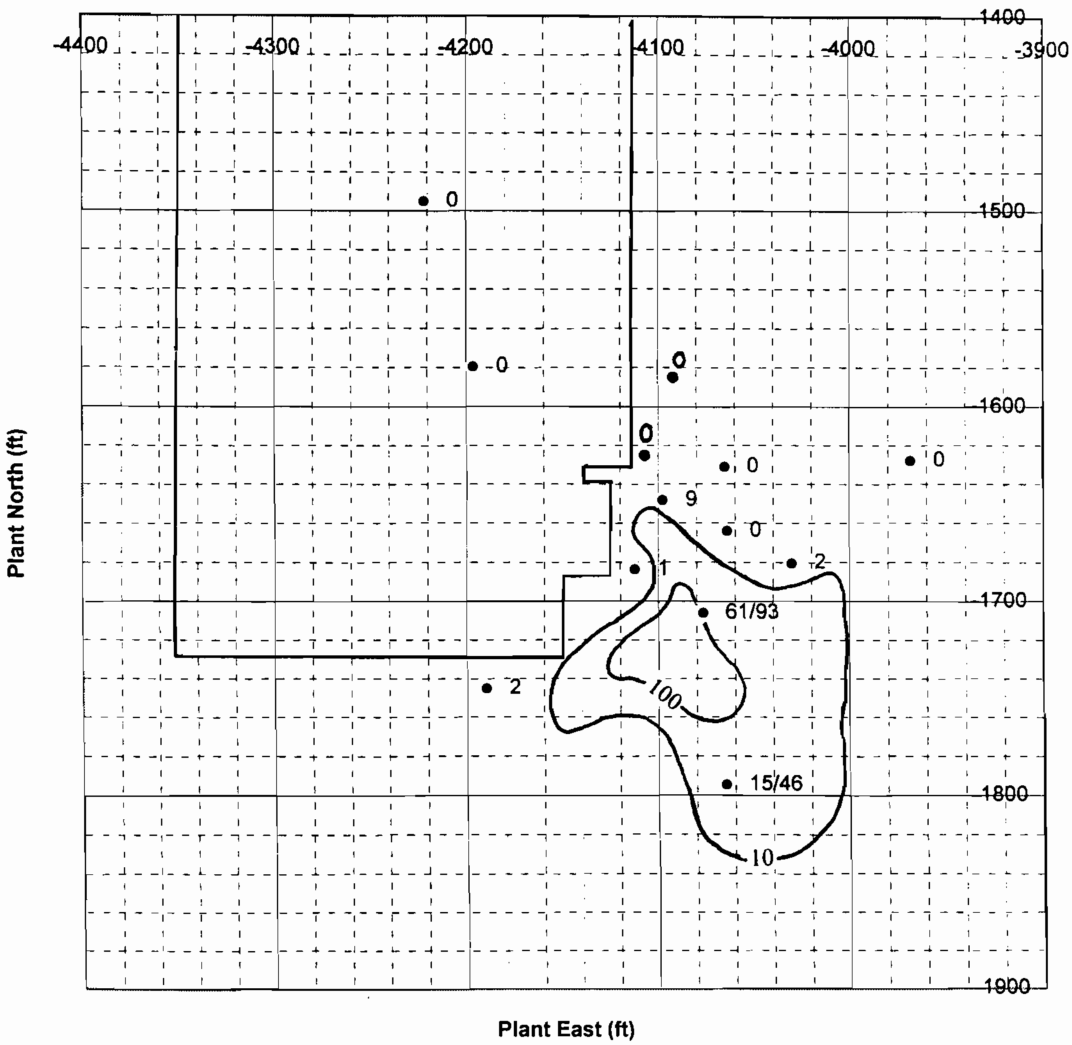
TCE LEVEL (355.0 - 359.9)



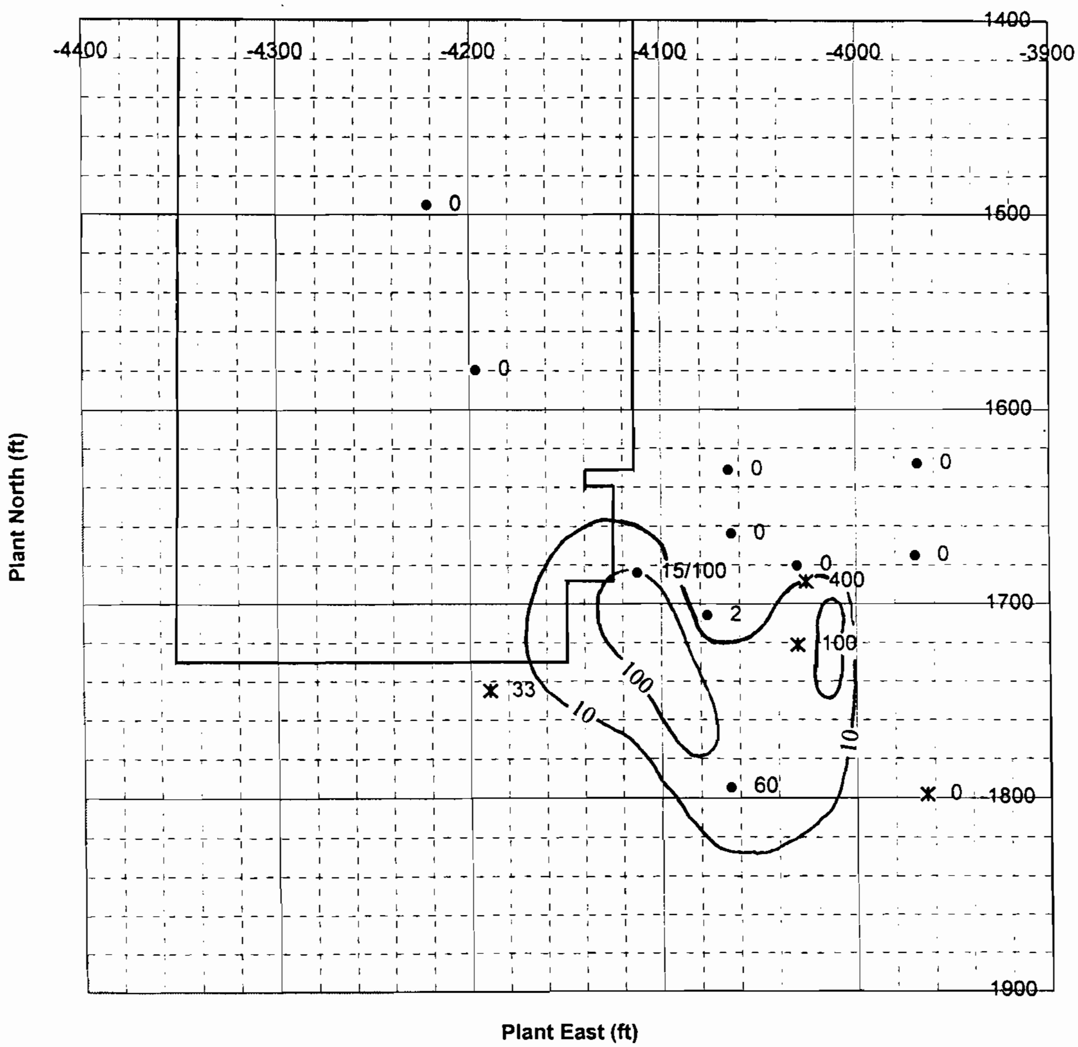


TCE LEVEL (350.0 - 354.9)
-4400
-4300
-4200
-4100
-4000
-3900
1400
1500
1600
1700
1800
1900
0
0
0
15
0
0
2/16
57/8,000
14
100
3,000
100
10
0
11
Plant North (ft)
Plant East (ft)

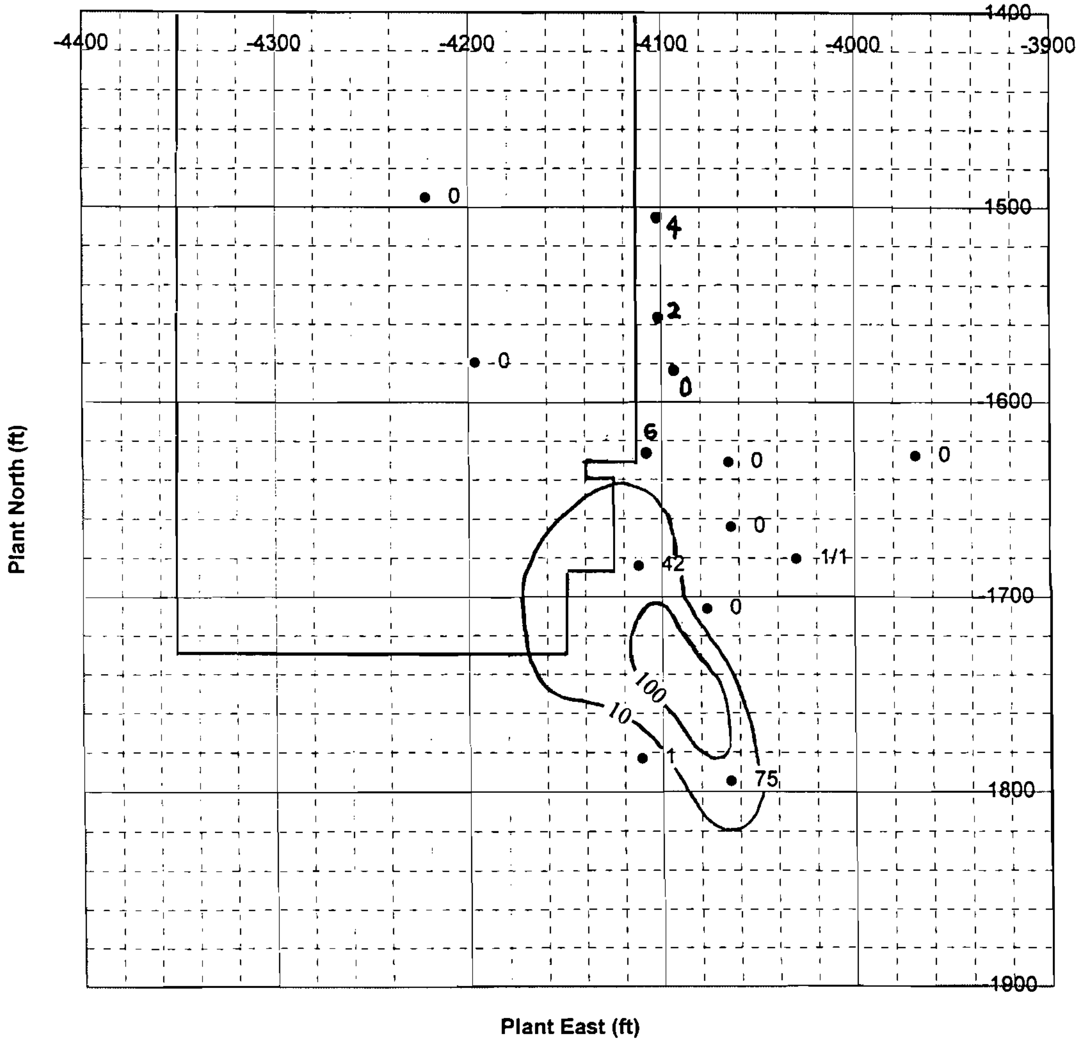
TCE LEVEL (345.0 - 349.9)



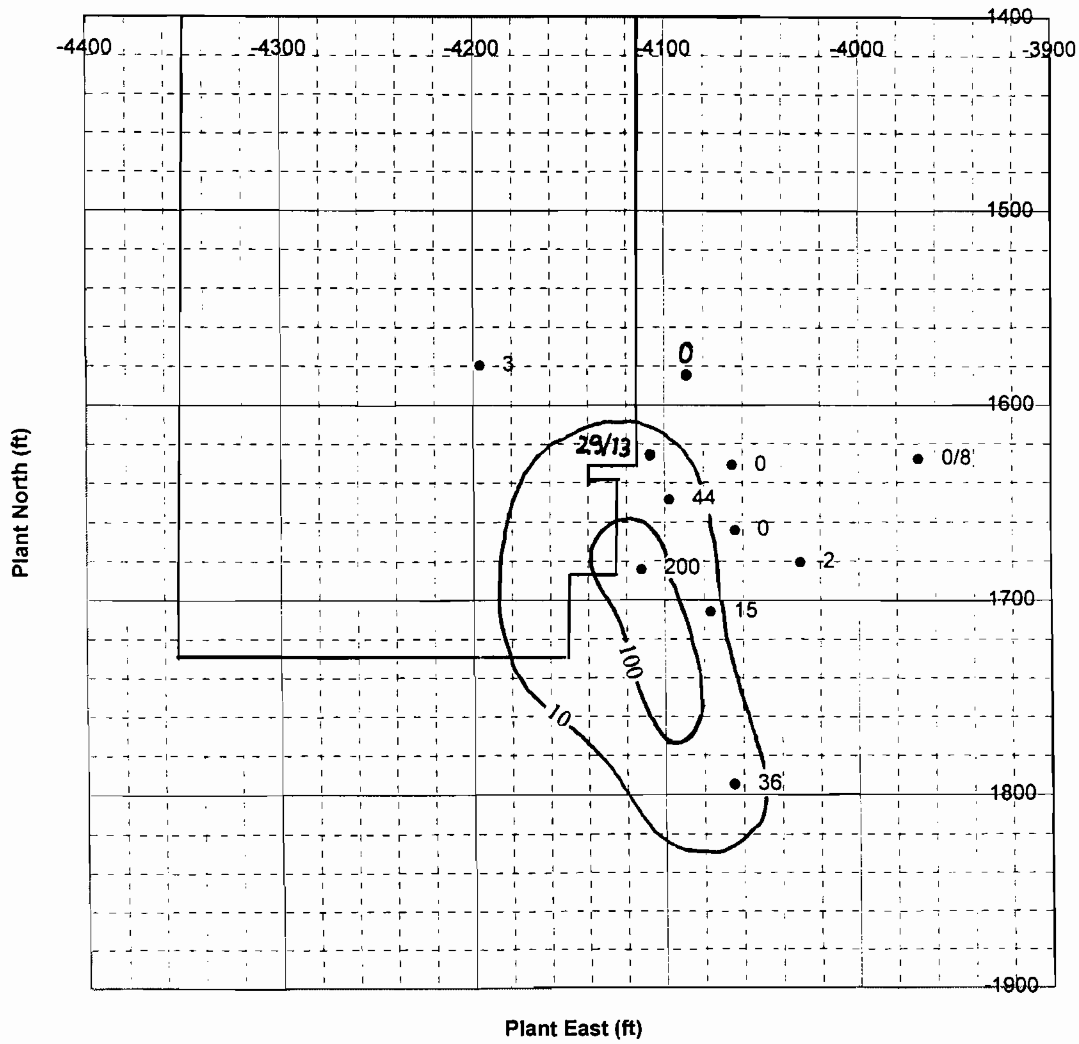
TCE LEVEL (340.0 - 344.9)



TCE LEVEL (335.0 - 339.9)



TCE LEVEL (330.0 - 334.9)

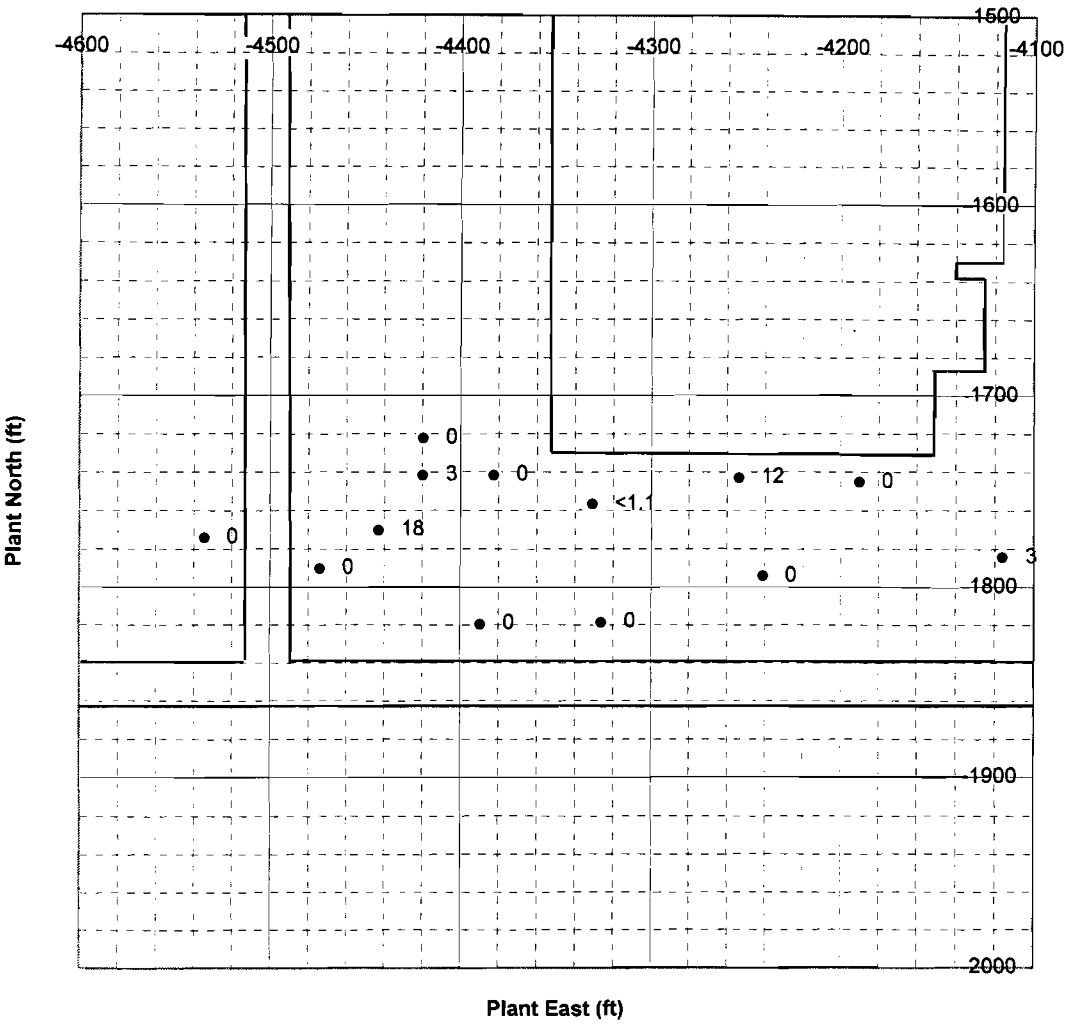


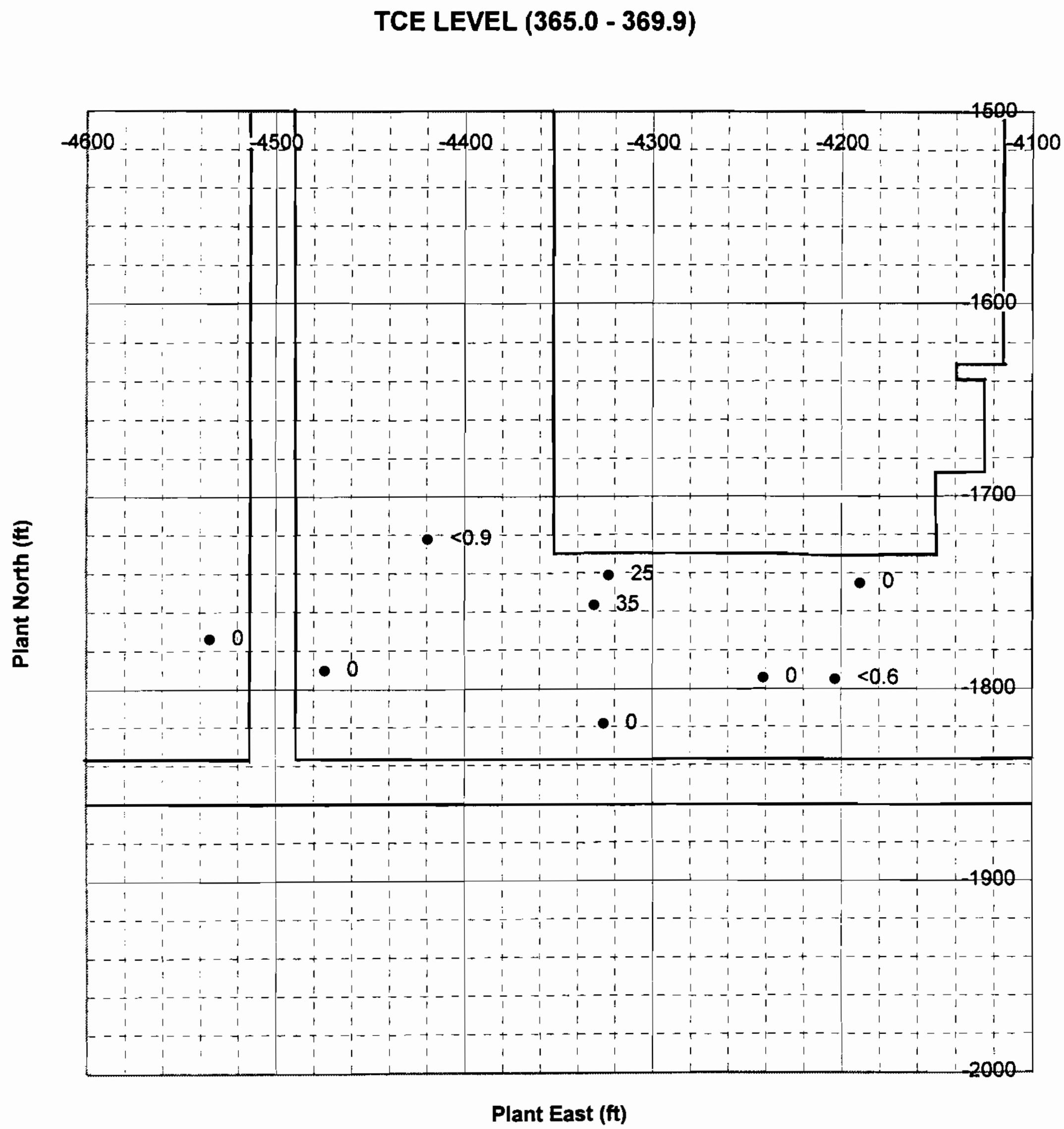
Appendix B

TCE in Soil Analyses (μg/g *or ppm*) for the Area of the C-400 Building Southwest Storm Sewer

THIS PAGE INTENTIONALLY LEFT BLANK

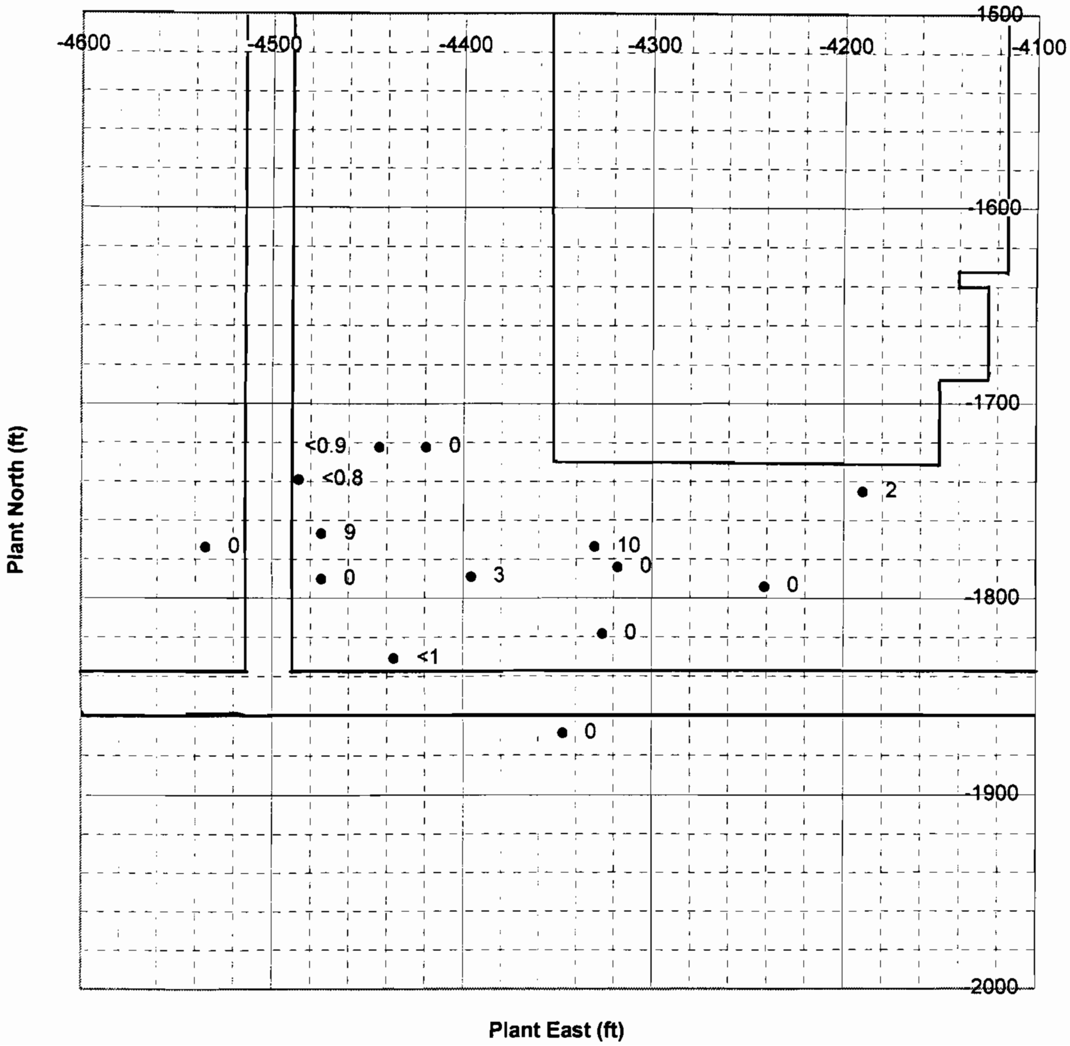
TCE LEVEL (370.0 - 374.9)



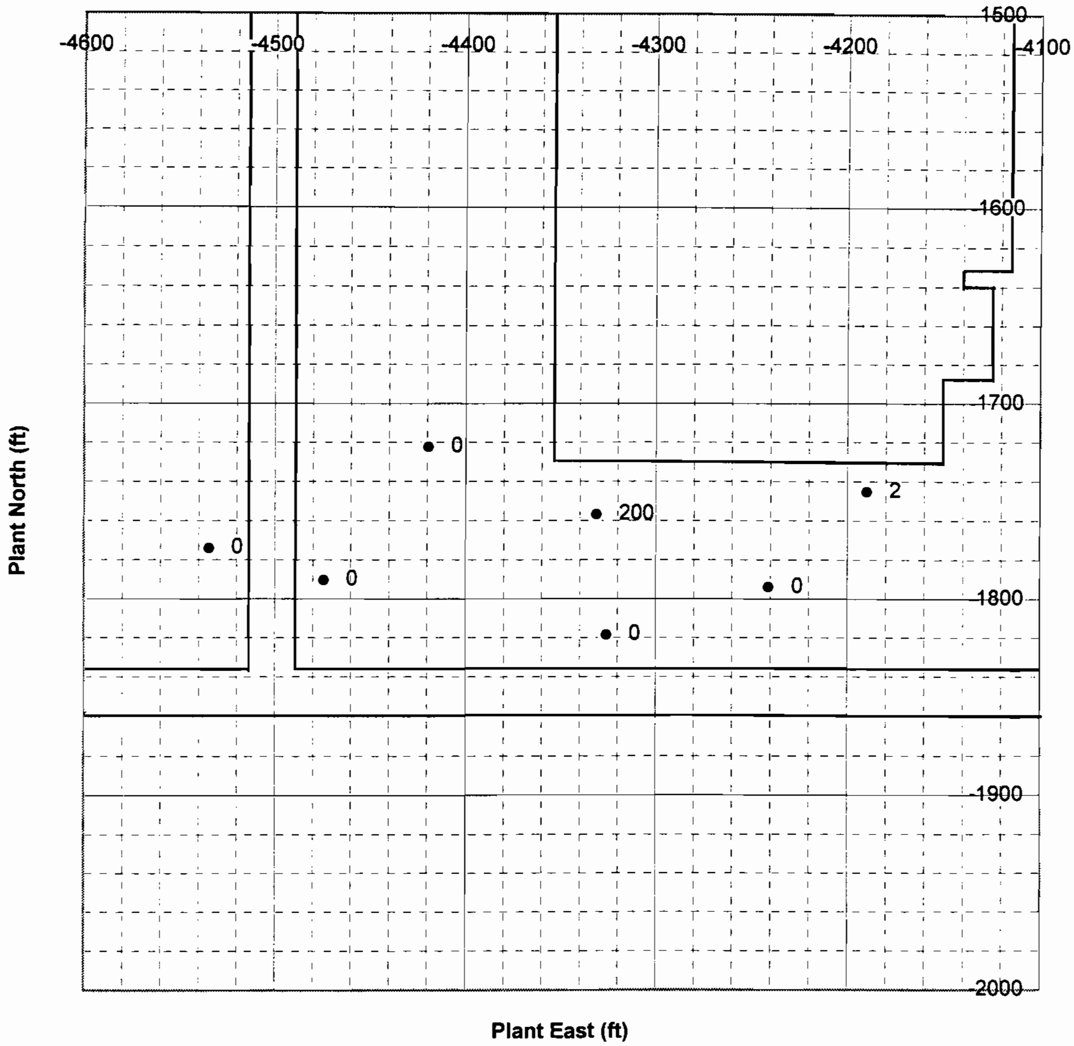


TCE LEVEL (365.0 - 369.9)
-4600
-4500
-4400
-4300
-4200
-4100
-1500
-1600
-1700
-1800
-1900
-2000
<0.9
25
35
0
0
0
<0.6
0
0
Plant North (ft)
Plant East (ft)

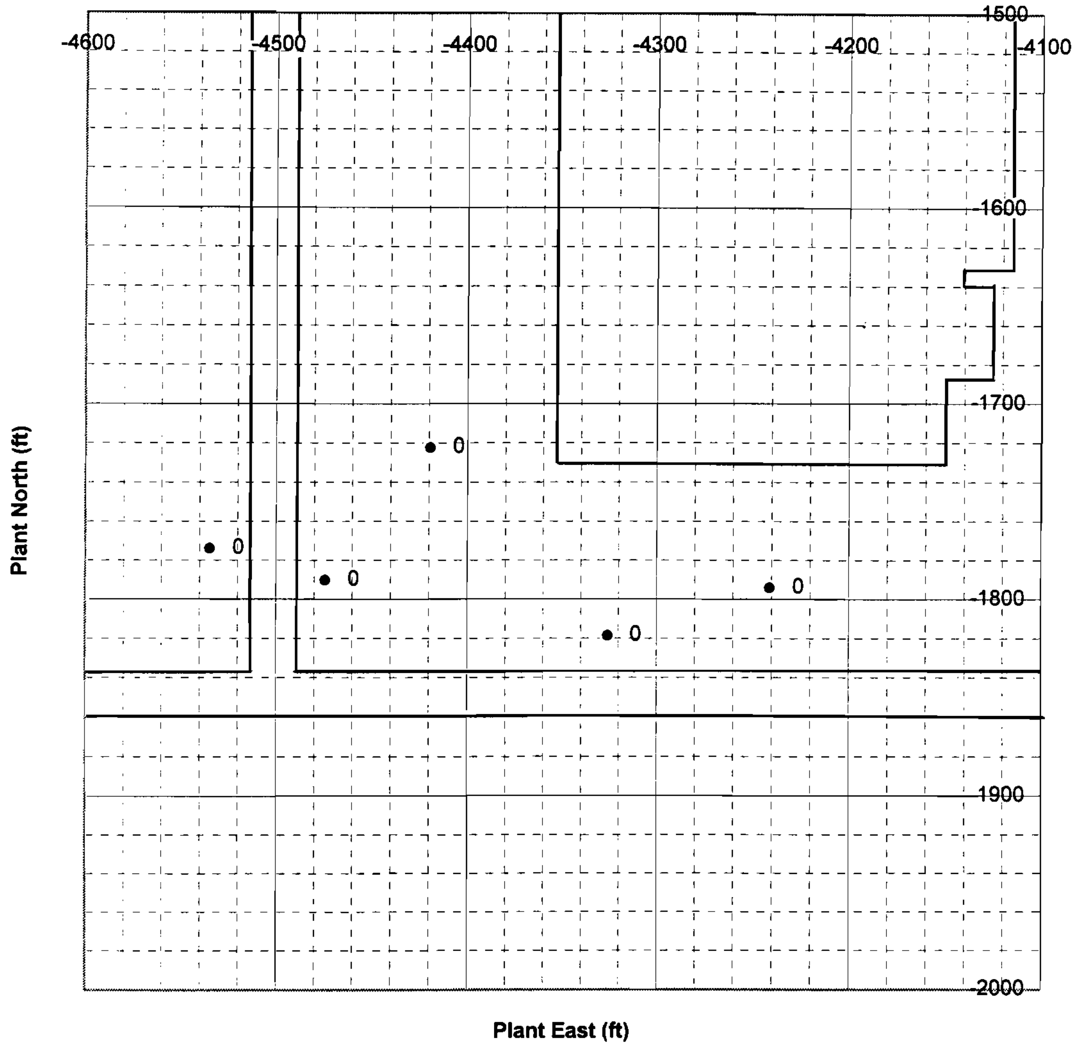
TCE LEVEL (360.0 - 364.9)



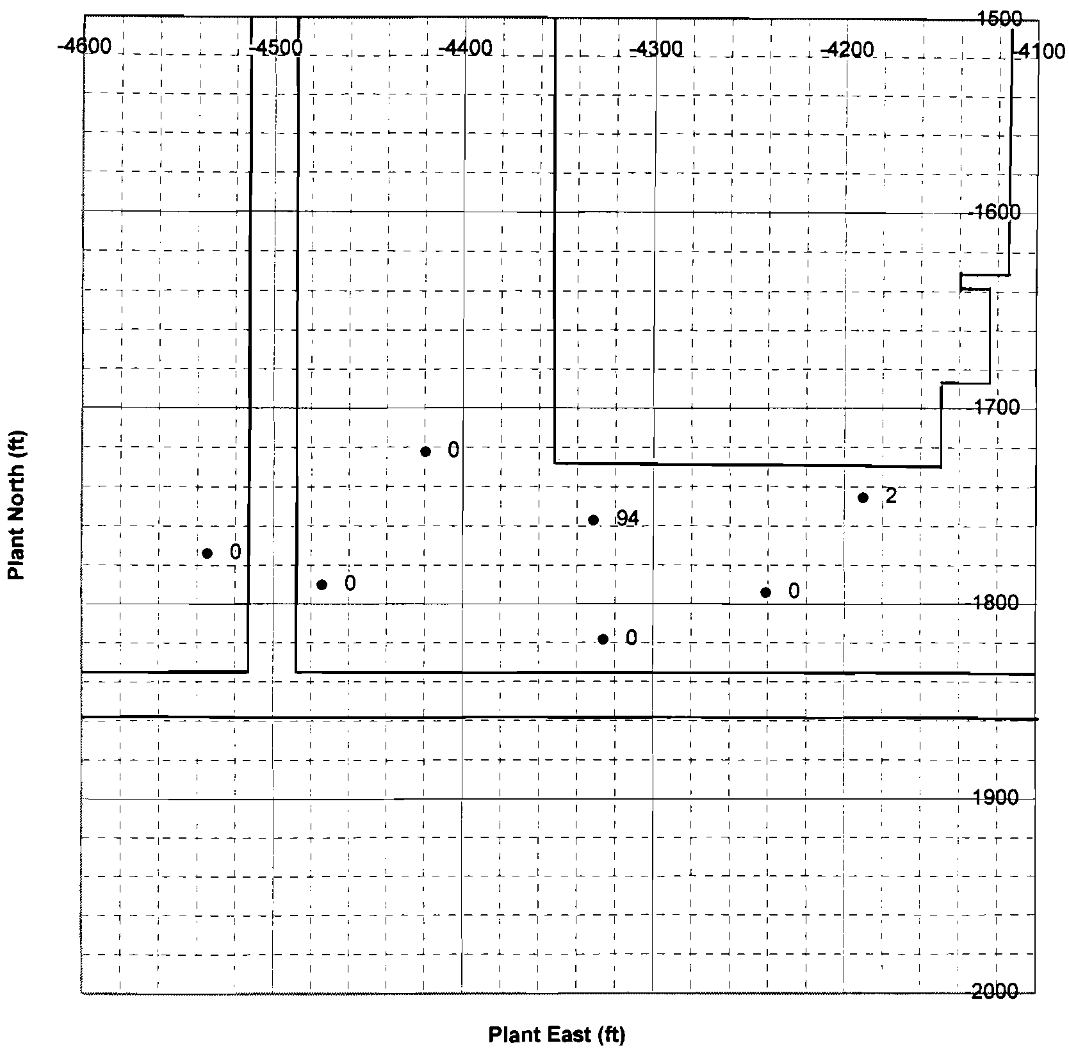
TCE LEVEL (355.0 - 359.9)



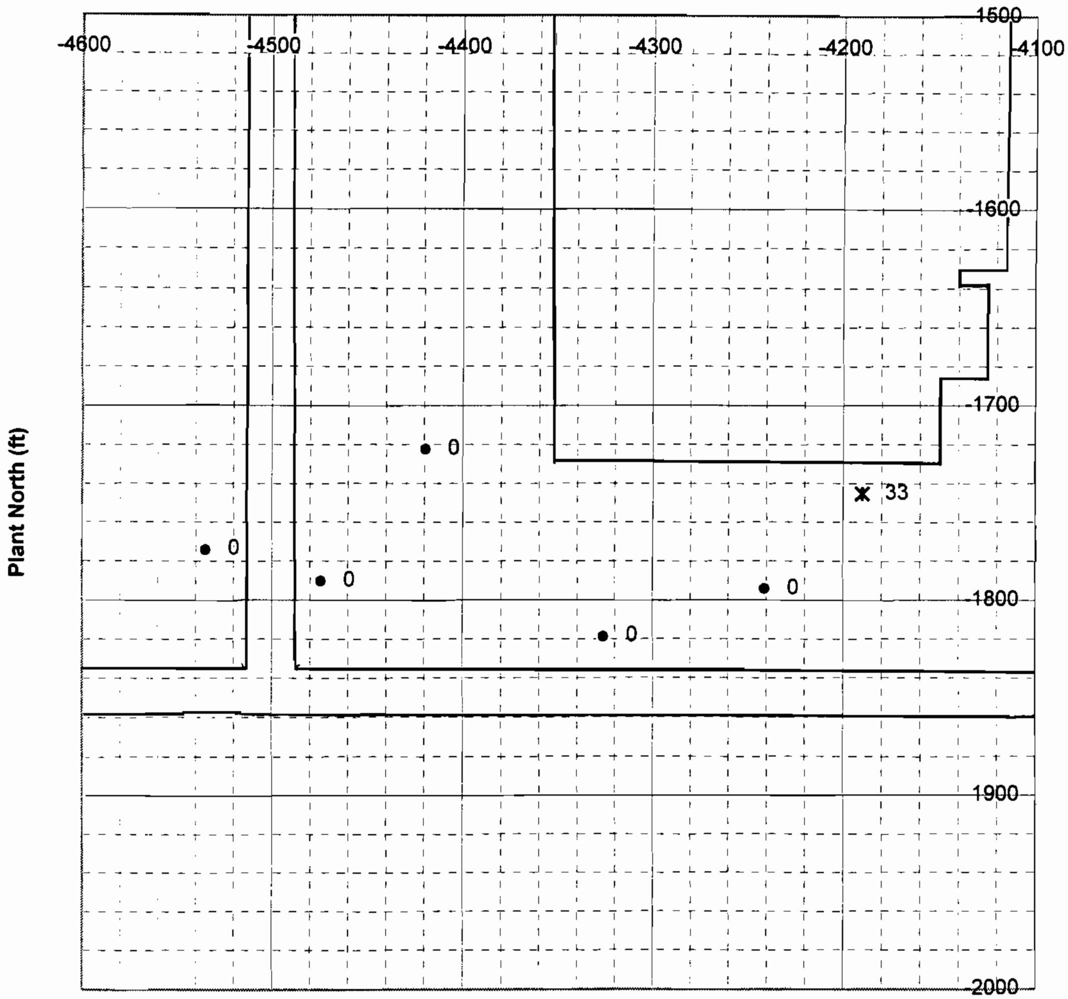
TCE LEVEL (350.0 - 354.9)



TCE LEVEL (345.0 - 349.9)

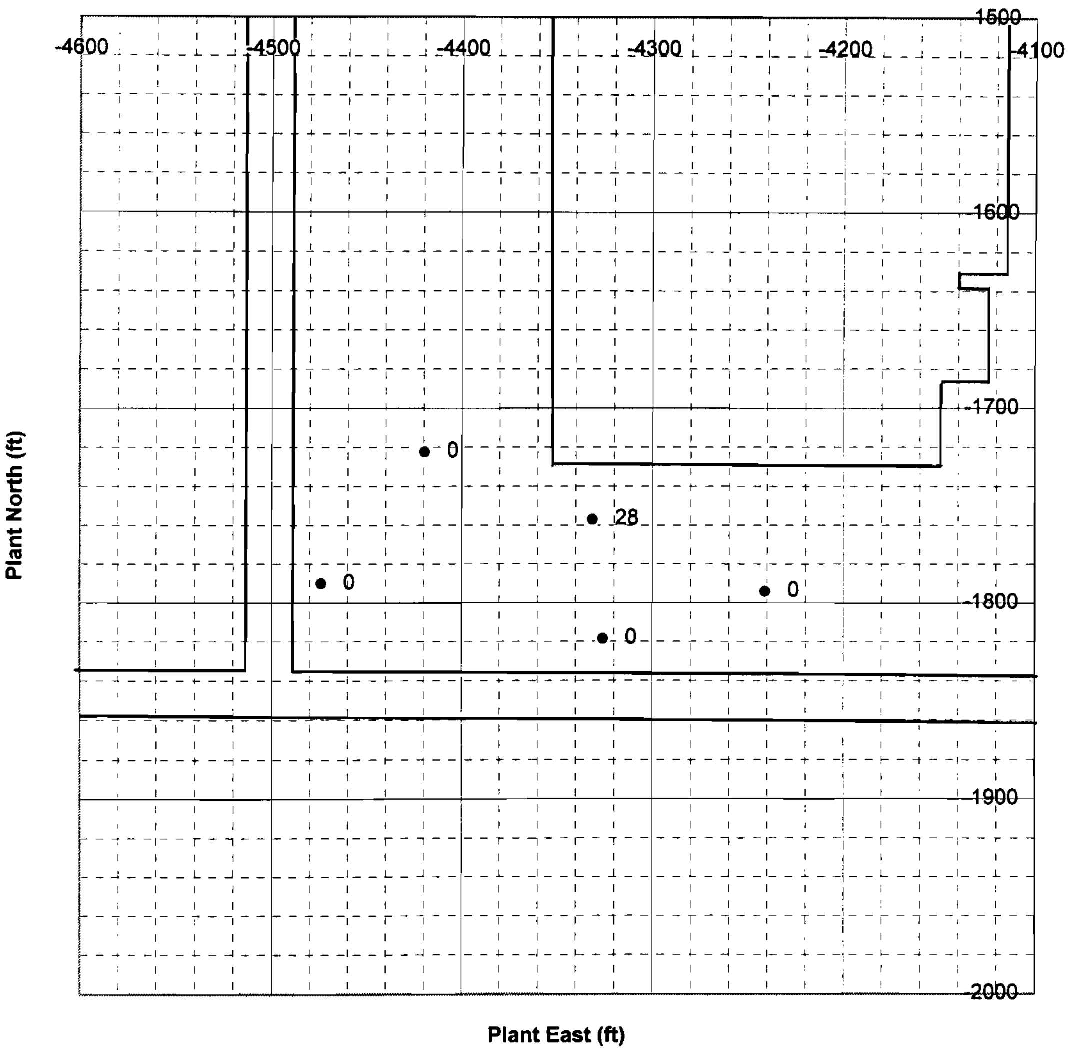


TCE LEVEL (340.0 - 344.9)



Plant East (ft)

TCE LEVEL (335.0 - 339.9)



Appendix C
Contoured Isoconcentration Maps of
Dissolved-Phase TCE (µg/L *or ppb)*
and
Contoured Isoactivity Maps of
Dissolved Beta Activity (pCi/L)
for the RGA

Ж water sample

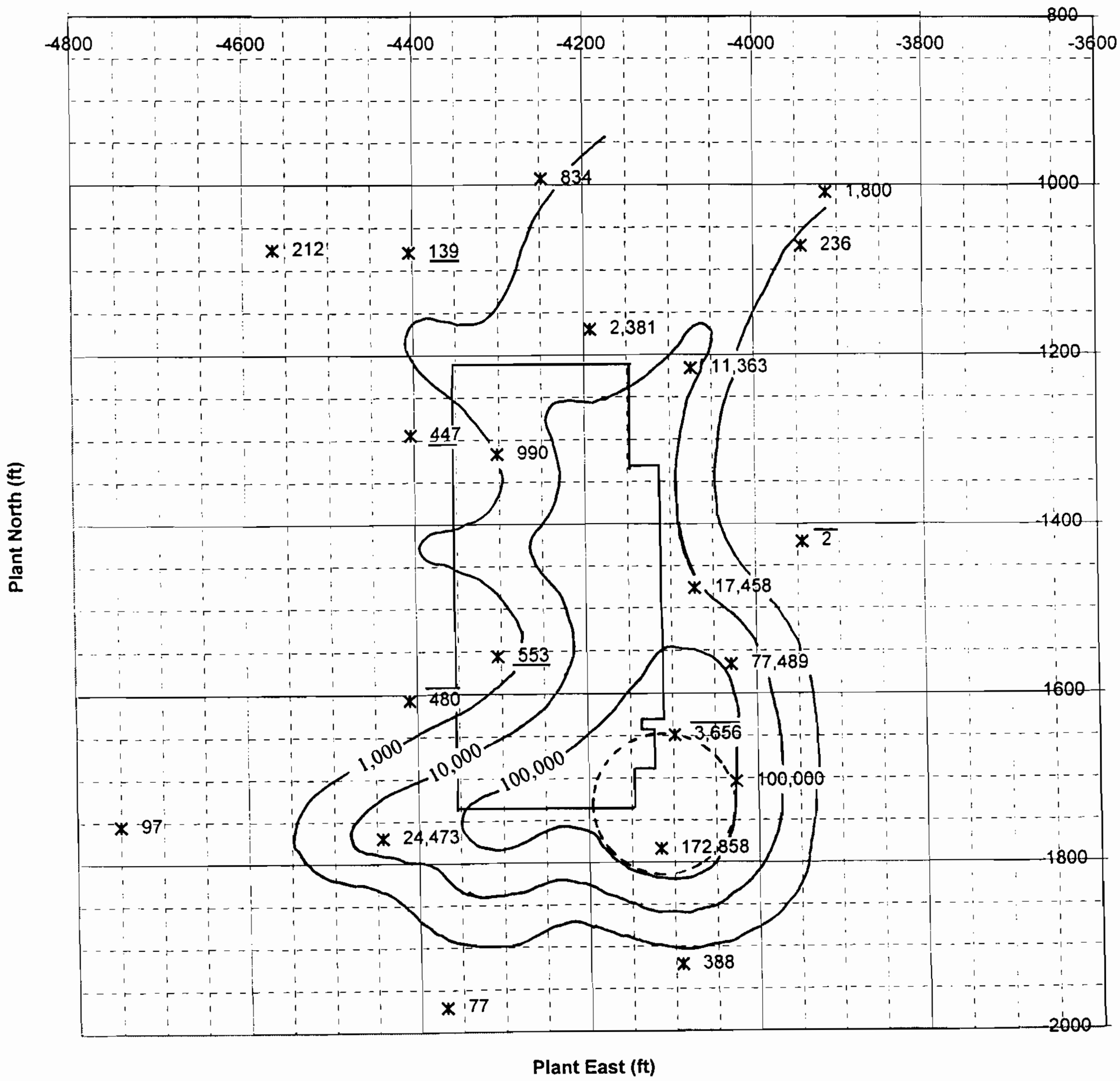
$\overline{\#}$ value is biased low by sampling or analytical methods

$\underline{\#}$ value is biased high by sampling or anlytical methods

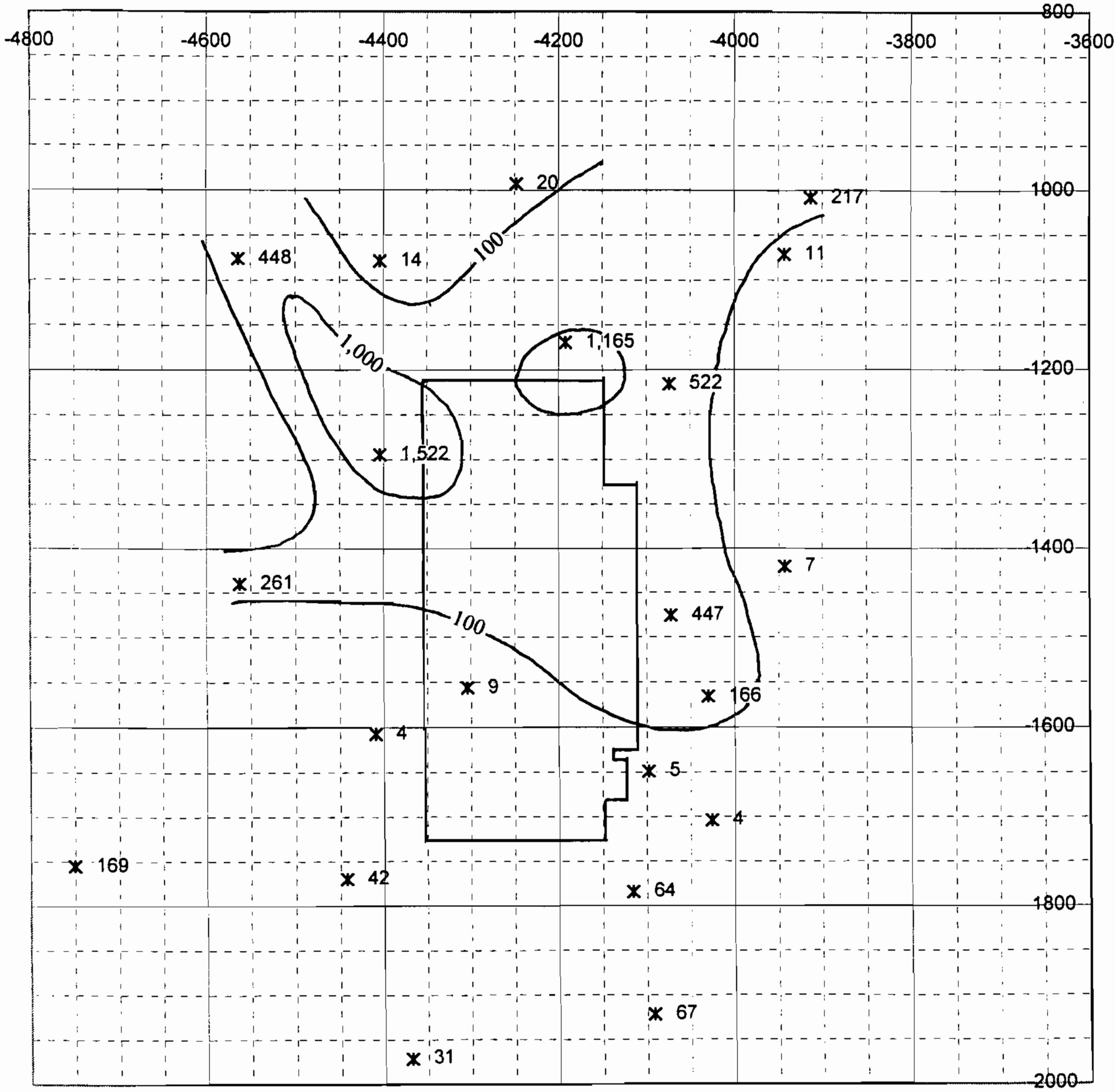
DNAPL source zone associated with the TCE transfer pump leak site

THIS PAGE INTENTIONALLY LEFT BLANK

TCE LEVEL (310.0 - 314.9)

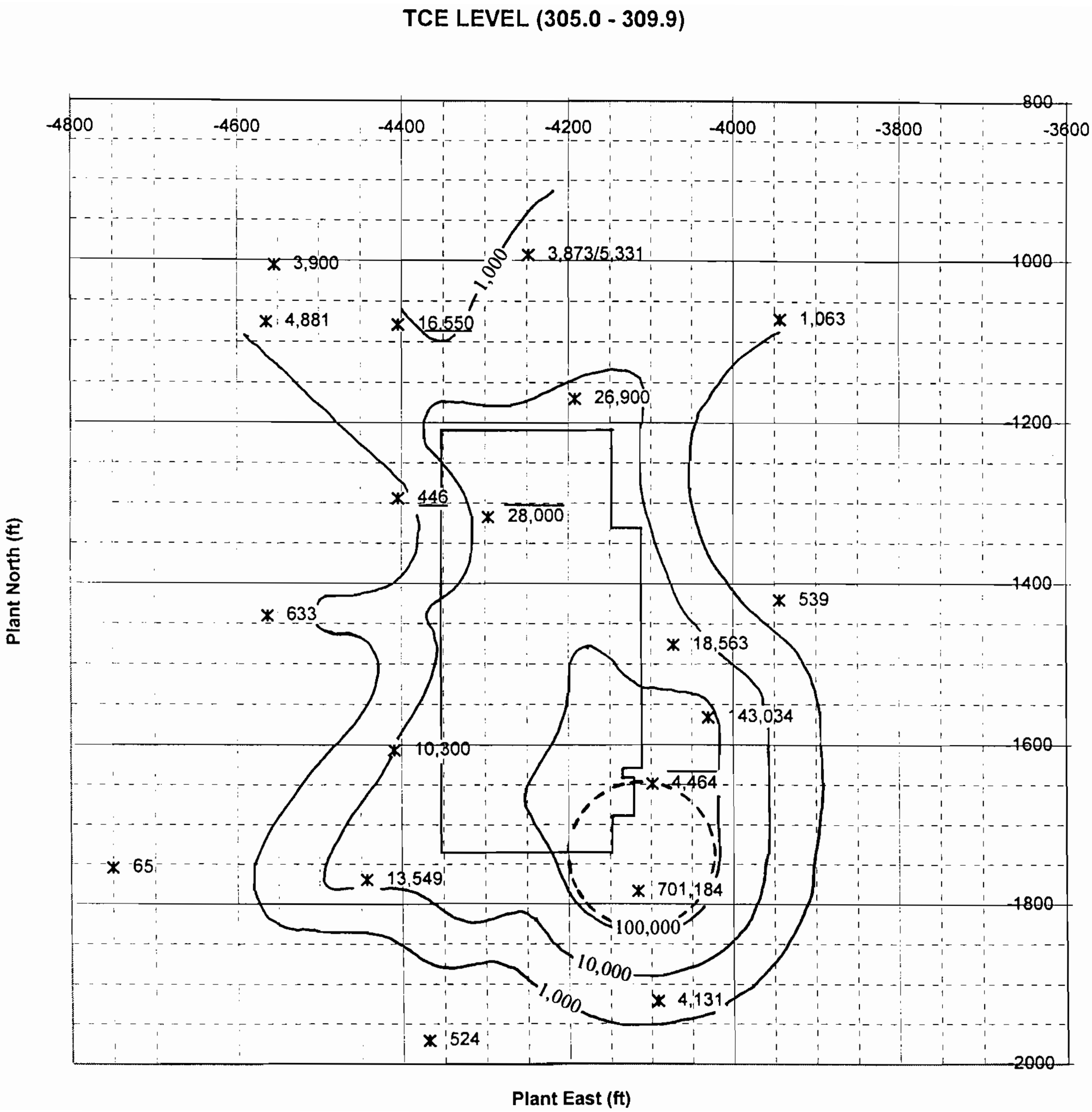


BETA ACTIVITY (310.0 - 314.9)



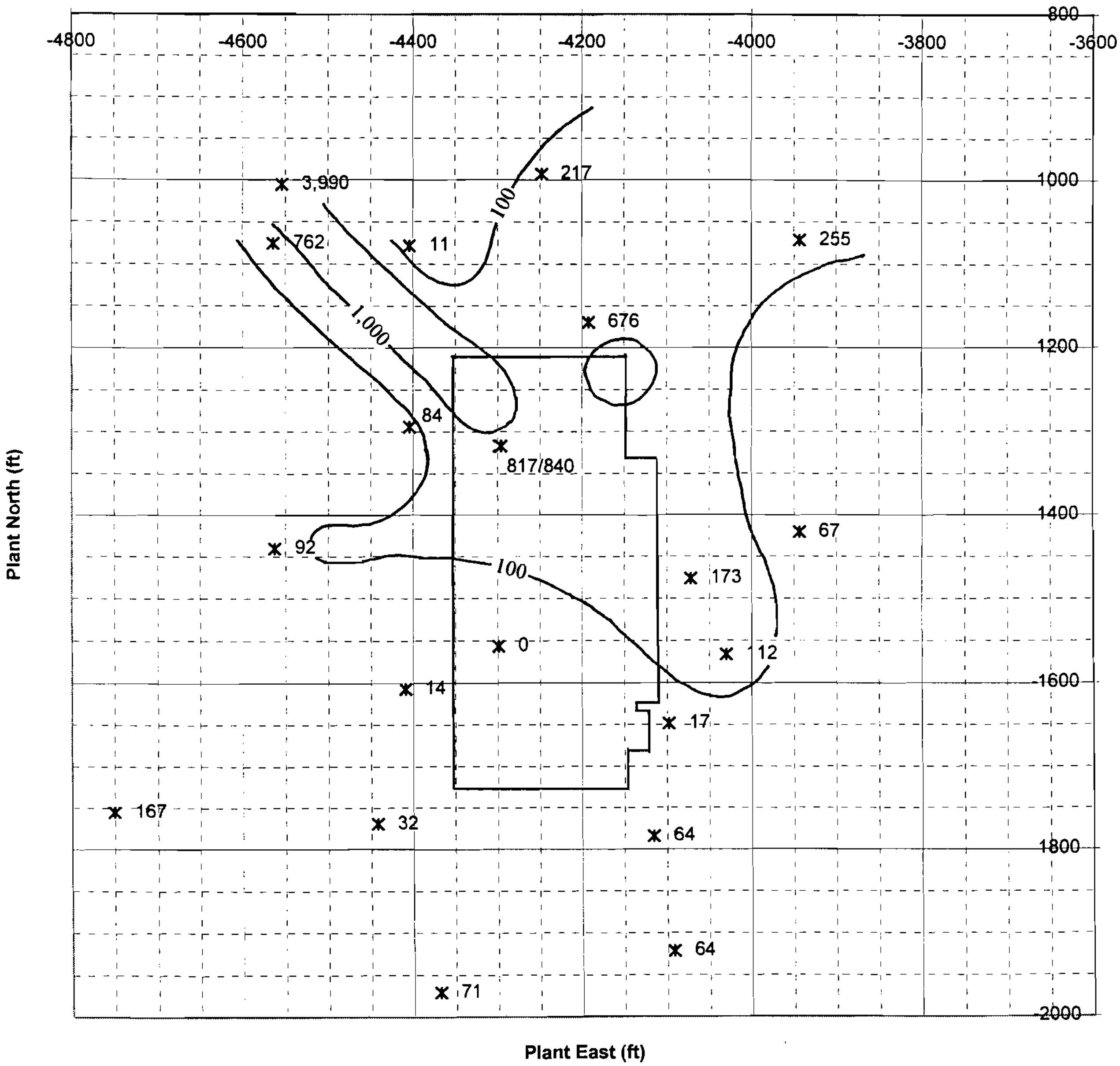
Plant North (ft)

Plant East (ft)

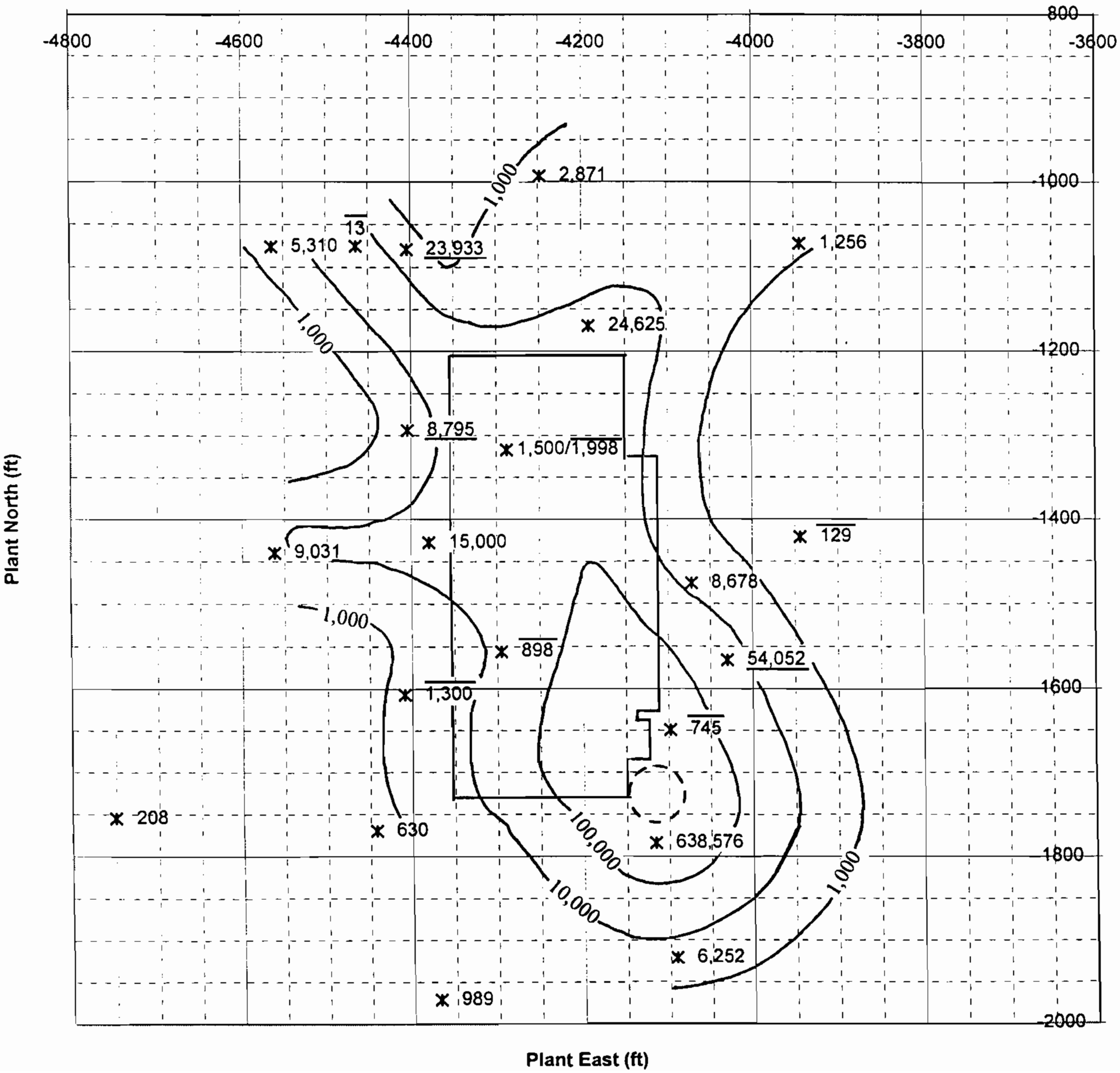


TCE LEVEL (305.0 - 309.9)
-4800
-4600
-4400
-4200
-4000
-3800
-3600
800
1000
1200
1400
1600
1800
2000
Plant North (ft)
Plant East (ft)
3,900
3,873/5,331
4,881
16,550
1,063
26,900
446
28,000
539
633
18,563
43,034
10,300
4,464
65
13,549
701,184
100,000
10,000
1,000
4,131
524

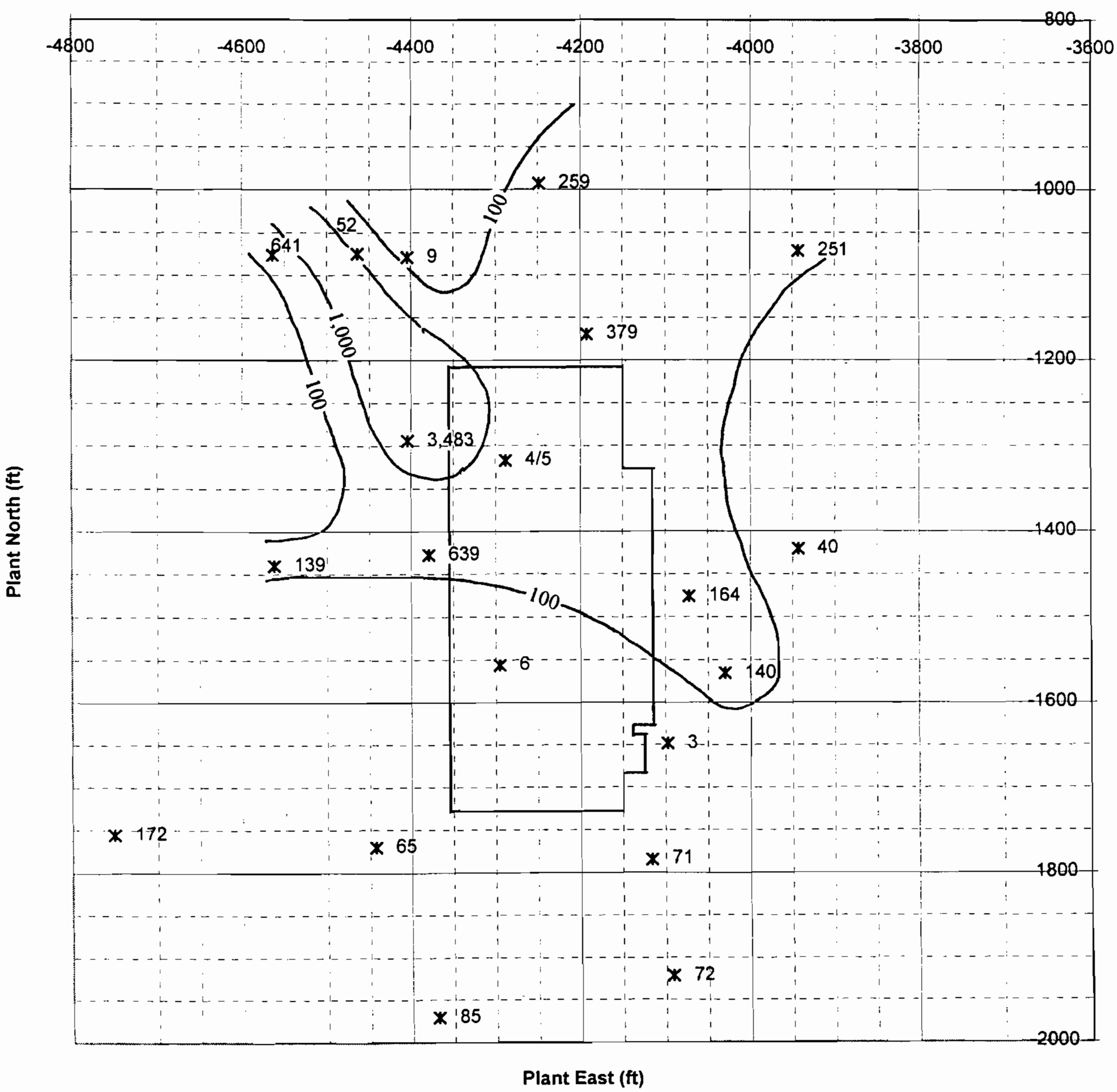
BETA ACTIVITY (305 - 309.9 ft amsl)



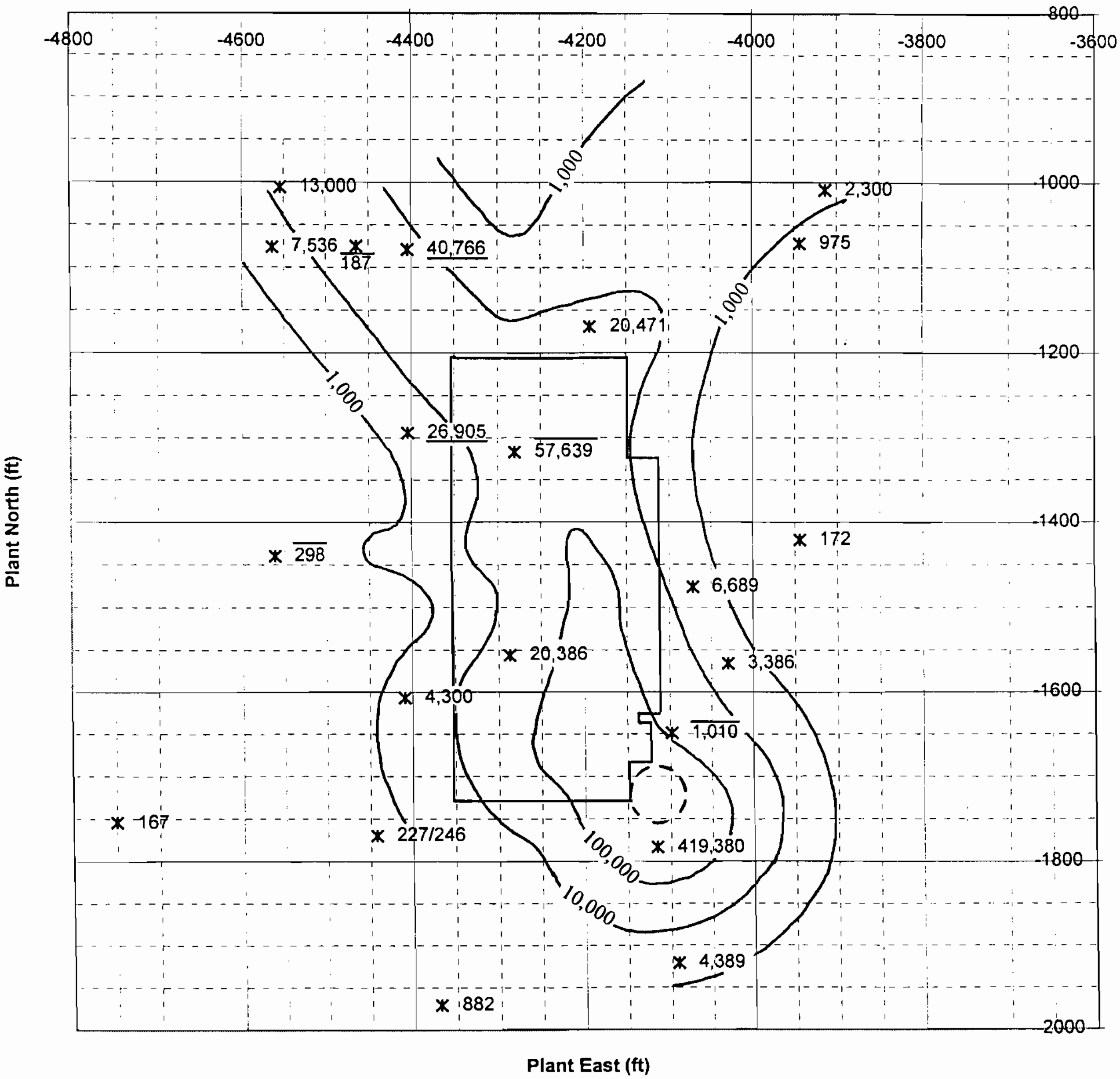
TCE LEVEL (300.0 - 304.9)



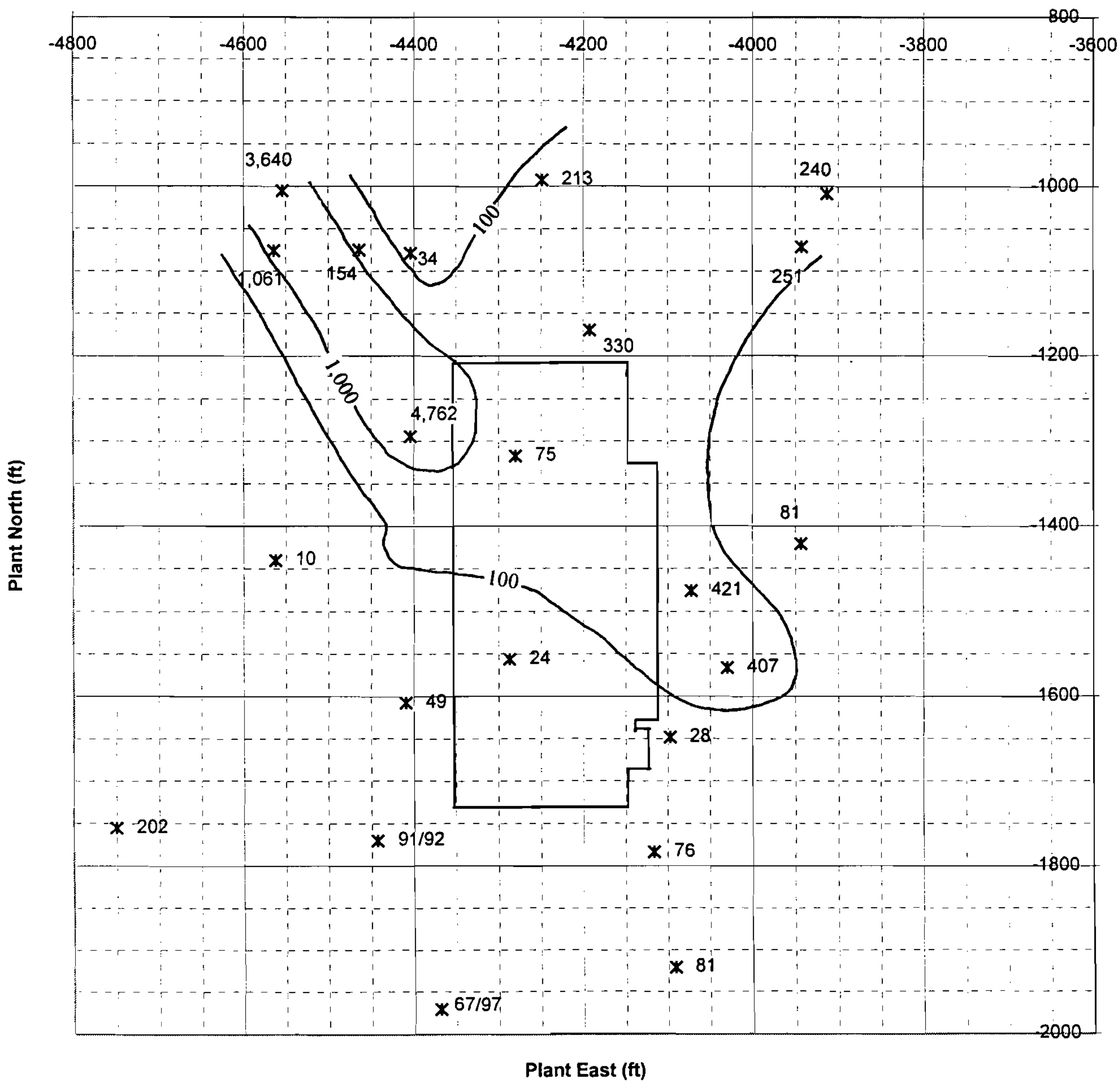
BETA ACTIVITY (300-304.9 ft amsl)



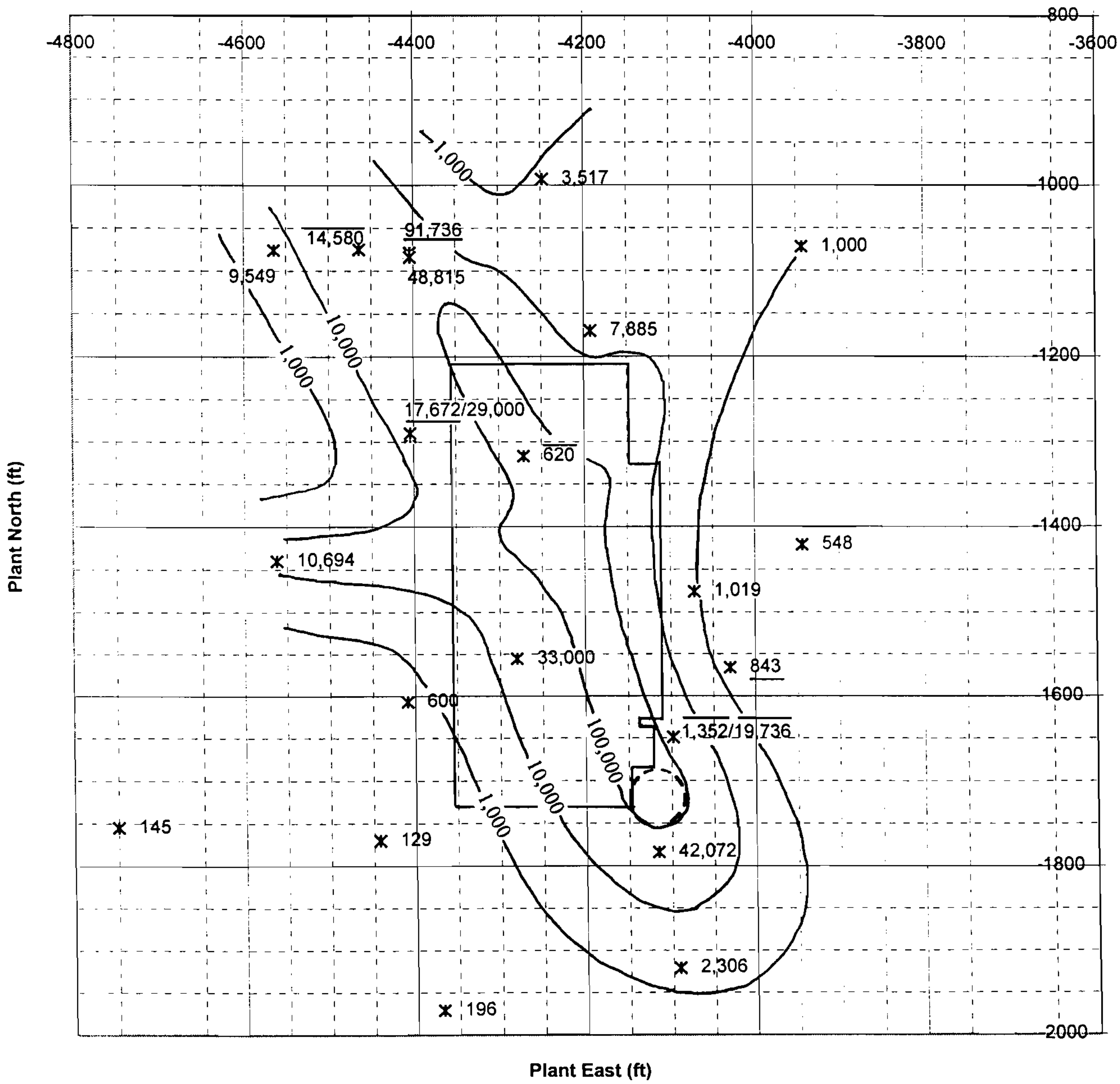
TCE LEVEL (295.0 - 299.9)



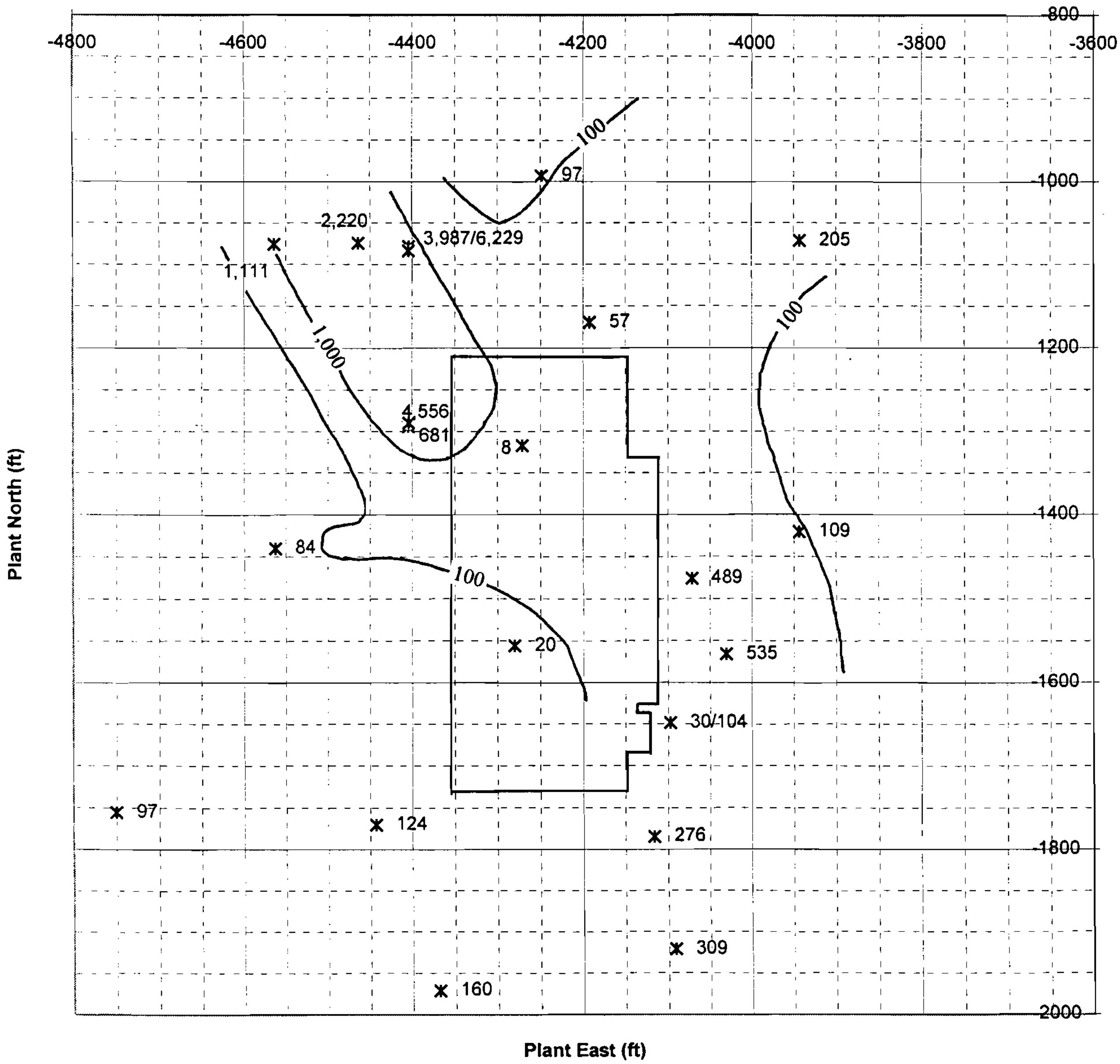
BETA ACTIVITY (295 - 299.9 ft amsl)



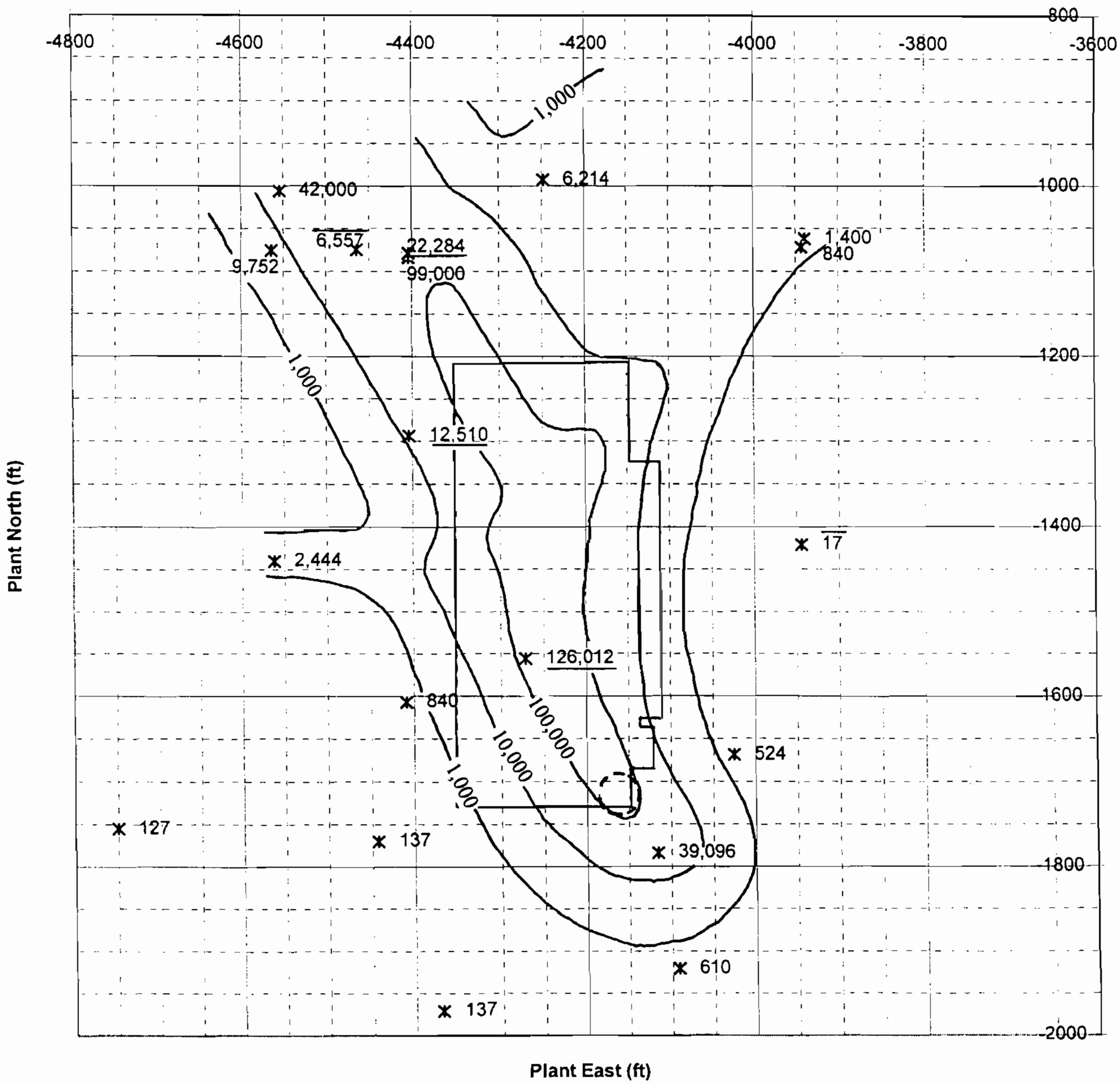
TCE LEVEL (290.0 - 294.9)



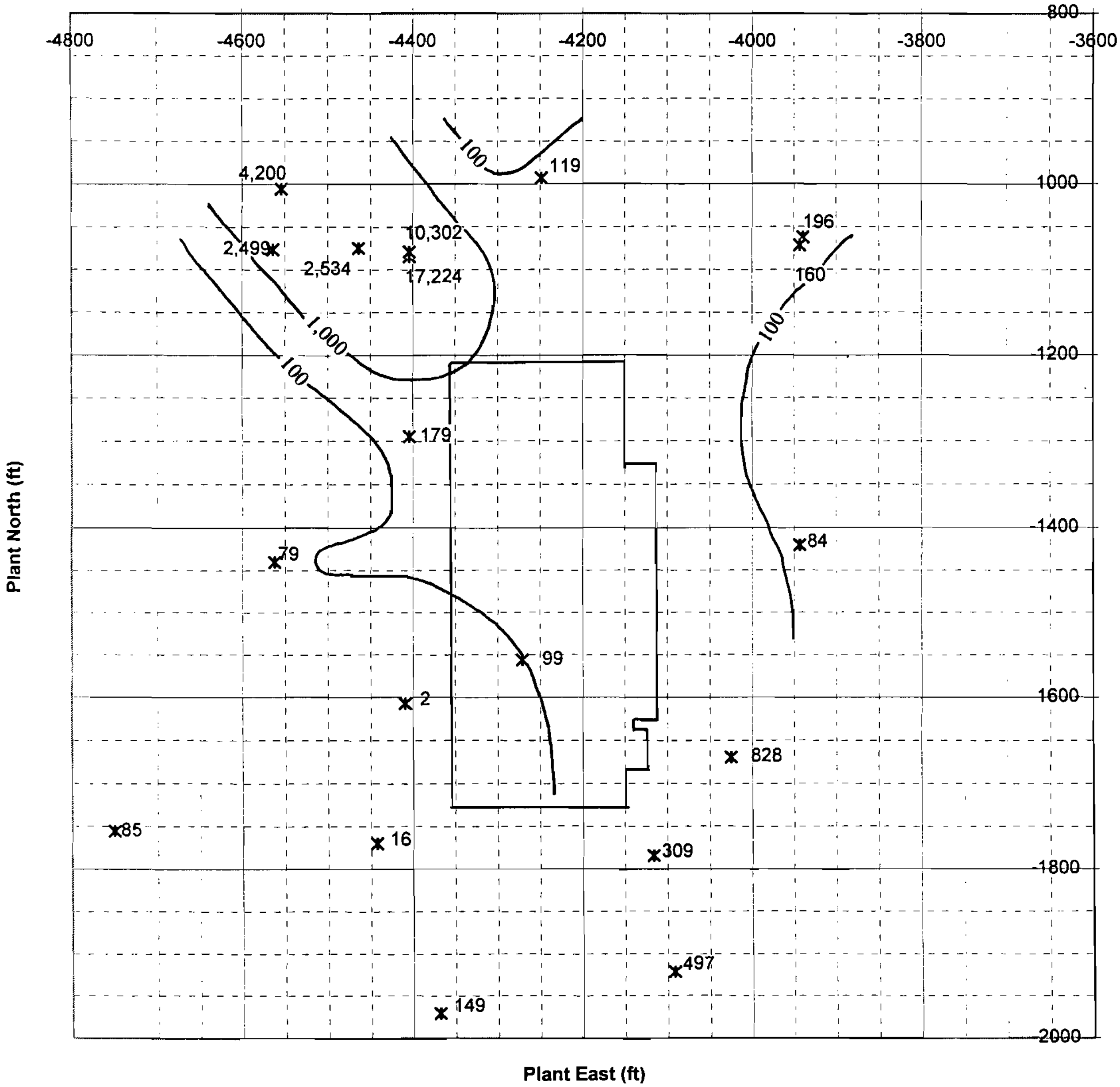
BETA ACTIVITY (290 - 294.9 ft amsl)



TCE LEVEL (285.0 - 289.9)



BETA ACTIVITY (285-289.9 ft amsl)



ERRATA SHEET

1) On page 8, paragraph 2, change

> "As an approximation, it is assumed that the mass of TCE is 190 l (50 gal)."
>
> to
>
> "As an approximation, it is assumed that the volume of TCE is 190 l (50 gal)."

2) On page 42, paragraph 1, change

> "The upgradient 100 mg/L (ppm) TCE isoconcentration contour appears to map the DNAPL source zones of the RGA. Moreover, the US Environmental Protection Agency recommends the use of 1% of the solubility of DNAPL (1% of the solubility of TCE is 110 mg/L) as an indication of DNAPL presence (EPA, 1992)."
>
> to
>
> "The upgradient 100 mg/L (ppm) TCE isoconcentration contour appears to map the DNAPL source zones of the RGA. Moreover, the US Environmental Protection Agency recommends the use of 1% of the solubility of DNAPL (1% of the solubility of TCE is 11 mg/L) as an indication of DNAPL presence (EPA, 1992)."

GWOU

WAG	SWMU	Description
WAG 6	11	C-400 Trichloroethylene Leak Site (GW)
	26	C-400 to C-404 Underground Transfer Line (GW)
	40	C-403 Neutralization Tank (GW)
	47	C-400 Technetium Storage Tank Area (GW)
	203	C-400 Sump (GW)
WAG 27	1	C-747-C Oil Land Farm
	209	C-720 Compressor Shop Pit Sump (GW)
	211	C-720 TCE Spill Site Northwest
WAG 28	99	C-745 Kellogg Building Site (previously AOC #C) (GW)
	183	McGraw UST (GW)
	193	McGraw Const Facilities (Southside Cylinder Yards) (GW)
	194	McGraw Construction Facilities (Southside) (GW)
	204	Dykes Road Historical Staging Area (GW)
WAG 22	2	C-749 Uranium Burial Ground [A]
	3	C-404 Low-Level Radioactive Waste Burial Ground [A]
	7	C-747-A Burial Ground (GW)
	30	C-747-A Burn Area (GW)
WAG 26	201	Northwest Groundwater Plume
	202	Northeast Groundwater Plume
	210	Southwest Groundwater Plume
WAG 3	4s	C-747 Contaminated Burial Ground (GW) [A]
Lasagna	91	UF6 Cylinder Drop Test Area

Footnotes:
A - Remedial action decisions for contaminated groundwater beneath these burial grounds will be deferred until the burial grounds are remediated; and DNAPL subsurface sources are to be addressed under BGOU.

SWOU

WAG	SWMU	Description
WAG 30	70	C-333-A Vaporizer [C]
	71	C-337-A Vaporizer [C]
WAG 8	82	C-531 Switchyard [C]
	83	C-533 Switchyard [C]
	84	C-535 Switchyard [C]
	85	C-537 Switchyard [C]
WAG 25	58	N-S Diversion Ditch (Outside Plt Security Area)
	59	N-S Diversion Ditch (Inside Plt Security Area) [A]
	60	C-375-E2 Effluent Ditch (KPDES 002) [B, C]
	61	C-375-E5 Effluent Ditch (KPDES 013) [B, C]
	64	Little Bayou Creek
	66	C-375-E3 Effluent Ditch (KPDES 010) [B, C]
	67	C-375-E4 Effluent Ditch (C-340 Ditch) [C]
	93	Concrete Disposal Area East of Plant Security Area
	105	Concrete Rubble Pile (3)
	106	Concrete Rubble Pile (4)
	107	Concrete Rubble Pile (5)
	108	Concrete Rubble Pile (6)
	109	Concrete Rubble Pile (7)
	113	Concrete Rubble Pile (11)
	168	KPDES Outfall Ditch 012 [C]
	171	C-617-A Lagoons [C]
WAG 29	102	Plant Storm Sewer (previously 96a, 96b, and 96c) [B, C, D]
WAG 18	62	C-375-S6 Southwest Ditch (KPDES 009) [B, C]
	63	C-375-W7 Oil Skimmer Ditch (KPDES 008) [B, C]
	65	Big Bayou Creek
	68	C-375-W8 Effluent Ditch (KPDES 015) [B, C]
	69	C-375-W9 Effluent Ditch (KPDES 001) [B, C]
	129	Concrete Rubble Pile (27)
	175	Concrete Rubble Pile (28)
	199	Big Bayou Creek Monitoring Station
	205	Eastern Portion of Yellow Water Line
WAG 7	8	C-746-K Inactive Sanitary Landfill [E]
N/A	N/A	Internal Ditches
N/A	N/A	C-340 Building Complex
WAG 12	17	C-616-E Sludge Lagoon [C]
	18	C-616-F Full-Flow Lagoon [C]
	42	C-616 Chromate Reduction Facility [C]

SWOU

WAG	SWMU	Description
WAG 13	21	C-611-W Sludge Lagoon [C]
	22	C-611-Y Overflow Lagoon [C]
	23	C-611-V Lagoons [C]
	185	C-611-4 Horseshoe Lagoon [C]
WAG 24	12s	C-747-A UF4 Drum Yard (SW) [F]
	14s	C-746-E Contaminated Scrapyard (SW) [F]
	15s	C-746-C Scrapyard (SW) [F]
WAG 14	13s	C-746-P Clean Scrapyard (SW) [F]
	16s	C-746-D Classified Scrapyard (SW) [F]

Footnotes:

A - Groundwater will be addressed under the GWOU.

B - Pipes and sewers under buildings will be addressed as part of the D&D scope.

C - Active facility.

D - Sanitary portion included in Soils OU.

E - Existing ROD focused on surface soils.

F - Scrap is scope of ongoing early action; underlying soil will fall within BGOU scope.

SSOU

WAG	SWMU	Description
WAG 2	86	C-631 Pumphouse and Cooling Tower [A]
	87	C-633 Pumphouse and Cooling Tower [A]
	88	C-635 Pumphouse and Cooling Tower [A]
	89	C-637 Pumphouse and Cooling Tower [A]
WAG 5	31	C-720 Compressor Pit Water Storage Tank
	76	C-632-B Sulfuric Acid (H_2SO_4) Storage Tank
	77	C-634-B Sulfuric Acid (H_2SO_4) Storage Tank
	169	C-410-E HF Vent Surge Protection Tank
WAG 6	11s	C-400 Trichloroethylene Leak Site (SS)
	26s	C-400 to C-404 Underground Transfer Line (SS)
	40s	C-403 Neutralization Tank (SS)
	47s	C-400 Technetium Storage Tank Area (SS)
	203s	C-400 Sump (SS)
WAGs 9&11	27	C-722 Acid Neutralization Tank [A]
	28	C-712 Acid Neutralization Tank [A]
	165	C-616-L Pipeline and Vault Soil Contamination [A]
	170	C-729 Acetylene Building Drain Pits
	19	C-410-B Neutralization Lagoon
	20	C-410-E H Emergency Holding Pond
	41	C-410-C Neutralization Tank
WAGs 16&19	78	C-420 PCB Spill Site
	137	C-746-A Inactive PCB Transformer/Sump
	153	C-331 PCB Soil Contamination (West side)
	155	C-333 PCB Soil Contamination (West side)
	156	C-310 PCB Soil Contamination (West side)
	161	C-743-T01 Trailer Site (Soil Backfill)
	164	KPDES Outfall Ditch 017 Flume (Soil Backfill)
	75	C-633 PCB Spill Site
	92	Fill Area for Dirt from the C-420 PCB Spill Site
	135	C-333 PCB Soil Contamination (North side of C-333)
	154	C-331 PCB Soil Contamination (Southeast side)
	160	C-745 Cylinder Yard Spoils Area (PCB Soil Contamination)
	162	C-617-A Sanitary Water Line (Soil Backfill) [A]
	163	C-304 Bldg/HVAC Piping System (Soil Backfill)
WAG 20	166	C-100 Trailer Complex Soil Contamination (East side)
	172	C-726 Sandblasting Facility
	195	Curlee Road Contaminated Soil Mound
	200	Soil Contamination South of TSCA Waste Storage Facility
	212	C-745-A Radiological Contamination Area

SSOU

WAG	SWMU	Description
WAG 21	138	C-100 Southside Berm
	158	Chilled Water System Leak Site
	176	C-331 RCW Leak Northwest Side
	177	C-331 RCW Leak East Side
	180	Outdoor Firing Range (WKWMA) [A]
	181	Outdoor Firing Range (PGDP) [A]
WAG 27	196	C-746-A Septic System
	209s	C-720 Compressor Shop Pit Sump (SS)
WAG 28	99s	C-745 Kellogg Building Site (previously AOC #C) (SS)
	183s	McGraw UST (SS)
	193s	McGraw Construciton Facilities (Southside Cylinder Yards) (SS)
	194s	McGraw Construction Facilities (Southside) (SS)
	204s	Dykes Road Historical Staging Area (SS)
WAG 23	32	C-728 Clean Waste Oil Tank [A]
	33	C-728 Motor Cleaning Facility [A]
	56	C-540-A PCB Waste Staging Area
	57	C-541-A PCB Waste Staging Area
	74	C-340 PCB Spill Site
	79	C-611 PCB Spill Site
	80	C-540 PCB Spill Site
	81	C-541 PCB Spill Site
	1s	C-747-C Oil Land Farm (SS)
WAG 29	38	C-615 Sewage Treatment Plant
	159	C-746-H3 Storage Pad
	178	C-724-A Paint Spray Booth
	179	Plant Sanitary Sewer System
WAG 30	55	C-405 Incinerator
	98	C-400 Basement Sump (previously AOC #B)
	101	C-340 Hydraulic System (previously AOC #E)
	167	C-720 Whiteroom Sump
	192	C-710 Acid Interceptor Pit
	198	C-410-D Area Soil Contamination
N/A	N/A	Site-Wide RAD
N/A	N/A	Site-Wide PCBs

Footnotes:
A - Active facility.

BGOU

WAG	SWMU	Description
WAG 3	4	C-747 Contaminated Burial Ground [A]
	5	C-746-F Classified Burial Ground
	6	C-747-B Burial Ground
WAG 14	13	C-746-P Clean Scrapyard
	16	C-746-D Classified Scrapyard
WAG 22	2	C-749 Uranium Burial Ground [A]
	3s	C-404 Low-Level Radioactive Waste Burial Ground [A]
	7s	C-747-A Burial Ground (BG)
	30s	C-747-A Burn Area (BG)
WAG 24	12	C-747-A UF4 Drum Yard
	14	C-746-E Contaminated Scrapyard
	15	C-746-C Scrapyard
N/A	145	Residential/Inert Landfill Borrow Area

Footnotes:

A - DNAPL subsurface source from GWOU is to be addressed under BGOU.

APPENDIX C7

Basis of Estimate
Feasibility Study for the GWOU
Vapor Extraction Technology
(Primary Source Area)

Description: This alternative primarily addresses the remediation of primary source areas containing VOCs, as both dissolved phase and DNAPL. The 0.4-hectare (1-acre) ‘case’ site used to develop the unit cost for this alternative is highly contaminated throughout the UCRS to a depth of 15 meters (50 ft) and located in a heavy industrial setting. A zone of contamination with surface area of 11,700 sq m (125,600 sq ft) and volume of 177,800 cu m (232,500 cu yds) is the target of the remedial action.

In this setting, vapor extraction requires 60 extraction wells, spaced 9 m (30 ft) apart, completed to a depth of 15 m (50 ft).

For this estimate, the following time frames were assumed:

construction	3 months
operation	3 years
long-term monitoring	27 years

This alternative includes the construction of 12 monitoring wells for quarterly compliance (3 years) and long-term (27 years) monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.02.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.02.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.02.03 Pre-Construction Characterization:
- Excavation permits and survey for 60 soil borings
- Installation of 60 pre-characterization soil borings to 15 m (50 ft) with collection of one soil sample every 1.5 m (5 ft)

WBS 01.02.04 Construction of System:
- Kick off meeting and readiness review
- Site preparation

- System construction requires 3 drill rigs. Construction extends over a 3-month period and includes installation of 12 monitoring wells to a depth of 21 m (70 ft) bgs.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.02.05 Operation and Maintenance of System:

- Operation and maintenance over a 3-year period

WBS 01.02.06 Demobilization of System:

- Demobilization of system abandons all injection and extraction wells and demobilizes treatment train systems over a 3-month period

WBS 01.02.07 Confirmatory Sampling/Report:

- Installation of 60 confirmatory soil borings to 15 m (50 ft) with collection of one soil sample every 1.5 m (5 ft). Requires the mobilization of 3 drill rigs.
- Final report, 4 versions

WBS 01.02.08 Long Term Monitoring:

- Monitoring activities are assumed to extend over 27 years – 1 sample per well per year
- Five Year Review

Primary Source Area - Vapor Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.02	Primary Source Area - Vapor Extraction: Total Cost						$19,634,697.31	27990			$1,186,921.00	$20,821,618.31	$23,880,629.93	$19,252,940.13
01.02.01	Project Plans (Direct - Capital Cost)						$0.00	988			$59,280.00	$59,280.00	$59,280.00	$59,280.00
01.02.01.01		Work Plan (4 versions)					$0.00	230			$13,800.00	$13,800.00	$13,800.00	$13,800.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.02.01.02		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.02.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.02.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.02.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.02.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.02.01.07		Operation and Maintenance Plan (4 versions)					$0.00	230			$13,800.00	$13,800.00	$13,800.00	$13,800.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.02.02	Design & Engineering (Direct - Capital Cost)						$434,660.50	0			$0.00	$434,660.50	$434,660.50	$434,660.50
01.02.02.01		Design Preparation (estimated @10% of construction costs)					$434,660.50	0			$0.00	$434,660.50	$434,660.50	$434,660.50
			Labor - Prepare 30% Design	1	lump sum	$195,597.23	$195,597.23				$0.00	$195,597.23	$195,597.23	$195,597.23
			Labor - Prepare 60% Design	1	lump sum	$130,398.15	$130,398.15				$0.00	$130,398.15	$130,398.15	$130,398.15
			Labor - Prepare 90% Design	1	lump sum	$65,199.08	$65,199.08				$0.00	$65,199.08	$65,199.08	$65,199.08
			Labor - Prepare CFC	1	lump sum	$43,466.05	$43,466.05				$0.00	$43,466.05	$43,466.05	$43,466.05
01.02.03	Pre-Construction Characterization (Direct - Capital Cost)						$1,211,000.00	3450			$150,712.50	$1,361,712.50	$1,361,712.50	$1,361,712.50
01.02.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.02.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.02.03.03		Installation of Pre-Characterization Borings					$1,201,000.00	3210			$126,712.50	$1,327,712.50	$1,327,712.50	$1,327,712.50
			Mobilization (Incl. Mob. Of 3 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$250,000.00	$250,000.00				$0.00	$250,000.00	$250,000.00	$250,000.00
			Install borings (Assume 60 borings to 50 ft, 6" dia. Assume Collect one soil every 5 ft [10 samples per boring])	60	ea	$10,000.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 1 month)				$0.00	2100		$27.00	$56,700.00	$56,700.00	$56,700.00	$56,700.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 1 month)				$0.00	525		$100.00	$52,500.00	$52,500.00	$52,500.00	$52,500.00

Primary Source Area - Vapor Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 1 month)				$0.00	525		$26.50	$13,912.50	$13,912.50	$13,912.50	$13,912.50
			Laboratory Analyses (Assume 600 soil samples for VOCs and 99Tc)	600	ea	$500.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$51,000.00	$51,000.00				$0.00	$51,000.00	$51,000.00	$51,000.00
			Labor - Data Management					60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
01.02.04	Construction of System (Direct - Capital Cost)						$3,843,069.00	12848			$503,536.00	$4,346,605.00	$4,365,695.23	$4,355,799.91
01.02.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.02.04.02		Readiness Reviews					$0.00	360			$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.02.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.02.04.04		System Construction					$3,580,940.00	10600			$419,740.00	$4,000,680.00	$4,005,174.81	$4,002,969.69
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 3 month construction and 3 year 0&M)	39	mo	$300.00	$11,700.00				$0.00	$11,700.00	$16,194.81	$13,989.69
			Shower/Change Trailer Rental (Assumes trailer retained during 3 month construction)	3	mo	$500.00	$1,500.00				$0.00	$1,500.00	$1,500.00	$1,500.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 3 month construction)	3	mo	$40.00	$120.00				$0.00	$120.00	$120.00	$120.00
			Utility Hookups (Electric, Propane, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Install Vapor Extraction Wells/Piping (Assume 60 Vapor Extraction Wells to 50 ft, 4 in. dia, SS, 50 ft of screen)	60	ea	$30,000.00	$1,800,000.00				$0.00	$1,800,000.00	$1,800,000.00	$1,800,000.00
			Install monitoring wells (Assume 12 monitoring wells to 70 ft, 4 in. dia, 10 ft of screen)	12	ea	$19,535.00	$234,420.00				$0.00	$234,420.00	$234,420.00	$234,420.00
			Vapor Extraction Unit and accessories (Assumes lump sum includes unit, royalty fees, surface and subsurface piping, pumps, electric)	1	lump sum	$1,100,200.00	$1,100,200.00				$0.00	$1,100,200.00	$1,100,200.00	$1,100,200.00
			Condenser and Vapor Treatment System - Includes Condenser @ $80,000, Cooling Tower @ $50,000, Vaccum Pump @ $100,000 and Vapor Treatment @ $200,000. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$430,000.00	$430,000.00				$0.00	$430,000.00	$430,000.00	$430,000.00
			Labor - Permit Requirements (Air)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Perform Air Compliance Test (Assume testing requires 2 people for 1 week)				$0.00	80		$100.00	$8,000.00	$8,000.00	$8,000.00	$8,000.00
			Labor - Security and Site Specific Training (Assume 12 people for 2 weeks)				$0.00	960		$27.00	$25,920.00	$25,920.00	$25,920.00	$25,920.00
			Labor - Construction/Sampling (Assume 3 H&S People [1 per rig] for 3 months)				$0.00	1560		$100.00	$156,000.00	$156,000.00	$156,000.00	$156,000.00
			Labor - Construction/Sampling (Assume 12 people for 3 months)				$0.00	6240		$27.00	$168,480.00	$168,480.00	$168,480.00	$168,480.00
			Labor - Construction/Sampling (Assume 3 Escorts for 3 months)				$0.00	1560		$26.50	$41,340.00	$41,340.00	$41,340.00	$41,340.00
01.02.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.02.04.06		Waste Management					$182,129.00	1808			$57,396.00	$239,525.00	$254,120.42	$246,430.23

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 120 6" dia. Borings @ 2.5 drums per boring [300 drums]; 60 4" dia. Vapor Extraction Wells @ 4 drums per boring [240 drums]; & 12 4" dia. Monitoring wells @ 6 drums per well [72 drums])	612	ea	$55.00	$33,660.00				$0.00	$33,660.00	$33,660.00	$33,660.00
			55-gal Drums to contain PPE (Assumes 192 borings/wells @ 1 drum per boring/well; Assumes PPE)	192	ea	$55.00	$10,560.00				$0.00	$10,560.00	$10,560.00	$10,560.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 6 months @ $1200 per month)	6	tank	$7,200.00	$43,200.00				$0.00	$43,200.00	$43,200.00	$43,200.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every 3 years for total of 3 years of O&M; Assume disposal cost @$7 per cu ft ($630), shipping cost for box @ $6000 per box ($6000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$36,630.00	$36,630.00				$0.00	$36,630.00	$50,702.22	$43,798.48
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 192 borings @ 1 soil sample per well/boring)	192	ea	$25.00	$4,800.00				$0.00	$4,800.00	$4,800.00	$4,800.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$901.00	$901.00				$0.00	$901.00	$901.00	$901.00
			Labor - Data Management				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Fork Truck Rental (Assumes rental for 6 months)	6	mo	$175.00	$1,050.00				$0.00	$1,050.00	$1,050.00	$1,050.00
			Flatbed Truck Rental (Assume rental for 6 months)	6	mo	$138.00	$828.00				$0.00	$828.00	$828.00	$828.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 212 wells/borings/transmodals)				$0.00	848		$27.00	$22,896.00	$22,896.00	$22,896.00	$22,896.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 6 months)				$0.00	240		$60.00	$14,400.00	$14,400.00	$14,400.00	$14,400.00
01.02.05	Operation & Maintenance of System (Direct - O&M Cost)						$459,348.00	1460			$87,600.00	$546,948.00	$757,070.04	$653,985.56
01.02.05.01		Operation & Maintenance					$459,348.00	1460			$87,600.00	$546,948.00	$757,070.04	$653,985.56
			Electric	3	yrs	$50,000.00	$150,000.00				$0.00	$150,000.00	$207,625.78	$179,354.96
			Telephone	36	months	$20.00	$720.00				$0.00	$720.00	$996.60	$860.90
			Propane (Assume system uses 4 gal per hr @ $2.00 per gal. System operation 24 hrs per day for 36 months)	36	months	$5,760.00	$207,360.00				$0.00	$207,360.00	$287,021.88	$247,940.29
			Water	36	months	$5.00	$180.00				$0.00	$180.00	$249.15	$215.23
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples per qtr for 3 years)	144	ea	$500.00	$72,000.00				$0.00	$72,000.00	$99,660.38	$86,090.38
			Laboratory Analyses - Monthly Compliance Vapor Samples (Assume 2 Vapor Sampling Points per month for 3 years)	72	ea	$200.00	$14,400.00				$0.00	$14,400.00	$19,932.08	$17,218.08
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$14,688.00	$14,688.00				$0.00	$14,688.00	$20,330.72	$17,562.44
			Labor - Data Management				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,661.01	$1,434.84

Primary Source Area - Vapor Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Operation and Maintenance (Assumes 2 people @ 40 hrs each per qtr for 3 years)				$0.00	960		$60.00	$57,600.00	$57,600.00	$79,728.30	$68,872.30
			Labor - Preparation of Quarterly Monitoring Reports (Assumes 1 person @ 40 hrs per qtr for 3 years)				$0.00	480		$60.00	$28,800.00	$28,800.00	$39,864.15	$34,436.15
01.02.06	Demob of System (Direct - Capital Cost)						$763,800.00	3120			$84,240.00	$848,040.00	$1,735,435.33	$401,540.60
01.02.06.01		Plug/Abandon Wells and Piping					$763,800.00	3120			$84,240.00	$848,040.00	$1,735,435.33	$401,540.60
			Plug/Abandon Wells and Piping (Assume P&A 60 Vapor Extraction Wells and 12 Monitoring Wells)	72	ea	$10,000.00	$720,000.00				$0.00	$720,000.00	$1,473,413.32	$340,914.62
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12.00 per day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	$172,389.36	$39,887.01
01.02.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$1,201,000.00	3550			$147,112.50	$1,348,112.50	$1,451,769.71	$1,194,374.54
01.02.07.01		Installation of Confirmatory Borings					$1,201,000.00	3210			$126,712.50	$1,327,712.50	$1,429,801.14	$1,176,300.94
			Mobilization (Incl. Mob. Of 3 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$250,000.00	$250,000.00				$0.00	$250,000.00	$269,222.66	$221,490.15
			Install borings (Assume 60 borings to 50 ft, 6" dia. Assume Collect one soil every 5 ft [10 samples per boring])	60	ea	$10,000.00	$600,000.00				$0.00	$600,000.00	$646,134.38	$531,576.35
			Labor - Construction/Sampling (Assume 4 people per rig for 1 month)				$0.00	2100		$27.00	$56,700.00	$56,700.00	$61,059.70	$50,233.97
			Labor - Construction/Sampling (Assume 1 H&S per rig for 1 month)				$0.00	525		$100.00	$52,500.00	$52,500.00	$56,536.76	$46,512.93
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 1 month)				$0.00	525		$26.50	$13,912.50	$13,912.50	$14,982.24	$12,325.93
			Laboratory Analyses (Assume 600 soil samples for VOCs and 99Tc)	600	ea	$500.00	$300,000.00				$0.00	$300,000.00	$323,067.19	$265,788.17
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$51,000.00	$51,000.00				$0.00	$51,000.00	$54,921.42	$45,183.99
			Labor - Data Management					60		$60.00	$3,600.00	$3,600.00	$3,876.81	$3,189.46
01.02.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$21,968.57	$18,073.60
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$10,338.15	$8,505.22
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$5,169.08	$4,252.61
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,876.81	$3,189.46
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,584.54	$2,126.31
01.02.08	Long Term Monitoring (Direct - O&M Cost)						$189,540.00	2574			$154,440.00	$343,980.00	$500,754.23	$115,863.24
01.02.08.01		Monitoring Activities (Groundwater)					$189,540.00	1974			$118,440.00	$307,980.00	$448,070.99	$103,673.52
			Labor - Perform Annual Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per year for 27 years)				$0.00	864		$60.00	$51,840.00	$51,840.00	$75,863.87	$17,553.19
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per year for 27 years)				$0.00	1080		$60.00	$64,800.00	$64,800.00	$94,829.84	$21,941.49
			Laboratory Analyses (Assume 12 gw samples per year for 27 years)	324	ea	$500.00	$162,000.00				$0.00	$162,000.00	$237,074.60	$54,853.72
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$27,540.00	$27,540.00				$0.00	$27,540.00	$40,302.68	$9,325.13
			Labor - Data Management				$0.00	30		$60.00	$1,800.00	$1,800.00		
01.02.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.02.09	Management and Integration Costs						$1,857,867.70	0			$0.00	$1,857,867.70	$2,133,275.51	$1,715,443.37
01.02.09.01		M& I Personnel Costs					$1,857,867.70	0			$0.00	$1,857,867.70	$2,133,275.51	$1,715,443.37

Primary Source Area - Vapor Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$1,857,867.70	$1,857,867.70				$0.00	$1,857,867.70	$2,133,275.51	$1,715,443.37
01.02.10	Indirect Costs						$1,704,652.95	0			$0.00	$1,704,652.95	$1,940,339.19	$1,590,953.78
01.02.10.01		Indirect Costs					$1,704,652.95	0			$0.00	$1,704,652.95	$1,940,339.19	$1,590,953.78
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$1,704,652.95	$1,704,652.95				$0.00	$1,704,652.95	$1,940,339.19	$1,590,953.78
01.02.11	Overhead Costs						$3,805,435.49	0			$0.00	$3,805,435.49	$4,364,511.70	$3,518,738.11
01.02.11.01		Overhead Costs					$3,805,435.49	0			$0.00	$3,805,435.49	$4,364,511.70	$3,518,738.11
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$3,805,435.49	$3,805,435.49				$0.00	$3,805,435.49	$4,364,511.70	$3,518,738.11
01.02.12	Contingency Costs						$4,164,323.66	0			$0.00	$4,164,323.66	$4,776,125.99	$3,850,588.03
01.02.12.01		Contingency Costs					$4,164,323.66	0			$0.00	$4,164,323.66	$4,776,125.99	$3,850,588.03
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$4,164,323.66	$4,164,323.66				$0.00	$4,164,323.66	$4,776,125.99	$3,850,588.03

Treated Volume: 1,512,750 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$229,117.50
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$78,023.41
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$242,977.88
Total Contingency per acre-foot of implementation	$137,529.70
Total Cost per acre-foot of implementation	$687,648.48
Total Cost (Present Worth) per acre-foot of implementation	$554,393.04

Basis of Estimate
Feasibility Study for the GWOU
Direct Heating Technology
(Primary Source Area)

Description: This alternative addresses the remediation of primary source areas containing VOCs, as both dissolved phase and DNAPL, and ^{99}Tc (to a lesser extent). The 0.4-hectare (1-acre) 'case' site used to develop the unit cost for this alternative is highly contaminated throughout the UCRS to a depth of 15 meters (50 ft) and located in a heavy industrial setting. A zone of contamination with surface area of 11,700 sq m (125,600 sq ft) and volume of 177,800 cu m (232,500 cu yds) is the target of the remedial action.

In this setting, direct heating requires 25 electrode arrays, consisting of 104 electrodes. Each electrode array has a diameter of approximately 11 m (35 ft) and is completed to a depth of 15 m (50 ft).

For this estimate, the following time frames were assumed:

construction	6 months
operation	9 years
long-term monitoring	29 years

This alternative includes the construction of 12 monitoring wells for quarterly compliance (9 months) and long-term (29 years) monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.03.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.03.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.03.03 Pre-Construction Characterization:
- Excavation permits and survey for 60 soil borings
- Installation of 60 pre-characterization soil borings to 15 m (50 ft) with collection of one soil sample every 1.5 m (5 ft)

WBS 01.03.04 Construction of System:
- Kick off meeting and readiness review

- Site preparation
- System construction requires 3 drill rigs. Construction extends over a 6-month period and includes installation of 12 monitoring wells to a depth of 21 m (70 ft) bgs.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.03.05 Operation and Maintenance of System:
- Operation and maintenance over a 9-month period

WBS 01.03.06 Demobilization of System:
- Demobilization of system abandons 104 electrodes and 12 monitoring wells and demobilizes treatment train systems over a 3-month period

WBS 01.03.07 Confirmatory Sampling/Report:
- Installation of 60 confirmatory soil borings to 15 m (50 ft) with collection of one soil sample every 1.5 m (5 ft). Requires the mobilization of 3 drill rigs.
- Final report, 4 versions

WBS 01.03.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 29 years – 1 sample per well per year
- Five Year Review

Primary Source Area - Direct Heating

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.03	Primary Source Area - Direct Heating						$36,065,859.05	46725			$1,817,993.00	$37,883,852.05	$17,331,112.64	$15,098,298.22
01.03.01	Project Plans (Direct - Capital Cost)						$0.00	1308			$78,480.00	$78,480.00	$78,480.00	$78,480.00
01.03.01.01		Work Plan (4 versions)					$0.00	345		$60.00	$20,700.00	$20,700.00	$20,700.00	$20,700.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
01.03.01.02		General Health & Safety Plan (4 versions)					$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D-1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	15		$60.00	$900.00	$900.00	$900.00	$900.00
01.03.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	315		$60.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
01.03.01.04		QA Plan (4 versions)					$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D-1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	15		$60.00	$900.00	$900.00	$900.00	$900.00
01.03.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138		$60.00	$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.03.01.06		Waste Management Plan (4 versions)					$0.00	210		$60.00	$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.03.01.07		Operation and Maintenance Plan (4 versions)					$0.00	345			$20,700.00	$20,700.00	$20,700.00	$20,700.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
01.03.02	Design & Engineering (Direct - Capital Cost)						$1,084,570.30	0			$0.00	$1,084,570.30	$1,084,570.30	$1,084,570.30
01.03.02.01		Design Preparation (estimated @10% of construction costs)					$1,084,570.30	0			$0.00	$1,084,570.30	$1,084,570.30	$1,084,570.30
			Labor - Prepare 30% Design	1	lump sum	$488,056.64	$488,056.64				$0.00	$488,056.64	$488,056.64	$488,056.64
			Labor - Prepare 60% Design	1	lump sum	$325,371.09	$325,371.09				$0.00	$325,371.09	$325,371.09	$325,371.09
			Labor - Prepare 90% Design	1	lump sum	$162,685.55	$162,685.55				$0.00	$162,685.55	$162,685.55	$162,685.55
			Labor - Prepare CFC	1	lump sum	$108,457.03	$108,457.03				$0.00	$108,457.03	$108,457.03	$108,457.03
01.03.03	Pre-Construction Characterization (Direct - Capital Cost)						$1,211,000.00	3450			$150,712.50	$1,361,712.50	$1,361,712.50	$1,361,712.50
01.03.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.03.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.03.03.03		Installation of Pre-Characterization Borings					$1,201,000.00	3210			$126,712.50	$1,327,712.50	$1,327,712.50	$1,327,712.50
			Mobilization (Incl. Mob. Of 3 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$250,000.00	$250,000.00				$0.00	$250,000.00	$250,000.00	$250,000.00
			Install borings (Assume 60 borings to 50 ft, 6" dia. Assume Collect one soil every 5 ft [10 samples per boring])	60	ea	$10,000.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 1 month)				$0.00	2100		$27.00	$56,700.00	$56,700.00	$56,700.00	$56,700.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 1 month)				$0.00	525		$100.00	$52,500.00	$52,500.00	$52,500.00	$52,500.00

Primary Source Area - Direct Heating

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 1 month)				$0.00	525		$26.50	$13,912.50	$13,912.50	$13,912.50	$13,912.50
			Laboratory Analyses (Assume 600 soil samples for VOCs and 99Tc)	600	ea	$500.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$51,000.00	$51,000.00				$0.00	$51,000.00	$51,000.00	$51,000.00
			Labor - Data Management					60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
01.03.04	Construction of System (Direct - Capital Cost)						$9,674,735.00	32189			$1,170,968.00	$10,845,703.00	$10,847,198.20	$10,842,497.50
01.03.04.01		Kick Off Meeting					$0.00	120			$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Kick Off Meeting (Assume 12 hours per person for 10 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.03.04.02		Readiness Reviews					$0.00	1200			$72,000.00	$72,000.00	$72,000.00	$72,000.00
			Labor - Attend Readiness Review #1 (Assume 12 hours per person for 25 people)				$0.00	300		$60.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00
			Labor - Attend Readiness Review #2 (Assume 12 hours per person for 25 people)				$0.00	300		$60.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00
			Labor - Attend Readiness Review #3 (Assume 12 hours per person for 25 people)				$0.00	300		$60.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00
			Labor - Attend Readiness Review #4 (Assume 12 hours per person for 25 people)				$0.00	300		$60.00	$18,000.00	$18,000.00	$18,000.00	$18,000.00
01.03.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.03.04.04		System Construction					$9,359,740.00	28760			$1,022,120.00	$10,381,860.00	$10,381,916.25	$10,381,492.65
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 6 month construction and 9 months of 0&M)	15	mo	$300.00	$4,500.00				$0.00	$4,500.00	$4,556.25	$4,132.65
			Shower/Change Trailer Rental (Assumes trailer retained during 6 month construction)	6	mo	$500.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 6 month construction)	6	mo	$40.00	$240.00				$0.00	$240.00	$240.00	$240.00
			Utility Hookups (Propane, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Utility Hookup (Electric)	1	lump sum	$70,000.00	$70,000.00				$0.00	$70,000.00	$70,000.00	$70,000.00
			Six-Phase Power Supply to Electrodes (Assume power supplied to 25 electrodes)	25	ea	$25,000.00	$625,000.00				$0.00	$625,000.00	$625,000.00	$625,000.00
			Install Perimeter Electrodes/Piping (Assume 79 to 50 ft bgs; 14" dia.; each electrode location will also function as a vaccum point)	79	ea	$71,000.00	$5,609,000.00				$0.00	$5,609,000.00	$5,609,000.00	$5,609,000.00
			Install Center Electrodes (Assume 25 to 50 bgs; 24 in. dia.; each electrode location will also function as a vaccum point)	25	ea	$71,000.00	$1,775,000.00				$0.00	$1,775,000.00	$1,775,000.00	$1,775,000.00
			Install monitoring wells (Assume 12 monitoring wells to 70 ft, 4 in. dia, 10 ft of screen)	12	ea	$70,000.00	$840,000.00				$0.00	$840,000.00	$840,000.00	$840,000.00
			Condenser and Vapor Treatment System - Includes Condenser @ $80,000, Cooling Tower @ $50,000, Vaccum Pump @ $100,000 and Vapor Treatment @ $200,000. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$430,000.00	$430,000.00				$0.00	$430,000.00	$430,000.00	$430,000.00
			Labor - Permit Requirements (Air)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Perform Air Compliance Test (Assume testing requires 2 people for 1 week)				$0.00	80		$100.00	$8,000.00	$8,000.00	$8,000.00	$8,000.00
			Labor - Security and Site Specific Training (Assume 18 people for 2 weeks)				$0.00	1440		$27.00	$38,880.00	$38,880.00	$38,880.00	$38,880.00
			Labor - Construction/Sampling (Assume 3 H&S People [1 per rig] for 6 months)				$0.00	3120		$100.00	$312,000.00	$312,000.00	$312,000.00	$312,000.00
			Labor - Construction/Sampling (Assume 18 people for 6 months)				$0.00	18720		$27.00	$505,440.00	$505,440.00	$505,440.00	$505,440.00

Primary Source Area - Direct Heating

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 5 Escorts for 6 months)				$0.00	5200		$26.50	$137,800.00	$137,800.00	$137,800.00	$137,800.00
01.03.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.03.04.06		Waste Management					$234,995.00	2109			$69,648.00	$304,643.00	$306,081.95	$301,804.85
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 120 6" dia. Borings @ 2.5 drums per boring [300 drums]; 79 14" dia. Electrode Borings @ 6 drums per boring [474 drums]; 25 24" dia. Electrode Borings @ 10 drums per boring [250 drums]; & 12 4" dia. Monitoring wells @ 6 drums per well [72 drums])	1096	ea	$55.00	$60,280.00				$0.00	$60,280.00	$60,280.00	$60,280.00
			55-gal Drums to contain PPE (Assumes 236 borings/wells @ 1 drum per boring/well; Assumes PPE)	236	ea	$55.00	$12,980.00				$0.00	$12,980.00	$12,980.00	$12,980.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 9 months @ $1200 per month)	6	tank	$10,800.00	$64,800.00				$0.00	$64,800.00	$64,800.00	$64,800.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every year for total of 9 months (assume 1 year) of O&M; Assume disposal cost @$7 per cu ft ($630), shipping cost for box @ $6000 per box ($6000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$36,630.00	$36,630.00				$0.00	$36,630.00	$37,545.75	$34,055.10
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 236 borings @ 1 soil sample per well/boring)	236	ea	$25.00	$5,900.00				$0.00	$5,900.00	$5,900.00	$5,900.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$1,088.00	$1,088.00				$0.00	$1,088.00	$1,088.00	$1,088.00
			Labor - Data Management				$0.00	25		$60.00	$1,500.00	$1,500.00	$1,500.00	$1,500.00
			Fork Truck Rental (Assumes rental for 9 months)	9	mo	$175.00	$1,575.00				$0.00	$1,575.00	$1,575.00	$1,575.00
			Flatbed Truck Rental (Assume rental for 9 months)	9	mo	$138.00	$1,242.00				$0.00	$1,242.00	$1,242.00	$1,242.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 256 wells/borings/transmodals)				$0.00	1024		$27.00	$27,648.00	$27,648.00	$27,648.00	$27,648.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 9 months)				$0.00	360		$60.00	$21,600.00	$21,600.00	$21,600.00	$21,600.00
01.03.05	Operation & Maintenance of System (Direct - O&M Cost)						$165,381.00	385			$23,100.00	$188,481.00	$193,193.03	$175,231.77
01.03.05.01		Operation & Maintenance					$165,381.00	385			$23,100.00	$188,481.00	$193,193.03	$175,231.77
			Electric	0.75	yrs	$50,000.00	$37,500.00				$0.00	$37,500.00	$38,437.50	$34,863.95
			Telephone	9	months	$20.00	$180.00				$0.00	$180.00	$184.50	$167.35
			Propane (Assume system uses 4 gal per hr @ $2.00 per gal. System operation 24 hrs per day for 9 months)	9	months	$5,760.00	$51,840.00				$0.00	$51,840.00	$53,136.00	$48,195.92
			Water	9	months	$5.00	$45.00				$0.00	$45.00	$46.13	$41.84

Primary Source Area - Direct Heating

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples per qtr for 3 qtrs)	36	ea	$500.00	$18,000.00				$0.00	$18,000.00	$18,450.00	$16,734.69
			Laboratory Analyses - Monthly Compliance Vapor Samples (Assume 6 Vapor Sampling Points per week for 9 months)	234	ea	$200.00	$46,800.00				$0.00	$46,800.00	$47,970.00	$43,510.20
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$11,016.00	$11,016.00				$0.00	$11,016.00	$11,291.40	$10,241.63
			Labor - Data Management				$0.00	25		$60.00	$1,500.00	$1,500.00	$1,537.50	$1,394.56
			Labor - Operation and Maintenance (Assumes2 people @ 40 hrs each per qtr for 3 qtrs)				$0.00	240		$60.00	$14,400.00	$14,400.00	$14,760.00	$13,387.76
			Labor - Preparation of Quarterly Monitoring Reports (Assumes 1 person @ 40 hrs per qtr for 3 qtrs)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,380.00	$6,693.88
01.03.06	Demob of System (Direct - Capital Cost)						$1,203,800.00	3120			$84,240.00	$1,288,040.00	$2,635,854.58	$609,877.31
01.03.06.01		Plug/Abandon Wells and Piping					$1,203,800.00	3120			$84,240.00	$1,288,040.00	$2,635,854.58	$609,877.31
			Plug/Abandon Wells and Piping (Assume P&A 104 Electrode Points and 12 Monitoring Wells)	116	ea	$10,000.00	$1,160,000.00				$0.00	$1,160,000.00	$2,373,832.58	$549,251.33
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12.00 per day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	$172,389.36	$39,887.01
01.03.07	Confirmatory Sampling/Report (Direct - O&M Costs)						$1,201,000.00	3550			$147,112.50	$1,348,112.50	$1,381,815.31	$1,253,347.22
01.03.07.01		Installation of Confirmatory Borings					$1,201,000.00	3210			$126,712.50	$1,327,712.50	$1,360,905.31	$1,234,381.24
			Mobilization (Incl. Mob. Of 3 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$250,000.00	$250,000.00				$0.00	$250,000.00	$256,250.00	$232,426.30
			Install borings (Assume 60 borings to 50 ft, 6" dia. Assume Collect one soil every 5 ft [10 samples per boring])	60	ea	$10,000.00	$600,000.00				$0.00	$600,000.00	$615,000.00	$557,823.13
			Labor - Construction/Sampling (Assume 4 people per rig for 1 month)				$0.00	2100		$27.00	$56,700.00	$56,700.00	$58,117.50	$52,714.29
			Labor - Construction/Sampling (Assume 1 H&S per rig for 1 month)				$0.00	525		$100.00	$52,500.00	$52,500.00	$53,812.50	$48,809.52
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 1 month)				$0.00	525		$26.50	$13,912.50	$13,912.50	$14,260.31	$12,934.52
			Laboratory Analyses (Assume 600 soil samples for VOCs and 99Tc)	600	ea	$500.00	$300,000.00				$0.00	$300,000.00	$307,500.00	$278,911.56
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$51,000.00	$51,000.00				$0.00	$51,000.00	$52,275.00	$47,414.97
			Labor - Data Management					60		$60.00	$3,600.00	$3,600.00	$3,690.00	$3,346.94
01.03.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$20,910.00	$18,965.99
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$9,840.00	$8,925.17
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,920.00	$4,462.59
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,690.00	$3,346.94
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,460.00	$2,231.29
01.03.08	Long Term Monitoring (Direct - O&M Cost)						$203,580.00	2723			$163,380.00	$366,960.00	$533,944.68	$123,542.76
01.03.08.01		Monitoring Activities (Groundwater)					$203,580.00	2123			$127,380.00	$330,960.00	$481,261.43	$111,353.04
			Labor - Perform Annual Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per year for 29 years)				$0.00	928		$60.00	$55,680.00	$55,680.00	$81,483.42	$18,853.43
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per year for 29 years)				$0.00	1160		$60.00	$69,600.00	$69,600.00	$101,854.27	$23,566.78
			Laboratory Analyses (Assume 12 gw samples per year for 29 years)	348	ea	$500.00	$174,000.00				$0.00	$174,000.00	$254,635.68	$58,916.95
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$29,580.00	$29,580.00				$0.00	$29,580.00	$43,288.07	$10,015.88

Primary Source Area - Direct Heating

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Data Management				$0.00	35		$60.00	$2,100.00	$2,100.00		
01.03.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.03.09	Management and Integration Costs						$3,312,411.86	0			$0.00	$3,312,411.86	$1,031,335.74	$514,774.03
01.03.09.01		M& I Personnel Costs					$3,312,411.86	0			$0.00	$3,312,411.86	$1,031,335.74	$514,774.03
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$3,312,411.86	$3,312,411.86				$0.00	$3,312,411.86	$1,031,335.74	$514,774.03
01.03.10	Indirect Costs						$3,508,818.43	0			$0.00	$3,508,818.43	$706,642.19	$179,888.10
01.03.10.01		Indirect Costs					$3,508,818.43	0			$0.00	$3,508,818.43	$706,642.19	$179,888.10
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$3,508,818.43	$3,508,818.43				$0.00	$3,508,818.43	$706,642.19	$179,888.10
01.03.11	Overhead Costs						$6,923,792.05	0			$0.00	$6,923,792.05	$2,041,507.82	$967,812.41
01.03.11.01		Overhead Costs					$6,923,792.05	0			$0.00	$6,923,792.05	$2,041,507.82	$967,812.41
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$6,923,792.05	$6,923,792.05				$0.00	$6,923,792.05	$2,041,507.82	$967,812.41
01.03.12	Contingency Costs						$7,576,770.41	0			$0.00	$7,576,770.41	$2,234,041.11	$1,059,086.17
01.03.12.01		Contingency Costs					$7,576,770.41	0			$0.00	$7,576,770.41	$2,234,041.11	$1,059,086.17
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$7,576,770.41	$7,576,770.41				$0.00	$7,576,770.41	$2,234,041.11	$1,059,086.17

Treated Volume: 1,512,750 cu ft

1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$460,948.90
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$60,727.81
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$108,831.20
Total Contingency per acre-foot of implementation	$64,329.75
Total Cost per acre-foot of implementation	$694,837.66
Total Cost (Present Worth) per acre-foot of implementation	$434,759.13

Basis of Estimate
Feasibility Study for the GWOU
Excavation Technology
(Primary Source Area)

Description: This alternative addresses the remediation of primary source areas containing VOCs, as both dissolved phase and DNAPL, and ^{99}Tc. The 'case' site used to develop the unit cost for this alternative is highly contaminated throughout the UCRS to a depth of 9 meters (30 ft) and located in a heavy industrial setting (such as the area adjacent to the southeast corner of the C-400 Building). A zone of contamination with surface area of 4,700 sq m (50,400 sq ft) and volume of 1,587 cu m (56,000 cu yds) is the target of the remedial action.

Excavation requires the removal and subsequent replacement of all above- and below-ground structures in the area to be remediated. A sheet piling wall, supplemented by a grout curtain where piling cannot be driven, is located around the perimeter of the excavation to stabilize the adjacent soils and minimize infiltration of groundwater. The excavation alternative includes a de-watering system.

For this estimate, the following time frames were assumed:

construction/operation	6 months
long-term monitoring	29 years

This alternative includes the construction of 12 wells for long-term monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.04.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.04.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.04.03 Pre-Construction Characterization:
- GPR survey to locate area utilities
- Excavation permits and survey for 60 soil borings
- Installation of 60 pre-characterization soil borings to 15 m (50 ft) with collection of one soil sample every 1.5 m (5 ft) – requires the mobilization of 3 drill rigs
- Sheet piling design

WBS 01.04.04 Construction of System:
- Kick off meeting and readiness review
- Site preparation
- Installation of 12 monitoring wells to a depth of 21 m (70 ft) bgs
- Earth moving equipment requirements include: 1 bulldozer, 4 excavators, 1 dump truck, 20 transmodal containers, and 4 flat bed trucks
- Site restoration (including replacement of structures and sheet piling removal)
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.04.05 Operation and Maintenance of System:
- None

WBS 01.04.06 Demobilization:
- Demobilization abandons all monitoring wells over a 3-month period

WBS 01.04.07 Confirmatory Sampling/Report:
- Final report, 4 versions

WBS 01.04.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 29 years – 1 sample per well per year
- Five Year Review

Primary Source Area - Excavation Technology

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.04	Primary Source Area - Excavation Technology: Total Costs						$275,679,294.95	55636			$3,185,128.50	$278,819,423.45	$282,373,948.11	$205,969,103.04
01.04.01	Project Plans (Direct - Capital Cost)						$500,000.00	$1,845.00			$110,700.00	$610,700.00	$610,700.00	$610,700.00
01.04.01.01		Work Plan (4 versions)					$0.00	415		$60.00	$24,900.00	$24,900.00	$24,900.00	$24,900.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.04.01.02		General Health & Safety Plan (4 versions)					$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.04.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	415		$60.00	$24,900.00	$24,900.00	$24,900.00	$24,900.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.04.01.04		QA Plan (4 versions)					$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.04.01.05		Sampling and Analysis Plan (4 versions)					$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.04.01.06		Waste Management Plan (4 versions)					$0.00	415		$60.00	$24,900.00	$24,900.00	$24,900.00	$24,900.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.04.01.07		Development of Waste Acceptance Criteria for C-746-U					$500,000.00	0			$0.00	$500,000.00	$500,000.00	$500,000.00
			Labor - Develop Waste Acceptance Criteria for the C-746-U Landfill	1	lump sum	500000	$500,000.00				$0.00	$500,000.00	$500,000.00	$500,000.00
01.04.02	Design & Engineering (Direct - Capital Cost)						$10,461,275.80	0			$0.00	$10,461,275.80	$10,461,275.80	$10,461,275.80
01.04.02.01		Design Preparation (estimated @10% of construction costs)					$10,461,275.80	0			$0.00	$10,461,275.80	$10,461,275.80	$10,461,275.80
			Labor - Prepare 30% Design	1	lump sum	$4,707,574.11	$4,707,574.11				$0.00	$4,707,574.11	$4,707,574.11	$4,707,574.11
			Labor - Prepare 60% Design	1	lump sum	$3,138,382.74	$3,138,382.74				$0.00	$3,138,382.74	$3,138,382.74	$3,138,382.74
			Labor - Prepare 90% Design	1	lump sum	$1,569,191.37	$1,569,191.37				$0.00	$1,569,191.37	$1,569,191.37	$1,569,191.37
			Labor - Prepare CFC	1	lump sum	$1,046,127.58	$1,046,127.58				$0.00	$1,046,127.58	$1,046,127.58	$1,046,127.58
01.04.03	Pre-Construction Characterization (Direct - Capital Cost)						$3,239,050.00	4330			$229,892.50	$3,468,942.50	$3,463,762.50	$3,463,762.50
01.04.03.01		Pre-Characterization Technical Support					$0.00	480			$48,000.00	$48,000.00	$48,000.00	$48,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 2 person for 30 days.)				$0.00	480		$100.00	$48,000.00	$48,000.00	$48,000.00	$48,000.00
01.04.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points and GPR points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.04.03.03		Pre-Characterization Utility Survey					$28,050.00	640			$55,180.00	$83,230.00	$78,050.00	$78,050.00
			Rental of Equipment to perform Ground Penetrating Radar Survey (Assume $1000 per day for 15 days)	15	day	$1,000.00	$15,000.00				$0.00	$15,000.00	$15,000.00	$15,000.00
			Shipment of Equipment by Air Freight (Assume 300 lbs @ $3.00 per lb)	300	lb	$3.00	$900.00				$0.00	$900.00	$900.00	$900.00
			Travel Costs for GPR Personnel - Per Diem (Assume $80 per day for 2 people for 30 days)	30	day	$160.00	$4,800.00				$0.00	$4,800.00	$4,800.00	$4,800.00
			Travel Costs for GPR Personnel - Air Fare (Assume $2000 per person round trip)	2	trip	$2,000.00	$4,000.00				$0.00	$4,000.00	$4,000.00	$4,000.00
			Travel Costs for GPR Personnel - Rental Car (Assume 1 car @ $45 per day for 30 days)	30	day	$45.00	$1,350.00				$0.00	$1,350.00	$1,350.00	$1,350.00
			Labor - Security and Site Specific Training (Assume 2 people for 2 weeks)				$0.00	160		$100.00	$16,000.00	$16,000.00	$16,000.00	$16,000.00
			Labor - Perform GPR (Assume 1 H&S People for 15 days)				$0.00	120		$100.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00

Primary Source Area - Excavation Technology

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Perform GPR (Assume 2 people for 15 days)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Perform GPR (Assume 1 Escort for 15 days)				$0.00	120		$26.50	$3,180.00	$3,180.00	$3,180.00	$3,180.00
			Labor - Prepare Summary Report	1	lump sum	$2,000.00	$2,000.00				$0.00	$2,000.00	$2,000.00	$2,000.00
01.04.03.04		Pre-Characterization Sheet Piling					$2,000,000.00	0			$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			Preparation of Sheet Piling Design	1	lump sum	$2,000,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
01.04.03.05		Installation of Pre-Characterization Borings					$1,201,000.00	3210			$126,712.50	$1,327,712.50	$1,327,712.50	$1,327,712.50
			Mobilization (Incl. Mob. Of 3 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$250,000.00	$250,000.00				$0.00	$250,000.00	$250,000.00	$250,000.00
			Install borings (Assume 60 borings to 50 ft, 6" dia. Assume Collect one soil every 5 ft [10 samples per boring])	60	ea	$10,000.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 1 month)				$0.00	2100		$27.00	$56,700.00	$56,700.00	$56,700.00	$56,700.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 1 month)				$0.00	525		$100.00	$52,500.00	$52,500.00	$52,500.00	$52,500.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 1 month)				$0.00	525		$26.50	$13,912.50	$13,912.50	$13,912.50	$13,912.50
			Laboratory Analyses (Assume 600 soil samples for VOCs and 99Tc)	600	ea	$500.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$51,000.00	$51,000.00				$0.00	$51,000.00	$51,000.00	$51,000.00
			Labor - Data Management					60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
01.04.04	Construction of System (Direct - Capital Cost)						$102,045,242.00	43878			$2,612,516.00	$104,612,758.00	$105,573,710.89	$105,101,744.02
01.04.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.04.04.02		Readiness Reviews					$0.00	2400			$144,000.00	$144,000.00	$144,000.00	$144,000.00
			Labor - Attend Readiness Review #1 (Assume 16 hours per person for 30 people)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #2 (Assume 16 hours per person for 30 people)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #3 (Assume 16 hours per person for 30 people)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #4 (Assume 16 hours per person for 30 people)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #5 (Assume 16 hours per person for 30 people)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
01.04.04.03		Site Preparation					$35,312,000.00	0			$0.00	$35,312,000.00	$35,312,000.00	$35,312,000.00
			Location of Utilities	1	lump sum	$12,000.00	$12,000.00				$0.00	$12,000.00	$12,000.00	$12,000.00
			Installation of Sheet Piling	1	lump sum	$15,000,000.00	$15,000,000.00				$0.00	$15,000,000.00	$15,000,000.00	$15,000,000.00
			Installation of Grout Curtains (Assume required in those areas where sheet piling can not be used)	1	lump sum	$1,000,000.00	$1,000,000.00				$0.00	$1,000,000.00	$1,000,000.00	$1,000,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			D&D of All Above Ground Structures (Assumes removal of loading dock, overhead crane, tank, utilities, roads, and railroad spur)	1	lump sum	$500,000.00	$500,000.00				$0.00	$500,000.00	$500,000.00	$500,000.00
			D&D of All Below Ground Structures (Assumes removal of sump)	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Provide a Replacement Overhead Crane for use by USEC (Assume 6 months for Excavation and 3 months for Site Restoration; Assume cost for Overhead Crane is $2000 per day)	9	month	$60,000.00	$540,000.00				$0.00	$540,000.00	$540,000.00	$540,000.00
			Supply Alternate Utilities (Assumes electric, telephone, water, fire alarm, etc.; Assume 6 months for Excavation and 3 months for Site Restoration)	9	month	$2,000,000.00	$18,000,000.00				$0.00	$18,000,000.00	$18,000,000.00	$18,000,000.00
01.04.04.04		System Construction					$60,374,652.00	39245			$2,377,700.00	$62,707,352.00	$62,707,352.00	$62,707,352.00
			Mobilization Costs for Drill Rig cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes 3 trailers retained during 6 month construction period; Assume trailer rents for $300 per month)	6	mo	$900.00	$5,400.00				$0.00	$5,400.00	$5,400.00	$5,400.00

Primary Source Area - Excavation Technology

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Shower/Change Trailer Rental (Assumes 3 trailers retained during 6 month construction; Assumes trailer rents for $500 per month)	6	mo	$1,500.00	$9,000.00				$0.00	$9,000.00	$9,000.00	$9,000.00
			Port-o-Let (3 @ $40/month) (Assumes Port-o-Let retained during 6 month construction)	6	mo	$120.00	$720.00				$0.00	$720.00	$720.00	$720.00
			Utility Hookups (Electric, Propane, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Bulldozer (Assume require 1 for 6 months @ $200 per hour)	1	ea	$288,000.00	$288,000.00				$0.00	$288,000.00	$288,000.00	$288,000.00
			End Loaders (Assume require 4 for 6 months @ $75.00 per hour)	4	ea	$108,000.00	$432,000.00				$0.00	$432,000.00	$432,000.00	$432,000.00
			Backfill Material (Assume require approximately 56,000 cubic yards of backfill; Backfill costs @ $5.00 per cubic yard (includes moving, loading, and dump truck)	56000	cu yd	$5.00	$280,000.00				$0.00	$280,000.00	$280,000.00	$280,000.00
			Transmodal to Contain Excavated Material (Assume rental of 20 transmodals for 6 months @ $12.00 per day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$43,800.00	$43,800.00
			Flatbed Truck Rental to move Intermodals (Assume 4 trucks for 6 months @ $138 per month)	6	mo	$552.00	$3,312.00				$0.00	$3,312.00	$3,312.00	$3,312.00
			Excavation Costs (Assume excavate approximately 56,000 cubic yards of material; Excavation costs @ $75.00 per cubic yard (includes excavator)	56000	cu yd	$75.00	$4,200,000.00				$0.00	$4,200,000.00	$4,200,000.00	$4,200,000.00
			Condenser and Vapor Emission Control System - (Assume price includes Condenser, Cooling Tower, Vaccum Pump, and Vapor Treatment. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$1,200,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Enclosure for Excavation Area	1	lump sum	$2,000,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			HEPA Vent for Excavation Enclosure	1	lump sum	$1,000,000.00	$1,000,000.00				$0.00	$1,000,000.00	$1,000,000.00	$1,000,000.00
			Dewatering System (Assume $50,000 for pump)	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Mobilize Treatment System for Excavated Material	1	lump sum	$500,000.00	$500,000.00				$0.00	$500,000.00	$500,000.00	$500,000.00
			Treatment System for Excavated Material (Assume Excavate approximately 56,000 cu yd; 1 cu yd = approx. 1 ton; treatment @ $800 per ton)	56000	ton	$800.00	$44,800,000.00				$0.00	$44,800,000.00	$44,800,000.00	$44,800,000.00
			Utilities for Treatment System for Excavated Material	1	lump sum	$300,000.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			Install monitoring wells (Assume 12 monitoring wells to 70 ft, 4 in. dia, 10 ft of screen, PVC)	12	ea	$19,535.00	$234,420.00				$0.00	$234,420.00	$234,420.00	$234,420.00
			Laboratory Analysis of Sidewall Samples during Excavation (Assume 1 sample collected every 10 sq ft for a total area of 30,000 sq ft (3000 samples)	3000	ea	$500.00	$1,500,000.00				$0.00	$1,500,000.00	$1,500,000.00	$1,500,000.00
			Laboratory Analysis of Excavated Material Prior to Treatment (Assume 50 samples per day for 100 days)	5000	ea	$500.00	$2,500,000.00				$0.00	$2,500,000.00	$2,500,000.00	$2,500,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$680,000.00	$680,000.00				$0.00	$680,000.00	$680,000.00	$680,000.00
			Labor - Data Management					765		$60.00	$45,900.00	$45,900.00	$45,900.00	$45,900.00
			Labor - Permit Requirements and Compliance Testing (RCRA, TSCA and Air)	1	lump sum	$300,000.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			Density/Compaction Testing (Assume 150 tests @ $300 per test	150	ea	$300.00	$45,000.00						$0.00	$0.00
			Labor - Security and Site Specific Training for Construction/Sampling Personnel (Assume 12 people for 2 weeks)				$0.00	960		$27.00	$25,920.00	$25,920.00	$25,920.00	$25,920.00
			Labor - Construction/Sampling (Assume 2 H&S People for 6 months)				$0.00	2080		$100.00	$208,000.00	$208,000.00	$208,000.00	$208,000.00
			Labor - Construction/Sampling (Assume 12 people for 6 months)				$0.00	12480		$27.00	$336,960.00	$336,960.00	$336,960.00	$336,960.00
			Material Treatment (Assume 7 Escorts for 6 months)				$0.00	7280		$26.50	$192,920.00	$192,920.00	$192,920.00	$192,920.00

Primary Source Area - Excavation Technology

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Excavated Material Treatment Personnel (Assume 14 people for 2 weeks)				$0.00	1120		$100.00	$112,000.00	$112,000.00	$112,000.00	$112,000.00
			Labor - Treatment of Excavated Material (Assume 14 people for 6 months)				$0.00	14560		$100.00	$1,456,000.00	$1,456,000.00	$1,456,000.00	$1,456,000.00
01.04.04.05		Site Restoration					$2,900,000.00	0			$0.00	$2,900,000.00	$2,900,000.00	$2,900,000.00
			Replacement of All Above Ground Structures (Assumes removal of loading dock, overhead crane, tank, utilities, roads, and railroad spur)	1	lump sum	$2,000,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			Grout for Sheet Piling Removal (Assume require 30,000 cu ft @ $30 per cu ft)	30000	cu ft	$30.00	$900,000.00				$0.00	$900,000.00	$900,000.00	$900,000.00
01.04.04.06		Waste Management					$3,458,590.00	2153			$86,016.00	$3,544,606.00	$4,505,558.89	$4,033,592.02
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 60 6" dia. Borings @ 2.5 drums per boring [150 drums] and 12 4" dia. Monitoring wells @ 6 drums per well [72 drums])	222	ea	$55.00	$12,210.00				$0.00	$12,210.00	$12,210.00	$12,210.00
			55-gal Drums to contain PPE (Assumes 72 borings/wells @ 1 drum per boring/well; Assumes PPE)	72	ea	$55.00	$3,960.00				$0.00	$3,960.00	$3,960.00	$3,960.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 9 months @ $1200 per month)	6	tank	$10,800.00	$64,800.00				$0.00	$64,800.00	$64,800.00	$64,800.00
			Treatment of Development Water (assume $50,000) and Water removed from excavation pit (Assume $350,000)	1	lump sum	$400,000.00	$400,000.00				$0.00	$400,000.00	$400,000.00	$400,000.00
			Laboratory Analysis of Treated Excavated Material (Assume 50 samples per day for 100 days)	5000	ea	$500.00	$2,500,000.00				$0.00	$2,500,000.00	$3,460,429.69	$2,989,249.27
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 72 borings @ 1 soil sample per well/boring)	72	ea	$25.00	$1,800.00				$0.00	$1,800.00	$1,800.00	$1,800.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$425,391.00	$425,391.00				$0.00	$425,391.00	$425,391.00	$425,391.00
			Labor - Data Management				$0.00	485		$60.00	$29,100.00	$29,100.00	$29,100.00	$29,100.00
			Fork Truck Rental (Assumes rental for 9 months)	9	mo	$175.00	$1,575.00				$0.00	$1,575.00	$1,575.00	$1,575.00
			Flatbed Truck Rental (Assume rental for 9 months)	9	mo	$138.00	$1,242.00				$0.00	$1,242.00	$1,242.00	$1,242.00
			Transmodal to Contain Treated Excavated Material (Assume rental of 20 transmodals for 6 months @ $12.00 per day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$43,800.00	$43,800.00
			Flatbed Truck Rental to move Intermodals Containing Treated Excavated Material to Landfill (Assume 4 trucks for 6 months @ $138 per month)	6	mo	$552.00	$3,312.00				$0.00	$3,312.00	$3,312.00	$3,312.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 152 wells/borings/transmodals)				$0.00	608		$27.00	$16,416.00	$16,416.00	$16,416.00	$16,416.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 9 months)				$0.00	360		$60.00	$21,600.00	$21,600.00	$21,600.00	$21,600.00
01.04.05	Operation & Maintenance of System (Direct - O&M Cost)						$0.00	0			$0.00	$0.00	$0.00	$0.00
01.04.05.01		Operation & Maintenance					$0.00	0			$0.00	$0.00	$0.00	$0.00
			O&M will not be required for this technology				$0.00				$0.00	$0.00	$0.00	$0.00
01.04.06	Demob of System (Direct - Capital Cost)						$320,000.00	3120			$84,240.00	$404,240.00	$827,239.73	$191,404.62
01.04.06.01		Plug/Abandon Wells and Piping and Demob Treatment System					$320,000.00	3120			$84,240.00	$404,240.00	$827,239.73	$191,404.62

Primary Source Area - Excavation Technology

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Plug/Abandon Wells and Piping (Assume P&A 12 Monitoring Wells)	12	ea	$10,000.00	$120,000.00				$0.00	$120,000.00	$245,568.89	$56,819.10
			Demob Treatment System	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	$172,389.36	$39,887.01
01.04.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$0.00	340			$20,400.00	$20,400.00	$20,910.00	$18,965.99
01.04.07.01		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$20,910.00	$18,965.99
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$9,840.00	$8,925.17
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,920.00	$4,462.59
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,690.00	$3,346.94
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,460.00	$2,231.29
01.04.08	Long Term Monitoring (Direct - O&M Cost)						$203,580.00	2123			$127,380.00	$330,960.00	$481,261.43	$111,353.04
01.04.08.01		Monitoring Activities (Groundwater)					$203,580.00	2123			$127,380.00	$330,960.00	$481,261.43	$111,353.04
			Labor - Perform Annual Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per year for 29 years)				$0.00	928		$60.00	$55,680.00	$55,680.00	$81,483.42	$18,853.43
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per year for 29 years)				$0.00	1160		$60.00	$69,600.00	$69,600.00	$101,854.27	$23,566.78
			Laboratory Analyses (Assume 12 gw samples per year for 29 years)	348	ea	$500.00	$174,000.00				$0.00	$174,000.00	$254,635.68	$58,916.95
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$29,580.00	$29,580.00				$0.00	$29,580.00	$43,288.07	$10,015.88
			Labor - Data Management				$0.00	35		$60.00	$2,100.00	$2,100.00		
01.04.08.02		5 Year Reviews					$0.00	0			$0.00	$0.00	$0.00	$0.00
			Labor - Prepare 5 Year Review Report (Assume Not Required for Areas where Excavation can be fully implemented)				$0.00	0		$60.00	$0.00	$0.00	$0.00	$0.00
01.04.09	Management and Integration Costs						$23,981,855.26	0			$0.00	$23,981,855.26	$24,287,772.07	$23,991,841.19
01.04.09.01		M& I Personnel Costs					$23,981,855.26	0			$0.00	$23,981,855.26	$24,287,772.07	$23,991,841.19
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$23,981,855.26	$23,981,855.26				$0.00	$23,981,855.26	$24,287,772.07	$23,991,841.19
01.04.10	Indirect Costs						$28,206,344.53	0			$0.00	$28,206,344.53	$28,564,825.41	$28,276,796.89
01.04.10.01		Indirect Costs					$28,206,344.53	0			$0.00	$28,206,344.53	$28,564,825.41	$28,276,796.89
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$28,206,344.53	$28,206,344.53				$0.00	$28,206,344.53	$28,564,825.41	$28,276,796.89
01.04.11	Overhead Costs						$50,958,062.67	0			$0.00	$50,958,062.67	$51,607,700.66	$16,110,924.07
01.04.11.01		Overhead Costs					$50,958,062.67	0			$0.00	$50,958,062.67	$51,607,700.66	$16,110,924.07
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$50,958,062.67	$50,958,062.67				$0.00	$50,958,062.67	$51,607,700.66	$16,110,924.07
01.04.12	Contingency Costs						$55,763,884.69	0			$0.00	$55,763,884.69	$56,474,789.62	$17,630,334.92
01.04.12.01		Contingency Costs					$55,763,884.69	0			$0.00	$55,763,884.69	$56,474,789.62	$17,630,334.92
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$55,763,884.69	$55,763,884.69				$0.00	$55,763,884.69	$56,474,789.62	$17,630,334.92

Treated Volume: 1,512,750 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$3,482,401.04
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$14,460.15
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$3,007,959.40
Total Contingency per acre-foot of implementation	$1,626,205.15
Total Cost per acre-foot of implementation	$8,131,025.73
Total Cost (Present Worth) per acre-foot of implementation	$5,930,929.85

Basis of Estimate
Feasibility Study for the GWOU
Steam Extraction Technology
(Secondary Source Area)

Description: This alternative addresses the remediation of secondary source areas containing VOCs, as both dissolved phase and DNAPL, and ^{99}Tc. The 0.4-hectare (1-acre) 'case' site used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and located in a heavy industrial setting. A zone of contamination with surface area of 11,700 sq m (125,600 sq ft) and volume of 355,500 cu m (465,000 cu yds) is the target of the remedial action.

In this setting, steam extraction requires a perimeter ring of 25 injection wells, spaced 15 m (50 ft) apart, and 9 interior extraction wells spaced 24 m (80 ft) apart, located on two diameters of the circle that are oriented normal to each other.

For this estimate, the following time frames were assumed:

construction	1 year
operation	2 years
long-term monitoring	28 years

This alternative includes the construction of 12 monitoring wells for quarterly compliance (2 years) and long-term (28 years) monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.05.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.05.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.05.03 Pre-Construction Characterization:
- Excavation permits and survey for 120 soil borings
- Installation of 120 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs

WBS 01.05.04 Construction of System:
- Kick off meeting and readiness review

- Site preparation
- System construction requires mobilization of 4 drill rigs. Construction extends over a 12-month period
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.05.05 Operation and Maintenance of System:

- Operation and maintenance over a 2-year period

WBS 01.05.06 Demobilization of System:

- Demobilization of system abandons all injection and extraction wells and demobilizes treatment train systems over a 3-month period

WBS 01.05.07 Confirmatory Sampling/Report:

- Installation of 120 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.05.08 Long Term Monitoring:

- Monitoring activities are assumed to extend over 28 years – 1 sample per well per year
- Five Year Review

Secondary Source Area - Steam Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.05	Secondary Source Area - Steam Extraction: Total Cost						$64,715,273.73	76668			$3,483,248.00	$68,198,521.73	$38,955,200.22	$36,196,136.60
01.05.01	Project Plans (Direct -Capital Cost)						$0.00	1593			$95,580.00	$95,580.00	$95,580.00	$95,580.00
01.05.01.01		Work Plan (4 versions)					$0.00	315			$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
01.05.01.02		General Health & Safety Plan (4 versions)					$0.00	150			$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D-1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	15		$60.00	$900.00	$900.00	$900.00	$900.00
01.05.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	315			$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
01.05.01.04		QA Plan (4 versions)					$0.00	150			$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D-1 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	15		$60.00	$900.00	$900.00	$900.00	$900.00
01.05.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.05.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.05.01.07		Operation and Maintenance Plan (4 versions)					$0.00	315			$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Prepare D-1 Version				$0.00	150		$60.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
			Labor - Prepare D0 Version				$0.00	75		$60.00	$4,500.00	$4,500.00	$4,500.00	$4,500.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
01.05.02	Design & Engineering (Direct - Capital Cost)						$2,093,161.60	0			$0.00	$2,093,161.60	$2,093,161.60	$2,093,161.60
01.05.02.01		Design Preparation (estimated @10% of construction costs)					$2,093,161.60	0			$0.00	$2,093,161.60	$2,093,161.60	$2,093,161.60
			Labor - Prepare 30% Design	1	lump sum	$941,922.72	$941,922.72				$0.00	$941,922.72	$941,922.72	$941,922.72
			Labor - Prepare 60% Design	1	lump sum	$627,948.48	$627,948.48				$0.00	$627,948.48	$627,948.48	$627,948.48
			Labor - Prepare 90% Design	1	lump sum	$313,974.24	$313,974.24				$0.00	$313,974.24	$313,974.24	$313,974.24
			Labor - Prepare CFC	1	lump sum	$209,316.16	$209,316.16				$0.00	$209,316.16	$209,316.16	$209,316.16
01.05.03	Pre-Construction Characterization (Direct - Capital Cost)						$2,112,000.00	6595			$274,780.00	$2,386,780.00	$2,386,780.00	$2,386,780.00
01.05.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.05.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.05.03.03		Installation of Pre-Characterization Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$2,352,780.00	$2,352,780.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$102,000.00	$102,000.00
			Labor - Data Management					115		$60.00	$6,900.00	$6,900.00	$6,900.00	$6,900.00
01.05.04	Construction of System (Direct - Capital Cost)						$19,102,108.00	43199			$1,829,508.00	$20,931,616.00	$21,318,244.25	$19,914,288.91
01.05.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.05.04.02		Readiness Reviews					$0.00	360			$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.05.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.05.04.04		System Construction					$18,809,790.00	40200			$1,713,060.00	$20,522,850.00	$20,768,147.25	$19,409,777.89
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 12 month construction and 2 year 0&M)	36	mo	$300.00	$10,800.00				$0.00	$10,800.00	$11,072.25	$9,564.63
			Shower/Change Trailer Rental (Assumes trailer retained during 12 month construction)	12	mo	$500.00	$6,000.00				$0.00	$6,000.00	$6,000.00	$6,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 12 month construction)	12	mo	$40.00	$480.00				$0.00	$480.00	$480.00	$480.00
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Utilities: Natural Gas Pipeline (12" dia) for system [5280 ft long, 1 ft wide, 4 ft deep] (Assumes Excavation Costs @ $5.00/yd, Pipeline Costs @ $25.00/ft, Hot Tap Pipe Costs @ $10,000, and Cutoff and Test Pipe @ $10,000)	1	lump sum	$155,910.00	$155,910.00				$0.00	$155,910.00	$155,910.00	$155,910.00
			Mobilization of Slant Hole Drill Rig (Assume 2 - 1 full time, 1 half time for 12 months)	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 2 for 12 months) - Costs covered under Pre-Characterization	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Install injection wells (Assume 25 injection wells to 100 ft, 4 in. dia, SS, 10 ft of screen, approx. 6 of the injection wells will be angled)	25	ea	$180,000.00	$4,500,000.00				$0.00	$4,500,000.00	$4,500,000.00	$4,500,000.00
			Install extraction wells (Assume 9 extraction wells to 100 ft, 6 in. dia, SS, 50 ft of screen)	9	ea	$280,000.00	$2,520,000.00				$0.00	$2,520,000.00	$2,520,000.00	$2,520,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Boiler Rental (Assume rental of 3 boilers for 36 months)	36	mo	$120,000.00	$4,320,000.00				$0.00	$4,320,000.00	$4,428,900.00	$3,825,850.34
			Treatment System Rental for Boiler Feed Water - Includes Air Stripper and Ion Exchange (Assume rental of 1 treatment system for 36 months)	36	mo	$50,000.00	$1,800,000.00				$0.00	$1,800,000.00	$1,845,375.00	$1,594,104.31
			ERT Monitoring System (Assume rental of 1 system for 36 months)	36	mo	$100,000.00	$3,600,000.00				$0.00	$3,600,000.00	$3,690,750.00	$3,188,208.62

Secondary Source Area - Steam Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Condenser and Vapor Treatment System - Includes Condenser @ $80,000, Cooling Tower @ $50,000, Vaccum Pump @ $100,000 and Vapor Treatment @ $200,000. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$430,000.00	$430,000.00				$0.00	$430,000.00	$430,000.00	$430,000.00
			Steam Injection Pipe (Assume 2400 ft @ $26.50 per ft)	2400	ft	$26.50	$63,600.00				$0.00	$63,600.00	$63,600.00	$63,600.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Permit Requirements (Air)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Perform Air Compliance Test (Assume testing requires 2 people for 1 week)				$0.00	80		$100.00	$8,000.00	$8,000.00	$8,000.00	$8,000.00
			Labor - Security and Site Specific Training (Assume 12 people for 2 weeks)				$0.00	960		$27.00	$25,920.00	$25,920.00	$25,920.00	$25,920.00
			Labor - Construction/Sampling (Assume 4 H&S People [1 per rig] for 12 months)				$0.00	8160		$100.00	$816,000.00	$816,000.00	$816,000.00	$816,000.00
			Labor - Construction/Sampling (Assume 12 people for 12 months)				$0.00	24480		$27.00	$660,960.00	$660,960.00	$660,960.00	$660,960.00
			Labor - Construction/Sampling (Assume 3 Escorts for 12 months)				$0.00	6120		$26.50	$162,180.00	$162,180.00	$162,180.00	$162,180.00
01.05.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.05.04.06		Waste Management					$212,318.00	2559			$90,048.00	$302,366.00	$443,697.00	$398,111.02
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 240 6" dia. Borings @ 5 drums per boring [1200 drums]; 25 4" dia. Injection Wells & 12 4" dia. Monitoring wells @ 8 drums per well [296 drums]; and 9 6" dia. Extraction Wells @ 12 drums per well [108 drums])	1604	ea	$55.00	$88,220.00				$0.00	$88,220.00	$135,665.82	$123,052.90
			55-gal Drums to contain PPE (Assumes 286 borings/wells @ 1 drum per boring/well; Assumes PPE)	286	ea	$55.00	$15,730.00				$0.00	$15,730.00	$24,189.79	$21,940.85
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 15 months)	6	tank		$0.00				$0.00	$0.00	$0.00	$0.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$76,890.63	$69,742.06
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every year for total of 2 years of O&M; Assume disposal cost @$7 per cu ft ($1,260), shipping cost for box @ $6000 per box ($12000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$43,260.00	$43,260.00				$0.00	$43,260.00	$44,350.51	$38,311.64
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 286 borings @ 1 soil sample per well/boring)	286	ea	$25.00	$7,150.00				$0.00	$7,150.00	$10,995.36	$9,973.12
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per 20 ft of piping and 1 sample per transmodal [approx. 25 cu yds] of concrete and debris, Assume 1000 ft of piping and 20 transmodals)	70	ea	$25.00	$1,750.00				$0.00	$1,750.00	3,581.21	$828.61
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$1,513.00	$1,513.00				$0.00	$1,513.00	$2,326.71	$2,110.39
			Labor - Data Management				$0.00	35		$60.00	$2,100.00	$2,100.00	$3,229.41	$2,929.17
			Fork Truck Rental (Assumes rental for 15 months)	15	mo	$175.00	$2,625.00				$0.00	$2,625.00	$4,036.76	$3,661.46
			Flatbed Truck Rental (Assume rental for 15 months)	15	mo	$138.00	$2,070.00				$0.00	$2,070.00	$3,183.27	$2,887.32

Secondary Source Area - Steam Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 306 wells/borings/transmodals)				$0.00	1224		$27.00	$33,048.00	$33,048.00	$50,821.63	$46,096.71
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$29,064.66	$26,362.50
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 15 months)				$0.00	600		$60.00	$36,000.00	$36,000.00	$55,361.25	$50,214.29
01.05.05	Operation & Maintenance of System (Direct - O&M Cost)						$306,232.00	12815			$768,900.00	$1,075,132.00	$1,653,351.43	$1,499,638.48
01.05.05.01		Operation & Maintenance					$306,232.00	12815			$768,900.00	$1,075,132.00	$1,653,351.43	$1,499,638.48
			Electric	2	yrs	$50,000.00	$100,000.00				$0.00	$100,000.00	$153,781.25	$139,484.13
			Telephone	24	months	$20.00	$480.00				$0.00	$480.00	$738.15	$669.52
			Propane (Assume system uses 4 gal per hr @ $2.00 per gal. System operation 24 hrs per day for 24 months)	24	months	$5,760.00	$138,240.00				$0.00	$138,240.00	$212,587.20	$192,822.86
			Water	24	months	$5.00	$120.00				$0.00	$120.00	$184.54	$167.38
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples per qtr for 2 years)	96	ea	$500.00	$48,000.00				$0.00	$48,000.00	$73,815.00	$66,952.38
			Laboratory Analyses - Monthly Compliance Vapor Samples (Assume 2 Vapor Sampling Points per month for 2 years)	48	ea	$200.00	$9,600.00				$0.00	$9,600.00	$14,763.00	$13,390.48
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$9,792.00	$9,792.00				$0.00	$9,792.00	$15,058.26	$13,658.29
			Labor - Data Management				$0.00	15		$60.00	$900.00	$900.00	$1,384.03	$1,255.36
			Labor - Operation and Maintenance (Assumes 3 people full time for two years)				$0.00	12480		$60.00	$748,800.00	$748,800.00	$1,151,514.00	$1,044,457.14
			Labor - Preparation of Quarterly Monitoring Reports (Assumes 1 person @ 40 hrs per qtr for 2 years)				$0.00	320		$60.00	$19,200.00	$19,200.00	$29,526.00	$26,780.95
01.05.06	Demob of System (Direct - Capital Cost)						$503,800.00	3120			$84,240.00	$588,040.00	$1,203,369.40	$278,432.54
01.05.06.01		Demob of System					$503,800.00	3120			$84,240.00	$588,040.00	$1,203,369.40	$278,432.54
			Plug/Abandon Wells and Piping (Assume P&A 25 Injections Wells, 9 Extraction Wells, and 12 Monitoring Wells)	46	ea	$10,000.00	$460,000.00				$0.00	$460,000.00	941,347.40	$217,806.56
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	172,389.36	$39,887.01
01.05.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$2,102,000.00	6695			$271,180.00	$2,373,180.00	$2,555,655.29	$2,102,543.93
01.05.07.01		Installation of Confirmatory Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$2,533,686.72	$2,084,470.34
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$215,378.13	$177,192.12
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,292,268.75	$1,063,152.70
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$120,956.36	$99,511.09
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$111,996.63	$92,139.90
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$29,679.11	$24,417.07
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$646,134.38	$531,576.35
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$109,842.84	$90,367.98
			Labor - Data Management					115		$60.00	$6,900.00	$6,900.00	$7,430.55	$6,113.13
01.05.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$21,968.57	$18,073.60

Secondary Source Area - Steam Extraction

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$10,338.15	$8,505.22
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$5,169.08	$4,252.61
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,876.81	$3,189.46
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,584.54	$2,126.31
01.05.08	Long Term Monitoring (Direct - O&M Cost)						$196,560.00	2651			$159,060.00	$355,620.00	$517,349.45	$119,703.00
01.05.08.01		Monitoring Activities (Groundwater)					$196,560.00	2051			$123,060.00	$319,620.00	$464,666.21	$107,513.28
			Labor - Perform Annual Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per year for 28 years)				$0.00	896		$60.00	$53,760.00	$53,760.00	$78,673.64	$18,203.31
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per year for 28 years)				$0.00	1120		$60.00	$67,200.00	$67,200.00	$98,342.06	$22,754.13
			Laboratory Analyses (Assume 12 gw samples per year for 28 years)	336	ea	$500.00	$168,000.00				$0.00	$168,000.00	$245,855.14	$56,885.33
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$28,560.00	$28,560.00				$0.00	$28,560.00	$41,795.37	$9,670.51
			Labor - Data Management				$0.00	35		$60.00	$2,100.00	$2,100.00		
01.05.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.05.09	Management and Integration Costs						$5,979,821.92	0			$0.00	$5,979,821.92	$6,364,698.29	$5,698,025.69
01.05.09.01		M& I Personnel Costs					$5,979,821.92	0			$0.00	$5,979,821.92	$6,364,698.29	$5,698,025.69
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$5,979,821.92	$5,979,821.92				$0.00	$5,979,821.92	$6,364,698.29	$5,698,025.69
01.05.10	Indirect Costs						$6,215,673.36	0			$0.00	$6,215,673.36	$6,476,182.35	$5,870,670.38
01.05.10.01		Indirect Costs					$6,215,673.36	0			$0.00	$6,215,673.36	$6,476,182.35	$5,870,670.38
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$6,215,673.36	$6,215,673.36				$0.00	$6,215,673.36	$6,476,182.35	$5,870,670.38
01.05.11	Overhead Costs						$12,464,212.50	0			$0.00	$12,464,212.50	$13,225,120.57	$11,861,417.95
01.05.11.01		Overhead Costs					$12,464,212.50	0			$0.00	$12,464,212.50	$13,225,120.57	$11,861,417.95
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$12,464,212.50	$12,464,212.50				$0.00	$12,464,212.50	$13,225,120.57	$11,861,417.95
01.05.12	Contingency Costs						$13,639,704.35	0			$0.00	$13,639,704.35	$14,472,373.16	$12,980,060.62
01.05.12.01		Contingency Costs					$13,639,704.35	0			$0.00	$13,639,704.35	$14,472,373.16	$12,980,060.62
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$13,639,704.35	$13,639,704.35				$0.00	$13,639,704.35	$14,472,373.16	$12,980,060.62

Treated Volume: 1,512,750 cu ft

1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$780,268.53
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$136,096.56
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$750,576.77
Total Contingency per acre-foot of implementation	$416,735.47
Total Cost per acre-foot of implementation	$2,083,677.33
Total Cost (Present Worth) per acre-foot of implementation	$1,042,276.46

Basis of Estimate
Feasibility Study for the GWOU
Pump and Treat Technology
(Secondary Source Area)

Description: This alternative addresses the remediation of secondary source areas containing VOCs, as both dissolved phase and DNAPL, and ^{99}Tc. The 0.4-hectare (1-acre) 'case' site used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and located in a heavy industrial setting. A zone of contamination with surface area of 11,700 sq m (125,600 sq ft) and volume of 355,500 cu m (465,000 cu yds) is the target of the remedial action.

In this setting, pump and treat requires 5 extraction wells (4 vertical wells and 1 slanted well) completed to a depth of 100 feet bgs. The cumulative pumping rate for this scenario is 200 gpm. (The number of wells and total pumping rate is based on optimization of capture zone modeling.)

For this estimate, the following time frames were assumed:

construction	6 months
operation	30 years
long-term monitoring	30 years

Long term/quarterly compliance monitoring under this alternative addresses the 5 extraction wells and 12 monitoring wells.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.06.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.06.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.06.03 Pre-Construction Characterization:
- Excavation permits and survey for 120 soil borings
- Installation of 120 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs

WBS 01.06.04 Construction of System:
- Kick off meeting and readiness review

- Site preparation
- System construction requires mobilization of 2 drill rigs. Construction extends over a 12-month period
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.06.05 Operation and Maintenance of System:
- Operation and maintenance over a 30-year period

WBS 01.06.06 Demobilization of System:
- Demobilization of system abandons all extraction and monitoring wells and demobilizes treatment train systems over a 6-month period

WBS 01.06.07 Confirmatory Sampling/Report:
- Installation of 120 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.06.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 30 years – 4 samples per well (includes the 5 extractions wells and 12 monitoring wells) per year
- Five Year Review

Secondary Source Area - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.06	Secondary Source Area - Pump & Treat: Total Cost						$52,483,858.65	145206			$7,815,616.00	$60,299,474.65	$80,506,776.58	$37,379,560.22
01.06.01	Project Plans (Direct - Capital Cost)						$0.00	1178			$70,680.00	$70,680.00	$70,680.00	$70,680.00
01.06.01.01		Work Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.06.01.02		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.06.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.06.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.06.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.06.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.06.01.07		Operation and Maintenance Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.06.02	Design & Engineering (Direct - Capital Cost)						$758,509.53	0			$0.00	$758,509.53	$758,509.53	$758,509.53
01.06.02.01		Design Preparation (estimated @10% of construction costs)					$758,509.53	0			$0.00	$758,509.53	$758,509.53	$758,509.53
			Labor - Prepare 30% Design	1	lump sum	$341,329.29	$341,329.29				$0.00	$341,329.29	$341,329.29	$341,329.29
			Labor - Prepare 60% Design	1	lump sum	$227,552.86	$227,552.86				$0.00	$227,552.86	$227,552.86	$227,552.86
			Labor - Prepare 90% Design	1	lump sum	$113,776.43	$113,776.43				$0.00	$113,776.43	$113,776.43	$113,776.43
			Labor - Prepare CFC	1	lump sum	$75,850.95	$75,850.95				$0.00	$75,850.95	$75,850.95	$75,850.95
01.06.03	Pre-Construction Characterization (Direct - Capital Cost)						$2,112,000.00	6595			$274,780.00	$2,386,780.00	$2,386,780.00	$2,386,780.00
01.06.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.06.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.06.03.03		Installation of Pre-Characterization Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$2,352,780.00	$2,352,780.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00

Secondary Source Area - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$102,000.00	$102,000.00
			Labor - Data Management					115		$60.00	$6,900.00	$6,900.00	$6,900.00	$6,900.00
01.06.04	Construction of System (Direct - Capital Cost)						$6,865,399.25	19318			$719,696.00	$7,585,095.25	$7,742,579.97	$7,360,816.89
01.06.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.06.04.02		Readiness Reviews					$0.00	360			$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.06.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.06.04.04		System Construction					$6,406,040.00	16680			$621,080.00	$7,027,120.00	$7,078,003.89	$6,954,498.63
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 6 month construction and 30 year 0&M)	366	mo	$300.00	$109,800.00				$0.00	$109,800.00	$160,683.89	$37,178.63
			Shower/Change Trailer Rental (Assumes trailer retained during 6 month construction)	6	mo	$500.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 6 month construction)	6	mo	$40.00	$240.00				$0.00	$240.00	$240.00	$240.00
			Utility Hookups (Electric, Propane, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 2 for 6 months) - Costs covered under Pre-Characterization	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Install GW Extraction Wells, Pumps, and Associated Piping (Assume 4 vertical extraction wells to 100 ft, each 8 in. dia., PVC riser, 50 ft of SS)	4	ea	$280,000.00	$1,120,000.00				$0.00	$1,120,000.00	$1,120,000.00	$1,120,000.00
			Install GW Extraction Wells, Pumps, and Associated Piping (Assume 1 angled extraction well to 100 ft bgs, each 8 in. dia., PVC riser, 50 ft of SS)	1	ea	$300,000.00	$300,000.00				$0.00	$300,000.00	$300,000.00	$300,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Install GW Treatment System and Accessories (Assume that systems pumps at rate of 200 gpm; System includes Air Stripper @ $120,000, Filter @ $20,000, and Ion Exchange System @ $100,000)	1	ea	$240,000.00	$240,000.00				$0.00	$240,000.00	$240,000.00	$240,000.00
			Condenser and Vapor Treatment System - Includes Condenser @ $80,000, Cooling Tower @ $50,000, Vaccum Pump @ $100,000 and Vapor Treatment @ $200,000. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$430,000.00	$430,000.00				$0.00	$430,000.00	$430,000.00	$430,000.00
			Construct Pad & Building to House Treatment System (Assume construction to PGDP specifications)	1	lump sum	$3,000,000.00	$3,000,000.00				$0.00	$3,000,000.00	$3,000,000.00	$3,000,000.00

Secondary Source Area - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Permit Requirements (Air)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Perform Air Compliance Test (Assume testing requires 2 people for 1 week)				$0.00	80		$100.00	$8,000.00	$8,000.00	$8,000.00	$8,000.00
			Labor - Security and Site Specific Training (Assume 10 people for 2 weeks)				$0.00	800		$27.00	$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Construction/Sampling (Assume 2 H&S People [1 per rig] for 6 months)				$0.00	2080		$100.00	$208,000.00	$208,000.00	$208,000.00	$208,000.00
			Labor - Construction/Sampling (Assume 10 people for 6 months)				$0.00	10400		$27.00	$280,800.00	$280,800.00	$280,800.00	$280,800.00
			Labor - Construction/Sampling (Assume 3 Escorts for 6 months)				$0.00	3120		$26.50	$82,680.00	$82,680.00	$82,680.00	$82,680.00
01.06.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.06.04.06		Waste Management					$379,359.25	2198			$72,216.00	$451,575.25	$558,176.08	$299,918.26
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 240 6" dia. Borings @ 5 drums per boring [1200 drums]; 12 4" dia. Monitoring wells @ 8 drums per well [96 drums]; and 5 8" dia. GW Extraction Wells @ 15 drums per well [75 drums])	1371	ea	$55.00	$75,405.00				$0.00	$75,405.00	$75,405.00	$75,405.00
			55-gal Drums to contain PPE (Assumes 257 borings/wells @ 1 drum per boring/well; Assumes PPE)	257	ea	$55.00	$14,135.00				$0.00	$14,135.00	$14,135.00	$14,135.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 9 months)	9	tank		$0.00				$0.00	$0.00	$0.00	$0.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every year for total of 30 years of O&M; Assume disposal cost @$7 per cu ft ($18,900), shipping cost for box @ $6000 per box ($180,000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$228,900.00	$228,900.00				$0.00	$228,900.00	$334,977.63	$77,506.27
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 257 borings @ 1 soil sample per well/boring)	257	ea	$25.00	$6,425.00				$0.00	$6,425.00	$6,425.00	$6,425.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$1,177.25	$1,177.25				$0.00	$1,177.25	$1,177.25	$1,177.25
			Labor - Data Management				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Fork Truck Rental (Assumes rental for 9 months)	9	mo	$175.00	$1,575.00				$0.00	$1,575.00	$1,575.00	$1,575.00
			Flatbed Truck Rental (Assume rental for 9 months)	9	mo	$138.00	$1,242.00				$0.00	$1,242.00	$1,242.00	$1,242.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 277 wells/borings/transmodals)				$0.00	1108		$27.00	$29,916.00	$29,916.00	$29,916.00	$29,916.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 9 months)				$0.00	360		$60.00	$21,600.00	$21,600.00	$21,600.00	$21,600.00
01.06.05	Operation & Maintenance of System (Direct - O&M Cost)						$7,401,480.00	93820			$5,629,200.00	$13,030,680.00	$19,069,402.54	$4,412,229.71
01.06.05.01		Operation & Maintenance					$7,401,480.00	93820			$5,629,200.00	$13,030,680.00	$19,069,402.54	$4,412,229.71
			Electric	30	yrs	$50,000.00	$1,500,000.00				$0.00	$1,500,000.00	$2,195,135.16	$507,904.77

Secondary Source Area - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Telephone	360	months	$20.00	$7,200.00				$0.00	$7,200.00	$10,536.65	$2,437.94
			Propane (Assume system uses 4 gal per hr @ $2.00 per gal. System operation 24 hrs per day for 360 months)	360	months	$5,760.00	$2,073,600.00				$0.00	$2,073,600.00	$3,034,554.84	$702,127.56
			Water	360	months	$5.00	$1,800.00				$0.00	$1,800.00	$2,634.16	$609.49
			Laboratory Analyses - Monthly Compliance Vapor Samples (Assume 2 Vapor Sampling Points per month for 30 years)	720	ea	$200.00	$144,000.00				$0.00	$144,000.00	$210,732.98	$48,758.86
			Laboratory Analyses - KPDES Compliance Discharge Samples (Assume 1 weekly for 30 years)	1560	ea	$2,000.00	$3,120,000.00				$0.00	$3,120,000.00	$4,565,881.13	$1,056,441.93
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$554,880.00	$554,880.00				$0.00	$554,880.00	$812,024.40	$187,884.13
			Labor - Data Management				$0.00	220		$60.00	$13,200.00	$13,200.00	$19,317.19	$4,469.56
			Labor - Operation and Maintenance (Assumes 1.5 people full time for 30 years)				$0.00	93600		$60.00	$5,616,000.00	$5,616,000.00	$8,218,586.03	$1,901,595.47
			Laboratory Analysis Costs for GW and Qrtly Report Costs included under Long Term Monitoring	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
01.06.06	Demob of System (Direct - Capital Cost)						$468,800.00	6240			$168,480.00	$637,280.00	$1,304,134.50	$301,747.31
01.06.06.01		Plug/Abandon Wells and Piping					$468,800.00	6240			$168,480.00	$637,280.00	$1,304,134.50	$301,747.31
			Plug/Abandon Wells and Associated Piping (Assume P&A 5 Extraction Wells and 12 Monitoring Wells)	17	ea	$25,000.00	$425,000.00				$0.00	$425,000.00	$869,723.14	$201,234.32
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 6 months)					6240		$27.00	$168,480.00	$168,480.00	$344,778.72	$79,774.02
01.06.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$2,102,000.00	6695			$271,180.00	$2,373,180.00	$4,856,493.10	$1,123,682.98
01.06.07.01		Installation of Confirmatory Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$4,814,746.39	$1,114,023.74
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$2,455,688.87	$568,191.03
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$229,852.48	$53,182.68
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$212,826.37	$49,243.22
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$56,398.99	$13,049.45
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$1,227,844.44	$284,095.51
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$208,733.55	$48,296.24
			Labor - Data Management					115		$60.00	$6,900.00	$6,900.00	$14,120.21	$3,267.10
01.06.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$41,746.71	$9,659.25
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$19,645.51	$4,545.53
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$9,822.76	$2,272.76
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$7,367.07	$1,704.57
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$4,911.38	$1,136.38
01.06.08	Long Term Monitoring (Direct - O&M Cost)						$1,193,400.00	11360			$681,600.00	$1,875,000.00	$2,743,918.95	$634,880.97
01.06.08.01		Monitoring Activities (Groundwater)					$1,193,400.00	10760			$645,600.00	$1,839,000.00	$2,691,235.70	$622,691.25

Secondary Source Area - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells and 5 Extraction Wells (Assume 2 people @ 24 hours per qtr for 30 years)				$0.00	5760		$60.00	$345,600.00	$345,600.00	$505,759.14	$117,021.26
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 30 years)				$0.00	4800		$60.00	$288,000.00	$288,000.00	$421,465.95	$97,517.72
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells and 5 gw samples from extraction wells per qtr for 30 years)	2040	ea	$500.00	$1,020,000.00				$0.00	$1,020,000.00	$1,492,691.91	$345,375.25
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$173,400.00	$173,400.00				$0.00	$173,400.00	$253,757.62	$58,713.79
			Labor - Data Management				$0.00	200		$60.00	$12,000.00	$12,000.00	$17,561.08	$4,063.24
01.06.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.06.09	Management and Integration Costs						$5,743,440.96	0			$0.00	$5,743,440.96	$7,786,499.72	$3,409,865.48
01.06.09.01		M& I Personnel Costs					$5,743,440.96	0			$0.00	$5,743,440.96	$7,786,499.72	$3,409,865.48
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$5,743,440.96	$5,743,440.96				$0.00	$5,743,440.96	$7,786,499.72	$3,409,865.48
01.06.10	Indirect Costs						$2,758,380.37	0			$0.00	$2,758,380.37	$2,972,708.56	$2,612,829.49
01.06.10.01		Indirect Costs					$2,758,380.37	0			$0.00	$2,758,380.37	$2,972,708.56	$2,612,829.49
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$2,758,380.37	$2,758,380.37				$0.00	$2,758,380.37	$2,972,708.56	$2,612,829.49
01.06.11	Overhead Costs						$11,020,553.63	0			$0.00	$11,020,553.63	$14,713,714.40	$6,831,625.82
01.06.11.01		Overhead Costs					$11,020,553.63	0			$0.00	$11,020,553.63	$14,713,714.40	$6,831,625.82
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$11,020,553.63	$11,020,553.63				$0.00	$11,020,553.63	$14,713,714.40	$6,831,625.82
01.06.12	Contingency Costs						$12,059,894.93	0			$0.00	$12,059,894.93	$16,101,355.32	$7,475,912.04
01.06.12.01		Contingency Costs					$12,059,894.93	0			$0.00	$12,059,894.93	$16,101,355.32	$7,475,912.04
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$12,059,894.93	$12,059,894.93				$0.00	$12,059,894.93	$16,101,355.32	$7,475,912.04

Treated Volume: 1,512,750 cu ft

1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$353,106.93
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$767,963.72
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$733,498.93
Total Contingency per acre-foot of implementation	$463,642.40
Total Cost per acre-foot of implementation	$2,318,211.99
Total Cost (Present Worth) per acre-foot of implementation	$1,076,353.42

Basis of Estimate
Feasibility Study for the GWOU
Oxidation Technology
(Secondary Source Area)

Description: This alternative addresses the remediation of secondary source areas containing VOCs, as both dissolved phase and DNAPL. The 0.4-hectare (1-acre) 'case' site used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and located in a heavy industrial setting. A zone of contamination with surface area of 11,700 sq m (125,600 sq ft) and volume of 355,500 cu m (465,000 cu yds) is the target of the remedial action.

In this setting, oxidation requires 20 injection wells completed to a depth of 100 feet bgs. This alternative requires the injection of 450,000 kg (1,000,000 lbs) of oxidant.

For this estimate, the following time frames were assumed:

construction/operation	1 year
long-term monitoring	29 years

This alternative includes the construction of 12 monitoring wells, in boreholes previously drilled for pre-construction characterization, for long-term monitoring (29 years).

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.07.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.07.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.07.03 Pre-Construction Characterization:
- Excavation permits and survey for 120 soil borings
- Installation of 120 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required.

WBS 01.07.04 Construction of System:
- Kick off meeting and readiness review
- Site preparation

- Assumes that 32 of the pre-characterization borings will be converted to injection/monitoring wells to 30 m (100 ft) depth. Construction extends over a 12-month period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.07.05 Operation and Maintenance of System:
- Cost of 450,000 kg (1,000,000 lbs) of oxidant

WBS 01.07.06 Demobilization of System:
- Demobilization of system abandons all extraction and monitoring wells and demobilizes treatment train systems over a 3-month period

WBS 01.07.07 Confirmatory Sampling/Report:
- Installation of 120 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.07.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 29 years – 1 sample per well per year
- Five Year Review

Secondary Source Area - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.07	Secondary Source Area - Oxidation: Total Cost						$424,642,395.18	25945			$1,096,811.00	$425,739,206.18	$427,303,275.08	$424,337,220.12
01.07.01	Project Plans (Direct - Capital Cost)						$0.00	1178			$70,680.00	$70,680.00	$70,680.00	$70,680.00
01.07.01.01		Work Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.07.01.02		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.07.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.07.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.07.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.07.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.07.01.07		Operation and Maintenance Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.07.02	Design & Engineering (Direct - Capital Cost)						$366,448.20	0			$0.00	$366,448.20	$366,448.20	$366,448.20
01.07.02.01		Design Preparation (estimated @10% of construction costs)					$366,448.20	0			$0.00	$366,448.20	$366,448.20	$366,448.20
			Labor - Prepare 30% Design	1	lump sum	$164,901.69	$164,901.69				$0.00	$164,901.69	$164,901.69	$164,901.69
			Labor - Prepare 60% Design	1	lump sum	$109,934.46	$109,934.46				$0.00	$109,934.46	$109,934.46	$109,934.46
			Labor - Prepare 90% Design	1	lump sum	$54,967.23	$54,967.23				$0.00	$54,967.23	$54,967.23	$54,967.23
			Labor - Prepare CFC	1	lump sum	$36,644.82	$36,644.82				$0.00	$36,644.82	$36,644.82	$36,644.82
01.07.03	Pre-Construction Characterization (Direct - Capital Cost)						$2,112,000.00	6595			$274,780.00	$2,386,780.00	$2,386,780.00	$2,386,780.00
01.07.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.07.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.07.03.03		Installation of Pre-Characterization Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$2,352,780.00	$2,352,780.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring]; Assume 32 of these borings will be converted to injection/monitoring wells)	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00

Secondary Source Area - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$600,000.00	$600,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$102,000.00	$102,000.00
			Labor - Data Management				$0.00	115		$60.00	$6,900.00	$6,900.00	$6,900.00	$6,900.00
01.07.04	Construction of System (Direct - Capital Cost)						$3,431,931.00	5634			$232,551.00	$3,664,482.00	$3,668,345.04	$3,644,266.97
01.07.04.01		Kick Off Meeting					$0.00	120			$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Kick Off Meeting (Assume 12 hours per person for 10 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.07.04.02		Readiness Reviews					$0.00	480			$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #4 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.07.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.07.04.04		System Construction					$3,210,080.00	2620			$110,715.00	$3,320,795.00	$3,320,795.00	$3,320,795.00
			Mobilization Costs cited under Pre-Construction Characterization (Assume 1 drill rig during system construction phase)	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 12 month construction)	12	mo	$300.00	$3,600.00				$0.00	$3,600.00	$3,600.00	$3,600.00
			Shower/Change Trailer Rental (Assumes trailer retained during 12 month construction)	12	mo	$500.00	$6,000.00				$0.00	$6,000.00	$6,000.00	$6,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 12 month construction)	12	mo	$40.00	$480.00				$0.00	$480.00	$480.00	$480.00
			Install injection wells (Assume 20 injection wells to 100 ft, 4 in. dia, SS, 10 ft of screen)	20	ea	$100,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Security and Site Specific Training (Assume 4 people for 2 weeks)				$0.00	320		$27.00	$8,640.00	$8,640.00	$8,640.00	$8,640.00
			Labor - Construction/Sampling (Assume 1 H&S People [1 per rig] for 2 months)				$0.00	350		$100.00	$35,000.00	$35,000.00	$35,000.00	$35,000.00
			Labor - Construction/Sampling (Assume 4 people for 2 months)				$0.00	1400		$27.00	$37,800.00	$37,800.00	$37,800.00	$37,800.00
			Labor - Construction/Sampling (Assume 1 Escort for 2 months)				$0.00	350		$26.50	$9,275.00	$9,275.00	$9,275.00	$9,275.00
01.07.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,500.00	$18,594.10
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,500.00	$18,594.10
01.07.04.06		Waste Management					$141,851.00	2414			$85,836.00	$227,687.00	$231,050.04	$208,877.87
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 240 6" dia. Borings @ 5 drums per boring [1200 drums]	1200	ea	$55.00	$66,000.00				$0.00	$66,000.00	$66,825.00	$60,612.24
			55-gal Drums to contain PPE (Assumes 240 borings/wells @ 1 drum per boring/well; Assumes PPE)	240	ea	$55.00	$13,200.00				$0.00	$13,200.00	$13,365.00	$12,122.45
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 15 months)	6	tank		$0.00				$0.00	$0.00	$0.00	$0.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,625.00	$45,918.37
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 252 borings @ 1 soil sample per well/boring)	252	ea	$25.00	$6,300.00				$0.00	$6,300.00	$6,378.75	$5,785.71

Secondary Source Area - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$1,156.00	$1,156.00				$0.00	$1,156.00	$1,170.45	$1,061.63
			Labor - Data Management				$0.00	26		$60.00	$1,560.00	$1,560.00	$1,579.50	$1,432.65
			Fork Truck Rental (Assumes rental for 15 months)	15	mo	$175.00	$2,625.00				$0.00	$2,625.00	$2,657.81	$2,410.71
			Flatbed Truck Rental (Assume rental for 15 months)	15	mo	$138.00	$2,070.00				$0.00	$2,070.00	$2,095.88	$1,901.02
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 272 wells/borings/transmodals)				$0.00	1088		$27.00	$29,376.00	$29,376.00	$29,743.20	$26,977.96
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$19,136.25	$17,357.14
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 15 months)				$0.00	600		$60.00	$36,000.00	$36,000.00	$36,450.00	$33,061.22
01.07.05	Operation & Maintenance of System (Direct - O&M Cost)						$207,900,000.00	0			$0.00	$207,900,000.00	$207,900,000.00	$207,900,000.00
01.07.05.01		Operation & Maintenance					$207,900,000.00	0			$0.00	$207,900,000.00	$207,900,000.00	$207,900,000.00
			Treatment Chemical Cost (Assume 2,100,000 lbs of TCE in RGA at SE corner of C-400 Building (includes TCE in soil matrix, DNAPL, and dissolved phase); Assume requires 22 lbs of Potassium Permanganate per 1 lb of TCE @ $1.50 per lb of Potassium Permanganate)	46200000	lbs	$1.50	$69,300,000.00				$0.00	$69,300,000.00	$69,300,000.00	$69,300,000.00
			Injection Services (Assumes 3 floods over a period of 1 year)	1	lump sum	$138,600,000.00	$138,600,000.00				$0.00	$138,600,000.00	$138,600,000.00	$138,600,000.00
01.07.06	Demob of System (Direct - Capital Cost)						$363,800.00	3120			$84,240.00	$448,040.00	$916,872.37	$212,143.59
01.07.06.01		Plug/Abandon Injection Wells					$363,800.00	3120			$84,240.00	$448,040.00	$916,872.37	$212,143.59
			Plug/Abandon Wells and Piping (Assume P&A 20 Injections Wells and 12 Monitoring Wells)	32	ea	$10,000.00	$320,000.00				$0.00	$320,000.00	$654,850.37	$151,517.61
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	$172,389.36	$39,887.01
01.07.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$2,102,000.00	6695			$271,180.00	$2,373,180.00	$2,432,509.50	$2,206,357.82
01.07.07.03		Installation of Confirmatory Borings					$2,102,000.00	6355			$250,780.00	$2,352,780.00	$2,411,599.50	$2,187,391.84
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$205,000.00	$185,941.04
			Install borings (Assume 120 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	120	ea	$10,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,230,000.00	$1,115,646.26
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$115,128.00	$104,424.49
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$106,600.00	$96,689.34
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$28,249.00	$25,622.68
			Laboratory Analyses (Assume 1200 gw samples for VOCs and 99Tc)	1200	ea	$500.00	$600,000.00				$0.00	$600,000.00	$615,000.00	$557,823.13
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$102,000.00	$102,000.00				$0.00	$102,000.00	$104,550.00	$94,829.93
			Labor - Data Management				$0.00	115		$60.00	$6,900.00	$6,900.00	$7,072.50	$6,414.97
01.07.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$20,910.00	$18,965.99
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$9,840.00	$8,925.17
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,920.00	$4,462.59

Secondary Source Area - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,690.00	$3,346.94
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,460.00	$2,231.29
01.07.08	Long Term Monitoring (Direct - O&M Cost)						$203,580.00	2723			$163,380.00	$366,960.00	$537,017.87	$124,253.82
01.07.08.01		Monitoring Activities (Groundwater)					$203,580.00	2123			$127,380.00	$330,960.00	$484,334.62	$112,064.11
			Labor - Perform Annual Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per year for 29 years)				$0.00	928		$60.00	$55,680.00	$55,680.00	$81,483.42	$18,853.43
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per year for 29 years)				$0.00	1160		$60.00	$69,600.00	$69,600.00	$101,854.27	$23,566.78
			Laboratory Analyses (Assume 12 gw samples per year for 29 years)	348	ea	$500.00	$174,000.00				$0.00	$174,000.00	$254,635.68	$58,916.95
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$29,580.00	$29,580.00				$0.00	$29,580.00	$43,288.07	$10,015.88
			Labor - Data Management				$0.00	35		$60.00	$2,100.00	$2,100.00	$3,073.19	$711.07
01.07.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.07.09	Management and Integration Costs						$43,515,314.04	0			$0.00	$43,515,314.04	$43,655,730.60	$43,382,186.08
01.07.09.01		M& I Personnel Costs					$43,515,314.04	0			$0.00	$43,515,314.04	$43,655,730.60	$43,382,186.08
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$43,515,314.04	$43,515,314.04				$0.00	$43,515,314.04	$43,655,730.60	$43,382,186.08
01.07.10	Indirect Costs						$1,689,818.52	0			$0.00	$1,689,818.52	$1,812,719.33	$1,623,229.55
01.07.10.01		Indirect Costs					$1,689,818.52	0			$0.00	$1,689,818.52	$1,812,719.33	$1,623,229.55
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$1,689,818.52	$1,689,818.52				$0.00	$1,689,818.52	$1,812,719.33	$1,623,229.55
01.07.11	Overhead Costs						$77,809,662.19	0			$0.00	$77,809,662.19	$78,095,517.17	$77,553,430.06
01.07.11.01		Overhead Costs					$77,809,662.19	0			$0.00	$77,809,662.19	$78,095,517.17	$77,553,430.06
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$77,809,662.19	$77,809,662.19				$0.00	$77,809,662.19	$78,095,517.17	$77,553,430.06
01.07.12	Contingency Costs						$85,147,841.24	0			$0.00	$85,147,841.24	$85,460,655.02	$84,867,444.02
01.07.12.01		Contingency Costs					$85,147,841.24	0			$0.00	$85,147,841.24	$85,460,655.02	$84,867,444.02
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$85,147,841.24	$85,147,841.24				$0.00	$85,147,841.24	$85,460,655.02	$84,867,444.02

Treated Volume: 1,512,750 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$213,347.55
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$6,072,038.75
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$3,558,054.14
Total Contingency per acre-foot of implementation	$2,460,860.11
Total Cost per acre-foot of implementation	$12,304,300.55
Total Cost (Present Worth) per acre-foot of implementation	$12,218,892.29

Basis of Estimate
Feasibility Study for the GWOU
Pump and Treat Technology
(Dissolved Phase Plume)

Description: This alternative addresses the remediation of a dissolved phase plume containing VOCs and ^{99}Tc. The 180 m (600 ft) wide 'case' plume used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and is located outside the PGDP industrial complex but within the DOE reservation. This alternative has a radius of influence of 90 m (300 ft) and develops a cross sectional containment zone of of 2,800 sq m (30,00 sq ft) within the RGA.

In this setting, pump and treat requires 5 extraction wells completed to a depth of 100 feet bgs. The extraction wells have a cumulative pumping rate of 750 liters/minute (200 gpm).

For this estimate, the following time frames were assumed:

construction	9 months
operation	29 years
long-term monitoring	29 years

This alternative includes the construction of 12 wells, to be sampled in addition to the 5 extraction wells, for quarterly compliance monitoring over the 29 years of operation and maintenance.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.08.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.08.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.08.03 Pre-Construction Characterization:
- Excavation permits and survey for 6 soil borings
- Installation of 6 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required for 3 months.

WBS 01.08.04 Construction of System:

- Kick off meeting and readiness review
- Site preparation
- Assumes construction of 5 extraction wells and 12 monitoring wells to 30 m (100 ft) depth. Construction extends over a 9-month period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.08.05 Operation and Maintenance of System:

- Operation and maintenance over a 29-year period

WBS 01.08.06 Demobilization of System:

- Demobilization of system abandons all extraction wells and monitoring wells and demobilizes treatment system over a 6-month period

WBS 01.08.07 Confirmatory Sampling/Report:

- Installation of 6 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.08.08 Long Term Monitoring:

- Monitoring activities are assumed to extend over 29 years – 4 samples per extraction and monitoring well per year
- Five Year Review

Dissolved Phase Plume - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.08	Dissolved Phase Plume - Pump & Treat: Total Cost						$62,825,591.39	231687			$12,331,392.00	$75,156,983.39	$95,413,751.62	$49,729,975.39
01.08.01	Project Plans (Direct - Capital Cost)						$0.00	1178			$70,680.00	$70,680.00	$70,680.00	$70,680.00
01.08.01.01		Work Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.08.01.02		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.08.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.08.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.08.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.08.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.08.01.07		Operation and Maintenance Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.08.02	Design & Engineering (Direct - Capital Cost)						$1,367,711.13	0			$0.00	$1,367,711.13	$1,367,711.13	$1,367,711.13
01.08.02.01		Design Preparation (estimated @10% of construction costs)					$1,367,711.13	0			$0.00	$1,367,711.13	$1,367,711.13	$1,367,711.13
			Labor - Prepare 30% Design	1	lump sum	$615,470.01	$615,470.01				$0.00	$615,470.01	$615,470.01	$615,470.01
			Labor - Prepare 60% Design	1	lump sum	$410,313.34	$410,313.34				$0.00	$410,313.34	$410,313.34	$410,313.34
			Labor - Prepare 90% Design	1	lump sum	$205,156.67	$205,156.67				$0.00	$205,156.67	$205,156.67	$205,156.67
			Labor - Prepare CFC	1	lump sum	$136,771.11	$136,771.11				$0.00	$136,771.11	$136,771.11	$136,771.11
01.08.03	Pre-Construction Characterization (Direct - Capital Cost)						$305,100.00	6490			$268,480.00	$573,580.00	$573,580.00	$573,580.00
01.08.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.08.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.08.03.03		Installation of Pre-Characterization Borings					$295,100.00	6250			$244,480.00	$539,580.00	$539,580.00	$539,580.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00

Dissolved Phase Plume - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$30,000.00	$30,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,100.00	$5,100.00
			Labor - Data Management					10		$60.00	$600.00	$600.00	$600.00	$600.00
01.08.04	Construction of System (Direct - Capital Cost)						$11,838,719.25	49181			$1,838,392.00	$13,677,111.25	$13,780,639.58	$13,529,839.33
01.08.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.08.04.02		Readiness Reviews					$0.00	600			$36,000.00	$36,000.00	$36,000.00	$36,000.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
01.08.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.08.04.04		System Construction					$11,380,560.00	47120			$1,744,300.00	$13,124,860.00	$13,124,860.00	$13,124,860.00
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 9 month construction)	9	mo	$300.00	$2,700.00				$0.00	$2,700.00	$2,700.00	$2,700.00
			Shower/Change Trailer Rental (Assumes trailer retained during 9 month construction)	9	mo	$500.00	$4,500.00				$0.00	$4,500.00	$4,500.00	$4,500.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 9 month construction)	9	mo	$40.00	$360.00				$0.00	$360.00	$360.00	$360.00
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 4 for 9 months) - Costs for mobilization of 2 rigs covered under Pre-Characterization Costs; Mob costs for 2 additional rigs covered here.)	1	lump sum	$100,000.00	$100,000.00				$0.00	$100,000.00	$100,000.00	$100,000.00
			Install GW Extraction Wells, Pumps, and Associated Piping (Assume 5 vertical extraction wells to 100 ft, each 8 in. dia., PVC riser, 50 ft of SS)	5	ea	$280,000.00	$1,400,000.00				$0.00	$1,400,000.00	$1,400,000.00	$1,400,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Construct Pad & Building to House Treatment System (Assume construction to PGDP specifications)	1	lump sum	$5,000,000.00	$5,000,000.00				$0.00	$5,000,000.00	$5,000,000.00	$5,000,000.00
			Install GW Treatment System and Accessories (Assume that systems pumps at rate of 200 gpm; System includes Air Stripper @ $120,000, Filter @ $20,000, and Ion Exchange System @ $100,000)	1	ea	$240,000.00	$240,000.00				$0.00	$240,000.00	$240,000.00	$240,000.00
			Condenser and Vapor Treatment System - Includes Condenser @ $80,000, Cooling Tower @ $50,000, Vaccum Pump @ $100,000 and Vapor Treatment @ $200,000. (Assume Vapor Treatment System includes Caustic Tank and Propane Tank)	1	lump sum	$430,000.00	$430,000.00				$0.00	$430,000.00	$430,000.00	$430,000.00
			Pipeline (Sensor controlled, double contained)	1	lump sum	$2,000,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			Sanitation Facilities (Lift Station to Sanitary Sewer)	1	lump sum	$1,000,000.00	$1,000,000.00				$0.00	$1,000,000.00	$1,000,000.00	$1,000,000.00
			Labor - Permit Requirements (Air)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Perform Air Compliance Test (Assume testing requires 2 people for 1 week)				$0.00	80		$100.00	$8,000.00	$8,000.00	$8,000.00	$8,000.00

Dissolved Phase Plume - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Security and Site Specific Training (Assume 20 people for 2 weeks)				$0.00	1600		$27.00	$43,200.00	$43,200.00	$43,200.00	$43,200.00
			Labor - Construction/Sampling (Assume 4 H&S People [1 per rig] for 9 months)				$0.00	6240		$100.00	$624,000.00	$624,000.00	$624,000.00	$624,000.00
			Labor - Construction/Sampling (Assume 20 people for 9 months)				$0.00	31200		$27.00	$842,400.00	$842,400.00	$842,400.00	$842,400.00
			Labor - Construction/Sampling (Assume 5 Escorts for 9 months)				$0.00	7800		$26.50	$206,700.00	$206,700.00	$206,700.00	$206,700.00
01.08.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.08.04.06		Waste Management					$378,159.25	1381			$53,292.00	$431,451.25	$534,979.58	$284,179.33
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 12 6" dia. Borings @ 5 drums per boring [60 drums]; 12 4" dia. Monitoring wells @ 8 drums per well [96 drums]; and 5 8" dia. GW Extraction Wells @ 15 drums per well [75 drums])	231	ea	$55.00	$12,705.00				$0.00	$12,705.00	$12,705.00	$12,705.00
			55-gal Drums to contain PPE (Assumes 29 borings/wells @ 1 drum per boring/well; Assumes PPE)	29	ea	$55.00	$1,595.00				$0.00	$1,595.00	$1,595.00	$1,595.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 12 months @ $1200 per month)	6	tank	$14,400.00	$86,400.00				$0.00	$86,400.00	$86,400.00	$86,400.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every year for total of 29 years of O&M; Assume disposal cost @$7 per cu ft ($18,270), shipping cost for box @ $6000 per box ($174,000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$222,270.00	$222,270.00				$0.00	$222,270.00	$325,275.13	$75,261.33
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 29 borings @ 1 soil sample per well/boring)	29	ea	$25.00	$725.00				$0.00	$725.00	$725.00	$725.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$208.25	$208.25				$0.00	$208.25	$208.25	$208.25
			Labor - Data Management				$0.00	5		$60.00	$300.00	$300.00	$300.00	$300.00
			Fork Truck Rental (Assumes rental for 12 months)	12	mo	$175.00	$2,100.00				$0.00	$2,100.00	$2,100.00	$2,100.00
			Flatbed Truck Rental (Assume rental for 12 months)	12	mo	$138.00	$1,656.00				$0.00	$1,656.00	$1,656.00	$1,656.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 49 wells/borings/transmodals)				$0.00	196		$27.00	$5,292.00	$5,292.00	$5,292.00	$5,292.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 12 months)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
01.08.05	Operation & Maintenance of System (Direct - O&M Cost)						$7,154,764.00	151010			$9,060,600.00	$16,215,364.00	$23,729,943.75	$5,490,573.84
01.08.05.01		Operation & Maintenance					$7,154,764.00	151010			$9,060,600.00	$16,215,364.00	$23,729,943.75	$5,490,573.84
			Electric	29	yrs	$50,000.00	$1,450,000.00				$0.00	$1,450,000.00	$2,121,963.99	$490,974.61
			Telephone	348	months	$20.00	$6,960.00				$0.00	$6,960.00	$10,185.43	$2,356.68
			Propane (Assume system uses 4 gal per hr @ $2.00 per gal. System operation 24 hrs per day for 348 months)	348	months	$5,760.00	$2,004,480.00				$0.00	$2,004,480.00	$2,933,403.01	$678,723.31

Dissolved Phase Plume - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Water	348	months	$5.00	$1,740.00				$0.00	$1,740.00	$2,546.36	$589.17
			Laboratory Analyses - Monthly Compliance Vapor Samples (Assume 2 Vapor Sampling Points per month for 29 years)	696	ea	$200.00	$139,200.00				$0.00	$139,200.00	$203,708.54	$47,133.56
			Laboratory Analyses - KPDES Compliance Discharge Samples (Assume 1 weekly for 29 years)	1508	ea	$2,000.00	$3,016,000.00				$0.00	$3,016,000.00	$4,413,685.09	$1,021,227.20
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$536,384.00	$536,384.00				$0.00	$536,384.00	$784,956.92	$181,621.33
			Labor - Data Management				$0.00	210		$60.00	$12,600.00	$12,600.00	$18,439.14	$4,266.40
			Labor - Operation and Maintenance (Assumes 2.5 people full time for 29 years)				$0.00	150800		$60.00	$9,048,000.00	$9,048,000.00	$13,241,055.27	$3,063,681.59
			Laboratory Analysis Costs for GW and Qrtly Report Costs included under Long Term Monitoring	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
01.08.06	Demob of System (Direct - Capital Cost)						$893,800.00	6240			$168,480.00	$1,062,280.00	$2,173,857.65	$502,981.64
01.08.06.01		Plug/Abandon Wells and Piping; Abandon Facility					$893,800.00	6240			$168,480.00	$1,062,280.00	$2,173,857.65	$502,981.64
			Plug/Abandon Wells and Associated Piping (Assume P&A 5 Extraction Wells and 12 Monitoring Wells)	17	ea	$50,000.00	$850,000.00				$0.00	$850,000.00	$1,739,446.29	$402,468.64
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 6 months)					6240		$27.00	$168,480.00	$168,480.00	$344,778.72	$79,774.02
01.08.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$295,100.00	6590			$264,880.00	$559,980.00	$1,145,947.21	$265,146.34
01.08.07.01		Installation of Confirmatory Borings					$295,100.00	6250			$244,480.00	$539,580.00	$1,104,200.50	$255,487.09
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$122,784.44	$28,409.55
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$229,852.48	$53,182.68
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$212,826.37	$49,243.22
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$56,398.99	$13,049.45
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$61,392.22	$14,204.78
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$10,436.68	$2,414.81
			Labor - Data Management					10		$60.00	$600.00	$600.00	$1,227.84	$284.10
01.08.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$41,746.71	$9,659.25
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$19,645.51	$4,545.53
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$9,822.76	$2,272.76
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$7,367.07	$1,704.57
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$4,911.38	$1,136.38
01.08.08	Long Term Monitoring (Direct - O&M Cost)						$1,153,620.00	10998			$659,880.00	$1,813,500.00	$2,653,918.41	$614,056.87
01.08.08.01		Monitoring Activities (Groundwater)					$1,153,620.00	10398			$623,880.00	$1,777,500.00	$2,601,235.16	$601,867.16
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells and 5 Extraction Wells (Assume 2 people @ 24 hours per qtr for 29 years)				$0.00	5568		$60.00	$334,080.00	$334,080.00	$488,900.50	$113,120.55
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 29 years)				$0.00	4640		$60.00	$278,400.00	$278,400.00	$407,417.09	$94,267.13

Dissolved Phase Plume - Pump & Treat

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells and 5 gw samples from extraction wells per qtr for 29 years)	1972	ea	$500.00	$986,000.00				$0.00	$986,000.00	$1,442,935.51	$333,862.74
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$167,620.00	$167,620.00				$0.00	$167,620.00	$245,299.04	$56,756.67
			Labor - Data Management				$0.00	190		$60.00	$11,400.00	$11,400.00	$16,683.03	$3,860.08
01.08.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.08.09	Management and Integration Costs						$7,068,041.28	0			$0.00	$7,068,041.28	$9,099,255.54	$4,482,913.83
01.08.09.01		M& I Personnel Costs					$7,068,041.28	0			$0.00	$7,068,041.28	$9,099,255.54	$4,482,913.83
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$7,068,041.28	$7,068,041.28				$0.00	$7,068,041.28	$9,099,255.54	$4,482,913.83
01.08.10	Indirect Costs						$3,981,372.53	0			$0.00	$3,981,372.53	$4,297,300.08	$3,797,664.25
01.08.10.01		Indirect Costs					$3,981,372.53	0			$0.00	$3,981,372.53	$4,297,300.08	$3,797,664.25
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$3,981,372.53	$3,981,372.53				$0.00	$3,981,372.53	$4,297,300.08	$3,797,664.25
01.08.11	Overhead Costs						$13,735,966.53	0			$0.00	$13,735,966.53	$17,438,167.95	$9,088,833.09
01.08.11.01		Overhead Costs					$13,735,966.53	0			$0.00	$13,735,966.53	$17,438,167.95	$9,088,833.09
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$13,735,966.53	$13,735,966.53				$0.00	$13,735,966.53	$17,438,167.95	$9,088,833.09
01.08.12	Contingency Costs						$15,031,396.68	0			$0.00	$15,031,396.68	$19,082,750.32	$9,945,995.08
01.08.12.01		Contingency Costs					$15,031,396.68	0			$0.00	$15,031,396.68	$19,082,750.32	$9,945,995.08
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$15,031,396.68	$15,031,396.68				$0.00	$15,031,396.68	$19,082,750.32	$9,945,995.08

Treated Volume: 6,000,000 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$130,436.56
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$199,866.42
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$223,860.09
Total Contingency per acre-foot of implementation	$138,540.77
Total Cost per acre-foot of implementation	$692,703.84
Total Cost (Present Worth) per acre-foot of implementation	$361,039.62

Basis of Estimate
Feasibility Study for the GWOU
Ozonation Technology
(Dissolved Phase Plume)

Description: This alternative addresses the remediation of a dissolved phase plume containing VOCs and ^{99}Tc. The 180 m (600 ft) wide 'case' plume used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and is located outside the PGDP industrial complex but within the DOE reservation. This alternative develops a treatment zone of 2,800 sq m (30,00 sq ft) cross section within the RGA.

In this setting, ozonation requires 6 treatment well systems completed to a depth of 100 feet bgs. Each treatment well has a 15 m (50 ft) radius of influence. These treatment wells consist of a basal ozone sparge point, a recirculation system, and a ^{99}Tc cation exchange resin canister.

For this estimate, the following time frames were assumed:

construction	6 months
operation	30 years
long-term monitoring	30 years

This alternative includes the construction of 12 wells for quarterly compliance monitoring over the 30 years of operation and maintenance.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.09.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.09.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.09.03 Pre-Construction Characterization:
- Excavation permits and survey for 6 soil borings
- Installation of 6 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required for 3 months.

WBS 01.09.04 Construction of System:
- Kick off meeting and readiness review

- Site preparation
- Assumes construction of 6 ozination treatment wells and 12 monitoring wells to 30 m (100 ft) depth. Construction extends over a 6-month period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.09.05 Operation and Maintenance of System:
- Operation and maintenance over a 30-year period

WBS 01.09.06 Demobilization of System:
- Demobilization of system abandons all ozination treatment wells and monitoring wells over a 6-month period

WBS 01.09.07 Confirmatory Sampling/Report:
- Installation of 6 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.09.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 30 years – 4 samples per well per year
- Five Year Review

Dissolved Phase Plume - Ozonation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.09	Dissolved Phase Plume - Ozonation: Total Cost						$11,686,800.45	56263			$2,651,520.00	$14,338,320.45	$18,523,128.66	$10,339,661.52
01.09.01	Project Plans (Direct - Capital Cost)						$0.00	1178			$70,680.00	$70,680.00	$70,680.00	$70,680.00
01.09.01.01		Work Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			D-1				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			D0				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			D1				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			D2				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.09.01.02		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			D-1				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			D0				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			D1				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			D2				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.09.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			D-1				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			D0				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			D1				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			D2				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.09.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			D-1				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			D0				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			D1				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			D2				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.09.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			D-1				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			D0				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			D1				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			D2				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.09.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			D-1				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			D0				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			D1				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			D2				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.09.01.07		Operation and Maintenance Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.09.02	Design & Engineering (Direct - Capital Cost)						$255,812.95	0			$0.00	$255,812.95	$255,812.95	$255,812.95
01.09.02.01		Design Preparation (estimated @10% of construction costs)					$255,812.95	0			$0.00	$255,812.95	$255,812.95	$255,812.95
			Labor - Prepare 30% Design	1	lump sum	$115,115.83	$115,115.83				$0.00	$115,115.83	$115,115.83	$115,115.83
			Labor - Prepare 60% Design	1	lump sum	$76,743.89	$76,743.89				$0.00	$76,743.89	$76,743.89	$76,743.89
			Labor - Prepare 90% Design	1	lump sum	$38,371.94	$38,371.94				$0.00	$38,371.94	$38,371.94	$38,371.94
			Labor - Prepare CFC	1	lump sum	$25,581.30	$25,581.30				$0.00	$25,581.30	$25,581.30	$25,581.30
01.09.03	Pre-Construction Characterization (Direct - Capital Cost)						$305,100.00	6490			$268,480.00	$573,580.00	$573,580.00	$573,580.00
01.09.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.09.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.09.03.03		Installation of Pre-Characterization Borings					$295,100.00	6250			$244,480.00	$539,580.00	$539,580.00	$539,580.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00

Dissolved Phase Plume - Ozonation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$30,000.00	$30,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,100.00	$5,100.00
			Labor - Data Management					10		$60.00	$600.00	$600.00	$600.00	$600.00
01.09.04	Construction of System (Direct - Capital Cost)						$1,990,729.50	13905			$567,400.00	$2,558,129.50	$2,590,990.39	$2,511,713.98
01.09.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.09.04.02		Readiness Reviews					$0.00	360			$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.09.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.09.04.04		System Construction					$1,705,040.00	12200			$494,800.00	$2,199,840.00	$2,199,840.00	$2,199,840.00
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 6 month construction)	6	mo	$300.00	$1,800.00				$0.00	$1,800.00	$1,800.00	$1,800.00
			Shower/Change Trailer Rental (Assumes trailer retained during 6 month construction)	6	mo	$500.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 6 month construction)	6	mo	$40.00	$240.00				$0.00	$240.00	$240.00	$240.00
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Install Ozonation systems (Assume 6, each with 50 ft radius of influence; 100 ft deep; 18" dia)	6	lump sum	$75,000.00	$450,000.00				$0.00	$450,000.00	$450,000.00	$450,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Security and Site Specific Training (Assume 7 people for 2 weeks)				$0.00	560		$27.00	$15,120.00	$15,120.00	$15,120.00	$15,120.00
			Labor - Construction/Sampling (Assume 2 H&S People [1 per rig] for 6 months)				$0.00	2080		$100.00	$208,000.00	$208,000.00	$208,000.00	$208,000.00
			Labor - Construction/Sampling (Assume 7 people for 6 months)				$0.00	7280		$27.00	$196,560.00	$196,560.00	$196,560.00	$196,560.00
			Labor - Construction/Sampling (Assume 2 Escorts for 6 months)				$0.00	2080		$26.50	$55,120.00	$55,120.00	$55,120.00	$55,120.00
01.09.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.09.04.06		Waste Management					$205,689.50	1265			$46,200.00	$251,889.50	$284,750.39	$205,473.98
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			55-gal Drums to contain Drill Cuttings (Assumes: 12 6" dia. Borings @ 5 drums per boring [60 drums]; 12 4" dia. Monitoring wells @ 8 drums per well [96 drums]; and 6 18" dia. Ozonation Wells @ 20 drums per well [120 drums])	276	ea	$55.00	$15,180.00				$0.00	$15,180.00	$15,180.00	$15,180.00

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			55-gal Drums to contain PPE (Assumes 30 borings/wells @ 1 drum per boring/well; Assumes PPE)	30	ea	$55.00	$1,650.00				$0.00	$1,650.00	$1,650.00	$1,650.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 9 months @ $1200 per month)	6	tank	$10,800.00	$64,800.00				$0.00	$64,800.00	$64,800.00	$64,800.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Disposal of Ion-Exchange Resin (Assume generation of 1 90 cu ft box every 5 years for total of 30 years of O&M; Assume disposal cost @$7 per cu ft ($3780), shipping cost for box @ $6000 per box ($36000), and Waste Analysis Characterization Costs of $30,000 ($30,000))	1	lump sum	$69,780.00	$69,780.00				$0.00	$69,780.00	$102,117.69	$23,627.73
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 30 borings @ 1 soil sample per well/boring)	30	ea	$25.00	$750.00				$0.00	$750.00	$750.00	$750.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$212.50	$212.50				$0.00	$212.50	$212.50	$212.50
			Labor - Data Management				$0.00	5		$60.00	$300.00	$300.00	$300.00	$300.00
			Fork Truck Rental (Assumes rental for 9 months)	9	mo	$175.00	$1,575.00				$0.00	$1,575.00	$1,575.00	$1,575.00
			Flatbed Truck Rental (Assume rental for 9 months)	9	mo	$138.00	$1,242.00				$0.00	$1,242.00	$1,242.00	$1,242.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 50 wells/borings/transmodals)				$0.00	200		$27.00	$5,400.00	$5,400.00	$5,400.00	$5,400.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 9 months)				$0.00	360		$60.00	$21,600.00	$21,600.00	$21,600.00	$21,600.00
01.09.05	Operation & Maintenance of System (Direct - O&M Cost)						$34,950.00	12480			$748,800.00	$783,750.00	$1,146,958.12	$265,380.24
01.09.05.01		Operation & Maintenance					$34,950.00	12480			$748,800.00	$783,750.00	$1,146,958.12	$265,380.24
			Electric	30	yrs	$865.00	$25,950.00				$0.00	$25,950.00	$37,975.84	$8,786.75
			Telephone	360	months	$20.00	$7,200.00				$0.00	$7,200.00	$10,536.65	$2,437.94
			Water	360	months	$5.00	$1,800.00				$0.00	$1,800.00	$2,634.16	$609.49
			Labor - Operation and Maintenance (Assumes 1 person full time for 30 years)				$0.00	12480		$60.00	$748,800.00	$748,800.00	$1,095,811.47	$253,546.06
			Laboratory Analysis Costs for GW and Qrtly Report Costs included under Long Term Monitoring	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
01.09.06	Demob of System (Direct - Capital Cost)						$233,800.00	6240			$168,480.00	$402,280.00	$823,228.77	$190,476.57
		Plug/Abandon Wells and Piping; Abandon Facility					$233,800.00	6240			$168,480.00	$402,280.00	$823,228.77	$190,476.57
			Plug/Abandon Wells and Associated Piping (Assume P&A 6 Ozonation Wells and 12 Monitoring Wells)	18	ea	$10,000.00	$180,000.00				$0.00	$180,000.00	$368,353.33	$85,228.65
			Disconnect Utilities	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$20,464.07	$4,734.93
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 6 months)					6240		$27.00	$168,480.00	$168,480.00	$344,778.72	$79,774.02
01.09.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$295,100.00	6590			$264,880.00	$559,980.00	$1,145,947.21	$265,146.34

Dissolved Phase Plume - Ozonation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.09.07.01		Installation of Confirmatory Borings					$295,100.00	6250			$244,480.00	$539,580.00	$1,104,200.50	$255,487.09
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$122,784.44	$28,409.55
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$229,852.48	$53,182.68
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$212,826.37	$49,243.22
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$56,398.99	$13,049.45
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$61,392.22	$14,204.78
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$10,436.68	$2,414.81
			Labor - Data Management					10		$60.00	$600.00	$600.00	$1,227.84	$284.10
01.09.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$41,746.71	$9,659.25
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$19,645.51	$4,545.53
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$9,822.76	$2,272.76
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$7,367.07	$1,704.57
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$4,911.38	$1,136.38
01.09.08	Long Term Monitoring (Direct - O&M Cost)						$842,400.00	9380			$562,800.00	$1,405,200.00	$2,056,402.62	$475,805.19
01.09.08.01		Monitoring Activities (Groundwater)					$842,400.00	8780			$526,800.00	$1,369,200.00	$2,003,719.37	$463,615.48
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per qtr for 30 years)				$0.00	3840		$60.00	$230,400.00	$230,400.00	$337,172.76	$78,014.17
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 30 years)				$0.00	4800		$60.00	$288,000.00	$288,000.00	$421,465.95	$97,517.72
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells per qtr for 30 years)	1440	ea	$500.00	$720,000.00				$0.00	$720,000.00	$1,053,664.88	$243,794.29
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$122,400.00	$122,400.00				$0.00	$122,400.00	$179,123.03	$41,445.03
			Labor - Data Management				$0.00	140		$60.00	$8,400.00	$8,400.00	$12,292.76	$2,844.27
01.09.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.09.09	Management and Integration Costs						$1,321,882.49	0			$0.00	$1,321,882.49	$1,732,720.01	$921,719.05
01.09.09.01		M& I Personnel Costs					$1,321,882.49	0			$0.00	$1,321,882.49	$1,732,720.01	$921,719.05
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$1,321,882.49	$1,321,882.49				$0.00	$1,321,882.49	$1,732,720.01	$921,719.05
01.09.10	Indirect Costs						$918,837.27	0			$0.00	$918,837.27	$1,036,827.78	$851,700.34
01.09.10.01		Indirect Costs					$918,837.27	0			$0.00	$918,837.27	$1,036,827.78	$851,700.34
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$918,837.27	$918,837.27				$0.00	$918,837.27	$1,036,827.78	$851,700.34
01.09.11	Overhead Costs						$2,620,524.15	0			$0.00	$2,620,524.15	$3,385,355.08	$1,889,714.54
01.09.11.01		Overhead Costs					$2,620,524.15	0			$0.00	$2,620,524.15	$3,385,355.08	$1,889,714.54
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$2,620,524.15	$2,620,524.15				$0.00	$2,620,524.15	$3,385,355.08	$1,889,714.54
01.09.12	Contingency Costs						$2,867,664.09	0			$0.00	$2,867,664.09	$3,704,625.73	$2,067,932.30

Dissolved Phase Plume - Ozonation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.09.12.01		Contingency Costs					$2,867,664.09	0			$0.00	$2,867,664.09	$3,704,625.73	$2,067,932.30
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$2,867,664.09	$2,867,664.09				$0.00	$2,867,664.09	$3,704,625.73	$2,067,932.30

Treated Volume: 6,000,000 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$31,321.76
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$31,575.98
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$44,684.59
Total Contingency per acre-foot of implementation	$26,895.58
Total Cost per acre-foot of implementation	$134,477.91
Total Cost (Present Worth) per acre-foot of implementation	$75,065.94

Basis of Estimate
Feasibility Study for the GWOU
Permeable Treatment Zone Technology
(Dissolved Phase Plume)

Description: This alternative addresses the remediation of a dissolved phase plume containing VOCs and ^{99}Tc. The 180 m (600 ft) wide 'case' plume used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and is located outside the PGDP industrial complex but within the DOE reservation. This alternative develops a treatment zone of 2,800 sq m (30,00 sq ft) cross section within the RGA.

In this setting, a permeable treatment zone of iron filings is constructed between 15 and 30 m (50 and 100 ft) bgs. The treatment zone consists of 2 'panels' of iron filings, one downgradient of the other, and each one being 15 cm (6 inches) thick.

For this estimate, the following time frames were assumed:

construction	9 months
operation	30 years
long-term monitoring	30 years

This alternative includes the construction of 12 wells for quarterly compliance monitoring over the 30 years of operation. Note, other than monitoring, an assumption that is unique to this alternative is that there are no maintenance costs over the 30-year period of this estimate.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.10.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.10.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.10.03 Pre-Construction Characterization:
- Excavation permits and survey for 6 soil borings
- Installation of 6 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required for 3 months.

WBS 01.10.04 Construction of System:

- Kick off meeting and readiness review
- Site preparation
- Assumes construction of 2 iron filings walls, each completed between 15 and 30 m (50 to 100 ft) bgs, each 180 m (600 ft) long, and 15 cm (6 inches) wide. Includes installation of 12 monitoring wells to 30 m (100 ft) depth. Construction extends over a 9-month period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.10.05 Operation and Maintenance of System:
- None

WBS 01.10.06 Demobilization of System:
- The only demobilization is the abandonment of monitoring wells over a 6-month period

WBS 01.10.07 Confirmatory Sampling/Report:
- Installation of 6 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.10.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 30 years – 4 samples per well per year
- Five Year Review

Dissolved Phase Plume - PTZ

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.10	Dissolved Phase Plume - PTZ: Total Cost						$17,554,819.93	68145			$2,898,592.00	$20,453,411.93	$24,830,510.64	$17,119,188.22
01.10.01	Project Plans (Direct - Capital Cost)						$0.00	1936			$124,080.00	$124,080.00	$124,080.00	$124,080.00
01.10.01.01		Work Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.10.01.02		General Health & Safety Plan (4 versions)					$0.00	200			$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.10.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.10.01.04		QA Plan (4 versions)					$0.00	200			$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.10.01.05		Sampling and Analysis Plan (4 versions)					$0.00	276			$16,560.00	$16,560.00	$16,560.00	$16,560.00
			Labor - Prepare D-1 Version				$0.00	132		$60.00	$7,920.00	$7,920.00	$7,920.00	$7,920.00
			Labor - Prepare D0 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	24		$60.00	$1,440.00	$1,440.00	$1,440.00	$1,440.00
01.10.01.06		Waste Management Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.10.02	Design & Engineering (Direct - Capital Cost)						$515,754.00	0			$0.00	$515,754.00	$515,754.00	$515,754.00
01.10.02.01		Design Preparation (estimated @10% of construction costs)					$515,754.00	0			$0.00	$515,754.00	$515,754.00	$515,754.00
			Labor - Prepare 30% Design	1	lump sum	$232,089.30	$232,089.30				$0.00	$232,089.30	$232,089.30	$232,089.30
			Labor - Prepare 60% Design	1	lump sum	$154,726.20	$154,726.20				$0.00	$154,726.20	$154,726.20	$154,726.20
			Labor - Prepare 90% Design	1	lump sum	$77,363.10	$77,363.10				$0.00	$77,363.10	$77,363.10	$77,363.10
			Labor - Prepare CFC	1	lump sum	$51,575.40	$51,575.40				$0.00	$51,575.40	$51,575.40	$51,575.40
01.10.03	Pre-Construction Characterization (Direct - Capital Cost)						$305,100.00	6490			$268,480.00	$573,580.00	$573,580.00	$573,580.00
01.10.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.10.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.10.03.03		Installation of Pre-Characterization Borings					$295,100.00	6250			$244,480.00	$539,580.00	$539,580.00	$539,580.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$30,000.00	$30,000.00

Dissolved Phase Plume - PTZ

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,100.00	$5,100.00
			Labor - Data Management					10		$60.00	$600.00	$600.00	$600.00	$600.00
01.10.04	Construction of System (Direct - Capital Cost)						$3,630,088.00	37802			$1,527,452.00	$5,157,540.00	$5,158,586.41	$5,157,013.49
01.10.04.01		Kick Off Meeting					$0.00	120			$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.10.04.02		Readiness Reviews					$0.00	600			$36,000.00	$36,000.00	$36,000.00	$36,000.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Attend Readiness Review #4 (Assume 8 hours per person for 25 people)				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
01.10.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.10.04.04		System Construction					$3,310,560.00	35640			$1,429,280.00	$4,739,840.00	$4,739,840.00	$4,739,840.00
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 9 month construction)	9	mo	$300.00	$2,700.00				$0.00	$2,700.00	$2,700.00	$2,700.00
			Shower/Change Trailer Rental (Assumes trailer retained during 9 month construction)	9	mo	$500.00	$4,500.00				$0.00	$4,500.00	$4,500.00	$4,500.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 9 month construction)	9	mo	$40.00	$360.00				$0.00	$360.00	$360.00	$360.00
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 4 for 9 months) - Costs for mobilization of 2 rigs covered under Pre-Characterization Costs; Mob costs for 2 additional rigs covered here.)	1	lump sum	$100,000.00	$100,000.00				$0.00	$100,000.00	$100,000.00	$100,000.00
			Install 2 Treatment Panels (Assume each panel will be 6" thick, 50 ft deep [50 to 100 ft bgs], and 600 ft long; Assume cost includes Injection Wells, Pipes, Pumps, Equipment, Guar Gum,and Granular Iron; Assume each treatment panel costs $1,000,000)	2	panel	$1,000,000.00	$2,000,000.00				$0.00	$2,000,000.00	$2,000,000.00	$2,000,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Security and Site Specific Training (Assume 14 people for 2 weeks)				$0.00	1120		$27.00	$30,240.00	$30,240.00	$30,240.00	$30,240.00
			Labor - Construction/Sampling (Assume 4 H&S People [1 per rig] for 9 months)				$0.00	6240		$100.00	$624,000.00	$624,000.00	$624,000.00	$624,000.00
			Labor - Construction/Sampling (Assume 14 people for 9 months)				$0.00	21840		$27.00	$589,680.00	$589,680.00	$589,680.00	$589,680.00
			Labor - Construction/Sampling (Assume 4 Escorts for 9 months)				$0.00	6240		$26.50	$165,360.00	$165,360.00	$165,360.00	$165,360.00
01.10.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,000.00	$20,000.00
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,000.00	$20,000.00
01.10.04.06		Waste Management					$239,528.00	1442			$54,972.00	$294,500.00	$295,546.41	$293,973.49
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00

Dissolved Phase Plume - PTZ

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			55-gal Drums to contain Drill Cuttings (Assumes: 12 6" dia. Borings @ 5 drums per boring [60 drums] and 12 4" dia. Monitoring wells @ 8 drums per well [96 drums])	156	ea	$55.00	$8,580.00				$0.00	$8,580.00	$8,580.00	$8,580.00
			55-gal Drums to contain PPE (Assumes 24 borings/wells @ 1 drum per boring/well; Assumes PPE)	24	ea	$55.00	$1,320.00				$0.00	$1,320.00	$1,320.00	$1,320.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 12 months @ $1200 per month)	6	tank	$14,400.00	$86,400.00				$0.00	$86,400.00	$86,400.00	$86,400.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Transmodal to Contain Waste Gaur Gum and Iron Filings (Assume rental of 20 transmodals for 12 months @ $12/day)	20	transmodal	$4,380.00	$87,600.00				$0.00	$87,600.00	$87,600.00	$87,600.00
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 24 borings @ 1 soil sample per well/boring)	24	ea	$25.00	$600.00				$0.00	$600.00	$600.00	$600.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 40 transmodals)	40	ea	$25.00	$1,000.00				$0.00	$1,000.00	$2,046.41	$473.49
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$272.00	$272.00				$0.00	$272.00	$272.00	$272.00
			Labor - Data Management				$0.00	6		$60.00	$360.00	$360.00	$360.00	$360.00
			Fork Truck Rental (Assumes rental for 12 months)	12	mo	$175.00	$2,100.00				$0.00	$2,100.00	$2,100.00	$2,100.00
			Flatbed Truck Rental (Assume rental for 12 months)	12	mo	$138.00	$1,656.00				$0.00	$1,656.00	$1,656.00	$1,656.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 64 wells/borings/transmodals)				$0.00	256		$27.00	$6,912.00	$6,912.00	$6,912.00	$6,912.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 12 months)				$0.00	480		$60.00	$28,800.00	$28,800.00	$28,800.00	$28,800.00
01.10.06	Demob of System (Direct - Capital Cost)						$643,800.00	6240			$168,480.00	$812,280.00	$1,662,255.80	$384,608.51
01.10.06.01		Plug/Abandon Wells					$643,800.00	6240			$168,480.00	$812,280.00	$1,662,255.80	$384,608.51
			Plug/Abandon Wells and Associated Piping (Assume 12 Monitoring Wells)	12	ea	$50,000.00	$600,000.00				$0.00	$600,000.00	$1,227,844.44	$284,095.51
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 6 months)					6240		$27.00	$168,480.00	$168,480.00	$344,778.72	$79,774.02
01.10.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$295,100.00	6590			$264,880.00	$559,980.00	$1,145,947.21	$265,146.34
01.10.07.01		Installation of Confirmatory Borings					$295,100.00	6250			$244,480.00	$539,580.00	$1,104,200.50	$255,487.09
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$122,784.44	$28,409.55
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$229,852.48	$53,182.68
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$212,826.37	$49,243.22
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$56,398.99	$13,049.45

Dissolved Phase Plume - PTZ

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$61,392.22	$14,204.78
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$10,436.68	$2,414.81
			Labor - Data Management					10		$60.00	$600.00	$600.00	$1,227.84	$284.10
01.10.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$41,746.71	$9,659.25
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$19,645.51	$4,545.53
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$9,822.76	$2,272.76
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$7,367.07	$1,704.57
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$4,911.38	$1,136.38
01.10.08	Long Term Monitoring (Direct - O&M Cost)						$814,320.00	9087			$545,220.00	$1,359,540.00	$1,989,582.70	$460,344.57
01.10.08.01		Monitoring Activities (Groundwater)					$814,320.00	8487			$509,220.00	$1,323,540.00	$1,936,899.46	$448,154.85
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per qtr for 29 years)				$0.00	3712		$60.00	$222,720.00	$222,720.00	$325,933.67	$75,413.70
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 29 years)				$0.00	4640		$60.00	$278,400.00	$278,400.00	$407,417.09	$94,267.13
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells per qtr for 29 years)	1392	ea	$500.00	$696,000.00				$0.00	$696,000.00	$1,018,542.71	$235,667.81
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$118,320.00	$118,320.00				$0.00	$118,320.00	$173,152.26	$40,063.53
			Labor - Data Management				$0.00	135		$60.00	$8,100.00	$8,100.00	$11,853.73	$2,742.69
01.10.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.10.09	Management and Integration Costs						$1,820,550.80	0			$0.00	$1,820,550.80	$2,233,957.22	$1,496,105.38
01.10.09.01		M& I Personnel Costs					$1,820,550.80	0			$0.00	$1,820,550.80	$2,233,957.22	$1,496,105.38
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$1,820,550.80	$1,820,550.80				$0.00	$1,820,550.80	$2,233,957.22	$1,496,105.38
01.10.10	Indirect Costs						$1,701,284.00	0			$0.00	$1,701,284.00	$1,922,549.77	$1,589,952.52
01.10.10.01		Indirect Costs					$1,701,284.00	0			$0.00	$1,701,284.00	$1,922,549.77	$1,589,952.52
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$1,701,284.00	$1,701,284.00				$0.00	$1,701,284.00	$1,922,549.77	$1,589,952.52
01.10.11	Overhead Costs						$3,738,140.74	0			$0.00	$3,738,140.74	$4,538,115.39	$3,128,765.76
01.10.11.01		Overhead Costs					$3,738,140.74	0			$0.00	$3,738,140.74	$4,538,115.39	$3,128,765.76
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$3,738,140.74	$3,738,140.74				$0.00	$3,738,140.74	$4,538,115.39	$3,128,765.76
01.10.12	Contingency Costs						$4,090,682.39	0			$0.00	$4,090,682.39	$4,966,102.13	$3,423,837.64
01.10.12.01		Contingency Costs					$4,090,682.39	0			$0.00	$4,090,682.39	$4,966,102.13	$3,423,837.64
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$4,090,682.39	$4,090,682.39				$0.00	$4,090,682.39	$4,966,102.13	$3,423,837.64

Treated Volume: 6,000,000 cu ft

1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$58,328.70
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$22,763.95
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$63,122.96
Total Contingency per acre-foot of implementation	$36,053.90
Total Cost per acre-foot of implementation	$180,269.51

Dissolved Phase Plume - PTZ

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)

Total Cost (Present Worth) per acre-foot of implementation $124,285.31

Basis of Estimate
Feasibility Study for the GWOU
Oxidation Technology
(Dissolved Phase Plume)

Description: This alternative addresses the remediation of a dissolved phase plume containing VOCs. A cylinder with a 60 m (200 ft) radius and 15 m (50 ft) height from within a plume of contamination (similar to that at the C-400 Building) defines the 'case' site used to develop the unit cost for this alternative.

In this setting, oxidation requires 20 injection wells completed to a depth of 30 m (100 ft) bgs. Each injection well has a 15 m (50 ft) length screen.

For this estimate, the following time frames were assumed:

construction	1 year
operation	2 years
long-term monitoring	29 years

This alternative includes the construction of 12 monitoring wells for quarterly compliance and long term monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.11.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.11.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.11.03 Pre-Construction Characterization:
- Excavation permits and survey for 6 soil borings
- Installation of 6 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required for 3 months.

WBS 01.11.04 Construction of System:
- Kick off meeting and readiness review
- Site preparation

- Assumes construction of 20 injection wells and 12 monitoring wells to 30 m (100 ft) depth. Construction extends over a 12-month period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.11.05 Operation and Maintenance of System:
- Injection of oxidant over a 2-year period
- Assumes 22 kg of potassium permanganate per 1 kg of TCE (total of 3972 kg TCE)

WBS 01.11.06 Demobilization of System:
- Demobilization of system abandons all oxidation injection wells and monitoring wells over a 3-month period

WBS 01.11.07 Confirmatory Sampling/Report:
- Installation of 6 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.11.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 29 years – 4 samples per well per year
- Five Year Review

Dissolved Phase Plume - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.11	Dissolved Phase Plume - Oxidation: Total Cost						$21,040,792.29	39645			$1,782,812.00	$22,823,604.29	$28,870,743.16	$21,713,008.77
01.11.01	Project Plans (Direct - Capital Cost)						$0.00	2356			$141,360.00	$141,360.00	$141,360.00	$141,360.00
01.11.01.01		Work Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.11.01.02		General Health & Safety Plan (4 versions)					$0.00	200			$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.11.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.11.01.04		QA Plan (4 versions)					$0.00	200			$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.11.01.05		Sampling and Analysis Plan (4 versions)					$0.00	276			$16,560.00	$16,560.00	$16,560.00	$16,560.00
			Labor - Prepare D-1 Version				$0.00	132		$60.00	$7,920.00	$7,920.00	$7,920.00	$7,920.00
			Labor - Prepare D0 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,600.00	$3,600.00
			Labor - Prepare D2 Version				$0.00	24		$60.00	$1,440.00	$1,440.00	$1,440.00	$1,440.00
01.11.01.06		Waste Management Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.11.01.07		Operation and Maintenance Plan (4 versions)					$0.00	420			$25,200.00	$25,200.00	$25,200.00	$25,200.00
			Labor - Prepare D-1 Version				$0.00	200		$60.00	$12,000.00	$12,000.00	$12,000.00	$12,000.00
			Labor - Prepare D0 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D1 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
01.11.02	Design & Engineering (Direct - Capital Cost)						$565,607.90	0			$0.00	$565,607.90	$565,607.90	$565,607.90
01.11.02.01		Design Preparation (estimated @10% of construction costs)					$565,607.90	0			$0.00	$565,607.90	$565,607.90	$565,607.90
			Labor - Prepare 30% Design	1	lump sum	$254,523.56	$254,523.56				$0.00	$254,523.56	$254,523.56	$254,523.56
			Labor - Prepare 60% Design	1	lump sum	$169,682.37	$169,682.37				$0.00	$169,682.37	$169,682.37	$169,682.37
			Labor - Prepare 90% Design	1	lump sum	$84,841.19	$84,841.19				$0.00	$84,841.19	$84,841.19	$84,841.19
			Labor - Prepare CFC	1	lump sum	$56,560.79	$56,560.79				$0.00	$56,560.79	$56,560.79	$56,560.79
01.11.03	Pre-Construction Characterization (Direct - Capital Cost)						$305,100.00	6490			$268,480.00	$573,580.00	$573,580.00	$573,580.00
01.11.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.11.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.11.03.03		Installation of Pre-Characterization Borings					$295,100.00	6250			$244,480.00	$539,580.00	$539,580.00	$539,580.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00

Dissolved Phase Plume - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$30,000.00	$30,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,100.00	$5,100.00
			Labor - Data Management					10		$60.00	$600.00	$600.00	$600.00	$600.00
01.11.04	Construction of System (Direct - Capital Cost)						$5,177,447.00	12002			$478,632.00	$5,656,079.00	$5,909,292.18	$5,860,279.22
01.11.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.11.04.02		Readiness Reviews					$0.00	480			$28,800.00	$28,800.00	$28,800.00	$28,800.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #4 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.11.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.11.04.04		System Construction					$4,913,080.00	9880			$382,860.00	$5,295,940.00	$5,295,940.00	$5,295,940.00
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 12 month construction)	12	mo	$300.00	$3,600.00				$0.00	$3,600.00	$3,600.00	$3,600.00
			Shower/Change Trailer Rental (Assumes trailer retained during 12 month construction)	12	mo	$500.00	$6,000.00				$0.00	$6,000.00	$6,000.00	$6,000.00
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 12 month construction)	12	mo	$40.00	$480.00				$0.00	$480.00	$480.00	$480.00
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 4 for 12 months) - Costs for mobilization of 2 rigs covered under Pre-Characterization Costs; Mob costs for 2 additional rigs covered here.)	1	lump sum	$100,000.00	$100,000.00				$0.00	$100,000.00	$100,000.00	$100,000.00
			Install injection wells (Assume 20 injection wells to 100 ft, 4 in. dia, SS, 50 ft of screen)	20	ea	$180,000.00	$3,600,000.00				$0.00	$3,600,000.00	$3,600,000.00	$3,600,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, SS, 50 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Security and Site Specific Training (Assume 16 people for 2 weeks)				$0.00	1280		$27.00	$34,560.00	$34,560.00	$34,560.00	$34,560.00
			Labor - Construction/Sampling (Assume 4 H&S People [1 per rig] for 2 months)				$0.00	1400		$100.00	$140,000.00	$140,000.00	$140,000.00	$140,000.00
			Labor - Construction/Sampling (Assume 16 people for 2 months)				$0.00	5600		$27.00	$151,200.00	$151,200.00	$151,200.00	$151,200.00
			Labor - Construction/Sampling (Assume 4 Escort for 2 months)				$0.00	1400		$26.50	$37,100.00	$37,100.00	$37,100.00	$37,100.00
01.11.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$20,500.00	$18,594.10
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$20,500.00	$18,594.10
01.11.04.06		Waste Management					$184,367.00	1562			$62,172.00	$246,539.00	$499,252.18	$452,145.11
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00

Dissolved Phase Plume - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			55-gal Drums to contain Drill Cuttings (Assumes: 12 6" dia. Borings @ 5 drums per boring [60 drums]; 20 4" dia. Injection Wells and 12 4" dia. Monitoring wells @ 8 drums per well [256 drums])	316	ea	$55.00	$17,380.00				$0.00	$17,380.00	$35,194.50	$31,922.45
			55-gal Drums to contain PPE (Assumes 44 borings/wells @ 1 drum per boring/well; Assumes PPE)	44	ea	$55.00	$2,420.00				$0.00	$2,420.00	$4,900.50	$4,444.90
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 15 months @ $1200 per month)	6	tank	$18,000.00	$108,000.00				$0.00	$108,000.00	$218,700.00	$198,367.35
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$101,250.00	$91,836.73
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 44 borings @ 1 soil sample per well/boring)	44	ea	$25.00	$1,100.00				$0.00	$1,100.00	$2,227.50	$2,020.41
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$272.00	$272.00				$0.00	$272.00	$550.80	$499.59
			Labor - Data Management				$0.00	6		$60.00	$360.00	$360.00	$729.00	$661.22
			Fork Truck Rental (Assumes rental for 15 months)	15	mo	$175.00	$2,625.00				$0.00	$2,625.00	$5,315.63	$4,821.43
			Flatbed Truck Rental (Assume rental for 15 months)	15	mo	$138.00	$2,070.00				$0.00	$2,070.00	$4,191.75	$3,802.04
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 64 wells/borings/transmodals)				$0.00	256		$27.00	$6,912.00	$6,912.00	$13,996.80	$12,695.51
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$38,272.50	$34,714.29
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 15 months)				$0.00	600		$60.00	$36,000.00	$36,000.00	$72,900.00	$66,122.45
01.11.05	Operation & Maintenance of System (Direct - O&M Cost)						$866,943.00	0			$0.00	$866,943.00	$1,755,559.58	$1,592,344.29
01.11.05.01		Operation & Maintenance					$866,943.00	0			$0.00	$866,943.00	$1,755,559.58	$1,592,344.29
			Treatment Chemical Cost (Assume 8757 lbs of TCE in RGA at SE corner of C-400 Building (Includes TCE in dissolved phase only); Assume requires 22 lbs of Potassium Permanganate per 1 lb of TCE @ $1.50 per lb of Potassium Permanganate)	192654	lbs	$1.50	$288,981.00				$0.00	$288,981.00	$585,186.53	$530,781.43
			Injection Services (Assumes continuous flood over a period of 2 years)	1	lump sum	$577,962.00	$577,962.00				$0.00	$577,962.00	$1,170,373.05	$1,061,562.86
01.11.06	Demob of System (Direct - Capital Cost)						$463,800.00	3120			$84,240.00	$548,040.00	$1,121,513.11	$259,492.84
01.11.06.01		Plug/Abandon Wells (20 monitoring and 10 injection)					$463,800.00	3120			$84,240.00	$548,040.00	$1,121,513.11	$259,492.84
			Plug/Abandon Wells and Piping (Assume P&A 20 Injections Wells and 12 Monitoring Wells)	42	ea	$10,000.00	$420,000.00				$0.00	$420,000.00	$859,491.11	$198,866.86
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 3 months)				$0.00	3120		$27.00	$84,240.00	$84,240.00	$172,389.36	$39,887.01
01.11.07	Confirmatory Sampling/Report (Direct - O&M Cost)\						$295,100.00	6590			$264,880.00	$559,980.00	$1,145,947.21	$265,146.34
01.11.07.01		Installation of Confirmatory Borings					$295,100.00	6250			$244,480.00	$539,580.00	$1,104,200.50	$255,487.09

Dissolved Phase Plume - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$409,281.48	$94,698.50
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$122,784.44	$28,409.55
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$229,852.48	$53,182.68
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$212,826.37	$49,243.22
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$56,398.99	$13,049.45
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$61,392.22	$14,204.78
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$10,436.68	$2,414.81
			Labor - Data Management					10		$60.00	$600.00	$600.00	$1,227.84	$284.10
01.11.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$41,746.71	$9,659.25
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$19,645.51	$4,545.53
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$9,822.76	$2,272.76
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$7,367.07	$1,704.57
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$4,911.38	$1,136.38
01.11.08	Long Term Monitoring (Direct - O&M Cost)						$814,320.00	9087			$545,220.00	$1,359,540.00	$1,989,582.70	$460,344.57
01.11.08.01		Monitoring Activities (Groundwater)					$814,320.00	8487			$509,220.00	$1,323,540.00	$1,936,899.46	$448,154.85
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per qtr for 29 years)				$0.00	3712		$60.00	$222,720.00	$222,720.00	$325,933.67	$75,413.70
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 29 years)				$0.00	4640		$60.00	$278,400.00	$278,400.00	$407,417.09	$94,267.13
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells per qtr for 29 years)	1392	ea	$500.00	$696,000.00				$0.00	$696,000.00	$1,018,542.71	$235,667.81
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$118,320.00	$118,320.00				$0.00	$118,320.00	$173,152.26	$40,063.53
			Labor - Data Management				$0.00	135		$60.00	$8,100.00	$8,100.00	$11,853.73	$2,742.69
01.11.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.11.09	Management and Integration Costs						$2,054,225.98	0			$0.00	$2,054,225.98	$2,640,488.54	$1,943,631.03
01.11.09.01		M& I Personnel Costs					$2,054,225.98	0			$0.00	$2,054,225.98	$2,640,488.54	$1,943,631.03
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$2,054,225.98	$2,054,225.98				$0.00	$2,054,225.98	$2,640,488.54	$1,943,631.03
01.11.10	Indirect Costs						$1,762,201.74	0			$0.00	$1,762,201.74	$1,977,140.17	$1,740,271.54
01.11.10.01		Indirect Costs					$1,762,201.74	0			$0.00	$1,762,201.74	$1,977,140.17	$1,740,271.54
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$1,762,201.74	$1,762,201.74				$0.00	$1,762,201.74	$1,977,140.17	$1,740,271.54
01.11.11	Overhead Costs						$4,171,325.81	0			$0.00	$4,171,325.81	$5,276,523.14	$3,968,349.29
01.11.11.01		Overhead Costs					$4,171,325.81	0			$0.00	$4,171,325.81	$5,276,523.14	$3,968,349.29
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$4,171,325.81	$4,171,325.81				$0.00	$4,171,325.81	$5,276,523.14	$3,968,349.29
01.11.12	Contingency Costs						$4,564,720.86	0			$0.00	$4,564,720.86	$5,774,148.63	$4,342,601.75
01.11.12.01		Contingency Costs					$4,564,720.86	0			$0.00	$4,564,720.86	$5,774,148.63	$4,342,601.75

Dissolved Phase Plume - Oxidation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$4,564,720.86	$4,564,720.86				$0.00	$4,564,720.86	$5,774,148.63	$4,342,601.75

Treated Volume: 6,000,000 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$60,340.42
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$35,509.31
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$71,831.54
Total Contingency per acre-foot of implementation	$41,920.32
Total Cost per acre-foot of implementation	$209,601.60
Total Cost (Present Worth) per acre-foot of implementation	$157,636.44

Basis of Estimate
Feasibility Study for the GWOU
Bioremediation Technology
(Dissolved Phase Plume)

Description: This alternative addresses the remediation of a dissolved phase plume containing VOCs. The 180 m (600 ft) wide ‘case’ plume used to develop the unit cost for this alternative is highly contaminated throughout the RGA to a depth of 30 meters (100 ft) and is located outside the PGDP industrial complex but within the DOE reservation. This alternative develops a treatment zone of 2,800 sq m (30,00 sq ft) cross section within the RGA.

In this setting, bioremediation requires 10 injection wells completed to a depth of 30 m (100 ft) bgs. Each injection well has a 15 m (50 ft) length screen.

For this estimate, the following time frames were assumed:

construction	4 years
operation	3 years
long-term monitoring	26 years

This alternative includes the construction of 12 monitoring wells for quarterly compliance and long term monitoring.

General:

- M&I (M&I) contract management is included at 20% of all Direct Costs.
- Indirect Cost is included as 26% of contractor costs.
- Overhead is included as 29.61 % of Direct Costs, M&I costs, and Indirect Costs.
- Contingency is included at 25% of Direct Costs, M&I Costs, Indirect Costs and Overhead Costs.

Work Breakdown Structure:

WBS 01.12.01 Project Plans:
- 4 versions each of the following: Work Plan, General Health and Safety Plan, Site Specific Health and Safety Plan, Quality Assurance Plan, Sampling and Analysis Plan, Waste Management Plan, and Operation and Maintenance Plan

WBS 01.12.02 Design and Engineering:
- 30%, 60%, and 90% Design Document
- CFC Design Document

WBS 01.12.03 Pre-Construction Characterization:
- Excavation permits and survey for 6 soil borings
- Installation of 6 pre-characterization soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Two drill rigs will be required for 3 months.

WBS 01.12.04 Construction of System:
- Kick off meeting and readiness review
- Site preparation

- Assumes construction of 10 injection wells and 12 monitoring wells to 30 m (100 ft) depth. Construction extends over a 4-year period.
- Site restoration
- Waste management assumes disposal of waste in the C-746-U Landfill

WBS 01.12.05 Operation and Maintenance of System:
- Injection of sodium lactate (biological nutrient) over a 3-year period
- Assumes injection of 1.8 million kg (4 million lb) total of sodium lactate

WBS 01.12.06 Demobilization of System:
- Demobilization of system abandons all injection wells and monitoring wells over a 6-month period

WBS 01.12.07 Confirmatory Sampling/Report:
- Installation of 6 confirmatory soil borings to 30 m (100 ft) with collection of one groundwater sample every 1.5 m (5 ft) from 15-30 m (50-100 ft) bgs. Requires the mobilization of 2 drill rigs.
- Final report, 4 versions

WBS 01.12.08 Long Term Monitoring:
- Monitoring activities are assumed to extend over 26 years – 4 samples per well per year
- Five Year Review

Dissolved Phase Plume - Bioremediation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
01.12	Dissolved Phase Plume - Bioremediation: Total Cost						$29,461,130.43	65147			$2,676,612.00	$32,137,742.43	$34,784,853.20	$28,258,130.52
01.12.01	Project Plans (Direct - Capital Cost)						$0.00	1178			$58,080.00	$58,080.00	$58,080.00	$58,080.00
01.12.01.01		Work Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.12.01.12		General Health & Safety Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.12.01.03		Site Specific Health and Safety Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.12.01.04		QA Plan (4 versions)					$0.00	100			$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D-1 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D0 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D1 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
			Labor - Prepare D2 Version				$0.00	10		$60.00	$600.00	$600.00	$600.00	$600.00
01.12.01.05		Sampling and Analysis Plan (4 versions)					$0.00	138			$8,280.00	$8,280.00	$8,280.00	$8,280.00
			Labor - Prepare D-1 Version				$0.00	66		$60.00	$3,960.00	$3,960.00	$3,960.00	$3,960.00
			Labor - Prepare D0 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D1 Version				$0.00	30		$60.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
			Labor - Prepare D2 Version				$0.00	12		$60.00	$720.00	$720.00	$720.00	$720.00
01.12.01.06		Waste Management Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.12.01.07		Operation and Maintenance Plan (4 versions)					$0.00	210			$12,600.00	$12,600.00	$12,600.00	$12,600.00
			Labor - Prepare D-1 Version				$0.00	100		$60.00	$6,000.00	$6,000.00	$6,000.00	$6,000.00
			Labor - Prepare D0 Version				$0.00	50		$60.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00
			Labor - Prepare D1 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
			Labor - Prepare D2 Version				$0.00	20		$60.00	$1,200.00	$1,200.00	$1,200.00	$1,200.00
01.12.02	Design & Engineering (Direct - Capital Cost)						$475,903.95	0			$0.00	$475,903.95	$475,903.95	$475,903.95
01.12.02.01		Design Preparation (estimated @10% of construction costs)					$475,903.95	0			$0.00	$475,903.95	$475,903.95	$475,903.95
			Labor - Prepare 30% Design	1	lump sum	$214,156.78	$214,156.78				$0.00	$214,156.78	$214,156.78	$214,156.78
			Labor - Prepare 60% Design	1	lump sum	$142,771.19	$142,771.19				$0.00	$142,771.19	$142,771.19	$142,771.19
			Labor - Prepare 90% Design	1	lump sum	$71,385.59	$71,385.59				$0.00	$71,385.59	$71,385.59	$71,385.59
			Labor - Prepare CFC	1	lump sum	$47,590.40	$47,590.40				$0.00	$47,590.40	$47,590.40	$47,590.40
01.12.03	Pre-Construction Characterization (Direct - Capital Cost)						$305,100.00	6490			$268,480.00	$573,580.00	$573,580.00	$573,580.00
01.12.03.01		Pre-Characterization Technical Support					$0.00	240			$24,000.00	$24,000.00	$24,000.00	$24,000.00
			Labor - Provide engineering drawings and obtain excavation permits. (Assume 1 person for 30 days.)				$0.00	240		$100.00	$24,000.00	$24,000.00	$24,000.00	$24,000.00
01.12.03.02		Pre-Characterization Site Survey					$10,000.00	0			$0.00	$10,000.00	$10,000.00	$10,000.00
			Locate pre-characterization boring points. (Assume 1 week duration)	1	lump sum	$10,000.00	$10,000.00				$0.00	$10,000.00	$10,000.00	$10,000.00
01.12.03.03		Installation of Pre-Characterization Borings					$295,100.00	6250			$244,480.00	$539,580.00	$539,580.00	$539,580.00
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$200,000.00	$200,000.00
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$112,320.00	$112,320.00

Dissolved Phase Plume - Bioremediation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$104,000.00	$104,000.00
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$27,560.00	$27,560.00
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$30,000.00	$30,000.00
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,100.00	$5,100.00
			Labor - Data Management					10		$60.00	$600.00	$600.00	$600.00	$600.00
01.12.04	Construction of System (Direct - Capital Cost)						$3,334,827.50	36441			$1,424,212.00	$4,759,039.50	$4,763,176.32	$4,750,189.72
01.12.04.01		Kick Off Meeting					$0.00	80			$4,800.00	$4,800.00	$4,800.00	$4,800.00
			Labor - Attend Kick Off Meeting (Assume 8 hours per person for 10 people)				$0.00	80		$60.00	$4,800.00	$4,800.00	$4,800.00	$4,800.00
01.12.04.02		Readiness Reviews					$0.00	360			$21,600.00	$21,600.00	$21,600.00	$21,600.00
			Labor - Attend Readiness Review #1 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #2 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
			Labor - Attend Readiness Review #3 (Assume 8 hours per person for 15 people)				$0.00	120		$60.00	$7,200.00	$7,200.00	$7,200.00	$7,200.00
01.12.04.03		Site Preparation					$60,000.00	0			$0.00	$60,000.00	$60,000.00	$60,000.00
			Site Preparation (includes redirection of traffic, fence removal, etc.)	1	lump sum	$60,000.00	$60,000.00				$0.00	$60,000.00	$60,000.00	$60,000.00
01.12.04.04		System Construction					$3,143,320.00	34840			$1,358,380.00	$4,501,700.00	$4,503,237.36	$4,495,816.15
			Mobilization Costs cited under Pre-Construction Characterization	0	lump sum	$0.00	$0.00				$0.00	$0.00	$0.00	$0.00
			Construction Trailer Rental (Assumes trailer retained during 48 month construction)	48	mo	$300.00	$14,400.00				$0.00	$14,400.00	$14,949.06	$12,298.63
			Shower/Change Trailer Rental (Assumes trailer retained during 48 month construction)	48	mo	$500.00	$24,000.00				$0.00	$24,000.00	$24,915.09	$20,497.71
			Port-o-Let (1 @ $40/month) (Assumes Port-o-Let retained during 48 month construction)	48	mo	$40.00	$1,920.00				$0.00	$1,920.00	$1,993.21	$1,639.82
			Utility Hookups (Electric, Water, Sewer, Telephone)	1	lump sum	$3,000.00	$3,000.00				$0.00	$3,000.00	$3,000.00	$3,000.00
			Mobilization of Vertical Hole Drill Rig - (Assume 4 for 48 months) - Costs for mobilization of 2 rigs covered under Pre-Characterization Costs; Mob costs for 2 additional rigs covered here.)	1	lump sum	$100,000.00	$100,000.00				$0.00	$100,000.00	$100,000.00	$100,000.00
			Install Injection Wells (Assume 10 vertical injection wells to 100 ft, each 4 in. dia., SS, 50 ft of screen)	10	ea	$180,000.00	$1,800,000.00				$0.00	$1,800,000.00	$1,800,000.00	$1,800,000.00
			Install monitoring wells (Assume 12 monitoring wells to 100 ft, 4 in. dia, 10 ft of screen)	12	ea	$100,000.00	$1,200,000.00				$0.00	$1,200,000.00	$1,200,000.00	$1,200,000.00
			Labor - Permit Requirements (Underground Injection Permit)				$0.00	200		$100.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
			Labor - Security and Site Specific Training (Assume 16 people for 2 weeks)				$0.00	1280		$27.00	$34,560.00	$34,560.00	$34,560.00	$34,560.00
			Labor - Construction/Sampling (Assume 4 H&S People [1 per rig] for 8 months)				$0.00	5560		$100.00	$556,000.00	$556,000.00	$556,000.00	$556,000.00
			Labor - Construction/Sampling (Assume 16 people for 8 months)				$0.00	22240		$27.00	$600,480.00	$600,480.00	$600,480.00	$600,480.00
			Labor - Construction/Sampling (Assume 4 Escorts for 8 months)				$0.00	5560		$26.50	$147,340.00	$147,340.00	$147,340.00	$147,340.00
01.12.04.05		Site Restoration					$20,000.00	0			$0.00	$20,000.00	$22,076.26	$17,297.33
			Site Restoration (Replacement of fences, gravel, minor road repair, etc.)	1	lump sum	$20,000.00	$20,000.00				$0.00	$20,000.00	$22,076.26	$17,297.33
01.12.04.06		Waste Management					$111,507.50	1161			$39,432.00	$150,939.50	$151,462.70	$150,676.25
			Disposal of Waste At C-746-U Landfill (Assume No Cost)	0		$0.00	$0.00				$0.00	$0.00	$0.00	$0.00

Dissolved Phase Plume - Bioremediation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			55-gal Drums to contain Drill Cuttings (Assumes: 12 6" dia. Borings @ 5 drums per boring [60 drums]; 10 4" dia. Injection Wells and 12 4" dia. Monitoring wells @ 8 drums per well [176 drums])	236	ea	$55.00	$12,980.00				$0.00	$12,980.00	$12,980.00	$12,980.00
			55-gal Drums to contain PPE (Assumes 34 borings/wells @ 1 drum per boring/well; Assumes PPE)	34	ea	$55.00	$1,870.00				$0.00	$1,870.00	$1,870.00	$1,870.00
			20,000 Gallon Storage Tanks to contain development water (Assumes rental of 6 tanks for 6 months @ $1200 per month)	6	tank	$7,200.00	$43,200.00				$0.00	$43,200.00	$43,200.00	$43,200.00
			Treatment of Development Water	1	lump sum	$50,000.00	$50,000.00				$0.00	$50,000.00	$50,000.00	$50,000.00
			Laboratory Analysis of Waste Sample - Drill Cuttings (Assume 34 borings @ 1 soil sample per well/boring)	34	ea	$25.00	$850.00				$0.00	$850.00	$850.00	$850.00
			Laboratory Analysis of Waste Sample - Demob Piping/Debris (Assume 1 sample per per transmodal [approx. 25 cu yds] of concrete and debris, Assume 20 transmodals)	20	ea	$25.00	$500.00				$0.00	$500.00	$1,023.20	$236.75
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$229.50	$229.50				$0.00	$229.50	$229.50	$229.50
			Labor - Data Management				$0.00	5		$60.00	$300.00	$300.00	$300.00	$300.00
			Fork Truck Rental (Assumes rental for 6 months)	6	mo	$175.00	$1,050.00				$0.00	$1,050.00	$1,050.00	$1,050.00
			Flatbed Truck Rental (Assume rental for 6 months)	6	mo	$138.00	$828.00				$0.00	$828.00	$828.00	$828.00
			Labor -Collection of Waste Sample for Drill Cuttings and Demob Debris (Assume 1 person @ 4 hours per 54 wells/borings/transmodals)				$0.00	216		$27.00	$5,832.00	$5,832.00	$5,832.00	$5,832.00
			Labor - Waste Disposal (Assume 2 labors for 350 hours each)				$0.00	700		$27.00	$18,900.00	$18,900.00	$18,900.00	$18,900.00
			Labor - Preparation of Waste Acceptance Criteria Packages (Assume 1 person quarter time for 6 months)				$0.00	240		$60.00	$14,400.00	$14,400.00	$14,400.00	$14,400.00
01.12.05	Operation & Maintenance of System (Direct - O&M Cost)						$7,200,000.00	0			$0.00	$7,200,000.00	$7,381,500.00	$6,376,417.23
01.12.05.01		Operation & Maintenance					$7,200,000.00	0			$0.00	$7,200,000.00	$7,381,500.00	$6,376,417.23
			Treatment Chemical Cost (Assume requires 4,000,000 lbs of Sodium Lactate @ $0.60 per lb)	4000000	lbs	$0.60	$2,400,000.00				$0.00	$2,400,000.00	$2,460,500.00	$2,125,472.41
			Injection Services (Assumes 12 injections over a period of 3 years)	1	lump sum	$4,800,000.00	$4,800,000.00				$0.00	$4,800,000.00	$4,921,000.00	$4,250,944.82
01.12.06	Demob of System (Direct - Capital Cost)						$263,800.00	6240			$168,480.00	$432,280.00	$884,620.99	$204,681.35
01.12.06.01		Plug/Abandon Wells and Piping; Abandon Facility					$263,800.00	6240			$168,480.00	$432,280.00	$884,620.99	$204,681.35
			Plug/Abandon Wells and Associated Piping (Assume P&A 10 Injection Wells and 12 Monitoring Wells)	22	ea	$10,000.00	$220,000.00				$0.00	$220,000.00	$450,209.63	$104,168.35
			Transmodal to Contain Pipe, Concrete, Debris from Demob of System (Assume rental of 20 transmodals for 6 months @ $12/day)	20	transmodal	$2,190.00	$43,800.00				$0.00	$43,800.00	$89,632.64	$20,738.97
			Labor - Demobilization of System (Assumes 6 people full time for 6 months)					6240		$27.00	$168,480.00	$168,480.00	$344,778.72	$79,774.02
01.12.07	Confirmatory Sampling/Report (Direct - O&M Cost)						$295,100.00	6590			$264,880.00	$559,980.00	$618,113.14	$484,307.82
01.12.07.01		Installation of Confirmatory Borings					$295,100.00	6250			$244,480.00	$539,580.00	$595,595.36	$466,664.55
			Mobilization (Incl. Mob. Of 2 Drill Rigs, set-up, Decon Pad, PPE, etc.	1	lump sum	$200,000.00	$200,000.00				$0.00	$200,000.00	$220,762.58	$172,973.26

Dissolved Phase Plume - Bioremediation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Install borings (Assume 6 borings to 100 ft, 6" dia. Assume Collect one gw sample every 5 ft from 50 ft bgs to 100 ft bgs [10 samples per boring])	6	ea	$10,000.00	$60,000.00				$0.00	$60,000.00	$66,228.77	$51,891.98
			Labor - Construction/Sampling (Assume 4 people per rig for 3 months)				$0.00	4160		$27.00	$112,320.00	$112,320.00	$123,980.26	$97,141.78
			Labor - Construction/Sampling (Assume 1 H&S per rig for 3 months)				$0.00	1040		$100.00	$104,000.00	$104,000.00	$114,796.54	$89,946.09
			Labor - Construction/Sampling (Assume 1 Escort per 4 workers for 3 months)				$0.00	1040		$26.50	$27,560.00	$27,560.00	$30,421.08	$23,835.71
			Laboratory Analyses (Assume 60 gw samples for VOCs and 99Tc)	60	ea	$500.00	$30,000.00				$0.00	$30,000.00	$33,114.39	$25,945.99
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$5,100.00	$5,100.00				$0.00	$5,100.00	$5,629.45	$4,410.82
			Labor - Data Management					10		$60.00	$600.00	$600.00	$662.29	$518.92
01.12.07.02		Final Report (assume 4 versions)					$0.00	340			$20,400.00	$20,400.00	$22,517.78	$17,643.27
			Labor - Prepare D-1 Version				$0.00	160		$60.00	$9,600.00	$9,600.00	$10,596.60	$8,302.72
			Labor - Prepare D0 Version				$0.00	80		$60.00	$4,800.00	$4,800.00	$5,298.30	$4,151.36
			Labor - Prepare D1 Version				$0.00	60		$60.00	$3,600.00	$3,600.00	$3,973.73	$3,113.52
			Labor - Prepare D2 Version				$0.00	40		$60.00	$2,400.00	$2,400.00	$2,649.15	$2,075.68
01.12.08	Long Term Monitoring (Direct - O&M Cost)						$730,080.00	8208			$492,480.00	$1,222,560.00	$1,789,122.96	$413,962.71
01.12.08.01		Monitoring Activities (Groundwater)					$730,080.00	7608			$456,480.00	$1,186,560.00	$1,736,439.72	$401,772.99
			Labor - Perform Qrtly Groundwater Sampling at 12 Monitoring Wells (Assume 2 people @ 16 hours per qtr for 26 years)				$0.00	3328		$60.00	$199,680.00	$199,680.00	$292,216.39	$67,612.28
			Labor - Prepare Qrtly Monitoring Reports (Assume 1 person @ 40 hours per qtr for 26 years)				$0.00	4160		$60.00	$249,600.00	$249,600.00	$365,270.49	$84,515.35
			Laboratory Analyses - Qrtly Compliance GW Samples (Assume 12 gw samples from monitoring wells per qtr for 26 years)	1248	ea	$500.00	$624,000.00				$0.00	$624,000.00	$913,176.23	$211,288.39
			SMO Costs (to cover validation and audit costs [assume 17% of lab costs])	1	lump sum	$106,080.00	$106,080.00				$0.00	$106,080.00	$155,239.96	$35,919.03
			Labor - Data Management				$0.00	120		$60.00	$7,200.00	$7,200.00	$10,536.65	$2,437.94
01.12.08.02		5 Year Reviews					$0.00	600			$36,000.00	$36,000.00	$52,683.24	$12,189.71
			Labor - Prepare 5 Year Review Report (Assume 100 hours per report for 6 reports)				$0.00	600		$60.00	$36,000.00	$36,000.00	$52,683.24	$12,189.71
01.12.09	Management and Integration Costs						$3,056,284.69	0			$0.00	$3,056,284.69	$3,308,819.47	$2,667,424.56
01.12.09.01		M& I Personnel Costs					$3,056,284.69	0			$0.00	$3,056,284.69	$3,308,819.47	$2,667,424.56
			M&I Personnel Costs to include contracting, engineering, project management, health and safety, document review, etc. (Assume 20% of Direct Costs)	1	lump sum	$3,056,284.69	$3,056,284.69				$0.00	$3,056,284.69	$3,308,819.47	$2,667,424.56
01.12.10	Indirect Costs						$1,498,873.87	0			$0.00	$1,498,873.87	$1,617,558.10	$1,437,397.28
01.12.10.01		Indirect Costs					$1,498,873.87	0			$0.00	$1,498,873.87	$1,617,558.10	$1,437,397.28
			Indirect Costs @ 26% of Contractor Costs (Assume Contractor Costs = Total of Pre-Construction Characterization, System Construction, and Demob of System Costs)	1	lump sum	$1,498,873.87	$1,498,873.87				$0.00	$1,498,873.87	$1,617,558.10	$1,437,397.28
01.12.11	Overhead Costs						$5,873,611.93	0			$0.00	$5,873,611.93	$6,357,407.63	$5,164,559.80
01.12.11.01		Overhead Costs					$5,873,611.93	0			$0.00	$5,873,611.93	$6,357,407.63	$5,164,559.80
			Overhead @ 29.61% (Overhead charged on Total of Direct Costs, M&I Costs, and Indirect Costs)	1	lump sum	$5,873,611.93	$5,873,611.93				$0.00	$5,873,611.93	$6,357,407.63	$5,164,559.80
01.12.12	Contingency Costs						$6,427,548.49	0			$0.00	$6,427,548.49	$6,956,970.64	$5,651,626.10
01.12.12.01		Contingency Costs					$6,427,548.49	0			$0.00	$6,427,548.49	$6,956,970.64	$5,651,626.10

Dissolved Phase Plume - Bioremediation

				Material				Labor				Total Cost	Total Cost	Total Cost
WBS Element				Quantity	Unit	Unit Price	Total	Hours	Craft Code	Rate	Total	Material + Labor	(Escalated)	(Present Worth)
			Contingency @ 25% (Contingency charged on Total of Direct Costs, M&I Costs, Indirect Costs, and Overhead Costs)	1	lump sum	$6,427,548.49	$6,427,548.49				$0.00	$6,427,548.49	$6,956,970.64	$5,651,626.10

Treated Volume: 6,000,000 cu ft
1 Acre-Foot = 43,560 cu ft

Total Escalated Capital Costs per acre-foot of implementation	$49,043.92
Total Escalated Operation and Maintenance Costs per acre-foot of implementation	$66,952.98
Overhead Costs (Includes M&I, Indirect, and Overhead Costs) per acre-foot of implementation	$81,920.28
Total Contingency per acre-foot of implementation	$50,507.61
Total Cost per acre-foot of implementation	$248,424.79
Total Cost (Present Worth) per acre-foot of implementation	$205,154.03

APPENDIX C8

DOE/OR/07-1857
Internal Draft
Primary Document

Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky

Volume 5. Appendix D Groundwater Background Document

Cleared for Public Release

DOE/OR/07-1857&D1
Primary Document

Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky

Volume 5. Appendix D Groundwater Background Document

Date Issued—June 2001

Prepared for the
Department of Energy
Office of Environmental Management

By
Bechtel Jacobs Company LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001
managed by
Bechtel Jacobs Company LLC
for the
U.S. Department of Energy
under contract DE-AC05-98OR22700

Science Applications International Corporation

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

KY/EM-XXX

BACKGROUND CONCENTRATIONS OF NATURALLY OCCURRING INORGANIC CHEMICALS AND SELECTED RADIONUCLIDES IN THE REGIONAL GRAVEL AQUIFER AND MCNAIRY FORMATION AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

JUNE 2001

KY/EM-XXX

BACKGROUND CONCENTRATIONS OF NATURALLY OCCURRING INORGANIC CHEMICALS AND SELECTED RADIONUCLIDES IN THE REGIONAL GRAVEL AQUIFER AND MCNAIRY FORMATION AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

Date Issued—June 2001

Prepared by
Center for Information Studies
The University of Tennessee
Knoxville, TN
and
Scientific Applications International Corporation
Oak Ridge, TN

Prepared for the
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

Environmental Management Activities at the
PADUCAH GASEOUS DIFFUSION PLANT
Paducah, Kentucky 42002
managed by
BECHTEL JACOBS COMPANY LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR22700

PREFACE

This report presents background concentrations for naturally occurring inorganic chemicals and selected radionuclides found in groundwater drawn from the Regional Gravel Aquifer (RGA) and the McNairy Formation at the Paducah Gaseous Diffusion Plant (PGDP), Paducah, Kentucky. In addition, this report compares the background concentrations to human health risk-based concentrations to develop a list of screening criteria that can be used to identify significant contamination in these groundwater sources at this facility. Such screening criteria are required for Resource Conservation and Recovery Act Appendix IX and Contract Laboratory Program total analyte list inorganic chemicals and for radionuclides to ensure that remedial investigations and feasibility studies for identified areas of concern and solid waste management units at PGDP focus on those contaminants that may influence human health risk. In addition, appropriate screening criteria are needed to determine if areas currently not under investigation should be added to the list of those areas to be investigated at PGDP. These values are to be used when completing work plans and reports produced as part of the environmental restoration and waste management programs at PGDP. The work was performed under Work Breakdown Structure 1.4.12.7.1.02.04 entitled Corrective Measures for Offsite Contamination.

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

TABLES

ACRONYMS

bgs	below ground surface
DOE	United States Department of Energy
ELCR	excess lifetime cancer risk
EPA	United States Environmental Protection Agency
HI	hazard index
IDs	identifiers
KDEP	Kentucky Department of Environmental Protection
PGDP	Paducah Gaseous Diffusion Plant
PQL	practical quantitation limit
RBCs	risk based concentrations
RGA	Regional Gravel Aquifer
TCE	trichloroethene

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

This report documents the methods used to develop background concentrations of naturally occurring inorganic chemicals and selected radionuclides present in groundwater drawn from the Regional Gravel Aquifer (RGA) and the McNairy Formation at the Paducah Gaseous Diffusion Plant (PGDP) located near Paducah, Kentucky. This report also presents the background concentrations developed and compares these concentrations to human health risk-based concentrations. Subsequent to this comparison, a list of screening criteria for the naturally occurring chemicals and selected radionuclides is developed. This list is provided so that users can determine if detected concentrations of naturally occurring inorganic chemicals and selected radionuclides are present at levels that represent contamination and at levels that may present an unacceptable risk to the health of groundwater users.

All data used in the development of the background concentrations were from groundwater taken from wells not believed to be impacted by contaminant releases from PGDP. The identifiers, general location, and screen depth of the background RGA wells are:

- MW103, south of the PGDP, deep RGA–79.5 to 90 feet below ground surface (ft bgs);
- MW106, northwest of the PGDP, middle RGA–62 to 75 ft bgs;
- MW141, west northwest of the PGDP, deep RGA–79 to 80 ft bgs;
- MW142, west northwest of the PGDP, upper RGA–42.5 to 52.5 ft bgs;
- MW150, east of the PGDP, deep RGA–66 to 96 ft bgs; and
- MW199, northwest of the PGDP, upper RGA–57 to 62 ft bgs.

The identifiers, general location, and screen depth of the background McNairy Formation wells are:

- MW102, south of the PGDP, middle McNairy Formation–136 to 146 ft bgs;
- MW120, southeast of the PGDP, deep McNairy Formation–160 to 170 ft bgs;
- MW121, northwest of the PGDP, deep McNairy Formation–200 to 210 ft bgs;
- MW122, east of the PGDP, middle McNairy Formation–148 to 158 ft bgs;
- MW133, northeast of the PGDP, upper McNairy Formation–80 to 90 ft bgs;
- MW140, west northwest of the PGDP, middle McNairy Formation–138 to 148 ft bgs;

Two additional McNairy Formation wells were considered for selection as background wells. These were MW239 and MW247. These wells, which are located in the north and south well fields installed as part of the northwest plume interim remedial action, were subsequently not selected as background wells because sampling results indicated that groundwater at these locations and depths may contain a primary PGDP contaminant, trichloroethene (TCE).

In the analyses of the groundwater data from these wells, data were summarized both over all observations within group (i.e., RGA and McNairy Formation) and over wells within group. Analyses were completed in this manner to ensure that the effect of temporal correlation between samples from a single well and the impact of varying well data set sizes could be examined. It should be noted that no attempt was made to adjust the background calculations for the effect of spatial correlation. This adjustment was not attempted because a preliminary analysis indicated that the number of wells within each group was not sufficient to allow for the estimation of any spatial correlation effects. If spatial correlation does exist, then the background concentrations may be underestimated. This effect is due to underestimation of the standard deviations and errors used in the derivation of the background concentrations (see Gilbert 1987; page 35). In any case, the net effect of not considering spatial correlation is that the background concentrations are unlikely to exceed the true background concentrations.

For inorganic chemicals, background concentrations were derived for both total and filtered samples over all observations within group and over wells within group after evaluating and correcting the data sets. Important reasons for correcting the data sets are listed below.

- Value in the data set was a nondetect, but the value was greater than the greatest detected concentration. In this case, the nondetect value was reduced to the greatest detected concentration in other samples taken from the well.

- Value was a detect that was much greater (generally more than 10×'s greater) than the next greatest detected concentration and appeared to be related to sample turbidity. In this case, the value was reduced to the next greatest detected concentration.

- Data point was for a filtered sample and was qualified "Q". In the data set used to derive the background concentrations, data points were "Q" qualified when analyses on a filtered sample were not performed because the results of the analyses of the total (unfiltered) sample were below the total sample's practical quantitation limit. In this case, the "Q" qualified data were modified by assigning to the data point the minimum detection limit of all samples taken from the well, or if there were no other nondetect results for the well, the minimum detection limit across all wells. This was done to ensure that the information such "nondetects" carry was included in the derivation of the background values.

For radionuclides, background concentrations were derived for total samples only because there were too few results from filtered samples. As with the summarization of the data for inorganic chemicals, some data were corrected during this activity. Reasons for correction of data for radionuclides were similar to those for inorganic chemicals.

Background concentrations for naturally occurring inorganic chemicals and selected radionuclides when data are summarized over all observations within group and summarized over wells within group are presented in Tables ES-1 and ES-2, respectively. In each of these tables, the background concentrations for inorganic chemicals in total and filtered samples and for radionuclides in total samples are listed by groundwater source. Also, human health risk-based concentrations (RBCs) based on residential use of groundwater and maximum contaminant limits (MCLs) are presented in each table.

Table ES-1. Background concentrations in total and filtered samples taken from the Regional Gravel Aquifer and McNairy Formation derived over all observations, residential use risk-based concentrations, and maximum contaminant levels

Analyte	Regional Gravel Aquifer Total Samples	Regional Gravel Aquifer Filtered Samples	McNairy Formation Total Samples	McNairy Formation Filtered Samples	Risk-based Concentration[a]	Maximum Contaminant Level[q]
Inorganic Chemicals (mg/L)						
Aluminum	2.189	0.311	0.687	0.579	1.5[HI]	0.050 - 0.200[k]
Antimony	0.060[b]	0.060[b]	0.060[b]	0.060[b]	0.00056[HI]	0.006
Arsenic	0.005[b]	0.005[b]	0.005[b]	0.005[b]	0.000035[CR]	0.050
Barium	0.235	0.200	0.296	0.268	0.10[HI]	2.000
Beryllium	0.004[b]	0.004[b]	0.017[b]	0.004[b]	0.000010[CR]	0.004
Cadmium	0.010[b]	0.010[b]	0.010[b]	0.010[b]	0.00066[HI]	0.005
Calcium	41.238	38.166	38.858	38.829	No Value	No Value
Chloride	91.021	No Data	19.708	No Data	No Value	250.000[k]
Chromium[d]	0.144	0.050[b]	0.060[b]	0.050[b]	0.0071[HI]	0.100
Cobalt	0.045[b]	0.045[b]	0.096	0.045[b]	0.091[HI]	No Value
Copper	0.036	0.020	0.057	0.013[b]	0.060[HI]	1.300
Fluoride	0.270	No Data	0.330	No Data	0.091[HI]	4.000
Iron	5.030	0.267	18.360	12.372	0.45[HI]	0.300[k]
Lead	0.129[c]	0.098[c]	0.050[b]	0.050[b]	0.00000015[HI]	0.015
Magnesium	16.262	16.215	13.418	14.171	No Value	No Value
Manganese	0.119	0.068	0.941	0.894	0.067[HI]	0.050[k]
Mercury	0.0002[b]	0.0002[e]	0.0002	0.0002[e]	0.00044[HI]	0.002
Molybdenum	0.050[b]	0.050[b]	0.050[b]	0.050[b]	0.0075[HI]	No Value
Nickel	0.682	0.305	0.109[b]	0.050[b]	0.030[HI]	0.100[o]
Nitrate as Nitrogen	15.561	No Data	1.474	No Data	2.40[HI]	10.000
Potassium	5.195	4.096	55.752	51.205	No Value	No Value
Selenium	0.005[b]	0.005[e]	0.005[b]	0.005[e]	0.0075[HI]	0.050
Silica	26.401	No Data	26.0	No Data	No Value	No Value
Silver	0.011[b]	0.060[b]	0.050[b]	0.050[b]	0.0075[HI]	0.100[k]
Sodium	59.450	60.433	29.2	27.98	No Value	No Value
Sulfate	19.947	No Data	28.9	No Data	No Value	500.000[h]
Thallium	0.056[b]	0.056[b]	0.644	0.056[b]	No Value	0.002
Uranium	0.002[b]	0.002[e]	0.001	0.001[e]	0.0045[HI]	0.020[h]
Vanadium	0.134	0.134	0.126	0.126	0.0092[HI]	No Value
Zinc	0.054	0.049	0.142	0.116	0.45[HI]	5.000[k]
Radionuclides (pCi/L)						
Gross Alpha	5.8	No Data	11.9	No Data	No Value	15[h]
Gross Beta	13.8	No Data	144.5	No Data	No Value	[i]
Neptunium-237[l]	0.8	No Data	0.5	No Data	0.13[CR]	[i]
Plutonium-239	0.1	No Data	0.2	No Data	0.12[CR]	[i]
Radium-226[m]	0.6	No Data	1.2	No Data	0.13[CR]	5[p]
Radon-222[n]	626	No Data	295	No Data	1.4[CR]	300[h]
Technetium-99	22.3	No Data	20.6	No Data	28.0[CR]	[i]
Thorium-230	1.1	No Data	1.5	No Data	1.0[CR]	[i]
Total Radium[f]	1.3	No Data	0.7	No Data	0.13[CR]	5[p]
Uranium-234[g]	0.7	0.33	0.3	No Data	0.87[CR]	[j]
Uranium-235[g]	0.3	0.015	0.2	No Data	0.82[CR]	[j]
Uranium-238[g]	0.7	0.35	0.3	No Data	0.62[CR]	[j]

Notes:

No Data indicates that a background concentration could not be derived because data were inadequate or not available.

No Value under "Risk-based Concentration" indicates that a value could not be derived because the analyte lacks toxicity values. No Value under "Maximum Contaminant Level" indicates that neither a primary nor a secondary maximum contaminant level was available.

Table ES-1. (continued)

[a] All risk-based concentrations (RBCs) were derived using methods presented in Appendix 2 of *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE/OR/07-1506&D1, as modified by comments from regulatory agencies). In each case, the value reported is the lesser of the RBCs based on child systemic toxicity (HI) and lifetime cancer risk (CR). For HI, all values are based on a target of 0.1. For CR, all values are based on a target of 1×10^{-6}.

[b] This analyte was not detected in any sample used in the background calculations or infrequently detected at concentrations similar to their detection limit. Therefore, the reported "background concentration" is the minimum detection limit used for the analyte. If lower detection limits are used in future sampling and analytical efforts, then the background concentration for this analyte should be reevaluated.

[c] The calculated 95% Upper Tolerance Limit (95% UTL) for this analyte exceeded the analyte's maximum detected value. Therefore, the background concentration selected for the analyte was the analyte's maximum detected value.

[d] Background values are for total chromium. Risk-based concentration is for Chromium VI.

[e] All data for this analyte were "Q" qualified. The definition of this qualifier is, "No result available or not required because total analyses is less than PQL ." Therefore, the reported "background concentration" is the minimum detection limit used for the total analyses. If lower detection limits are used in future sampling and analytical efforts, then the background concentration for this analyte should be reevaluated.

[f] The risk-based concentration for Total Radium is that for radium-226 (+D). That value is the smallest of all those for radium isotopes.

[g] Background values for uranium isotopes were calculated from the uranium metal background concentration because data for individual isotopes was lacking. In this calculation, the natural abundance, by weight, (i.e., 0.0056% U-234, 0.72% U-235, and 99.27% U-238) and the specific activities (i.e., 6.21×10^{6} pCi/mg U-234, 2.15×10^{3} pCi/mg U-235, and 3.35 pCi/mg U-238) of the uranium isotopes were used. The RBCs for Uranium-235 and Uranium-238 were calculated using the cancer slope factors for Uranium-235+D and Uranium-238+D, respectively.

[h] Proposed value.

[i] If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or any organ is not to exceed 4 mrem/year.

[j] Proposed MCL for natural uranium (0.020 mg/L) is approximately equal to 30 pCi/L. This value applies to the sum of all isotopes.

[k] Secondary MCL.

[l] Risk-based concentration calculated using cancer slope factors for Neptunium+D.

[m] Risk-based concentration calculated using cancer slope factors for Radium-226+D.

[n] Risk-based concentration calculated using cancer slope factors for Radon-222+D.

[o] The EPA has deleted from the CFR both the MCL and the MCLG for nickel which have been vacated by court ruling, effective February 23, 1995 (60 FR 33926, June 29, 1995).

[p] The MCLs listed here for Radium-226 and Total Radium actually apply to combined Radium-226 and Radium-228.

[q] Federal and state MCLs were taken from the "Federal and State Guidelines" page found at the "Risk Assessment Information System" site at http://risk.lsd.ornl.gov/cgi-bin/guide/GUID_9709.

Table ES-2. Background concentrations in total and filtered samples taken from the Regional Gravel Aquifer and McNairy Formation derived over averages within wells, residential use risk-based concentrations, and maximum contaminant levels

Analyte	Regional Gravel Aquifer Total Samples	Regional Gravel Aquifer Filtered Samples	McNairy Formation Total Samples	McNairy Formation Filtered Samples	Risk-based Concentration[a]	Maximum Contaminant Level[q]
Inorganic Chemicals (mg/L)						
Aluminum	1.64	0.201	0.75	0.587	1.5HI	0.050 - 0.200k
Antimony	0.060[b]	0.060[b]	0.060[b]	0.060[b]	0.00056[HI]	0.006
Arsenic	0.005[b]	0.005[b]	0.005[b]	0.005[b]	0.000035[CR]	0.050
Barium	0.202	0.179	0.265	0.266	0.10[HI]	2.000
Beryllium	0.004[b]	0.004[b]	0.017[b]	0.004[b]	0.000010[CR]	0.004
Cadmium	0.010[b]	0.010[b]	0.010[b]	0.010[b]	0.00066[HI]	0.005
Calcium	40.0	35.8	39.47	40.27	No Value	No Value
Chloride	89.2	No Data	20.23	No Data	No Value	250.000[k]
Chromium[d]	0.134	0.050[b]	0.060[b]	0.050[b]	0.0071[HI]	0.100
Cobalt	0.045[b]	0.045[b]	0.072	0.045[b]	0.091[HI]	No Value
Copper	0.034	0.018	0.033	0.013[b]	0.060[HI]	1.300
Fluoride	0.245	No Data	0.298	No Data	0.091[HI]	4.000
Iron	3.72	0.164	15.83	9.446	0.45[HI]	0.300[k]
Lead	0.250	0.250	0.050[b]	0.050[b]	0.00000015[HI]	0.015
Magnesium	15.7	15.4	16.457	16.533	No Value	No Value
Manganese	0.082	0.048	0.729	0.682	0.067[HI]	0.050[k]
Mercury	0.0002[b]	0.0002[e]	0.0002[b]	0.0002[e]	0.00044[HI]	0.002
Molybdenum	0.050[b]	0.050[b]	0.050[b]	0.050[b]	0.0075[HI]	No Value
Nickel	0.682	0.305	0.109[b]	0.050[b]	0.030[HI]	0.100[o]
Nitrate as Nitrogen	13.5	No Data	1.43	No Data	2.40[HI]	10.000
Potassium	4.47	3.70	64.080	58.750	No Value	No Value
Selenium	0.005[b]	0.005[e]	0.005[b]	0.005[e]	0.0075[HI]	0.050
Silica	21.1	No Data	29.4	No Data	No Value	No Value
Silver	0.011[b]	0.060[b]	0.050[b]	0.050[b]	0.0075[HI]	0.100[k]
Sodium	63.5	65.7	24.92	25.90	No Value	No Value
Sulfate	19.1	No Data	27.27	No Data	No Value	500.000[h]
Thallium	0.056[b]	0.056[b]	0.255	0.056[b]	No Value	0.002
Uranium	0.002[b]	0.002[e]	0.001[b]	0.001	0.0045[HI]	0.020[h]
Vanadium	0.139	0.131	0.119	0.107	0.0092[HI]	No Value
Zinc	0.025	0.026	0.104	0.080	0.45[HI]	5.000[k]
Radionuclides (pCi/L)						
Gross Alpha	2.36	No Data	5.3	No Data	No Value	15[h]
Gross Beta	7.3	No Data	125.4	No Data	No Value	[i]
Neptunium-237[l]	0.21	No Data	0.13	No Data	0.13[CR]	[i]
Plutonium-239	0.03	No Data	0.04	No Data	0.12[CR]	[i]
Radium-226[m]	0.10	No Data	0.29	No Data	0.13[CR]	5[p]
Radon-222[n]	555.3	No Data	228.3	No Data	1.4[CR]	300[h]
Technetium-99	10.8	No Data	7.8	No Data	28.0[CR]	[i]
Thorium-230	0.54	No Data	0.40	No Data	1.0[CR]	[i]
Total Radium[f]	0.46	No Data	0.36	No Data	0.13[CR]	5[p]
Uranium-234[g]	0.7	0.33	0.3	No Data	0.87[CR]	[j]
Uranium-235[g]	0.3	0.015	0.2	No Data	0.82[CR]	[j]
Uranium-238[g]	0.7	0.35	0.3	No Data	0.62[CR]	[j]

Notes:

No Data indicates that a background concentration could not be derived because data were inadequate or not available.

No Value under "Risk-based Concentration" indicates that a value could not be derived because the analyte lacks toxicity values. No Value under "Maximum Contaminant Level" indicates that neither a primary nor a secondary maximum contaminant level was available.

Table ES-2. (continued)

[a] All risk-based concentrations (RBCs) were derived using methods presented in Appendix 2 of *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE/OR/07-1506&D1, as modified by comments from regulatory agencies). In each case, the value reported is the lesser of the RBCs based on child systemic toxicity (HI) and lifetime cancer risk (CR). For HI, all values are based on a target of 0.1. For CR, all values are based on a target of 1×10^{-6}.

[b] This analyte was not detected in any sample used in the background calculations or infrequently detected at concentrations similar to their detection limit. Therefore, the reported "background concentration" is the minimum detection limit used for the analyte. If lower detection limits are used in future sampling and analytical efforts, then the background concentration for this analyte should be reevaluated.

[c] The calculated 95% Upper Tolerance Limit (95% UTL) for this analyte exceeded the analyte's maximum detected value. Therefore, the background concentration selected for the analyte was the analyte's maximum detected value.

[d] Background values are for total chromium. Risk-based concentration is for Chromium VI.

[e] All data for this analyte were "Q" qualified. The definition of this qualifier is, "No result available or not required because total analyses is less than PQL." Therefore, the reported "background concentration" is the minimum detection limit used for the total analyses. If lower detection limits are used in future sampling and analytical efforts, then the background concentration for this analyte should be reevaluated.

[f] The risk-based concentration for Total Radium is that for radium-226 (+D). That value is the smallest of all those for radium isotopes.

[g] Background values for uranium isotopes were calculated from the uranium metal background concentration because data for individual isotopes was lacking. In this calculation, the natural abundance, by weight, (i.e., 0.0056% U-234, 0.72% U-235, and 99.27% U-238) and the specific activities (i.e., 6.21×10^6 pCi/mg U-234, 2.15×10^3 pCi/mg U-235, and 3.35 pCi/mg U-238) of the uranium isotopes were used. The RBCs for Uranium-235 and Uranium-238 were calculated using the cancer slope factors for Uranium-235+D and Uranium-238+D, respectively.

[h] Proposed value.

[i] If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or any organ is not to exceed 4 mrem/year.

[j] Proposed MCL for natural uranium (0.020 mg/L) is approximately equal to 30 pCi/L. This value applies to the sum of all isotopes.

[k] Secondary MCL.

[l] Risk-based concentration calculated using cancer slope factors for Neptunium+D.

[m] Risk-based concentration calculated using cancer slope factors for Radium-226+D.

[n] Risk-based concentration calculated using cancer slope factors for Radon-222+D.

[o] The EPA has deleted from the CFR both the MCL and the MCLG for nickel which have been vacated by court ruling, effective February 23, 1995 (60 FR 33926, June 29, 1995).

[p] The MCLs listed here for Radium-226 and Total Radium actually apply to combined Radium-226 and Radium-228.

[q] Federal and state MCLs were taken from the "Federal and State Guidelines" page found at the "Risk Assessment Information System" site at http://risk.lsd.ornl.gov/cgi-bin/guide/GUID_9709.

1. INTRODUCTION

For the Paducah Gaseous Diffusion Plant (PGDP) to plan remedial investigations, complete final remedial investigations and feasibility study reports, and identify potential "new" release locations, both the background concentrations of all constituents that might be detected in environmental samples and the appropriate risk-based screening criteria must be established. However, as noted in regulatory agency comments on *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991) and other documents, the reference sampling performed during the site investigations was not adequate to establish background concentrations in groundwater at the PGDP. Similarly, the regulatory agencies have noted that the groundwater background concentrations derived in *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a) are suspect because the methods used to collect groundwater samples providing the data analyzed in that report are different than methods currently used for remedial investigations at the PGDP. As noted in those comments, the agencies believed that the methods used to collect those samples (i.e., bailers) may have resulted in background concentrations for metals which are greater than the concentrations expected to be found in samples collected using current methods at the PGDP (i.e., bladder pumps).

This report provides groundwater background concentrations for naturally occurring inorganic analytes and selected radionuclides and documents the source and derivation of these values. This document also compares these background concentrations to human health risk-based screening values (i.e., risk-based concentrations) derived using methods in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996a).

1.1 REGULATORY ISSUES

Guidance provided by the United States Environmental Protection Agency (EPA) recommends the establishment of background concentrations early in the remedial investigation/feasibility study process to ensure that only site-related contaminants are considered when planning clean-up activities (EPA 1988, 1989a, 1991a, 1991b, and 1995). Similarly, the Commonwealth of Kentucky encourages the development of background concentrations so that these values can be used to guide clean-up decisions (KDEP 1995). Therefore, background concentrations are needed when initiating or finalizing clean-up activities at the PGDP.

1.2 ORGANIZATION OF THE REPORT

This report is presented in five chapters. In Chapt. 1, the need for background and risk-based concentrations, some regulatory issues, and the report organization is discussed. In Chap. 2, the data used to derive the background concentrations are presented and evaluated. In Chapt. 3, the methods used to derive the background concentrations are discussed, and the background values are presented. In Chapt. 4, the sources of the human health risk-based concentrations, regulatory values, and other values to which the background concentrations are compared are discussed. Finally, in Chapt. 5, tables combining the background values, the human health risk-based values, the regulatory values, and other values are presented, and results shown in these tables are discussed. In addition, in Chapt. 5, general conclusions regarding these comparisons are provided.

To simplify the presentation of the large amount of analytical information contained in this report, appendices were prepared which summarize the data and its evaluation. Specifically, in App. A, information supporting background well selection is presented; in App. B, the data and its evaluation for each analyte within aquifer classification (i.e., group) are shown; and, in App. C, analyses of the relationship between sample turbidity and analyte concentrations and between dissolved solids results and analyte concentrations are presented.

2. DATA EVALUATION

Similar to *Background Levels of Selected Radionuclide and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997) and unlike *Background Concentrations and Human Health Risk-based Screening Criteria for Metals in Soil at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1996b), all groundwater background concentrations presented in this document were derived using parametric statistics. Data used in the statistical analyses were from wells which were either installed in areas or screened at depths that have not been impacted by contaminants migrating from the PGDP. In this chapter, the data and its sources are presented, and the data evaluation and it results are described.

2.1 SELECTION OF BACKGROUND WELLS

All background data were drawn from the Paducah EMEF Electronic Data System. However, prior to accessing this system, sets of background wells for the Regional Gravel Aquifer (RGA) and the McNairy Formation were compiled. The wells selected for each of these sets, including location and depth of screening, are presented in Table 2.1. The general location of each of these wells in relation to the PGDP and the major contaminant plumes is depicted in Fig. 2.1. Additional information about well locations is shown in App. A.

Table 2.1. Initial well list

RGA Wells			McNairy Formation Wells		
Well ID	Location[a]	Screened Depth[b]	Well ID	Location[a]	Screened Depth[b]
MW103	N(-3500.84) E(-6252.14)	79.5 – 90	MW102	N(-3502.5) E(-6267.3)	136 – 146
MW106	N(8438.90) E(990.93)	62 – 75	MW120	N(-5880.16) E(-1489.08)	160 – 170
MW141	N(6544.69) E(-12173.02)	79 – 80	MW121	N(6161.5) E(-5677.7)	200 – 210
MW142	N(6529.75) E(-12162.411)	42.5 – 52.5	MW122	N(717.1) E(1876.2)	148 – 158
MW150	N(2239.80) E(-4652.86)	66 – 96	MW133	N(9124.7) E(-1715.7)	80 – 90
MW199	N(10090.1) E(-10076.6)	57 – 62	MW140	N(6558.5) E(-12179.2)	138 – 148
			MW239	N(7330) E(-5204)	147 – 157
			MW247	N(1358) E(-7433)	135 – 145

See App. A for additional well information, including construction and location diagrams and a complete list of sampling times by analyte class.

[a] All locations are in plant coordinates.

[b] All screening depths are in feet below ground surface.

As shown in Table 2.1, the initial background well list for the RGA consisted of 6 wells, and the initial background well list for the McNairy Formation consisted of 8 wells. After selecting these wells and acquiring the analytical data from each, sampling results were examined to determine the frequency of detection of major plant-related contaminants (i.e., organic compounds, especially trichloroethene, and

Fig. 2.1. Location of wells selected as potential sources of data to be used to determine background groundwater concentrations of naturally occurring inorganic chemicals and selected radionuclides at the Paducah Gaseous Diffusion Plant.

technetium-99). The following subsections describe the results of this evaluation for each well and present the conclusions drawn from this evaluation. (Note, the information used to develop the following subsections is presented in its entirety in App. A.)

2.1.1 Evaluation of Background Wells for the RGA

In total, 6 wells were selected for evaluation as background RGA wells. These wells were MW103, MW106, MW141, MW142, MW150, and MW199.

2.1.1.1 Evaluation of MW103

Monitoring well MW103 was installed in November 1991. Between the date of installation and February 1998, samples from this well were analyzed 11 times for one or more organic compounds, 12 times for one or more radionuclides, and 10 times for inorganic chemicals. In total, over all sampling times, the only organic compound detected was *cis*-1,2-dichloroethene. This compound was detected at a concentration of 1.8 µg/liter in a single sample collected in May 1997 (Sample ID 5327-97).

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values are either similar to or less than their detection error. In total, over all sampling times, technetium-99 was detected 7 times at concentrations ranging from 5 ±93 pCi/liter (May 1993; Sample ID 5178-93) to 20 ±18 pCi/liter (July 1994; Sample ID 6026-94).

These results indicate that MW103 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic solvent, *cis*-1,2-dichloroethene, was detected in a sample taken from this well, the detected concentration of 1.8 µg/liter is below the method detection limit (5 µg/liter) for this analyte in water (SW-846, Method 8240). Additionally, the organic solvent was detected in only one of 11 samples so there is evidence that the detection may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small in all cases and below the detection error in most cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.1.2 Evaluation of MW106

Monitoring well MW106 was installed in November 1991. Between the date of installation and February 1998, samples from this well were analyzed 13 times for one or more organic compounds, 13 times for one or more radionuclides, and 7 times for inorganic chemicals. In total, over all sampling times, the only organic compound detected was trichloroethene. This compound was detected at a concentration of 1 XJX µg/liter in a single sample collected in March 1994 (Sample ID 4697-94). (“XJX” are data qualifiers that indicate that the detected concentration is estimated.)

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were either similar to or less than the detection error. In total, over all sampling times, technetium-99 was detected 13 times at concentrations ranging from 1 ±10 pCi/liter (February 1996; Sample ID 5289-96) to 29 ±23 pCi/liter (September 1993; Sample ID 5322-93).

These results indicate that MW106 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic solvent, trichloroethene, was detected in a sample taken from this well, the detected concentration of 1XJX µg/liter is below the method detection limit (5 µg/liter) for this analyte in water (SW-846, Method 8240). Additionally, the organic solvent was detected in only one of 7 samples so there is evidence that the detection may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small in all cases and below the detection error in most cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.1.3 Evaluation of MW 141

Monitoring well MW141 was installed in April 1990. Between the date of installation and February 1998, samples from this well were analyzed 10 times for one or more organic compounds, 10 times for one or more radionuclides, and 9 times for inorganic chemicals. In total, over all sampling times, the only organic compounds detected were bis(2-ethylhexyl)phthalate and pyrene. Bis(2-ethylhexyl)phthalate was detected at a concentration of 5J µg/liter in a single sample collected in April 1990 (Sample ID CH200429-00000), and pyrene was detected at a concentration of 3J µg/liter in a single sample collected in March 1991 (Sample ID CH210011-00000).

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were less than the detection error in each case. In total, over all sampling times, technetium-99 was detected 7 times at concentrations ranging from -0.23 ±1.49 pCi/liter (March 1991; Sample ID CH210011-00000) to 15 ±20 pCi/liter (January 1994; Sample ID 4229-94).

These results indicate that MW141 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although two organic compounds, bis(2-ethylhexyl)phthalate and pyrene, were detected in samples taken from this well, the detected concentrations of both were very small, estimated values, and below the organic compounds' method detection limit (10 µg/liter per SW-846, Method 8270). Additionally, one of the detected organic compounds, bis(2-ethylhexyl)phthalate is a known laboratory contaminant. Finally, the lack of multiple detections of either organic compound is evidence that the detections may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.1.4 Evaluation of MW 142

Monitoring well MW142 was installed in April 1990. Between the date of installation and February 1998, samples from this well were analyzed 14 times for one or more organic compounds, 14 times for one or more radionuclides, and 13 times for inorganic chemicals. In total, over all sampling times, the only organic compound detected was toluene. This compound was detected at a concentration of 1J µg/liter in a single sample collected in August 1990 (Sample ID CH200674-00000).

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were less than the detection error in each case. In total, over all sampling times, technetium-99 was detected 10 times at concentrations ranging from -1.6 ±1.59 pCi/liter (March 1991; Sample ID CH210012-00000) to 16 ±19 pCi/liter (February 1995; Sample ID 5464-95).

These results indicate that MW142 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic compound, toluene, was detected in a sample taken from this well, the detected concentration was very small, an estimated value, and near the organic compound's detection limit (5 µg/liter per SW-846, Method 8240). Additionally, the detected organic compound, toluene, is a known laboratory contaminant. Finally, the lack of multiple detections of the organic compound is evidence that the detection may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.1.5 Evaluation of MW 150

Monitoring well MW150 was installed in August 1990. Between the date of installation and February 1998, samples from this well were analyzed 13 times for one or more organic compounds, 13 times for one or more radionuclides, and 6 times for inorganic chemicals. In total, over all sampling times, the only organic compound detected was toluene. This compound was detected at concentrations of 23 and 12 µg/liter in a sample and duplicate collected in September 1990 (Sample IDs CH200691-00000 and CH200692-00000).

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were less than the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 11 times at concentrations ranging from 0.9 ±2.12 pCi/liter (March 1991; Sample ID CH210030-00000) to 22 ±19 pCi/liter (February 1995; Sample ID 5468-95).

These results indicate that MW150 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic compound, toluene, was detected in two samples taken from this well, the detected concentrations were small. (Note, the detected values did exceed the method detection limit for toluene, which is 10 µg/liter per SW-846, Method 8240). Additionally, the detected organic compound, toluene, is a known laboratory contaminant. Finally, the lack of multiple detections of the organic compound is evidence that the detections may have been anomalous events. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may also be anomalous.

2.1.1.6 Evaluation of MW 199

Monitoring well MW199 was installed in May 1991. Between the date of installation and February 1998, samples from this well were analyzed 10 times for one or more organic compounds, 10 times for one or more radionuclides, and 9 times for inorganic chemicals. In total, over all sampling times, the only organic compound detected was bis(2-ethylhexyl)phthalate. This compound was detected at a concentration of 6J µg/liter in a sample collected in May 1991 (Sample ID CH210240-00000).

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were less than the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 8 times at concentrations ranging from -2.3 ±3.1 pCi/liter (May 1991; Sample ID CH210240-00000) to 24 ±20 pCi/liter (July 1994; Sample ID 6074-94).

These results indicate that MW199 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic compound, bis(2-ethylhexyl)phthalate, was detected in a sample taken from this well, the detected concentration was very small, an estimated value, and below the organic compound's detection limit (10 µg/liter per SW-846, Method 8270). Additionally, the detected organic compound, bis(2-ethylhexyl)phthalate, is a known laboratory contaminant. Finally, the lack of multiple detections of the organic compound is evidence that the detection may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may also be anomalous.

2.1.2 Evaluation of Background Wells for the McNairy Formation

In total, 8 wells were selected for evaluation as background McNairy Formation wells. These wells were MW102, MW120, MW121, MW122, MW133, MW140, MW239, and MW247.

2.1.2.1 Evaluation of MW102

Monitoring well MW102 was installed in December 1991. Between the date of installation and February 1998, samples from this well were analyzed 14 times for one or more organic compounds, 14 times for one or more radionuclides, and 13 times for inorganic chemicals. In total, over all sampling times, no organic compounds were detected in samples collected from this well. However, the radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 10 times at concentrations ranging from 2 ±10 pCi/liter (September 1995; Sample ID 7467-95) to 23 ±19 pCi/liter (April 1994; Sample ID 5183-94).

These results indicate that MW102 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may be anomalous.

2.1.2.2 Evaluation of MW120

Monitoring well MW120 was installed in November 1989. Between the date of installation and February 1998, samples from this well were analyzed 15 times for one or more organic compounds, 15 times for one or more radionuclides, and 15 times for inorganic chemicals. In total, over all sampling times, four organic compounds have been detected in 2 samples collected from this well. In a sample collected in February 1990 (Sample ID CH200300-00000), bis(2-ethylhexy)phthalate was detected at a concentration of 210 µg/liter, and in a sample collected in April 1990 (Sample ID CH200414-00000), ethylbenzene, toluene, and xylene were detected at concentrations of 2J, 5, and 12 µg/liter, respectively.

The radionuclide, technetium-99, was detected more frequently in samples taken from this well, but detected values were less than or equal to the detection error in all but two instances. In total, over all sampling times, technetium-99 was detected 12 times at concentrations ranging from 1 ±12 pCi/liter (November 1997; Sample ID 5793-97) to 21 ±20 pCi/liter (February 1995; Sample ID 5448-95). [The two instances when technetium-99 concentration exceeded the detection error were in February 1991 (Sample ID CH210107-000) and February 1995 (Sample ID 5448-95). The detected concentrations and their errors are 2.6 ± 2.03 pCi/liter and 21 ± 20 pCi/liter, respectively.]

These results indicate that MW120 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although organic compounds were detected in samples taken from this well, three of these compounds (ethylbenzene, toluene, and xylene) are related to fuel use (i.e., may be a sampling artifact) and were detected at low concentrations that are similar to or below the compounds' detection limits (5 µg/liter per SW-846, Method 8240). Additionally, the result for ethylbenzene is an estimated value. The result for the remaining organic compound, bis(2-ethylhexyl)phthalate, is relatively high and does exceed the detection limit for this compound in water (10 µg/liter per SW-846, Method 8270); however, this compound is also a known laboratory contaminant. Finally, the lack of multiple detections for all the organic compounds is evidence that the detection of each may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but two cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.2.3 Evaluation of MW121

Monitoring well MW121 was installed in November 1989. Between the date of installation and February 1998, samples from this well were analyzed 15 times for one or more organic compounds, 16 times for one or more radionuclides, and 10 times for inorganic chemicals. In total, over all sampling times, 6 organic compounds were detected in three samples collected from this well. In a sample collected in February 1990 (Sample ID CH200304-00000), 4-nitrophenol, bis(2-ethylhexyl)phthalate, and di-n-butylphthalate were detected at concentrations of 15J, 300BJ, and 2J µg/liter, respectively. In a sample collected in April 1990 (Sample ID CH200419-00000), acetone and bis(2-ethylhexyl)phthalate were detected at concentrations of 320BEJ and 170BJ µg/liter, respectively. Finally, in a sample collected in March 1994 (Sample ID 4864-94), trichloroethene was detected at a concentration of 2 µg/liter.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but two instances. In total, over all sampling times, technetium-99 was detected 8 times at concentrations ranging from 2 pCi/liter (February 1990; Sample ID 719-90) to 27 ±23 pCi/liter (June 1994; Sample ID 5517-94). [The two instances when technetium-99 concentration exceeded the detection error were in March 1991 (Sample ID CH210001-00000) and June 1994 (Sample ID 5517-94). The detected concentrations and their errors are 3.1 ± 1.4 pCi/liter and 27 ± 23 pCi/liter, respectively.]

These results indicate that MW121is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although organic compounds were detected in samples taken from this well, all results, except that for trichloroethene, were estimated values. Additionally, the "B" qualifier was attached to the three detections with the greatest results (i.e., those for acetone and bis(2-ethylhexyl)phthalate) indicating that these laboratory contaminants were also detected in one or more associated blank samples. The detected concentrations of the other three organic compounds, 4-nitrophenol, di-n-butylphthalate, and trichloroethene are very small and below the detection limits for these compounds (50, 10, and 5 µg/liter per SW-846; Method 8270, respectively). Finally, the lack of multiple detections of the organic compounds is evidence that the detections of each may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but two cases. Therefore, the technetium-99 detections may also be anomalous.

2.1.2.4 Evaluation of MW122

Monitoring well MW122 was installed in November 1989. Between the date of installation and February 1998, samples from this well were analyzed 17 times for one or more organic compounds, 16 times for one or more radionuclides, and 12 times for inorganic chemicals. In total, over all sampling times, 1 organic compound was detected in a sample collected from this well. In a sample collected in April 1990 (Sample ID CH200423-00000), bis(2-ethylhexyl)phthalate was detected at 189BJ µg/liter.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 12 times at concentrations ranging from 1 ±11 pCi/liter (February 1997; Sample ID 5145-97) to 20 ±20 pCi/liter (February 1995; Sample ID 5456-95). [The single instance when technetium-99 concentration exceeded the detection error was in March 1991 (Sample ID CH210005-00000). The detected concentration and its error is 5.9 ± 3.2 pCi/liter.]

These results indicate that MW122 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic compound was detected at a relatively high concentration in a sample taken from this well, this result is an estimated value to which the "B" qualifier is attached. Therefore, the organic compound, which is a known laboratory contaminant, was also detected in one or more associated blank samples. Finally, the lack of multiple detections of the organic compound is evidence that the detection may have been an anomaly.

Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may also be anomalous.

2.1.2.5 Evaluation of MW133

Monitoring well MW133 was installed in November 1989. Between the date of installation and February 1998, samples from this well were analyzed 12 times for one or more organic compounds, 12 times for one or more radionuclides, and 8 times for inorganic chemicals. In total, over all sampling times, 3 organic compounds were detected in two samples collected from this well. In a sample collected in May 1990 (Sample ID CH200432-00000), bis(2-ethylhexyl)phthalate and chloroform were detected at 230BJ and 1J µg/liter, respectively. In a sample collected in August 1990 (Sample ID CH200676-00000), carbon disulfide was detected at 2J µg/liter.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 11 times at concentrations ranging from -2 ±0 pCi/liter (November 1997; Sample ID 5789-97) to 22 ±22 pCi/liter (September 1993; Sample ID 6740-93). [The single instance when technetium-99 concentration exceeded the detection error was in May 1990 (Sample ID CH200432-00000). The detected concentration and its error is 9 ± 6 pCi/liter.]

These results indicate that MW133 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although three organic compounds were detected in samples taken from this well, all are known laboratory contaminants, all have results that are estimated values that are below the detection limit for the contaminant (10, 5, and 5 µg/liter per SW-846, Method 8240 or 8270, for bis(2-ethylhexyl)phthalate, chloroform, and carbon disulfide, respectively), and one is qualified "B", indicating the organic compound was also detected in one or more associated blank samples. Finally, the lack of multiple detections of the organic compounds is evidence that each of the detections may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may also be anomalous.

2.1.2.6 Evaluation of MW140

Monitoring well MW140 was installed in March 1990. Between the date of installation and February 1998, samples from this well were analyzed 13 times for one or more organic compounds, 13 times for one or more radionuclides, and 13 times for inorganic chemicals. In total, over all sampling times, 1 organic compound was detected in a sample collected from this well. In a sample collected in May 1990 (Sample ID CH200428-00000), benzene was detected at 1J µg/liter.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but one instance. In total, over all sampling times, technetium-99 was detected 10 times at concentrations ranging from -0.67 ±1.74 pCi/liter (March 1991; Sample ID CH210009-00000) to 13 ±11 pCi/liter (November 1997; Sample ID 5796-97). [The single instance when technetium-99 concentration exceeded the detection error was in November 1997 (Sample ID 5796-97). The detected concentration and its error is 13 ± 11 pCi/liter.]

These results indicate that MW140 is acceptable as a background well because it is screened in an area outside the influence of contaminants migrating from the PGDP. Although an organic compound was detected in samples taken from this well, the compound is a known laboratory contaminant, was detected at a concentration near its detection limit (5 µg/liter per SW-846, Method 8240), and is an estimated value. Finally, the lack of multiple detections of the organic compounds is evidence that the detection may have been an anomaly. Similarly, although technetium-99 was detected, the detected values were very small and less than the detection error in all but one case. Therefore, the technetium-99 detections may also be anomalous.

2.1.2.7 Evaluation of MW239

Monitoring well MW239 was installed in September 1994. Between the date of installation and February 1998, samples from this well were analyzed 31 times for one or more organic compounds, 31 times for one or more radionuclides, and 32 times for inorganic chemicals. In total, over all sampling times, 1 organic compound was detected in three samples collected from this well. In a samples collected in December 1996, June 1997, and August 1997 (Sample IDs 6395-96, 5409-97, and 5575-97, respectively), trichloroethene was detected at 2, 7, and 7 µg/liter, respectively.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but four instances. In total, over all sampling times, technetium-99 was detected 27 times at concentrations ranging from 1 ±11 pCi/liter (August 1995; Sample ID 7230-95) to 20 ±19 pCi/liter (April 1995; Sample ID 6143-95).

The detection of trichloroethene in three samples indicates that monitoring well MW239 may be screened in an area that is being impacted by contaminants migrating from the PGDP. Because other wells are available for which evidence of no impact is stronger, this well was removed from the list of potential background wells.

2.1.2.8 Evaluation of MW247

Monitoring well MW247 was installed in September 1994. Between the date of installation and February 1998, samples from this well were analyzed 32 times for one or more organic compounds, 32 times for one or more radionuclides, and 31 times for inorganic chemicals. In total, over all sampling times, 1 organic compound was detected in four samples collected from this well. In samples collected in September 1995, March 1997, May 1997, and July 1997 (Sample IDs 7393-95, 5180-97, 5339-97, and 5524-97, respectively), trichloroethene was detected at 2, 1, 2, and 9,600 µg/liter, respectively.

The radionuclide, technetium-99, was detected in several samples taken from this well, but detected values were less than or equal to the detection error in all but six instances. In total, over all sampling times, technetium-99 was detected 25 times at concentrations ranging from -12 ±0 pCi/liter (November 1997; Sample ID 5857-97) to 1,953 ±43 pCi/liter (July 1997; Sample ID 5524-97).

Although the concentrations of trichloroethene and technetium-99 in Sample ID 5524-97 appear anomalous because they differ so markedly from other results, the presence of trichloroethene in three other samples indicates that monitoring well MW247 may be screened in an area that is being impacted by contaminants migrating from the PGDP. Therefore, because other wells are available for which evidence of no impact is stronger, this well was removed from the list of potential background wells.

2.2 DATA EVALUATION

After the list of potential wells was evaluated, and the background wells selected from that list, the inorganic chemical data from each well were evaluated, and anomalous values were identified and corrected. This section summarizes the methods used for the identification and correction of anomalous values and the results of the data evaluation and correction.

2.2.1 Reasons for Removing or Correcting Inorganic Chemical Data

Reasons for removing or correcting data are listed in the following bullets.

- Sample was collected before 1993. These data were deleted from the data set to remove sampling bias. Prior to 1993, some samples were collected using methods (i.e., bailers) that are inconsistent with methods used after 1993 (i.e., bladder pumps). Generally, because samples collected with bailers are more likely to contain higher amounts of particulates than samples collected with bladder pumps, and because particulate levels are directly related to the concentrations of inorganic chemicals (see App. C), deletion of these data resulted in a data set which yielded lower background values when analyzed.

- Value was a nondetect but was greater than the greatest detected value from a sample from the well. In this case, the nondetect concentration was reduced to the greatest detected value from a sample taken from the well. These data were corrected so that nondetect values would not bias the background concentrations high.

- Value was a detect that was much greater (generally more than 10×'s greater) than the next greatest detect and appeared to be related to sample turbidity. In this case, the value was reduced to the next greatest detected value. These data were corrected so that turbidity of the sample would not bias high the resulting background concentrations. Note, the effect of turbidity upon the results for total samples is discussed in more detail in Chapt. 5.

- Value was a detect that was much smaller (generally more than 10×'s smaller) than the next smallest detect. In this case, the value was increased to the next smallest value. These data were corrected so that very small results would not unduly impact the standard error of the data set and bias high the background concentrations.

- Data point was for a filtered sample and was qualified "Q". In the data set used to derive the background concentrations, data points were "Q" qualified when analyses on a filtered sample were not performed because the results of the analyses of the total (unfiltered) sample were below the total sample's practical quantitation limit. In this case, the "Q" qualified data were modified by assigning to the data point the minimum detection limit for the analyte from all samples taken from the well or, if none of the samples taken from the well had a numerical result for the analyte, the minimum detection limit for the analyte over all wells. This was done to ensure that the information such "nondetects" carry was included in the derivation of the background values. Generally, not including this correction would have resulted in greater background concentrations because, generally, the standard error of a data set increases as sample size decreases.

2.2.2 Reasons for Removing or Correcting Radionuclide Data

After evaluating the inorganic data for each of the background wells, the radionuclide data was evaluated to remove or correct anomalous values. The reasons for removing or correcting these data are listed in the following bullets.

- Sample was collected before 1993. Data from samples collected prior to 1993 were deleted from the data set to remove sampling bias. As noted previously, some samples collected prior to 1993 were collected using methods (i.e., bailers) that are inconsistent with the methods currently used for remedial investigations (i.e., bladder pumps).

- Value was a detect that was much greater (generally more than 10×'s greater) than the next greatest detect and appeared to be related to sample turbidity. In this case, the value was reduced to the next greatest detected value. As noted previously, these data were corrected so that turbidity of the sample would not bias high the resulting background concentrations.

- Value was a detect that was much smaller (generally more than 10×'s smaller) than the next smallest detect. In this case the value was increased to the next greatest value. As noted previously, these data were corrected so that results with very small values would not unduly impact the standard error of the data set and bias high the background concentrations.

- Observation was "Q" qualified. In the data set used to derive the background concentrations, data points for radionuclides were "Q" qualified when analyses were planned but not performed because the sample contained an indicator radionuclide at a concentration less than the minimum detection limit. As noted previously, all "Q" qualified data were assigned the minimum detection limit used for other samples taken from the well or across wells. This procedure was followed so that the information "Q" qualified data could be included in the derivation of the background values.

Unlike the data sets for inorganic chemicals, where there was at least one observation for each inorganic chemicals from each background well, the data sets for several radionuclides did not include observations from all wells. The radionuclide data sets lacking observations from all wells are neptunium-237, plutonium-239, radium-226, radon-222, thorium-230, and total radium. Additionally, please note that only results for total samples were available and that data sets for uranium isotopes were not available.

2.2.3 Summary of Data Evaluation

This subsection summarizes the data evaluation. In addition, this subsection presents the summary statistics calculated for each analyte. As with the discussion of background well selection, the results are segregated by analyte class within an aquifer. Note, a more detailed presentation of the results summarized here are in App. B.

For the RGA inorganic chemical data set, 2,108 observations were available in the corrected data sets over all analytes and wells. Of these 2,108 observations, 281 or 13.3% of the total number of observations were modified for one of the reasons discussed earlier. Of the 281 observations that were modified, 179 observations (8.5% of the total number of observations) were corrected for being "Q" qualified, 1 observation (<0.1% of the total) was corrected for being anomalously small, 11 observations (<0.1% of the total) were corrected for being anomalously large, and 90 observations (4.3% of the total) were corrected because the nondetect value reported exceeded the maximum detected value reported. A complete summary of these results by analyte is presented in Table 2.2. Please note, the summary statistics presented in this table are for the corrected data sets presented in App. B.

For the McNairy Formation inorganic chemical data set, 2,151 observations were available in the corrected data set over all analytes and wells. Of these 2,151 observations, 280 or 13.0% of the total number of observations were modified for one of the reasons discussed earlier. Of the 280 observations that were modified, 217 observations (10% of the total number of observations) were corrected for being "Q" qualified, 13 observations (<0.1% of the total) were corrected for being anomalously large, 49 observations (2.2% of the total) were corrected because the nondetect value reported exceeded the maximum detected value reported, and 1 observation was corrected for other reasons (i.e., blank contamination). A complete summary is presented in Table 2.3. Please note, the summary statistics reported in this table are for the corrected data sets presented in App. B.

Table 2.2. Summary of evaluation of RGA inorganic chemical data

Analyte	Number of Data Points	Number of Data Points Corrected for: "Q" Qualified Data	Small Values	Large Values	Nondetect > Max Detect	Other	Total Percent Corrected	Frequency of Detection	Minimum Value [a] (pCi/liter)	Maximum Value [a] (pCi/liter)	Overall Average [b] (pCi/liter)	Weighted Average [b] (pCi/liter)
Aluminum	40	0	0	2	7	0	22.5	29/40	0.100	2.60	0.638	0.654
Aluminum, Dissolved	36	3	0	1	5	0	25.0	19/36	0.082	0.259	0.166	0.167
Antimony	44	0	0	0	0	0	0	0/44	0.060	0.25	0.111	0.113
Antimony, Dissolved	37	5	0	0	0	0	13.5	0/37	0.060	0.190	0.083	0.084
Arsenic	44	0	0	0	0	0	0	2/44	0.005	0.007	0.005	0.005
Arsenic, Dissolved	44	42	0	0	0	0	95.5	0/44	0.005	0.005	0.005	0.005
Barium	44	0	0	0	2	0	4.5	41/44	0.010	0.282	0.119	0.127
Barium, Dissolved	44	2	0	0	2	0	9.1	39/44	0.005	0.200	0.111	0.119
Beryllium	44	0	0	0	0	0	0	0/44	0.004	0.025	0.009	0.010
Beryllium, Dissolved	40	3	0	0	0	0	5.0	0/40	0.004	0.015	0.007	0.007
Cadmium	44	0	0	0	2	0	4.5	1/44	0.010	0.100	0.020	0.020
Cadmium, Dissolved	44	7	0	0	0	0	15.9	0/44	0.010	0.025	0.013	0.013
Calcium	44	0	0	0	0	0	0	44/44	2.88	56.5	21.7	22.7
Calcium, Dissolved	40	0	1	0	0	0	2.5	40/40	10.9	37	21.6	22.7
Chloride	43	0	0	0	0	0	0	43/43	2.9	109.1	37.1	40.1
Chromium	37	0	0	1	0	0	2.7	11/37	0.050	0.232	0.069	0.075
Chromium, Dissolved	37	0	0	0	0	0	0	1/37	0.050	0.092	0.054	0.054
Cobalt	44	0	0	0	0	0	0	0/40	0.045	0.100	0.052	0.052
Cobalt, Dissolved	40	3	0	0	1	0	10.0	0/40	0.045	0.050	0.049	0.049
Copper	44	0	0	0	7	0	15.9	7/44	0.010	0.100	0.017	0.018
Copper, Dissolved	40	3	0	0	3	0	7.5	3/40	0.010	0.025	0.013	0.013
Fluoride	35	0	0	0	0	0	0	34/35	0.100	0.270	0.163	0.169
Iron	44	0	0	3	0	0	6.8	37/44	0.010	9.2	1.33	1.41
Iron, Dissolved	40	2	0	1	10	0	32.5	21/40	0.010	0.333	0.080	0.085
Lead	32	0	0	0	3	0	9.4	4/32	0.050	0.250	0.088	0.135
Lead, Dissolved	32	3	0	0	1	0	12.5	1/32	0.050	0.250	0.097	0.140

[a] The minimum and maximum values over all observations and all wells for the corrected data set are reported.

[b] The overall average is the arithmetic average of all analyte results over all wells. The weighted average is the arithmetic average of the within well averages from the corrected data set.

[c] Because no numerical results were in the mercury, dissolved; selenium, dissolved; and uranium, dissolved data sets, it was not possible to determine or calculate any of the summary statistics. Therefore, NV appears in the summary statistics' columns.

Table 2.3. Summary of evaluation of McNairy Formation inorganic chemical data

Analyte	Number of Data Points	Number of Data Points Corrected for: "Q" Qualified Data	Small Values	Large Values	Nondetect > Max Detect	Other	Total Percent Corrected	Frequency of Detection	Minimum Value [a] (mg/liter)	Maximum Value [a] (mg/liter)	Overall Average [b] (mg/liter)	Weighted Average [b] (mg/liter)
Aluminum	37	0	0	2	11	0	35.1	23/37	0.100	0.750	0.284	0.335
Aluminum, Dissolved	32	4	0	0	3	0	21.9	21/32	0.087	0.772	0.209	0.241
Antimony	46	0	0	0	0	0	0	0/46	0.060	0.250	0.127	0.127
Antimony, Dissolved	41	13	0	0	0	0	31.7	0/41	0.060	0.185	0.078	0.074
Arsenic	46	0	0	1	0	0	2.2	2/46	0.005	0.005	0.005	0.005
Arsenic, Dissolved	45	43	0	0	0	0	95.6	0/45	0.005	0.005	0.005	0.005
Barium	46	0	0	1	0	0	2.2	44/46	0.070	0.354	0.155	0.161
Barium, Dissolved	46	0	0	0	0	0	0	44/46	0.050	0.320	0.143	0.144
Beryllium	46	0	0	0	1	0	2.2	1/46	0.004	0.025	0.011	0.011
Beryllium, Dissolved	41	6	0	0	0	0	14.6	0/41	0.004	0.015	0.007	0.008
Cadmium	46	0	0	0	3	0	6.5	0/46	0.010	0.100	0.024	0.023
Cadmium, Dissolved	46	11	0	0	0	0	23.9	0/46	0.010	0.025	0.013	0.013
Calcium	46	0	0	0	0	0	0	46/46	6.48	41.0	22.6	24.4
Calcium, Dissolved	41	0	0	0	0	0	0	41/41	5.5	41.1	21.8	22.6
Chloride	45	0	0	0	0	0	0	45/45	2.6	31.0	10.0	11.4
Chromium	36	0	0	1	0	0	2.8	1/36	0.050	0.060	0.054	0.054
Chromium, Dissolved	36	0	0	0	0	0	0	0/36	0.050	0.060	0.053	0.053
Cobalt	46	0	0	0	0	0	0	1/46	0.045	0.121	0.055	0.056
Cobalt, Dissolved	41	6	0	0	0	0	14.6	0/41	0.045	0.050	0.048	0.048
Copper	46	0	0	1	13	0	30.4	5/46	0.010	0.100	0.019	0.019
Copper, Dissolved	41	5	0	0	1	0	14.6	1/41	0.010	0.025	0.014	0.014
Fluoride	38	0	0	0	0	0	0	38/38	0.16	0.33	0.224	0.229
Iron	46	0	0	1	0	0	2.2	45/46	0.222	20.30	7.37	7.33
Iron, Dissolved	41	0	0	1	0	0	2.6	39/41	0.024	12.4	5.05	4.71
Lead	30	0	0	0	0	0	0	0/30	0.050	0.250	0.124	0.147
Lead, Dissolved	30	5	0	0	0	0	16.7	0/30	0.050	0.250	0.122	0.145

[a] The minimum and maximum values over all observations and all wells for the corrected data set are reported.

[b] The overall average is the arithmetic average of all analyte results over all wells. The weighted average is the arithmetic average of the within well averages for the corrected data set.

[c] Because no numerical results were in the mercury, dissolved; selenium, dissolved; and uranium, dissolved data sets, it was not possible to determine or calculate any of the summary statistics. Therefore, NV appears in the summary statistics' columns.

For the RGA radionuclide data set, 339 observations were available in the corrected data set over all analytes and wells. Of these 339 observations, 7 or 2.1% of the total number of observations were modified for one of the reasons discussed earlier. Of the 7 observations that were modified, 2 observations (<1% of the total) were corrected for being "Q" qualified, and 5 observations (1.4% of the total) were corrected for being anomalously large. A complete summary is presented in Table 2.4. Please note, the summary statistics reported in Table 2.4 are for the corrected data sets presented in App. B.

For the McNairy radionuclide data set, 334 observations were available in the corrected data set over all analytes and wells. Of these 334 observations, 3 or less than 1% of the total number of observations were modified for one of the reasons discussed earlier. Of the 3 observations that were modified, 1 observation (<1% of the total) was corrected for being "Q" qualified, and 2 observations (<1% of the total) were corrected for being anomalously small. A complete summary is presented in Table 2.4. Please note, the summary statistics reported in Table 2.4 are for the corrected data sets presented in App. B.

Overall, very few corrections were made to the data sets used to derive the background values. In total, 571 of 4,932 observations (11.6%) were modified or corrected. Of the 571 corrections, over one-half (i.e., 399 or 8.1% of total number of observations) were for insertion of the minimum detection limit as a value for an analyte when the observation was "Q" qualified. The next most common reason for correcting or modifying the data set was to reduce a nondetect value to the maximum detected value either within a well's data set or over an analyte's data set. A total of 139 observations (2.8% of total number of observations) was corrected for this reason. Of the remaining 33 corrections (<1% of the total number of observations), 3 were for anomalously small values that were increased to the next smallest detected value, 29 were for anomalously large values that were decreased to the next greatest detected value, and 1 was for the reduction of a maximum detection value that was "B" qualified. (Note, a "B" qualifier indicates that the chemical was also detected in at least one blank sample associated with the observation.)

Table 2.4. Summary of evaluation of RGA and McNairy Formation radionuclide data

Analyte	Number of Data Points	Number of Data Points Corrected for: "Q" Qualified Data	Small Values	Large Values	Nondetect > Max Detect	Other	Total Percent Corrected	Frequency of Detection	Minimum Value [a] (pCi/liter)	Maximum Value [a] (pCi/liter)	Overall Average [b] (pCi/liter)	Weighted Average [b] (pCi/liter)
RGA data sets												
Gross Alpha	56	0	0	3	0	0	5.4	56/56	-5.3	7.5	1.29	1.36
Gross Beta	58	0	0	2	0	0	3.4	58/58	-3.0	20.0	5.80	5.80
Neptunium-237	28	0	0	0	0	0	0	25/28	-0.4	0.8	0.11	0.11
Plutonium-239	28	0	0	0	0	0	0	5/28	0	0.2	0.02	0.02
Radium-226	28	2	0	0	0	0	0	5/28	0	0.7	0.09	0.09
Radon-222	39	0	0	0	0	0	0	39/39	5.5	626	361.2	398.0
Technetium-99	54	0	0	0	0	0	0	54/59	0	29	7.9	7.8
Thorium-230	28	0	0	0	0	0	0	24/28	0	1.1	0.39	0.39
Total Radium	20	0	0	0	0	0	0	17/20	-1.0	1.3	0.07	0.06
McNairy Formation data sets												
Gross Alpha	65	0	0	0	0	0	0	65/65	-18	18.9	2.40	2.26
Gross Beta	65	0	0	0	0	0	0	65/65	1	236	38.8	39.5
Neptunium-237	21	0	0	0	0	0	0	19/21	-0.7	0.5	0.00	0.00
Plutonium-239	21	0	0	0	0	0	0	4/21	0	0.2	0.02	0.02
Radium-226	21	1	0	0	0	0	4.8	4/21	0	1.3	0.20	0.20
Radon-222	40	0	2	0	0	0	5.0	38/40	37	333	139.7	140.3
Technetium-99	65	0	0	0	0	0	0	50/65	-7	27	6.4	6.4
Thorium-230	21	0	0	0	0	0	0	14/21	-0.1	2.3	0.25	0.25
Total Radium	15	0	0	0	0	0	0	15/15	-0.7	0.7	0.26	0.26

[a] The minimum and maximum values over all observations and all wells for the corrected data set are reported.

[b] The overall average is the arithmetic average of all analyte results over all wells. The weighted average is the arithmetic average of the within well averages for the corrected data set.

THIS PAGE INTENTIONALLY LEFT BLANK

3. DERIVATION AND PRESENTATION OF BACKGROUND VALUES

This chapter discusses the methods used to derive the background concentrations and presents the background values for each analyte within an aquifer. Note, discussions of the significance of the background values, uncertainties in their derivation, and comparisons against various criteria are in Chapt. 5.

Because multiple observations were available for each analyte and well combination, two sets of background values are presented. The first set contains background concentrations derived ignoring the well of origin of the observation. The second set contains background concentrations derived after summarizing the observations within wells.

Also, as shown in Chapt. 2, the number of detected observations varied by analyte. In fact, for some analytes, the data set contained only nondetect values. Because of this, the data sets developed in Chapt. 2 were segregated into two groups. In Group 1 are those analytes for which background values were derived qualitatively. In Group 2 are those analytes for which background values were derived quantitatively.

3.1 GROUP 1 ANALYTES AND DERIVATION OF THEIR BACKGROUND VALUES

Analytes falling into Group 1 are listed in the Tables 3.1 (RGA) and 3.2 (McNairy Formation). In each table is the analyte's frequency of detection, minimum detection limit, maximum detected value, and selected background value. Unlike Group 2 analytes where background concentrations were derived both over all observations and over wells, background concentrations for analytes falling in Group 1 were only derived over all observations.

Analytes assigned to Group 1 met one of the following two criteria:

- Analyte was not detected in any sample within an aquifer.
- Analyte was detected in fewer than 10% of all samples, exhibited little variation in detected concentrations, and had detected concentrations that were similar to their detection limits.

(Note, for some analytes the maximum detected values reported in Tables 3.1 and 3.2 differ from the maximum values reported for the analyte in Chapt. 2. This is the result of the data evaluation process used in Chapt. 2. As discussed in Chapt. 2, if an analyte was never detected in a well, the value reported as the maximum concentration for samples taken from the well was the maximum detection limit over all samples from the well. This value may exceed the maximum detected value over all samples from all wells. Please see App. B for additional information concerning maximum detected concentrations.

As noted above, the background values reported in Tables 3.1 and 3.2 were qualitatively determined. For those analytes that were never detected, the background value selected is the minimum detection limit over all samples from all wells within an aquifer. The minimum detection limit was chosen in this case because this value best represents the maximum value that could be present in any sample and not be reported as a detected value. (Note, if lower detection limits are used in the future for these analytes, additional evaluation of the analytes' background values should be considered.) For those analytes that were infrequently detected, the background value selected is the maximum detected value over all samples from all wells within an aquifer. The maximum detected value was chosen in this case because previous statistical analyses with similar data have shown that any value derived from an assumed distribution (e.g., the 95% upper tolerance limit of a normal distribution; see Subsect. 3.2) would exceed this

Table 3.1. Group 1 analytes and their background values–RGA data sets

Analyte	Frequency of Detection	Minimum Detection Limit (mg/liter)	Maximum Detected Value (mg/liter)	Selected Background Value (mg/liter)
Antimony	0/44	0.060	None	0.060
Antimony, Dissolved	0/37	0.060	None	0.060
Arsenic	2/44	0.005	0.007	0.007
Arsenic, Dissolved	0/44	0.005	None	0.005
Beryllium	0/44	0.004	None	0.004
Beryllium, Dissolved	0/40	0.004	None	0.004
Cadmium	1/44	0.010	0.012	0.012
Cadmium, Dissolved	0/44	0.010	None	0.010
Chromium, Dissolved	1/37	0.050	0.092	0.092
Cobalt	0/44	0.045	None	0.045
Cobalt, Dissolved	0/40	0.045	None	0.045
Mercury	0/32	0.0002	None	0.0002
Mercury, Dissolved [a]	0/32	None	None	0.0002
Molybdenum	0/40	0.050	None	0.050
Molybdenum, Dissolved	0/36	0.050	None	0.050
Selenium	0/39	0.005	None	0.005
Selenium, Dissolved [a]	0/39	None	None	0.005
Silver	0/11	0.011	None	0.011
Silver, Dissolved	0/11	0.060	None	0.011 [b]
Thallium	0/35	0.056	None	0.056
Thallium, Dissolved	1/35	0.056	0.063	0.056 [c]
Uranium	2/46	0.001	0.002	0.002
Uranium, Dissolved [a]	0/8	None	None	0.002

[a] There were no numerical results in the data sets for mercury, dissolved; selenium, dissolved; or uranium, dissolved. Therefore, the value selected for the background concentration in the dissolved samples is the value for the total (i.e., unfiltered) sample.

[b] The minimum detection limit for silver, dissolved exceeds the minimum detection limit for silver. Because it would be nonsensical to have a background value for dissolved samples that exceeds that for total samples, the background value for the dissolved sample was reduced to that for total samples.

[c] The maximum detected value for thallium, dissolved, which should be selected following the rules described in the main text, exceeds the background value selected for thallium. Because it would be nonsensical to have a background for dissolved samples that exceeds that for total samples, the background value for the dissolved sample was reduced to that for the total samples.

Table 3.2. Group 1 analytes and their background values–McNairy Formation data sets

Analyte	Frequency of Detection	Minimum Detection Limit (mg/liter)	Maximum Detected Value (mg/liter)	Selected Background Value (mg/liter)
Antimony	0/46	0.060	None	0.060
Antimony, Dissolved	0/41	0.060	None	0.060
Arsenic	2/46	0.005	0.005	0.005
Arsenic, Dissolved	0/45	0.005	None	0.005
Beryllium	1/46	0.004	0.017	0.017
Beryllium, Dissolved	0/41	0.004	None	0.004
Cadmium	0/46	0.010	None	0.010
Cadmium, Dissolved	0/46	0.010	None	0.010
Chromium	1/36	0.050	0.060	0.060
Chromium, Dissolved	0/36	0.050	None	0.050
Cobalt, Dissolved	0/41	0.045	None	0.045
Copper, Dissolved	1/41	0.010	0.013	0.013
Lead	0/30	0.050	None	0.050
Lead, Dissolved	0/30	0.050	None	0.050
Mercury	1/30	0.0002	0.0002	0.0002
Mercury, Dissolved [a]	0/30	None	None	0.0002
Molybdenum	0/37	0.050	None	0.050
Molybdenum, Dissolved	0/32	0.050	None	0.050
Nickel	2/46	0.050	0.109	0.109
Nickel, Dissolved	0/41	0.050	None	0.050
Selenium	0/40	0.005	None	0.005
Selenium, Dissolved [a]	0/40	None	None	0.005
Silver	0/19	0.050	None	0.050
Silver, Dissolved[b]	0/19	0.060	None	0.050
Thallium, Dissolved	0/26	0.056	None	0.056
Uranium	1/52	0.001	0.001	0.001
Uranium, Dissolved [a]	0/15	None	None	0.001

[a] No numerical results were available for dissolved mercury, selenium, or uranium. Therefore, the value selected for the background concentration in the dissolved samples is that for the total sample.

[b] The minimum detection limit for silver, dissolved exceeds the minimum detection limit for silver. Because it would be nonsensical to have a background value for dissolved samples that exceeds that for total samples, the background value for the dissolved sample was reduced to that for total samples.

maximum detected value. As discussed in Subsect. 3.2, when the calculated value exceeds the maximum detected value, then the maximum detected value becomes the selected background value.

In total, for the RGA, 23 of the 64 analyte data sets were assigned to Group 1. For the McNairy Formation, 27 of the 64 analyte data sets were assigned to Group 1.

3.2 GROUP 2 ANALYTES AND DERIVATION OF THEIR BACKGROUND VALUES

Analytes falling into Group 2 are listed in the Tables 3.3 and 3.4 (RGA) and Tables 3.5 and 3.6 (McNairy Formation). In Tables 3.3 and 3.5, statistics for the corrected data sets summarized over all observations are presented. In Tables 3.4 and 3.6, statistics for the corrected data sets summarized over average concentration within well are presented. Specifically, Tables 3.3 and 3.5 present the following information for all observations in the corrected data sets: analyte name, frequency of detection, minimum and maximum value (from tables in Chapt.2), maximum detected value over all observations (from App. B), 95% upper tolerance limit (95% UTL), and selected background value. Specifically, Tables 3.4 and 3.6, present the following information for observations over average concentration within wells in the corrected data set: analyte name, minimum and maximum average concentration over wells (from tables in Chapt. 2), 95% UTL, and selected background value.

Analytes assigned to Group 2 meet both of the following criteria:

- Analyte was detected in at least one sample within an aquifer.
- The detected concentrations of the analyte were not similar to the detection limit used for the analyte in other samples (i.e., the analyte displayed marked variation in the detected concentrations.)

For Tables 3.3 and 3.5, the selected background values are the lessor of the maximum detected value and the 95% UTL. For Tables 3.4 and 3.6, the selected background values are the lessor of the maximum average concentration within a well and the 95% UTL. The calculation of the 95% UTL is described below.

The upper 95% UTL was calculated using the methods for normal distributions described in Sects. 11.2 and 11.3 of *Statistical Methods for Environmental Pollution Monitoring* (Gilbert 1987). The general formulas used for this calculation are as follows:

$$\hat{x}_p = \bar{x} + Z_p s \qquad \textbf{[1]}$$

where:

$\hat{x}_p$ is an estimate of the p^{th} quantile (i.e., p^{th} percentile) of the analyte's distribution.
$\bar{x}$ is the mean concentration assuming a normal distribution.
Z_p is p^{th} quantile of the standard normal distribution from Table A1 in Gilbert (1987).
s is the standard deviation assuming a normal distribution.

Table 3.3. Background values for Group 2 analytes over all observations–RGA data sets

Analyte	Freq.[a]	Corrected Data (mg/liter) Min[b]	Max[b]	Max Detect[c]	95% UTL[d] (mg/liter)	Selected Background Value[e] (mg/liter)
Aluminum	29/40	0.100	2.60	2.6	2.189	2.189
Aluminum, Dissolved	19/36	0.082	0.259	0.259	0.311	0.311
Barium	41/44	0.010	0.282	0.282	0.235	0.235
Barium, Dissolved	39/44	0.005	0.200	0.200	0.221	0.200
Calcium	44/44	2.88	56.5	56.5	41.238	41.238
Calcium, Dissolved	40/40	10.9	37	37	38.166	38.166
Chloride	43/43	2.9	109.1	109.1	91.021	91.021
Chromium	11/37	0.050	0.232	0.232	0.144	0.144
Copper	7/44	0.010	0.100	0.036	0.048	0.036
Copper, Dissolved	3/44	0.010	0.025	0.02	0.025	0.020
Fluoride	34/35	0.100	0.270	0.270	0.283	0.270
Iron	37/44	0.010	9.2	9.2	5.030	5.030
Iron, Dissolved	21/40	0.010	0.333	0.333	0.267	0.267
Lead	4/32	0.050	0.250	0.129	0.252	0.129
Lead, Dissolved	1/32	0.050	0.250	0.098	0.281	0.098
Magnesium	44/44	0.879	18.7	18.7	16.262	16.262
Magnesium, Dissolved	39/39	3.01	17	17	16.215	16.215
Manganese	30/44	0.005	0.165	0.165	0.119	0.119
Manganese, Dissolved	21/40	0.005	0.128	0.128	0.068	0.068
Nickel	10/44	0.050	1.66	1.66	0.682	0.682
Nickel, Dissolved	7/40	0.050	0.382	0.382	0.305	0.305
Nitrate as N	33/43	1.0	38.3	38.3	15.561	15.561
Potassium	22/44	2.0	5.51	5.51	5.195	5.195
Potassium, Dissolved	25/40	2.0	4.26	4.26	4.096	4.096
Silica	43/43	7.68	27	27	26.401	26.401
Sodium	44/44	3.71	69.6	69.6	59.450	59.450
Sodium, Dissolved	40/40	0.317	69.0	69.0	60.433	60.433
Sulfate	32/32	4.0	22.6	22.6	19.947	19.947
Vanadium	22/33	0.023	0.147	0.147	0.134	0.134
Vanadium, Dissolved	21/33	0.020	0.141	0.141	0.134	0.134
Zinc	17/44	0.005	0.072	0.072	0.054	0.054
Zinc, Dissolved	13/40	0.005	0.083	0.083	0.049	0.049
Gross Alpha	56/56	-5.3	7.5	7.5	5.8	5.8
Gross Beta	58/58	-3.0	20.0	20	13.8	13.8
Neptunium-237	25/28	-0.4	0.8	0.8	0.8	0.8
Plutonium-239	5/28	0	0.2	0.2	0.1	0.1
Radium-226	5/28	0	0.7	0.7	0.6	0.6
Radon-222	39/39	5.5	626	626	684.9	626
Technetium-99	54/59	0	29	29	22.3	22.3
Thorium-230	24/28	0	1.1	1.1	1.2	1.1
Total Radium	17/20	-1.0	1.3	1.3	1.5	1.3

[a] Freq = the number of samples in which the analyte was detected over the total number of samples.
[b] Min = the minimum value for the analyte over all observations in the corrected data set.
Max = the maximum value for the analyte over all observations in the corrected data set.
[c] Max Detect = the maximum detected value over all observations in the corrected data set. This value may differ from the Max value because detection limits for samples varied between wells.
[d] 95% UTL = the 95% upper confidence limit on the 95th quantile of all observations assuming a normal distribution and temporal and spatial independence between samples.
[e] The lessor of the maximum detected value and the 95% UTL.

Table 3.4. Background values for Group 2 analytes over wells–RGA data sets

Analyte	Corrected Data (mg/liter) Min[a]	Max[a]	95% UTL[b] (mg/liter)	Selected Background Value[c] (mg/liter)
Aluminum	0.181	1.64	2.870	1.64
Aluminum, Dissolved	0.130	0.201	0.279	0.201
Barium	0.042	0.202	0.330	0.202
Barium, Dissolved	0.031	0.179	0.312	0.179
Calcium	11.4	40.0	59.864	40.0
Calcium, Dissolved	11.8	35.8	54.474	35.8
Chloride	4.8	89.2	144.623	89.2
Chromium	0.053	0.134	0.191	0.134
Copper	0.013	0.034	0.048	0.034
Copper, Dissolved	0.010	0.018	0.023	0.018
Fluoride	0.108	0.245	0.376	0.245
Iron	0.215	3.72	6.031	3.72
Iron, Dissolved	0.019	0.164	0.313	0.164
Lead	0.050	0.250	0.470	0.250
Lead, Dissolved	0.064	0.250	0.460	0.250
Magnesium	2.97	15.7	24.284	15.7
Magnesium, Dissolved	3.27	15.4	23.737	15.4
Manganese	0.010	0.082	0.150	0.082
Manganese, Dissolved	0.006	0.048	0.085	0.048
Nickel	0.070	0.523	0.829	0.523
Nickel, Dissolved	0.061	0.288	0.442	0.288
Nitrate as N	1.04	13.5	21.425	13.5
Potassium	2.35	4.47	6.099	4.47
Potassium, Dissolved	2.0	3.70	5.065	3.70
Silica	16.8	21.1	24.691	21.1
Sodium	14.1	63.5	93.855	63.5
Sodium, Dissolved	16.2	65.7	97.794	65.7
Sulfate	6.8	19.1	27.061	19.1
Vanadium	0.023	0.139	0.214	0.139
Vanadium, Dissolved	0.020	0.131	0.209	0.131
Zinc	0.016	0.025	0.033	0.025
Zinc, Dissolved	0.011	0.026	0.036	0.026
Gross Alpha	0.09	2.36	4.1	2.36
Gross Beta	3.9	7.3	10.4	7.3
Neptunium-237	-0.01	0.21	0.7	0.21
Plutonium-239	0.01	0.03	0.1	0.03
Radium-226	0.06	0.10	0.2	0.10
Radon-222	82.6	555.3	1045	555.3
Technetium-99	5.2	10.8	16.3	10.8
Thorium-230	0.26	0.54	1.1	0.54
Total Radium	-0.26	0.46	1.9	0.46

[a] Min = the minimum average concentration for the analyte over wells in the corrected data set.
Max = the maximum average concentration for the analyte over wells in the corrected data set.

[b] 95% UTL = the 95% upper confidence limit on the 95th quantile of the well average concentrations assuming a normal distribution and spatial independence between wells.

[c] The lessor of the maximum average concentration and the 95% UTL.

Table 3.5. Background values for Group 2 analytes over all observations–McNairy Formation data sets

Analyte	Freq.[a]	Corrected Data (mg/liter) Min[b]	Max[b]	Max Detect[c]	95% UTL[d] (mg/liter)	Selected Background Value[e] (mg/liter)
Aluminum	23/37	0.100	0.750	0.750	0.687	0.687
Aluminum, Dissolved	21/32	0.087	0.772	0.772	0.579	0.579
Barium	44/46	0.070	0.354	0.354	0.296	0.296
Barium, Dissolved	44/46	0.050	0.320	0.320	0.268	0.268
Calcium	46/46	6.48	41.0	41.0	38.858	38.858
Calcium, Dissolved	41/41	5.5	41.1	41.1	38.829	38.829
Chloride	45/45	2.6	31.0	31.0	19.708	19.708
Cobalt	1/46	0.045	0.121	0.121	0.096	0.096
Copper	5/46	0.010	0.100	0.100	0.057	0.057
Fluoride	38/38	0.16	0.33	0.33	0.339	0.33
Iron	45/46	0.222	20.3	20.3	18.630	18.630
Iron, Dissolved	39/41	0.024	12.4	12.4	12.372	12.372
Magnesium	46/46	2.14	17.6	17.6	13.418	13.418
Magnesium, Dissolved	41/41	2.3	17.3	17.3	14.171	14.171
Manganese	46/46	0.082	0.983	0.983	0.941	0.941
Manganese, Dissolved	41/41	0.040	1.05	1.05	0.894	0.894
Nitrate as Nitrogen	3/45	1.0	2.3	2.3	1.474	1.474
Potassium	39/46	3.82	86.1	86.1	55.752	55.752
Potassium, Dissolved	33/41	2.0	101.0	101.0	51.205	51.205
Silica	45/45	8.73	36.0	36.0	39.886	36.0
Sodium	46/46	14.1	29.2	29.2	29.922	29.2
Sodium, Dissolved	41/41	13.7	27.98	27.98	29.642	27.98
Sulfate	37/37	6.9	28.9	28.9	32.217	28.9
Thallium	2/27	0.056	1.02	1.02	0.644	0.644
Vanadium	17/27	0.050	0.187	0.187	0.126	0.126
Vanadium, Dissolved	15/27	0.048	0.163	0.163	0.126	0.126
Zinc	27/46	0.005	0.190	0.190	0.142	0.142
Zinc, Dissolved	23/41	0.005	0.160	0.160	0.116	0.116
Gross Alpha	65/65	-18	18.9	18.9	11.9	11.9
Gross Beta	65/65	1	236	236	144.5	144.5
Neptunium-237	19/21	-0.7	0.5	0.5	0.7	0.5
Plutonium-239	4/21	0	0.2	0.2	0.2	0.2
Radium-226	4/21	0	1.3	1.3	1.2	1.2
Radon-222	38/40	37	333	333	295.0	295.0
Technetium-99	50/65	-7	27	27	20.6	20.6
Thorium-230	14/21	-0.1	2.3	2.3	1.5	1.5
Total Radium	15/15	-0.7	0.7	0.7	1.3	0.7

[a] Freq = the number of samples in which the analyte was detected over the total number of samples.
[b] Min = the minimum value for the analyte over all observations in the corrected data set.
Max = the maximum value for the analyte over all observations in the corrected data set.
[c] Max Detect = the maximum detected value over all observations in the corrected data set. This value may differ from the Max value because detection limits for samples varied between wells.
[d] 95% UTL = the 95% upper confidence limit on the 95th quantile of all observations assuming a normal distribution and temporal and spatial independence between samples.
[e] the lessor of the maximum detected value and the 95% UTL.

Table 3.6. Background values for Group 2 analytes over wells–McNairy Formation data sets

Analyte	Corrected Data (mg/liter) Min[a]	Corrected Data (mg/liter) Max[a]	95% UTL[b] (mg/liter)	Selected Background Value[c] (mg/liter)
Aluminum	0.172	0.750	1.135	0.75
Aluminum, Dissolved	0.152	0.587	0.872	0.587
Barium	0.085	0.265	0.385	0.265
Barium, Dissolved	0.077	0.266	0.391	0.266
Calcium	18.17	39.47	53.777	39.47
Calcium, Dissolved	8.56	40.27	61.849	40.27
Chloride	3.62	20.23	32.901	20.23
Cobalt	0.048	0.072	0.087	0.072
Copper	0.011	0.033	0.049	0.033
Fluoride	0.173	0.298	0.399	0.298
Iron	0.328	15.83	29.051	15.83
Iron, Dissolved	0.165	9.446	17.459	9.446
Magnesium	4.146	16.457	24.387	16.457
Magnesium, Dissolved	3.348	16.533	25.087	16.533
Manganese	0.113	0.729	1.374	0.729
Manganese, Dissolved	0.113	0.682	1.192	0.682
Nitrate as Nitrogen	1.00	1.43	1.717	1.43
Potassium	6.440	64.080	102.569	64.080
Potassium, Dissolved	5.699	58.750	93.990	58.750
Silica	13.0	29.4	48.651	29.4
Sodium	15.28	24.92	36.532	24.92
Sodium, Dissolved	15.71	25.90	35.683	25.90
Sulfate	7.40	27.27	39.962	27.27
Thallium	0.058	0.255	0.386	0.255
Vanadium	0.050	0.119	0.165	0.119
Vanadium, Dissolved	0.050	0.107	0.152	0.107
Zinc	0.012	0.104	0.166	0.104
Zinc, Dissolved	0.008	0.080	0.128	0.080
Gross Alpha	-1.1	5.3	10.5	5.3
Gross Beta	11.2	125.4	207.8	125.4
Neptunium-237	-0.2	0.13	1.3	0.13
Plutonium-239	0.01	0.04	0.153	0.04
Radium-226	0.11	0.29	0.887	0.29
Radon-222	64.0	228.3	388.1	228.3
Technetium-99	4.2	7.8	11.0	7.8
Thorium-230	0.11	0.40	1.4	0.4
Total Radium	0.20	0.36	0.9	0.36

[a] Min = the minimum average concentration for the analyte over wells in the corrected data set.
Max = the maximum average concentration for the analyte over wells in the corrected data set.

[b] 95% UTL = the 95% upper confidence limit on the 95th quantile of the well average concentrations assuming a normal distribution and spatial independence between wells.

[c] The lessor of the maximum average concentration and the 95% UTL.

$$UL_{1-\alpha}(x_p) = \bar{x} + sK_{1-\alpha,p} \qquad \textbf{[2]}$$

where:

$UL_{1-\alpha}(x_p)$ is the upper 100(1-α)% confidence limit of the true p^{th} quantile.
$\bar{x}$ is the mean concentration assuming a normal distribution.
s is the standard deviation assuming a normal distribution.
$K_{1-\alpha,p}$ is selected from Table A3 in Gilbert (1987).

For calculations of the 95% UTL, p equaled 0.95 (i.e. 95^{th} quantile), and " equaled 0.95. Therefore, the 95% UTL equals the 95% upper confidence limit of the 95^{th} quantile.

When reducing data over all observations, the mean ($\bar{x}$) and standard deviation (s) used in these equations were derived over all observations using the following formulas:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \textbf{[3]}$$

where:

$\bar{x}$ is the mean over all observations.
x_i is value for any particular observation.
n is the total number of observations.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2} \qquad \textbf{[4]}$$

where:

s is the standard deviation of all observations.
n is the total number of observations.
x_i is the value for any particular observation.
$\bar{x}$ is the mean over all observations.

Formulas [3] and [4] were also used when calculating the mean and standard deviation for derivation of the 95% UTLs for averages within well. However, the parameters used in these equations differed. In both formulas, (x_i) became the average within well versus the value for any particular observation, and (n) became the total number of wells providing information. Therefore, ($\bar{x}$) became the mean over well averages, and (s) became the standard deviation of the well average concentrations.

3.3 DERIVATION OF BACKGROUND CONCENTRATIONS FOR URANIUM ISOTOPES

No uranium isotopic results were available in the background data sets. Therefore, background concentrations for uranium isotopes were derived utilizing the known relationship between the concentration of total uranium in units of mass and the concentrations of the three major uranium isotopes (uranium-234, uranium-235, and uranium-238) in units of activity. Steps taken in this derivation are presented below.

- Convert total uranium mass concentration (mg/liter) to isotopic-specific mass concentration using the mass fraction of each isotope. Note, the natural isotopic mass fractions were used in this calculation because it is assumed that the uranium concentrations in the background wells are not affected by plant releases.

- Convert isotopic-specific mass concentrations (mg/liter) to units of activity by multiplying by the specific activity of the uranium isotope.

  These two steps can be combined as in the following equation.

$$C_i = C_{total\ U} \times F_i \times SA_i \qquad \textbf{[5]}$$

where:

C_i is the concentration of the uranium isotope in pCi/liter.
$C_{total\ U}$ is the concentration of the total uranium in mg/liter.
F_i is the mass fraction of the uranium isotope.
SA_i is the specific activity of the uranium isotope (pCi/mg).

The variables used in this equation and the resulting uranium isotope concentrations are shown in Table 3.7.

Table 3.7. Parameters used to convert total uranium concentrations to isotopic uranium concentrations

Parameter	Uranium Isotope		
	Uranium-234	**Uranium-235**	**Uranium-238**
Total U concentration for RGA (mg/liter)		----------------0.002----------------	
Fraction of Total U Mass (unitless)	0.000056	0.0072	0.9927
Specific Activity (pCi/mg)	6.21×10^6	2.15×10^3	3.35×10^2
Isotopic Uranium Concentration (pCi/liter)[a]	0.7	0.03	0.7
Total U concentration for McNairy Formation (mg/liter)		----------------0.001----------------	
Fraction of Total U Mass (unitless)	0.000056	0.0072	0.9927
Specific Activity (pCi/mg)	6.21×10^6	2.15×10^3	3.35×10^2
Isotopic Uranium Concentration (pCi/liter)[a]	0.3	0.02	0.3

[a] Values rounded to one significant digit.

3.4 SUMMARY OF BACKGROUND CONCENTRATIONS

Table 3.8 presents a summary of selected background concentrations both over all observations and over means within wells. As shown in this table, the selected background concentrations for the RGA and McNairy Formation are similar for most analytes.

If the selected background concentrations are compared between method of derivation within aquifer (i.e., using all observations versus using averages within wells), then several of the selected background concentrations for the 67 analytes are seen to be identical, and none vary by as much as an order of magnitude. In fact, for the RGA, only nine analytes have selected background concentrations that vary by more than a factor of 2 between method of derivation. These analytes and the factors of their difference are lead, dissolved (2.6); zinc (2.2); gross alpha (2.5); neptunium-237 (3.8); plutonium-239 (3.3); radium-226 (6); technetium-99 (2.1); thorium-230 (2); and total radium (2.8). For the McNairy Formation, only seven analytes have selected background values which vary by more than a factor of 2 between method of derivation. These analytes and the factors of their difference are thallium (2.5); gross alpha (2.2); neptunium-237 (3.8); plutonium-239 (5); radium-226 (4.1); technetium-99 (2.7); thorium-230 (3.8).

Table 3.8. Summary of selected RGA and McNairy Formation background concentrations

Analyte	Over All Observations		Over Wells	
	RGA	McNairy	RGA	McNairy
Inorganic Chemicals (mg/L)				
Aluminum	2.189	0.687	1.64	0.75
Aluminum, Dissolved	0.311	0.579	0.201	0.587
Antimony	0.060 [a]	0.060 [a]	0.060 [a]	0.060 [a]
Antimony, Dissolved	0.060 [a]	0.060 [a]	0.060 [a]	0.060 [a]
Arsenic	0.005 [a]	0.005 [a]	0.005 [a]	0.005 [a]
Arsenic, Dissolved	0.005 [a]	0.005 [a]	0.005 [a]	0.005 [a]
Barium	0.235	0.296	0.202	0.265
Barium, Dissolved	0.200	0.268	0.179	0.266
Beryllium	0.004 [a]	0.017 [a]	0.004 [a]	0.017 [a]
Beryllium, Dissolved	0.004 [a]	0.004 [a]	0.004 [a]	0.004 [a]
Cadmium	0.010 [a]	0.010 [a]	0.010 [a]	0.010 [a]
Cadmium, Dissolved	0.010 [a]	0.010 [a]	0.010 [a]	0.010 [a]
Calcium	41.238	38.858	40.0	39.47
Calcium, Dissolved	38.166	38.829	35.8	40.27
Chloride	91.021	19.708	89.2	20.23
Chromium	0.144	0.060 [a]	0.134	0.060 [a]
Chromium, Dissolved	0.050 [a]	0.050 [a]	0.050 [a]	0.050 [a]
Cobalt	0.045 [a]	0.096	0.045 [a]	0.072
Cobalt, Dissolved	0.045 [a]	0.045 [a]	0.045 [a]	0.045 [a]
Copper	0.036	0.057	0.034	0.033
Copper, Dissolved	0.020	0.013 [a]	0.018	0.013 [a]
Fluoride	0.270	0.330	0.245	0.298
Iron	5.030	18.360	3.72	15.83
Iron, Dissolved	0.267	12.372	0.164	9.446
Lead	0.129	0.050 [a]	0.250	0.050 [a]
Lead, Dissolved	0.098	0.050 [a]	0.250	0.050 [a]
Magnesium	16.262	13.418	15.7	16.457
Magnesium, Dissolved	16.215	14.171	15.4	16.533
Manganese	0.119	0.941	0.082	0.729
Manganese, Dissolved	0.068	0.894	0.048	0.682
Mercury	0.0002 [a]	0.0002 [a]	0.0002 [a]	0.0002 [a]
Mercury, Dissolved	0.0002 [a]	0.0002 [a]	0.0002 [a]	0.0002 [a]
Molybdenum	0.050 [a]	0.050 [a]	0.050 [a]	0.050 [a]
Molybdenum, Dissolved	0.050 [a]	0.050 [a]	0.050 [a]	0.050 [a]
Nickel	0.682	0.109 [a]	0.682	0.109 [a]
Nickel, Dissolved	0.305	0.050 [a]	0.305	0.050 [a]
Nitrate as Nitrogen	15.561	1.474	13.5	1.43
Potassium	5.195	55.752	4.47	64.080
Potassium, Dissolved	4.096	51.205	3.70	58.750
Selenium	0.005 [a]	0.005 [a]	0.005 [a]	0.005 [a]
Selenium, Dissolved	0.005 [a]	0.005 [a]	0.005 [a]	0.005 [a]
Silica	26.401	36.0	21.1	29.4
Silver	0.011 [a]	0.050 [a]	0.011 [a]	0.050 [a]
Silver, Dissolved	0.060 [a]	0.050 [a]	0.060 [a]	0.050 [a]
Sodium	59.450	29.2	63.5	24.92
Sodium, Dissolved	60.433	27.98	65.7	25.90
Sulfate	19.947	28.9	19.1	27.27
Thallium	0.056 [a]	0.644	0.056 [a]	0.255
Thallium, Dissolved	0.056 [a]	0.056 [a]	0.056 [a]	0.056 [a]
Uranium	0.002 [a]	0.001 [a]	0.002 [a]	0.001 [a]
Uranium, Dissolved	0.002 [a]	0.001	0.002 [a]	0.001

Table 3.8. (continued)

Analyte	Over All Observations		Over Wells	
	RGA	McNairy	RGA	McNairy
Inorganic Chemicals (mg/L) (continued)				
Vanadium	0.134	0.126	0.139	0.119
Vanadium, Dissolved	0.134	0.126	0.131	0.107
Zinc	0.054	0.142	0.025	0.104
Zinc, Dissolved	0.049	0.116	0.026	0.080
Radionuclides (pCi/L)				
Gross Alpha	5.8	11.9	2.36	5.3
Gross Beta	13.8	144.5	7.3	125.4
Neptunium-237	0.8	0.5	0.21	0.13
Plutonium-239	0.1	0.2	0.03	0.04
Radium-226	0.6	1.2	0.10	0.29
Radon-222	626	295	555.3	228.3
Technetium-99	22.3	20.6	10.8	7.8
Thorium-230	1.1	1.5	0.54	0.40
Total Radium	1.3	0.7	0.46	0.36
Uranium-234 [b]	0.7	0.3	0.7	0.3
Uranium-235 [b]	0.3	0.2	0.3	0.2
Uranium-238 [b]	0.7	0.3	0.7	0.3

[a] Background value was derived qualitatively over all observations because analyte was never detected or was detected infrequently at a concentration near the analyte's detection limit.

[b] Uranium isotopic concentrations were derived from the mass concentration of uranium. See Subsect 3.3.

Similarly, if the selected background concentrations are compared between aquifers within method of derivation, most of the background concentrations for the 67 analytes are similar. However, several concentrations do vary by more than an order of magnitude. For example, when the selected backgrounds derived using all observations are compared between aquifers, seven vary by more than an order of magnitude (i.e., nitrate as nitrogen; iron, dissolved; manganese, dissolved; potassium; potassium, dissolved; thallium; and gross beta). In total, when selected background concentrations derived over all observations are compared between aquifers, fourteen analytes are seen to have selected background concentrations that are more than a factor of 2 greater for the RGA than for the McNairy Formation, and thirteen analytes are seen to have selected background concentrations that are more than a factor of 2 greater for the McNairy Formation than for the RGA. The analytes with selected backgrounds concentrations that are greater for the RGA and their factor of difference are aluminum (3.2); chloride (4.6); chromium (2.4); lead (2.6); nickel (6.3); nickel, dissolved (6.1); nitrate as nitrogen (10.6); sodium (2.0); sodium, dissolved (2.0); uranium (2.0); uranium, dissolved (2.0); radon-222 (2.1); uranium-234 (2.3); and uranium-238 (2.3). The analytes with selected background concentrations that are more than a factor of 2 greater for the McNairy Formation than for the RGA and their factor of difference are beryllium (4.3); cobalt (2.1); iron (3.7); iron, dissolved (46.3); manganese (7.9); manganese, dissolved (13.1); potassium (10.7); potassium, dissolved (12.5); silver (4.5); thallium (11.5); gross beta (10.5); plutonium-239 (2.0); and radium-226 (2.0).

Generally, the comparisons between methods of derivation within aquifers indicate that the methods of derivation gave similar results, and the comparisons between aquifers within method of derivation indicate that the waters of the RGA are different than the waters of the McNairy Formation. Of greatest importance is the differences between aquifers because these differences indicate that when used to evaluate environmental data, the background concentrations from the appropriate aquifer must be used. (Note, in the aforementioned comparisons, no attempt was made to segregate those analytes which had their background concentrations derived using primarily nondetect results [i.e., Group 1 analytes]. If only Group 2 analytes are considered fewer noticeable differences would be observed.)

4. SOURCES OF RISK-BASED CONCENTRATIONS AND OTHER COMPARISON CRITERIA

This chapter discusses the methods used to derive the risk-based concentrations and the sources of the other criteria to which the background values are compared in Chapt. 5. This chapter also presents the various criteria. Generally, most of this material is presented by reference to limit the size of this document.

4.1 RISK-BASED CONCENTRATIONS

All risk-based concentrations (RBCs) to which background concentrations are compared in Chapt. 5 were derived using methods presented in App. 2 of *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996a) for the derivation of risk-based preliminary remediation goals (risk-based PRGs). Note, because the inhalation exposure equations, some toxicity values, and some chemical-specific parameters have changed since the production of the aforementioned document, the risk-based concentrations for some analytes presented here differ from those presented for groundwater use in Table 2 in App. 2 of that document.

Salient points about the RBCs used in Chapt. 5 are as follows:

- the RBCs are for exposure to water under a residential scenario.
- the exposure routes considered when deriving the RBCs were ingestion of groundwater, dermal contact with water while showering, inhalation of vapors emitted by water while showering, and inhalation of vapors emitted by water while using water in the home.
- the exposure duration used in the calculation of the RBC for carcinogenic chemicals was 40 years and assumed 6 years for exposure as a child and 34 years as exposure as an adult.
- the exposure duration used in the calculation of the RBC for noncarcinogenic chemicals was one year, and the individual assumed to be exposed was a child from 1 to 7 years of age.
- the toxicity values used in the calculations were for chronic exposure to water.
- the target excess lifetime cancer risk used in the calculation was 1×10^{-6}.
- the target hazard index (a measure of systemic toxicity) was 0.1.
- if an analyte has both systemic toxic and cancer effects, then the RBC used in Chapt. 5 is the lesser of the RBCs calculated for these endpoints.

Table 4.1 presents the RBCs used in Chapt. 5.

4.2 REGULATORY VALUES

In Chapt. 5, the selected background concentrations are compared to two sets of values from regulatory sources. These are maximum contaminant levels (MCLs) and Commonwealth of Kentucky risk-based screening values.

Table 4.1. RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	RBC[a]	MCL[b]	KDEP[c]
	Inorganic Chemicals (mg/L)		
Aluminum[d]	1.5[HI]	0.050 – 0.200	37
Antimony	0.00056[HI]	0.006	0.015
Arsenic[e]	0.000035[CR]	0.050	0.000038
Barium	0.10[HI]	2.000	2.6
Beryllium	0.000010[CR]	0.004	0.000016
Cadmium	0.00066[HI]	0.005	0.018
Calcium	NV	NV	NV
Chloride[f]	NV	250	NV
Chromium[g]	0.0071[HI]	0.100	0.18
Cobalt	0.091[HI]	NV	NV
Copper	0.060[HI]	1.3	1.4
Fluoride	0.091[HI]	4.0	2.2
Iron[h]	0.45[HI]	0.3	NV
Lead[i]	0.00000015[HI]	0.015	0.004
Magnesium	NV	NV	NV
Manganese[j]	0.067[HI]	0.050	0.18
Mercury	0.00044[HI]	0.002	0.011
Molybdenum	0.0075[HI]	NV	0.180
Nickel[s]	0.030[HI]	0.100	0.730
Nitrate as Nitrogen	2.40[HI]	10	58
Potassium	NV	NV	NV
Selenium	0.0075[HI]	0.050	0.18
Silica	NV	NV	NV
Silver[j]	0.0075[HI]	0.100	0.18
Sodium	NV	NV	NV
Sulfate[k]	NV	500	NV
Thallium	NV	0.002	NV
Uranium[k]	0.0045[HI]	0.020	0.11
Vanadium	0.0092[HI]	NV	NV
Zinc[j]	0.45[HI]	5.0	11
	Radionuclides (pCi/L)		
Gross Alpha	NV	15	NV
Gross Beta[l]	NV	See footnote	NV
Neptunium-237[l]	0.13[CR]	See footnote	NV
Plutonium-239[l]	0.12[CR]	See footnote	NV
Radium-226[m]	0.13[CR]	5	NV
Radon-222[n]	1.4[CR]	300	NV
Technetium-99[l]	28.0[CR]	See footnote	NV
Thorium-230[l]	1.0[CR]	See footnote	NV
Total Radium[o]	0.13[CR]	5	NV
Uranium-234[p]	0.87[CR]	30	NV
Uranium-235[p, q]	0.82[CR]	30	NV
Uranium-238[p, r]	0.62[CR]	30	NV

Notes:

NV indicates that a value is not available for the analyte.

[a] The derivation of the risk-based concentrations (RBCs) is discussed in Subsect. 4.1. Under this column, "CR" indicates that the most sensitive target for the RBC is cancer risk, and HI indicates that the most sensitive target for the RBC is systemic toxicity.

[b] The source of the maximum contaminant levels (MCLs) is discussed in Subsect. 4.2. Values presented here are a mixture of primary and secondary MCLs and proposed values. If both federal and Commonwealth of Kentucky MCLs were available, then the lesser of the two is presented. If not otherwise indicated the MCL is a primary MCL.

[c] The source of the Commonwealth of Kentucky Department of Environmental Protection's (KDEP's) risk-base screening values is discussed in Subsect. 4.2.
[d] The MCL reported for aluminum is a secondary MCL.
[e] The KDEP value reported is that for carcinogenic effects.
[f] The MCL reported for chloride is a secondary MCL.
[g] The RBC and the KDEP value are for Chromium VI.
[h] The MCL reported for iron is a secondary MCL.
[i] The RBC for lead is based upon a reference dose that has not received peer approval and was supplied to PGDP by the Commonwealth of Kentucky for screening purposes.
[j] The MCLs for manganese and silver are secondary MCLs.
[k] The MCLs for sulfate and uranium are a proposed values.
[l] If two or more radionuclides are present, then the sum of their annual dose equivalent to the total body or any organ is not to exceed 4 mrem/year.
[m] The RBC was calculated using the cancer slope factor for radium-226+D. The MCL for radium-226 applies to a combination of radium-226 and radium-228.
[n] The RBC was calculated using the cancer slope factor for radon-222+D.
[o] The RBC for Total Radium is that for radium-226(+D). That value is the smallest of all those for radium isotopes. The MCL for Total Radium applies to a combination of radium-226 and radium-228.
[p] The proposed MCL for natural uranium isotopes is 0.020 mg/liter. This is approximately equal to 30 pCi/liter for total uranium if natural abundance is assumed.
[q] The RBC was calculated using the cancer slope factor for uranium-235+D.
[r] The RBC was calculated using the cancer slope factor for uranium-238+D.
[s] The EPA has deleted from the CFR both the MCL and MCLG for nickel, which have been vacated by court ruling, effective February 23, 1995.

The maximum contaminant levels used in Chapt. 5 were taken from the "Federal and State Guideline Values" page of the "Risk Assessment Information System" at http://risk.lsd.ornl.gov/cgi-bin/guide/GUID_9709 DOE 1999 and include both primary and secondary MCLs as well as proposed values. If the federal MCL differed from the Commonwealth of Kentucky MCL, the lesser of the two values was used in the comparison. Table 4.1 presents the MCLs used in Chapt. 5.

The Commonwealth of Kentucky risk-based screening values used in Chapt. 5 were taken from App. A of the *Risk Assessment Guidance* (KDEP 1995c) prepared by the Department of Environmental Protection of the Commonwealth of Kentucky. Table 4.1 presents the Commonwealth of Kentucky risk-based screening values used in Chapt. 5.

4.3 LITERATURE VALUES

In Chapt. 5, the selected background concentrations are compared to three sets of reference values derived in earlier reports and to a set of values taken from the reference materials. The earlier reports from which the reference values were taken are *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume*, *Paducah Gaseous Diffusion Plant* (DOE 1994a) (Tech Report), *Results of the Site Investigation*, *Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991) (Site Investigation), and *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995) (Moore Report). The reference materials providing the additional set of values are *The Properties of Groundwater* (Matthess and Harvey 1982), *Hydrogeology* (Davis and DeWiest 1966), *Ground Water Quality Protection* (Canter et al. 1987), and *Metals in Groundwater* (Allen *et al.* 1993). Each of the four sets of values is presented in Table 4.2.

Table 4.2. Reference values for groundwater taken from earlier reports produced for the PGDP and from literature sources

Analyte	Tech Report[a]	Site Investigation[b]	Moore Report[c]	Literature Sources[d]
Inorganic Chemicals (mg/L)				
Aluminum	2.19	8.880	NV	NV
Aluminum, Dissolved	NV	0.195	NV	0.0001 to 0.1
Antimony	0.111	ND	0.050	NV
Antimony, Dissolved	NV	0.027	NV	0.0001 to 0.1
Arsenic	0.011	ND	0.023	NV
Arsenic, Dissolved	NV	ND	NV	0.0001 to 0.1
Barium	0.286	0.210	0.15	NV
Barium, Dissolved	NV	0.195	NV	0.0001 to 0.1
Beryllium	0.009	ND	0.003	NV
Beryllium, Dissolved	NV	ND	NV	<0.001
Cadmium	0.021	ND	0.005	NV
Cadmium, Dissolved	NV	ND	NV	0.0001 to 0.1
Calcium	44.2	38.700	NV	NV
Calcium, Dissolved	NV	38.100	NV	1.0 to 1000
Chloride	68.6	NV	NV	1.0 to 1000
Chromium	0.131	0.031	0.040	NV
Chromium, Dissolved	NV	0.002	NV	0.0001 to 0.1
Cobalt	0.096	0.008	0.010	NV
Cobalt, Dissolved	NV	0.005	NV	0.0001 to 0.1
Copper	0.022	0.012	0.090	NV
Copper, Dissolved	NV	ND	NV	0.0001 to 0.1
Fluoride	0.354	NV	NV	0.01 to 10.0
Iron	5.06	16.400	NV	NV
Iron, Dissolved	NV	2.04	NV	0.01 to 10
Lead	0.104	0.004	0.015	NV
Lead, Dissolved	NV	ND	NV	0.0001 to 0.1
Magnesium	16.7	15.200	NV	NV
Magnesium, Dissolved	NV	15.0	NV	1.0 to 1000
Manganese	0.159	0.335	NV	NV
Manganese, Dissolved	NV	0.264	NV	0.0001 to 0.1
Mercury	0.0004	ND	0.0002	NV
Mercury, Dissolved	NV	ND	NV	NV
Molybdenum	0.100	NV	NV	NV
Molybdenum, Dissolved	NV	NV	NV	0.0001 to 0.1
Nickel	0.062	0.010	0.009	NV
Nickel, Dissolved	NV	0.005	NV	0.0001 to 0.1
Nitrate as Nitrogen	6.13	NV	NV	0.01 to 10.0
Potassium	6.18	8.510	NV	NV
Potassium, Dissolved	NV	8.850	NV	0.01 to 10.0
Selenium	0.009	0.003	0.001	NV
Selenium, Dissolved	NV	0.003	NV	0.0001 to 0.1
Silica	39.3	NV	NV	NV
Silver	0.004	ND	0.010	NV
Silver, Dissolved	NV	ND	NV	<0.001
Sodium	60.2	97.600	200	NV
Sodium, Dissolved	NV	98.300	NV	1.0 to 1000
Sulfate	19.9	NV	NV	1.0 to 1000
Thallium	0.108	ND	0.012	NV
Thallium, Dissolved	NV	ND	NV	<0.001
Uranium	0.002	NV	NV	NV
Uranium, Dissolved	NV	NV	NV	0.0001 to 0.1

Table 4.2. (continued)

Analyte	Tech Report[a]	Site Investigation[b]	Moore Report[c]	Literature Sources[d]
Inorganic Chemicals (mg/L) (continued)				
Vanadium	0.137	0.005	0.010	NV
Vanadium, Dissolved	NV	0.001	NV	0.0001 to 0.1
Zinc	0.027	0.116	0.6	NV
Zinc, Dissolved	NV	0.049	NV	0.0001 to 0.1
Radionuclides (pCi/L)				
Gross Alpha	NV	ND	NV	NV
Gross Beta	NV	19	NV	NV
Neptunium-237	NV	ND	NV	NV
Plutonium-239	NV	ND	NV	NV
Radium-226	NV	NV	NV	NV
Radon-222	NV	NV	NV	NV
Technetium-99	NV	ND	NV	NV
Thorium-230	1.41	0.26	NV	NV
Total Radium	0.938	NV	NV	NV
Uranium-234	1.21	0.53	NV	NV
Uranium-235	0.153	ND	NV	NV
Uranium-238	1.04	ND	NV	NV

Notes:

NV = No value reported.

ND = Value reported as detection limit in CH2M Hill 1992 (Table 4-2 or 4-3).

[a] Values from *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a).

[b] Values from Tables 4-2 and 4-3 in *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991).

[c] Values from Table 9 in *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995). Although presented here as being for samples drawn from the RGA, Moore states that these background values are “maximum background concentrations in groundwater” at the PGDP.

[d] List taken from that presented in Table 4.2 in *Hydrogeology* (Davis and DeWiest 1966). Note, only dissolved concentrations are presented because total concentrations are highly dependent on methods of sample collection and sample preservation.

THIS PAGE INTENTIONALLY LEFT BLANK

5. RESULTS AND DISCUSSION

In this chapter, tables comparing the background concentrations presented in Chapt. 3 with the various criteria introduced in Chapt. 4 are presented, and the results of these comparisons are discussed. In addition, some of the uncertainties associated with the background concentrations and their derivation are noted.

5.1 COMPARISON OF BACKGROUND CONCENTRATIONS TO RBCS, MCLS, AND KDEP RISK-BASED SCREENING VALUES

Tables comparing the background concentrations to RBCs, MCLs, and KDEP risk-based screening values are presented on the following pages. In Tables 5.1 and 5.2, the background concentrations derived for the RGA over all observations and over average concentrations within wells, respectively, are compared to these values. In Tables 5.3 and 5.4, the background concentrations derived for the McNairy Formation over all observations and over average concentrations within wells, respectively, are compared to these values. The following sections discusses the results presented in these tables.

5.1.1 Aluminum

RGA. When summarized over all observations and over averages within wells, the background concentrations for aluminum in water drawn from the RGA (2.189 and 1.64 mg/l, respectively) exceed both the RBC (1.5 mg/l) and MCL (0.200 mg/l); however, both of these background concentrations are markedly lower than the KDEP risk-based screening value (37 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for aluminum in water drawn from the McNairy Formation (0.687 and 0.75 mg/l, respectively) exceed only the MCL (0.200 mg/l). Both of these background concentrations are lower than the RBC (1.5 mg/l) and the KDEP risk-based screening value (37 mg/l).

5.1.2 Aluminum, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for aluminum, dissolved in water drawn from the RGA (0.311 and 0.201 mg/l, respectively) exceed only the MCL (0.200 mg/l). Both of these background concentrations are lower than the RBC (1.5 mg/l) and the KDEP risk-based screening value (37 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for aluminum, dissolved in water drawn from the McNairy Formation (0.579 and 0.587 mg/l, respectively) exceed only the MCL (0.200 mg/l). Both of these background concentrations are lower than the RBC (1.5 mg/l) and the KDEP risk-based screening value (37 mg/l).

5.1.3 Antimony

RGA. When summarized over all observations and over averages within wells, the qualitatively determined backgrounds concentration for antimony in water drawn from the RGA (0.060 mg/l for both) exceed all three comparison criteria (RBC, 0.00056 mg/l; MCL, 0.006 mg/l; KDEP screening value, 0.015 mg/l).

Table 5.1. Comparison of RGA background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Criteria RBC[b]	Criteria MCL[c]	Criteria KDEP[d]	Criteria Exceeded?
Inorganic Chemicals (mg/L)					
Aluminum	2.189	1.5[HI]	0.050 – 0.200	37	RBC, MCL
Aluminum, Dissolved	0.311	1.5[HI]	0.050 – 0.200	37	MCL
Antimony	0.060†	0.00056[HI]	0.006	0.015	RBC, MCL, KDEP
Antimony, Dissolved	0.060†	0.00056[HI]	0.006	0.015	RBC, MCL, KDEP
Arsenic	0.005†	0.000035[CR]	0.050	0.000038	RBC, KDEP
Arsenic, Dissolved	0.005†	0.000035[CR]	0.050	0.000038	RBC, KDEP
Barium	0.235	0.10[HI]	2.000	2.6	RBC
Barium, Dissolved	0.200	0.10[HI]	2.000	2.6	RBC
Beryllium	0.004†	0.000010[CR]	0.004	0.000016	RBC, KDEP
Beryllium, Dissolved	0.004†	0.000010[CR]	0.004	0.000016	RBC, KDEP
Cadmium	0.010†	0.00066[HI]	0.005	0.018	RBC, MCL
Cadmium, Dissolved	0.010†	0.00066[HI]	0.005	0.018	RBC, MCL
Calcium	41.238	NV	NV	NV	None
Calcium, Dissolved	38.166	NV	NV	NV	None
Chloride	91.021	NV	250	NV	None
Chromium	0.144	0.0071[HI]	0.100	0.18	RBC, MCL
Chromium, Dissolved	0.050†	0.0071[HI]	0.100	0.18	RBC
Cobalt	0.045†	0.091[HI]	NV	NV	None
Cobalt, Dissolved	0.045†	0.091[HI]	NV	NV	None
Copper	0.036	0.060[HI]	1.3	1.4	None
Copper, Dissolved	0.020	0.060[HI]	1.3	1.4	None
Fluoride	0.270	0.091[HI]	4.0	2.2	RBC
Iron	5.030	0.45[HI]	0.3	NV	RBC, MCL
Iron, Dissolved	0.267	0.45[HI]	0.3	NV	None
Lead	0.129	0.00000015[HI]	0.015	0.004	RBC, MCL, KDEP
Lead, Dissolved	0.098	0.00000015[HI]	0.015	0.004	RBC, MCL, KDEP
Magnesium	16.262	NV	NV	NV	None
Magnesium, Dissolved	16.215	NV	NV	NV	None
Manganese	0.119	0.067[HI]	0.050	0.18	RBC, MCL
Manganese, Dissolved	0.068	0.067[HI]	0.050	0.18	RBC, MCL
Mercury	0.0002†	0.00044[HI]	0.002	0.011	None
Mercury, Dissolved	0.0002†	0.00044[HI]	0.002	0.011	None
Molybdenum	0.050†	0.0075[HI]	NV	0.180	RBC
Molybdenum, Dissolved	0.050†	0.0075[HI]	NV	0.180	RBC
Nickel	0.682	0.030[HI]	0.100	0.730	RBC, MCL
Nickel, Dissolved	0.305	0.030[HI]	0.100	0.730	RBC, MCL
Nitrate as Nitrogen	15.561	2.40[HI]	10	58	RBC, MCL
Potassium	5.195	NV	NV	NV	None
Potassium, Dissolved	4.096	NV	NV	NV	None
Selenium	0.005†	0.0075[HI]	0.050	0.18	None
Selenium, Dissolved	0.005†	0.0075[HI]	0.050	0.18	None
Silica	26.401	NV	NV	NV	None
Silver	0.011†	0.0075[HI]	0.100	0.18	RBC
Silver, Dissolved	0.060†	0.0075[HI]	0.100	0.18	RBC
Sodium	59.450	NV	NV	NV	None
Sodium, Dissolved	60.433	NV	NV	NV	None
Sulfate	19.947	NV	500	NV	None
Thallium	0.056†	NV	0.002	NV	MCL
Thallium, Dissolved	0.056†	NV	0.002	NV	MCL

Table 5.1. (continued)

Analyte	Background[a]	Criteria			Criteria Exceeded?
		RBC[b]	MCL[c]	KDEP[d]	
Inorganic Chemicals (mg/L) (continued)					
Uranium	0.002†	0.0045[HI]	0.020	0.11	None
Uranium, Dissolved	0.002†				None
Vanadium	0.134	0.0092[HI]	NV	NV	RBC
Vanadium, Dissolved	0.134				RBC
Zinc	0.054	0.45[HI]	5.0	11	None
Zinc, Dissolved	0.049				None
Radionuclides (pCi/L)					
Gross Alpha	5.8	NV	15	NV	None
Gross Beta	13.8	NV	See footnote[e]	NV	None
Neptunium-237	0.8	0.13[CR]	See footnote[e]	NV	RBC
Plutonium-239	0.1	0.12[CR]	See footnote[e]	NV	None
Radium-226	0.6	0.13[CR]	5	NV	RBC
Radon-222	626	1.4[CR]	300	NV	RBC, MCL
Technetium-99	22.3	28.0[CR]	See footnote[e]	NV	None
Thorium-230	1.1	1.0[CR]	See footnote[e]	NV	RBC
Total Radium	1.3	0.13[CR]	5	NV	RBC
Uranium-234	0.7	0.87[CR]	30	NV	None
Uranium-235	0.3	0.82[CR]	30	NV	None
Uranium-238	0.7	0.62[CR]	30	NV	RBC

Notes:

Criteria are only listed once for analyte type (e.g., once for both aluminum and aluminum, dissolved) because the same criterion applies to both.

NV indicates that a value is not available for the analyte.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than the concentrations reported here.

[b] See Subsect. 4.1 for a discussion of the derivation of the RBCs. RBCs marked with HI are based on a target hazard index of 1. RBCs marked with CR are based on a cancer risk of 1×10^{-6}.

[c] See Subsect 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.

[d] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.

[e] A definitive value can not be calculated. See footnote l to Table 4.1.

Table 5.2. Comparison of RGA background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Criteria RBC[b]	Criteria MCL[c]	Criteria KDEP[d]	Criteria Exceeded?
Inorganic Chemicals (mg/L)					
Aluminum	1.64	1.5[HI]	0.050 – 0.200	37	RBC, MCL
Aluminum, Dissolved	0.201				MCL
Antimony	0.060[†]	0.00056[HI]	0.006	0.015	RBC, MCL, KDEP
Antimony, Dissolved	0.060[†]				RBC, MCL, KDEP
Arsenic	0.005[†]	0.000035[CR]	0.050	0.000038	RBC, KDEP
Arsenic, Dissolved	0.005[†]				RBC, KDEP
Barium	0.202	0.10[HI]	2.000	2.6	RBC
Barium, Dissolved	0.179				RBC
Beryllium	0.004[†]	0.000010[CR]	0.004	0.000016	RBC, KDEP
Beryllium, Dissolved	0.004[†]				RBC, KDEP
Cadmium	0.010[†]	0.00066[HI]	0.005	0.018	RBC, MCL
Cadmium, Dissolved	0.010[†]				RBC, MCL
Calcium	40.0	NV	NV	NV	None
Calcium, Dissolved	35.8				None
Chloride	89.2	NV	250	NV	None
Chromium	0.134	0.0071[HI]	0.100	0.18	RBC, MCL
Chromium, Dissolved	0.050[†]				RBC
Cobalt	0.045[†]	0.091[HI]	NV	NV	None
Cobalt, Dissolved	0.045[†]				None
Copper	0.034	0.060[HI]	1.3	1.4	None
Copper, Dissolved	0.018				None
Fluoride	0.245	0.091[HI]	4.0	2.2	RBC
Iron	3.72	0.45[HI]	0.3	NV	RBC, MCL
Iron, Dissolved	0.164				None
Lead	0.250	0.00000015[HI]	0.015	0.004	RBC, MCL, KDEP
Lead, Dissolved	0.250				RBC, MCL, KDEP
Magnesium	15.7	NV	NV	NV	None
Magnesium, Dissolved	15.4				None
Manganese	0.082	0.067[HI]	0.050	0.18	RBC, MCL
Manganese, Dissolved	0.048				None
Mercury	0.0002[†]	0.00044[HI]	0.002	0.011	None
Mercury, Dissolved	0.0002[†]				None
Molybdenum	0.050[†]	0.0075[HI]	NV	0.180	RBC
Molybdenum, Dissolved	0.050[†]				RBC
Nickel	0.682	0.030[HI]	0.100	0.730	RBC, MCL
Nickel, Dissolved	0.305				RBC, MCL
Nitrate as Nitrogen	13.5	2.40[HI]	10	58	RBC, MCL
Potassium	4.47	NV	NV	NV	None
Potassium, Dissolved	3.70				None
Selenium	0.005[†]	0.0075[HI]	0.050	0.18	None
Selenium, Dissolved	0.005[†]				None
Silica	21.1	NV	NV	NV	None
Silver	0.011[†]	0.0075[HI]	0.100	0.18	RBC
Silver, Dissolved	0.060[†]				RBC
Sodium	63.5	NV	NV	NV	None
Sodium, Dissolved	65.7				None
Sulfate	19.1	NV	500	NV	None
Thallium	0.056[†]	NV	0.002	NV	MCL
Thallium, Dissolved	0.056[†]				MCL

Table 5.2. (continued)

Analyte	Background[a]	Criteria: RBC[b]	Criteria: MCL[c]	Criteria: KDEP[d]	Criteria Exceeded?
Inorganic Chemicals (mg/L) (continued)					
Uranium	0.002†	0.0045^HI	0.020	0.11	None
Uranium, Dissolved	0.002†				None
Vanadium	0.139	0.0092^HI	NV	NV	RBC
Vanadium, Dissolved	0.131				RBC
Zinc	0.025	0.45^HI	5.0	11	None
Zinc, Dissolved	0.026				None
Radionuclides (pCi/L)					
Gross Alpha	2.36	NV	15	NV	None
Gross Beta	7.3	NV	See footnote[e]	NV	None
Neptunium-237	0.21	0.13^CR	See footnote[e]	NV	RBC
Plutonium-239	0.03	0.12^CR	See footnote[e]	NV	None
Radium-226	0.10	0.13^CR	5	NV	None
Radon-222	555.3	1.4^CR	300	NV	RBC, MCL
Technetium-99	10.8	28.0^CR	See footnote[e]	NV	None
Thorium-230	0.54	1.0^CR	See footnote[e]	NV	None
Total Radium	0.46	0.13^CR	5	NV	RBC
Uranium-234	0.7	0.87^CR	30	NV	None
Uranium-235	0.3	0.82^CR	30	NV	None
Uranium-238	0.7	0.62^CR	30	NV	RBC

Notes:

Criteria are only listed once for analyte type (e.g., once for both aluminum and aluminum, dissolved because the same criterion applies to both.

NV indicates that a value is not available for the analyte.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at a concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] See Subsect. 4.1 for a discussion of the derivation of the RBCs. RBCs marked with HI are based on a target hazard index of 1. RBCs marked with CR are based on a cancer risk of 1×10^{-6}.

[c] See Subsect. 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.

[d] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.

[e] A definitive value can not be calculated. See footnote l to Table 4.1.

Table 5.3. Comparison of McNairy Formation background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Criteria: RBC[b]	Criteria: MCL[c]	Criteria: KDEP[d]	Criteria Exceeded?
		Inorganic Chemicals (mg/L)			
Aluminum	0.687	1.5[HI]	0.050 – 0.200	37	MCL
Aluminum, Dissolved	0.579				MCL
Antimony	0.060[†]	0.00056[HI]	0.006	0.015	RBC, MCL, KDEP
Antimony, Dissolved	0.060[†]				RBC, MCL, KDEP
Arsenic	0.005[†]	0.000035[CR]	0.050	0.000038	RBC, KDEP
Arsenic, Dissolved	0.005[†]				RBC, KDEP
Barium	0.296	0.10[HI]	2.000	2.6	RBC
Barium. Dissolved	0.268				RBC
Beryllium	0.017[†]	0.000010[CR]	0.004	0.000016	RBC, MCL, KDEP
Beryllium, Dissolved	0.004[†]				RBC, KDEP
Cadmium	0.010[†]	0.00066[HI]	0.005	0.018	RBC, MCL
Cadmium, Dissolved	0.010[†]				RBC, MCL
Calcium	38.858	NV	NV	NV	None
Calcium, Dissolved	38.829				None
Chloride	19.708	NV	250	NV	None
Chromium	0.060[†]	0.0071[HI]	0.100	0.18	RBC
Chromium, Dissolved	0.050[†]				RBC
Cobalt	0.096	0.091[HI]	NV	NV	RBC
Cobalt, Dissolved	0.045[†]				None
Copper	0.057	0.060[HI]	1.3	1.4	None
Copper, Dissolved	0.013[†]				None
Fluoride	0.330	0.091[HI]	4.0	2.2	RBC
Iron	18.360	0.45[HI]	0.3	NV	RBC, MCL
Iron, Dissolved	12.372				RBC, MCL
Lead	0.050[†]	0.00000015[HI]	0.015	0.004	RBC, MCL, KDEP
Lead, Dissolved	0.050[†]				RBC, MCL, KDEP
Magnesium	13.418	NV	NV	NV	None
Magnesium, Dissolved	14.171				None
Manganese	0.941	0.067[HI]	0.050	0.18	RBC, MCL, KDEP
Manganese, Dissolved	0.894				RBC, MCL, KDEP
Mercury	0.0002[†]	0.00044[HI]	0.002	0.011	None
Mercury, Dissolved	0.0002[†]				None
Molybdenum	0.050[†]	0.0075[HI]	NV	0.180	RBC
Molybdenum, Dissolved	0.050[†]				RBC
Nickel	0.109[†]	0.030[HI]	0.100	0.730	RBC, MCL
Nickel, Dissolved	0.050[†]				RBC
Nitrate as Nitrogen	1.474	2.40[HI]	10	58	None
Potassium	55.752	NV	NV	NV	None
Potassium, Dissolved	51.205				None
Selenium	0.005[†]	0.0075[HI]	0.050	0.18	None
Selenium, Dissolved	0.005[†]				None
Silica	26.0	NV	NV	NV	None
Silver	0.050[†]	0.0075[HI]	0.100	0.18	RBC
Silver, Dissolved	0.050[†]				RBC
Sodium	29.2	NV	NV	NV	None
Sodium, Dissolved	27.98				None
Sulfate	28.9	NV	500	NV	None
Thallium	0.644	NV	0.002	NV	MCL
Thallium, Dissolved	0.056[†]				MCL

Table 5.3. (continued)

Analyte	Background[a]	Criteria RBC[b]	MCL[c]	KDEP[d]	Criteria Exceeded?
Inorganic Chemicals (mg/L) (continued)					
Uranium	0.001†	0.0045[HI]	0.020	0.11	None
Uranium, Dissolved	0.001				None
Vanadium	0.126	0.0092[HI]	NV	NV	RBC
Vanadium, Dissolved	0.126				RBC
Zinc	0.142	0.45[HI]	5.0	11	None
Zinc, Dissolved	0.116				None
Radionuclides (pCi/L)					
Gross Alpha	11.9	NV	15	NV	None
Gross Beta	144.5	NV	See footnote[e]	NV	None
Neptunium-237	0.5	0.13[CR]	See footnote[e]	NV	RBC
Plutonium-239	0.2	0.12[CR]	See footnote[e]	NV	RBC
Radium-226	1.2	0.13[CR]	5	NV	RBC
Radon-222	295	1.4[CR]	300	NV	RBC
Technetium-99	20.6	28.0[CR]	See footnote[e]	NV	None
Thorium-230	1.5	1.0[CR]	See footnote[e]	NV	RBC
Total Radium	0.7	0.13[CR]	5	NV	RBC
Uranium-234	0.3	0.87[CR]	30	NV	None
Uranium-235	0.2	0.82[CR]	30	NV	None
Uranium-238	0.3	0.62[CR]	30	NV	None

Notes:

Criteria are only listed once for analyte type (e.g., once for both aluminum and aluminum, dissolved) because the same criterion applies to both.

NV indicates that a value is not available for the analyte.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] See Subsect. 4.1 for a discussion of the derivation of the RBCs. RBCs marked with HI are based on a target hazard index of 1. RBCs marked with CR are based on a cancer risk of 1×10^{-6}.

[c] See Subsect 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.

[d] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.

[e] A definitive value can not be calculated. See footnote l to Table 4.1.

Table 5.4. Comparison of McNairy Formation background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Criteria			Criteria Exceeded?
		RBC[b]	MCL[c]	KDEP[d]	
Inorganic Chemicals (mg/L)					
Aluminum	0.75	1.5^{HI}	0.050 – 0.200	37	MCL
Aluminum, Dissolved	0.587				MCL
Antimony	0.060†	0.00056^{HI}	0.006	0.015	RBC, MCL, KDEP
Antimony, Dissolved	0.060†				RBC, MCL, KDEP
Arsenic	0.005†	0.000035^{CR}	0.050	0.000038	RBC, KDEP
Arsenic, Dissolved	0.005†				RBC, KDEP
Barium	0.265	0.10^{HI}	2.000	2.6	RBC
Barium, Dissolved	0.266				RBC
Beryllium	0.017†	0.000010^{CR}	0.004	0.000016	RBC, MCL, KDEP
Beryllium, Dissolved	0.004†				RBC, KDEP
Cadmium	0.010†	0.00066^{HI}	0.005	0.018	RBC, MCL
Cadmium, Dissolved	0.010†				RBC, MCL
Calcium	39.47	NV	NV	NV	None
Calcium, Dissolved	40.27				None
Chloride	20.23	NV	250	NV	None
Chromium	0.060†	0.0071^{HI}	0.100	0.18	RBC
Chromium, Dissolved	0.050†				RBC
Cobalt	0.072	0.091^{HI}	NV	NV	None
Cobalt, Dissolved	0.045†				None
Copper	0.033	0.060^{HI}	1.3	1.4	None
Copper, Dissolved	0.013†				None
Fluoride	0.298	0.091^{HI}	4.0	2.2	RBC
Iron	15.83	0.45^{HI}	0.3	NV	RBC, MCL
Iron, Dissolved	9.446				RBC, MCL
Lead	0.050†	0.00000015^{HI}	0.015	0.004	RBC, MCL, KDEP
Lead, Dissolved	0.050†				RBC, MCL, KDEP
Magnesium	16.457	NV	NV	NV	None
Magnesium, Dissolved	16.533				None
Manganese	0.729	0.067^{HI}	0.050	0.18	RBC, MCL, KDEP
Manganese, Dissolved	0.682				RBC, MCL, KDEP
Mercury	0.0002†	0.00044^{HI}	0.002	0.011	None
Mercury, Dissolved	0.0002†				None
Molybdenum	0.050†	0.0075^{HI}	NV	0.180	RBC
Molybdenum, Dissolved	0.050†				RBC
Nickel	0.109†	0.030^{HI}	0.100	0.730	RBC, MCL
Nickel, Dissolved	0.050†				RBC
Nitrate as Nitrogen	1.43	2.40^{HI}	10	58	None
Potassium	64.080	NV	NV	NV	None
Potassium, Dissolved	58.750				None
Selenium	0.005†	0.0075^{HI}	0.050	0.18	None
Selenium, Dissolved	0.005†				None
Silica	29.4	NV	NV	NV	None
Silver	0.050†	0.0075^{HI}	0.100	0.18	RBC
Silver, Dissolved	0.050†				RBC
Sodium	24.92	NV	NV	NV	None
Sodium, Dissolved	25.90				None
Sulfate	27.27	NV	500	NV	None
Thallium	0.255	NV	0.002	NV	MCL
Thallium, Dissolved	0.056†				MCL

Table 5.4. (continued)

Analyte	Background[a]	Criteria RBC[b]	MCL[c]	KDEP[d]	Criteria Exceeded?
Inorganic Chemicals (mg/L) (continued)					
Uranium	0.001†	0.0045[HI]	0.020	0.11	None
Uranium, Dissolved	0.001				None
Vanadium	0.119	0.0092[HI]	NV	NV	RBC
Vanadium, Dissolved	0.107				RBC
Zinc	0.104	0.45[HI]	5.0	11	None
Zinc, Dissolved	0.080				None
Radionuclides (pCi/L)					
Gross Alpha	5.3	NV	15	NV	None
Gross Beta	125.4	NV	See footnote[e]	NV	None
Neptunium-237	0.13	0.13[CR]	See footnote[e]	NV	None
Plutonium-239	0.04	0.12[CR]	See footnote[e]	NV	None
Radium-226	0.29	0.13[CR]	5	NV	RBC
Radon-222	228.3	1.4[CR]	300	NV	RBC
Technetium-99	7.8	28.0[CR]	See footnote[e]	NV	None
Thorium-230	0.40	1.0[CR]	See footnote[e]	NV	None
Total Radium	0.36	0.13[CR]	5	NV	RBC
Uranium-234	0.3	0.87[CR]	30	NV	None
Uranium-235	0.2	0.82[CR]	30	NV	None
Uranium-238	0.3	0.62[CR]	30	NV	None

Notes:

Criteria are only listed once for analyte type (e.g., once for both aluminum and aluminum, dissolved because the same criterion applies to both.

NV indicates that a value is not available for the analyte.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] See Subsect. 4.1 for a discussion of the derivation of the RBCs. RBCs marked with HI are based on a target hazard index of 1. RBCs marked with CR are based on a cancer risk of 1×10^{-6}.

[c] See Subsect. 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.

[d] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.

[e] A definitive value can not be calculated. See footnote l to Table 4.1.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony in water drawn from the McNairy Formation (0.060 mg/l for both) exceed all three comparison criteria (RBC, 0.00056 mg/l; MCL, 0.006 mg/l; KDEP screening value, 0.015 mg/l).

5.1.4 Antimony, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony, dissolved in water drawn from the RGA (0.060 mg/l for both) exceed all three comparison criteria (RBC, 0.00056 mg/l; MCL, 0.006 mg/l; KDEP screening value, 0.015 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony, dissolved in water drawn from the McNairy Formation (0.060 mg/l for both) exceed all three comparison criteria (RBC, 0.00056 mg/l; MCL, 0.006 mg/l; KDEP screening value, 0.015 mg/l).

5.1.5 Arsenic

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic in water drawn from the RGA (0.005 mg/l for both) exceed both the RBC and KDEP screening value (0.000035 and 0.000038 mg/l, respectively); however, both background concentrations are markedly lower than the MCL (0.050 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic in water drawn from the McNairy Formation (0.005 mg/l for both) exceed both the RBC and KDEP screening value (0.000035 and 0.000038 mg/l, respectively); however, both background concentrations are markedly lower than the MCL (0.050 mg/l).

5.1.6 Arsenic, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic, dissolved in water drawn from the RGA (0.005 mg/l for both) exceed both the RBC and KDEP screening value (0.000035 mg/l and 0.000038 mg/l, respectively); however, both of these background concentrations are markedly lower than the MCL (0.050 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic, dissolved in water drawn from the McNairy Formation (0.005 mg/l for both) exceed both the RBC and KDEP screening value (0.000035 and 0.000038 mg/l, respectively); however, both of these background concentrations are markedly lower than the MCL (0.050 mg/l).

5.1.7 Barium

RGA. When summarized over all observations and over averages within wells, the background concentrations for barium in water drawn from the RGA (0.235 and 0.202 mg/l, respectively) exceed only the RBC (0.10 mg/l). Both of these background concentrations are markedly lower than the MCL and KDEP screening value (2.000 and 2.6 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for barium in water drawn from the McNairy Formation (0.296 and 0.265 mg/l, respectively) exceed only the RBC (0.10 mg/l). Both of these background concentrations are markedly lower than the MCL and KDEP screening value (2.000 and 2.6 mg/l, respectively).

5.1.8 Barium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for barium, dissolved in water drawn from the RGA (0.200 and 0.179 mg/l, respectively) exceed only the RBC (0.10 mg/l). Both of these background concentrations are markedly lower than the MCL and KDEP screening value (2.000 and 2.6 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for barium, dissolved in water drawn from the McNairy Formation (0.268 and 0.266 mg/l, respectively) exceed only the RBC (0.10 mg/l). Both of these background concentrations are markedly lower than the MCL and KDEP screening value (2.000 and 2.6 mg/l, respectively).

5.1.9 Beryllium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium in water drawn from the RGA (0.004 mg/l for both) exceed both the RBC and the KDEP screening value (0.000010 and 0.000016 mg/l, respectively); however, these background concentrations equal the MCL for beryllium (0.004 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium in water drawn from the McNairy Formation (0.017 mg/l for both) exceed all three values used for comparison (RBC, 0.000010 mg/l; MCL, 0.004 mg/l; KDEP screening value, 0.000016 mg/l).

5.1.10 Beryllium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium, dissolved in water drawn from the RGA (0.004 mg/l for both) exceed both the RBC and the KDEP screening value (0.000010 and 0.000016 mg/l, respectively); however, these background concentrations equal the MCL for beryllium (0.004 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium, dissolved in water drawn from the McNairy Formation (0.004 mg/l for both) exceed both the RBC and the KDEP screening value (0.000010 and 0.000016 mg/l, respectively); however, these background concentrations equal the MCL for beryllium (0.004 mg/l).

5.1.11 Cadmium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium in water drawn from the RGA (0.010 mg/l for both) exceed both the RBC and the MCL (0.00066 and 0.005 mg/l, respectively); however, these background concentrations are less than the KDEP screening value (0.018 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium in water drawn from the McNairy Formation (0.010 mg/l for both) exceed both the RBC and the MCL (0.00066 and 0.005 mg/l, respectively); however, these background concentrations are less than the KDEP screening value (0.018 mg/l).

5.1.12 Cadmium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium, dissolved in water drawn from the RGA (0.010 mg/l for both) exceed both the RBC and the MCL (0.00066 and 0.005 mg/l, respectively); however, these background concentrations are less than the KDEP screening value (0.018 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium, dissolved in water drawn from the McNairy Formation (0.010 mg/l for both) exceed both the RBC and the MCL (0.00066 and 0.005 mg/l, respectively); however, these background concentrations are less than the KDEP screening value (0.018 mg/l).

5.1.13 Calcium

RGA. No values are available for comparison. The background concentrations for calcium in water drawn from the RGA when summarized over all observations and over averages within wells are 41.238 and 40.0 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for calcium in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 38.858 and 39.47 mg/l, respectively.

5.1.14 Calcium, Dissolved

RGA. No values are available for comparison. The background concentrations for calcium, dissolved in water drawn from the RGA when summarized over all observations and over averages within wells are 38.166 and 35.8 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for calcium in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 38.829 and 40.27 mg/l, respectively.

5.1.15 Chloride

RGA. When summarized over all observations and over averages within wells, the background concentrations for chloride in water drawn from the RGA (91.021 and 89.2 mg/l, respectively) are markedly less than the MCL (250 mg/l), the only value available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for chloride in water drawn from the McNairy Formation (19.708 and 20.23 mg/l, respectively) are markedly less than the MCL (250 mg/l), the only value available for comparison.

5.1.16 Chromium

RGA. When summarized over all observations and over averages within wells, the background concentrations for chromium in water drawn from the RGA (0.144 and 0.134 mg/l, respectively) exceed both the RBC and the MCL (0.0071 and 0.100 mg/l, respectively); however, these background values are less than the KDEP screening value (0.18 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium in water drawn from the McNairy

Formation (0.060 mg/l for both) exceed only the RBC (0.0071 mg/l). These background values are less than the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

5.1.17 Chromium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium, dissolved in water drawn from the RGA (0.050 mg/l for both) exceed only the RBC (0.0071 mg/l). These background values are less than the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) exceed only the RBC (0.0071 mg/l). These background values are less than the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

5.1.18 Cobalt

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt in water drawn from the RGA (0.045 mg/l for both) do not exceed the RBC (0.091 mg/l), the only value available for comparison.

McNairy Formation. When summarized over all observations but not when summarized over averages within wells, the background concentration for cobalt in water drawn from the McNairy Formation (0.096 and 0.072 mg/l, respectively) exceeds the RBC (0.091 mg/l), the only value available for comparison.

5.1.19 Cobalt, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt, dissolved in water drawn from the RGA (0.045 mg/l for both) do not exceed the RBC (0.091 mg/l), the only value available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt, dissolved in water drawn from the McNairy Formation (0.045 mg/l, respectively) do not exceed the RBC (0.091 mg/l), the only value available for comparison.

5.1.20 Copper

RGA. When summarized over all observations and over averages within wells, the background concentrations for copper in water drawn from the RGA (0.036 and 0.034 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.060 mg/l; MCL, 1.3 mg/l; KDEP screening value, 1.4 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for copper in water drawn from the McNairy Formation (0.057 and 0.033 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.060 mg/l; MCL, 1.3 mg/l; KDEP screening value, 1.4 mg/l).

5.1.21 Copper, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for copper, dissolved in water drawn from the RGA (0.020 and 0.018 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.060 mg/l; MCL, 1.3 mg/l; KDEP screening value, 1.4 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for copper, dissolved in water drawn from the McNairy Formation (0.013 mg/l for both) do not exceed any comparison criteria (RBC, 0.060 mg/l; MCL, 1.3 mg/l; KDEP screening value, 1.4 mg/l).

5.1.22 Fluoride

RGA. When summarized either over all observation or over averages within wells, the background concentrations for fluoride in water drawn from the RGA (0.270 and 0.245 mg/l, respectively) exceed the RBC (0.091 mg/l); however, the background concentrations are markedly less than the MCL and KDEP screening value (4.0 and 2.2 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for fluoride in water drawn from the McNairy Formation (0.330 and 0.298 mg/l, respectively) exceed the RBC (0.091 mg/l); however, the background concentrations are markedly less than the MCL and KDEP screening value (4.0 and 2.2 mg/l, respectively).

5.1.23 Iron

RGA. When summarized over all observations and over averages within wells, the background concentrations for iron in water drawn from the RGA (5.030 and 3.72 mg/l, respectively) exceed the RBC and MCL (0.45 and 0.3 mg/l, respectively). There is no KDEP screening value available for this analyte.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for iron in water drawn from the McNairy Formation (18.360 and 15.83, mg/l, respectively) exceed the RBC and MCL (0.45 and 0.3 mg/l, respectively). There is no KDEP screening value for this analyte.

5.1.24 Iron, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for iron, dissolved in water drawn from the RGA (0.267 and 0.164 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.45 mg/l; MCL, 0.3 mg/l; KDEP screening value, not available).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for iron, dissolved in water drawn from the McNairy Formation (12.372 and 9.446 mg/l, respectively) exceed the RBC and MCL (0.45 and 0.3 mg/l, respectively). There is no KDEP screening value available for this analyte.

5.1.25 Lead

RGA. When summarized over all observations and over averages within wells, the background concentrations for lead in water drawn from the RGA (0.129 and 0.250 mg/l, respectively) exceed all three comparison criteria (RBC, 0.00000015 mg/l; MCL, 0.015 mg/l; KDEP screening value, 0.004 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for lead in water drawn from the McNairy Formation (0.050 mg/l for both) exceed all three comparison criteria (RBC, 0.00000015 mg/l; MCL, 0.015 mg/l; KDEP screening value, 0.004 mg/l).

5.1.26 Lead, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for lead, dissolved in water drawn from the RGA (0.098 and 0.250 mg/l, respectively) exceed all three comparison criteria (RBC, 0.00000015 mg/l; MCL, 0.015 mg/l; KDEP screening value, 0.004 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for lead, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) exceed all three comparison criteria (RBC, 0.00000015 mg/l; MCL, 0.015 mg/l; KDEP screening value, 0.004 mg/l).

5.1.27 Magnesium

RGA. No values are available for comparison. The background concentrations for magnesium in water drawn from the RGA when summarized over all observations and over averages within wells are 16.262 and 15.7 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for magnesium in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 13.418 and 16.457 mg/l, respectively.

5.1.28 Magnesium, Dissolved

RGA. No values are available for comparison. The background concentrations for magnesium, dissolved in water drawn from the RGA when summarized over all observations and over averages within wells are 16.215 and 15.4 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for magnesium, dissolved in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 14.171 and 16.533 mg/l, respectively.

5.1.29 Manganese

RGA. When summarized over all observations and over averages within wells, the background concentrations for manganese in water drawn from the RGA (0.119 and 0.082 mg/l, respectively) exceed the RBC and MCL (0.067 and 0.050 mg/l, respectively); however, the background concentrations are less than the KDEP screening value (0.18 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for manganese in water drawn from the McNairy Formation (0.941 and 0.729 mg/l, respectively) exceed all three comparison criteria (RBC, 0.067 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

5.1.30 Manganese, Dissolved

RGA. When summarized over all observations, the background concentration for manganese, dissolved in water drawn from the RGA (0.068 mg/l) exceeds the RBC and MCL (0.067 and 0.050 mg/l, respectively); however, when summarized over averages within well, the background concentration for manganese, dissolved in water drawn from the RGA (0.048 mg/l) did not exceed either the RBC or the MCL (0.067 and 0.050 mg/l, respectively). The two background concentrations are less than the KDEP screening value (0.18 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for manganese, dissolved in water drawn from the McNairy Formation (0.894 and 0.682 mg/l, respectively) exceed all three comparison criteria (RBC, 0.067 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

5.1.31 Mercury

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury in water drawn from the RGA (0.0002 mg/l for both) do not exceed any comparison criteria (RBC, 0.00044 mg/l; MCL, 0.002 mg/l; KDEP screening value, 0.011 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury in water drawn from the McNairy Formation (0.0002 mg/l for both) do not exceed any comparison criteria (RBC, 0.00044 mg/l; MCL, 0.002 mg/l; KDEP screening value, 0.011 mg/l).

5.1.32 Mercury, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury, dissolved in water drawn from the RGA (0.0002 mg/l for both) do not exceed any comparison criteria (RBC, 0.00044 mg/l; MCL, 0.002 mg/l; KDEP screening value, 0.011 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury, dissolved in water drawn from the McNairy Formation (0.0002 mg/l for both) do not exceed any comparison criteria (RBC, 0.00044 mg/l; MCL, 0.002 mg/l; KDEP screening value, 0.011 mg/l).

5.1.33 Molybdenum

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum in water drawn from the RGA (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than the KDEP screening value (0.180 mg/l). An MCL for molybdenum is not available.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum in water drawn from the McNairy Formation (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than the KDEP screening value (0.180 mg/l). An MCL for molybdenum is not available.

5.1.34 Molybdenum, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum, dissolved in water drawn from the RGA (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than the KDEP screening value (0.180 mg/l). An MCL for molybdenum is not available.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than the KDEP screening value (0.180 mg/l). An MCL for molybdenum is not available.

5.1.35 Nickel

RGA. When summarized over all observations and over averages within wells, the background concentrations for nickel in water drawn from the RGA (0.682 mg/l for both) exceed the RBC and MCL (0.030 and 0.100 mg/l, respectively); however, the two background concentrations are less than the KDEP screening value (0.730 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for nickel in water drawn from the McNairy Formation (0.109 mg/l for both) exceed the RBC and MCL (0.030 and 0.100 mg/l, respectively); however, the two background concentrations are less than the KDEP screening value (0.730 mg/l).

5.1.36 Nickel, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for nickel, dissolved in water drawn from the RGA (0.305 mg/l for both) exceed the RBC and MCL (0.030 and 0.100 mg/l, respectively); however, the two background concentrations are less than the KDEP screening value (0.730 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentration for nickel, dissolved in water drawn from the McNairy Formation (0.050 mg/l) exceed the RBC (0.030 mg/l); however, the two background concentrations are less than the MCL and the KDEP screening value (0.100 and 0.730 mg/l, respectively).

5.1.37 Nitrate as Nitrogen

RGA. When summarized over all observations and over averages within wells, the background concentrations for nitrate as nitrogen in water drawn from the RGA (15.561 and 13.5 mg/l, respectively) exceed the RBC and MCL (2.40 and 10 mg/l, respectively); however, the two background concentrations are less than the KDEP screening value (58 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for nitrate as nitrogen in water drawn from the McNairy Formation (1.47 and 1.43 mg/l, respectively) do not exceed any comparison criteria (RBC, 2.40 mg/l; MCL, 10 mg/l; KDEP screening value, 58 mg/l).

5.1.38 Potassium

RGA. No values are available for comparison. The background concentrations for potassium in water drawn from the RGA when summarized over all observations and over averages within wells are 5.195 and 4.47 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for potassium in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 55.572 and 64.080 mg/l, respectively.

5.1.39 Potassium, Dissolved

RGA. No values are available for comparison. The background concentrations for potassium, dissolved in water drawn from the RGA when summarized over all observations and over averages within wells are 4.096 and 3.70 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for potassium, dissolved in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 51.205 and 58.750 mg/l, respectively.

5.1.40 Selenium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium in water drawn from the RGA (0.005 mg/l for both) do not exceed any comparison criteria (RBC, 0.0075 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium in water drawn from the McNairy Formation (0.005 mg/l for both) do not exceed any comparison criteria (RBC, 0.0075 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

5.1.41 Selenium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium, dissolved in water drawn from the RGA (0.005 mg/l for both) do not exceed any comparison criteria (RBC, 0.0075 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium, dissolved in water drawn from the McNairy Formation (0.005 mg/l for both) do not exceed any comparison criteria (RBC, 0.0075 mg/l; MCL, 0.050 mg/l; KDEP screening value, 0.18 mg/l).

5.1.42 Silica

RGA. No values are available for comparison. The background concentrations for silica in water drawn from the RGA when summarized over all observations and over averages within wells are 26.401 and 21.1 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for silica in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 26.0 and 29.4 mg/l, respectively.

5.1.43 Silver

RGA. When summarized either over all observation or over averages within wells, the qualitatively determined background concentrations for silver in water drawn from the RGA (0.011 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than both the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver in water drawn from the McNairy Formation (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than both the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

5.1.44 Silver, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver, dissolved in water drawn from the RGA (0.060 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than both the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) exceed the RBC (0.0075 mg/l); however, the background concentrations are less than both the MCL and the KDEP screening value (0.100 and 0.18 mg/l, respectively).

5.1.45 Sodium

RGA. No values are available for comparison. The background concentrations for sodium in water drawn from the RGA when summarized over all observations and over averages within wells are 59.450 and 63.5 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for sodium in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 29.2 and 24.92 mg/l, respectively.

5.1.46 Sodium, Dissolved

RGA. No values are available for comparison. The background concentrations for sodium, dissolved in water drawn from the RGA when summarized over all observations and over averages within wells are 60.433 and 65.7 mg/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for sodium, dissolved in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 27.98 and 25.90 mg/l, respectively.

5.1.47 Sulfate

RGA. When summarized over all observations and over averages within wells, the background concentrations for sulfate in water drawn from the RGA (19.947 and 19.1 mg/l, respectively) are less than the MCL (500 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for sulfate in water drawn from the McNairy Formation (28.9 and 27.27 mg/l, respectively) are less than the MCL (500 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

5.1.48 Thallium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for thallium in water drawn from the RGA (0.056 mg/l for both) exceed the MCL (0.002 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for thallium in water drawn from the McNairy Formation (0.644 and 0.255 mg/l, respectively) exceed the MCL (0.002 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

5.1.49 Thallium, Dissolved

RGA. When summarized over all observation and over averages within wells, the qualitatively determined background concentrations for thallium, dissolved in water drawn from the RGA (0.056 mg/l for both) exceed the MCL (0.002 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observation and over averages within wells, the qualitatively determined background concentrations for thallium, dissolved in water drawn from the RGA (0.056 mg/l for both) exceed the MCL (0.002 mg/l). Neither an RBC nor a KDEP screening value are available for comparison.

5.1.50 Uranium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium in water drawn from the RGA (0.002 mg/l for both) do not exceed any comparison criteria (RBC, 0.0045 mg/l; MCL, 0.020 mg/l; KDEP screening value, 0.11 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium in water drawn from the McNairy Formation (0.001 mg/l for both) do not exceed any comparison criteria (RBC, 0.0045 mg/l; MCL, 0.020 mg/l; KDEP screening value, 0.11 mg/l).

5.1.51 Uranium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium, dissolved in water drawn from the RGA (0.002 mg/l for both) do not exceed any comparison criteria (RBC, 0.0045 mg/l; MCL, 0.020 mg/l; KDEP screening value, 0.11 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium, dissolved in water drawn from the McNairy Formation (0.001 mg/l for both) do not exceed any comparison criteria (RBC, 0.0045 mg/l; MCL, 0.020 mg/l; KDEP screening value, 0.11 mg/l).

5.1.52 Vanadium

RGA. When summarized over all observations and over averages within wells, the background concentrations for vanadium in water drawn from the RGA (0.134 and 0.139 mg/l, respectively) exceed the RBC (0.0092 mg/l). Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for vanadium in water drawn from the McNairy Formation (0.126 and 0.119 mg/l, respectively) exceed the RBC (0.0092 mg/l). Neither an MCL nor a KDEP screening value are available for comparison.

5.1.53 Vanadium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for vanadium, dissolved in water drawn from the RGA (0.134 and 0.131 mg/l, respectively) exceed the RBC (0.0092 mg/l). Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for vanadium, dissolved in water drawn from the McNairy Formation (0.126 and 0.107 mg/l, respectively) exceed the RBC (0.0092 mg/l). Neither an MCL nor a KDEP screening value are available for comparison.

5.1.54 Zinc

RGA. When summarized over all observations and over averages within wells, the background concentrations for zinc in water drawn from the RGA (0.054 and 0.025 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.45 mg/l; MCL, 5.0 mg/l; KDEP screening value, 11 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for zinc in water drawn from the McNairy Formation (0.142 and 0.104 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.45 mg/l; MCL, 5.0 mg/l; KDEP screening value, 11 mg/l).

5.1.55 Zinc, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for zinc, dissolved in water drawn from the RGA (0.049 and 0.026 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.45 mg/l; MCL, 5.0 mg/l; KDEP screening value, 11 mg/l).

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for zinc in water drawn from the McNairy Formation (0.142 and 0.104 mg/l, respectively) do not exceed any comparison criteria (RBC, 0.45 mg/l; MCL, 5.0 mg/l; KDEP screening value, 11 mg/l).

5.1.56 Gross Alpha

RGA. When summarized over all observation and over averages within wells, the background concentrations for gross alpha in water drawn from the RGA (5.8 and 2.36 pCi/l, respectively) do not exceed the MCL (15 pCi/l). Neither an RBC nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for gross alpha in water drawn from the McNairy Formation (11.9 and 5.3 pCi/l, respectively) do not exceed the MCL (15 pCi/l). Neither an RBC nor a KDEP screening value are available for comparison.

5.1.57 Gross Beta

RGA. No values are available for comparison. The background concentrations for gross beta in water drawn from the RGA when summarized over all observations and over averages within wells are 13.8 and 7.3 pCi/l, respectively.

McNairy Formation. No values are available for comparison. The background concentrations for gross beta in water drawn from the McNairy Formation when summarized over all observations and over averages within wells are 144.5 and 125.4 pCi/l, respectively.

5.1.58 Neptunium-237

RGA. When summarized over all observations and over averages within wells, the background concentrations for neptunium-237 in water drawn from the RGA (0.8 and 0.21 pCi/l, respectively) exceed the RBC (0.13 pCi/l). Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations, the background concentration for neptunium-237 in water drawn from the McNairy Formation (0.5 pCi/l) exceeds the RBC (0.13 pCi/l); however, when summarized over averages within wells, the background concentration (0.13 pCi/l) equals the RBC. Neither an MCL nor a KDEP screening value are available for comparison.

5.1.59 Plutonium-239

RGA. When summarized over all observations and over averages within wells, the background concentrations for plutonium-239 in water drawn from the RGA (0.1 and 0.03 pCi/l, respectively) are less than the RBC (0.12 pCi/l). Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations, the background concentration for plutonium-239 in water drawn from the McNairy Formation (0.2 pCi/l) exceeds the RBC (0.12 pCi/l); however, when summarized over averages within wells, the background concentration (0.04 pCi/l) is less than the RBC. Neither an MCL nor a KDEP screening value are available for comparison.

5.1.60 Radium-226

RGA. When summarized over all observations, the background concentration for radium-226 in water drawn from the RGA (0.6 pCi/l) exceeds the RBC (0.13 pCi/l); however, when summarized over averages within wells, the background concentration (0.10 pCi/l) is less than the RBC. Neither background concentration exceeds the MCL (5 pCi/l). A KDEP screening value is not available.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for radium-226 in water drawn from the McNairy Formation (1.2 and 0.29 pCi/l, respectively) exceed the RBC (0.13 pCi/l); however, these background concentrations are less than the MCL (5 pCi/l). A KDEP screening value is not available.

5.1.61 Radon-222

RGA. When summarized over all observations and over averages within wells, the background concentrations for radon-222 in water drawn from the RGA (626 and 555.3 pCi/l, respectively) exceed the RBC and the MCL (1.4 and 300 pCi/l, respectively). A KDEP screening value is not available.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for radon-222 in water drawn from the McNairy Formation (295 and 228.3 pCi/l, respectively) exceed the RBC (1.4 pCi/l); however, these background concentrations are less than the MCL (300 pCi/l). A KDEP screening value is not available.

5.1.62 Technetium-99

RGA. When summarized over all observations and over averages within wells, the background concentrations for technetium-99 in water drawn from the RGA (22.3 and 10.8 pCi/l, respectively) do not exceed the RBC (28.0 pCi/l). Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for technetium-99 in water drawn from the McNairy Formation (20.6 and 7.8 pCi/l, respectively) do not exceed the RBC (28.0 pCi/l). Neither an MCL nor a KDEP screening value are available for comparison.

5.1.63 Thorium-230

RGA. When summarized over all observations, the background concentration for thorium-230 in water drawn from the RGA (1.1 pCi/l) exceeds the RBC (1.0 pCi/l); however when summarized over averages within well, the background concentration (0.54 pCi/l) does not exceed the RBC. Neither an MCL nor a KDEP screening value are available for comparison.

McNairy Formation. When summarized over all observations, the background concentration for thorium-230 in water drawn from the McNairy Formation (1.5 pCi/l) exceeds the RBC (1.0 pCi/l); however when summarized over averages within well, the background concentration (0.40 pCi/l) does not exceed the RBC. Neither an MCL nor a KDEP screening value are available for comparison.

5.1.64 Total Radium

RGA. When summarized over all observations and over averages within wells, the background concentrations for total radium in water drawn from the RGA (1.3 and 0.46 pCi/l, respectively) exceed the RBC (0.13 pCi/l); however, both background concentrations are less than the MCL (5 pCi/l). A KDEP screening value is not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for total radium in water drawn from the McNairy Formation (0.7 and 0.36 pCi/l, respectively) exceed the RBC (0.13 pCi/l); however, both background concentrations are less than the MCL (5 pCi/l). A KDEP screening value is not available for comparison.

5.1.65 Uranium-234

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-234 in water drawn from the RGA (0.7 pCi/l for both) do not exceed the RBC or MCL (0.87 and 30 pCi/l, respectively). A KDEP screening value is not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-234 in water drawn from the McNairy Formation (0.3 pCi/l for both) do not exceed the RBC or MCL (0.87 and 30 pCi/l, respectively). A KDEP screening value is not available for comparison.

5.1.66 Uranium-235

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-235 in water drawn from the RGA (0.3 pCi/l for both) do not exceed the RBC or MCL (0.82 and 30 pCi/l, respectively). A KDEP screening value is not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-235 in water drawn from the McNairy Formation (0.2 pCi/l for both) do not exceed the RBC or MCL (0.82 and 30 pCi/l, respectively). A KDEP screening value is not available for comparison.

5.1.67 Uranium-238

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-238 in water drawn from the RGA (0.7 pCi/l for both) do exceed the RBC (0.62 pCi/L) but not the MCL (30 pCi/l). A KDEP screening value is not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-238 in water drawn from the McNairy Formation (0.3 pCi/l for both) do not exceed the RBC or the MCL (0.62 and 30 pCi/l, respectively). A KDEP screening value is not available for comparison.

5.1.68 Summary of Comparisons Between Background Concentrations and RBCs, MCLs, and KDEP Screening Values

In summary, as shown in Fig. 5.1, without considering if the background concentrations were derived quantitatively or qualitatively, 37 of 67 RGA background concentrations derived from all observations, 34 of 67 RGA background concentrations derived from averages within wells, 38 of 67 McNairy Formation background concentrations derived from all observations, and 34 of 67 McNairy Formation background concentrations derived from averages within wells exceed one or more of the risk-based comparison criteria. Of the 37 RGA background concentrations derived from all observations that exceed one or more risk-based criteria, 34 exceed at least the RBC, 18 exceed at least the MCL, and 8 exceed at least the KDEP risk-based screening value. Of the 34 RGA background concentrations derived from averages within wells that exceed one or more risk-based criteria, 31 exceed at least the RBC, 17 exceed at least the MCL, and 8 exceed at least the KDEP risk-based screening value. Of the 38 McNairy Formation background concentrations derived from all observations that exceed one or more risk-based criteria, 34 exceed at least the RBC, 16 exceed at least the MCL, and 10 exceed at least the KDEP risk-based screening value. Of the 34 McNairy Formation background concentrations derived from averages within wells that exceed one or more risk-based criteria, 30 exceed at least the RBC, 16 exceed at least the MCL, and 10 exceed at least the KDEP risk-based screening criteria.

If the method of derivation of the background concentration is considered (i.e., quantitatively versus qualitatively), then a marked proportion of the background concentrations that exceed one or more risk-based criteria are seen to fall within the group of background concentrations that were derived qualitatively. For background concentrations derived qualitatively, 15 of 23 RGA background concentrations derived from all observations, 15 of 23 RGA background concentrations derived from averages within wells, 19 of 26 McNairy Formation background concentrations derived from all observations, and 19 of 26 McNairy Formation background concentrations derived from averages within wells are seen to exceed one or more risk-based comparison criteria. However, for background concentrations derived quantitatively, only 22 of 44 RGA background concentrations derived from all observations, 19 of 44 RGA background concentrations derived from averages within wells, 19 of 41 McNairy Formation background concentrations derived

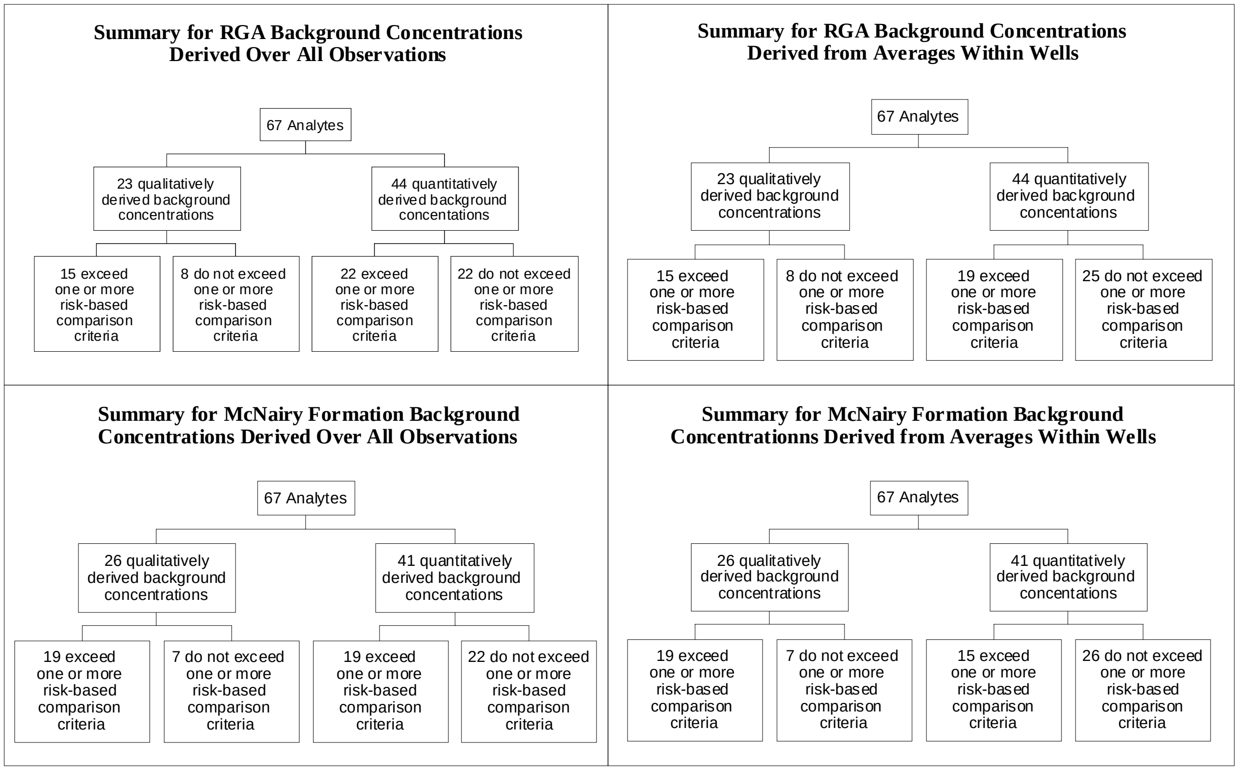


Fig. 5.1. Summary of comparisons of background concentrations to risk-based criteria.

from all observations, and 15 of 41 McNairy Formation Background concentrations derived from averages within wells are seen to exceed one or more risk-based comparison criteria.

Tables 5.5, 5.6, 5.7, and 5.8 illustrate the magnitude by which the background concentrations exceed their risk-based comparison criteria. Values in these tables were derived using the following equation [6]:

$$\text{Value} = \frac{\text{Background Concentration}}{\text{Comparison Criterion}} \qquad \textbf{[6]}$$

Therefore, the values in Tables 5.5, 5.6, 5.7, and 5.8 are the factors by which the background concentrations exceed the comparison criteria.

5.1.68.1 Summary of comparisons to RBCs

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived qualitatively over all observations and that are greater than their RBCs are identical with the RGA background concentrations that were derived qualitatively over averages within wells and that are greater than their RBCs. Additionally, the factor by which the background concentrations for each of these analytes exceed their RBC is similar. For both methods of derivation, six RGA background concentrations exceed their RBCs by more than 2 or more orders of magnitude, two RGA background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and five RGA background concentrations exceed their RBCs by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived qualitatively that exceed their RBC by more than 2 orders of magnitude–antimony; antimony, dissolved; arsenic; arsenic, dissolved; beryllium; and beryllium, dissolved.

- Analytes with RGA background concentration derived qualitatively that exceed their RBC by more than 1 but less than 2 orders of magnitude– cadmium and cadmium, dissolved.

- Analytes with RGA background concentrations derived qualitatively that exceed their RBC by less than 1 order of magnitude–chromium, dissolved; molybdenum; molybdenum, dissolved; silver; and silver, dissolved.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived qualitatively over all observations and over averages within well that exceed their RBCs are similar to those for the RGA. When placed in the groups used above, eight McNairy Formation background concentrations are seen to exceed their RBCs by more than 2 or more orders of magnitude, two McNairy Formation background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and eight McNairy Formation background concentrations exceed their RBCs by less than 1 order of magnitude. Analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their RBC by more than 2 orders of magnitude–antimony; antimony, dissolved; arsenic; arsenic, dissolved; beryllium; beryllium, dissolved; lead; and lead, dissolved.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their RBC by more than 1 but less than 2 orders of magnitude–cadmium and cadmium, dissolved.

Table 5.5. Factors of difference for the comparison of RGA background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Factor[b]		
		RBC[c]	MCL[d]	KDEP[e]
		Inorganic Chemicals (mg/L)		
Aluminum	2.189	1.46	**10.95**	<
Aluminum, Dissolved	0.311	<	1.56	<
Antimony	0.060 †	***107.14***	**10.00**	4.00
Antimony, Dissolved	0.060 †	***107.14***	**10.00**	4.00
Arsenic	0.005 †	***142.86***	=	***131.58***
Arsenic, Dissolved	0.005 †	***142.86***	=	***131.58***
Barium	0.235	2.35	<	<
Barium. Dissolved	0.200	2.00	<	<
Beryllium	0.004 †	***400.00***	=	***250.00***
Beryllium, Dissolved	0.004 †	***400.00***	=	***250.00***
Cadmium	0.010 †	**15.15**	2.00	<
Cadmium, Dissolved	0.010 †	**15.15**	2.00	<
Calcium	41.238	NV	NV	NV
Calcium, Dissolved	38.166	NV	NV	NV
Chloride	91.021	NV	<	NV
Chromium	0.144	**20.28**	1.44	<
Chromium, Dissolved	0.050 †	7.04	<	<
Cobalt	0.045 †	<	NV	NV
Cobalt, Dissolved	0.045 †	<	<	<
Copper	0.036	<	<	<
Copper, Dissolved	0.020	<	<	<
Fluoride	0.270	2.97	<	<
Iron	5.030	**11.18**	**16.77**	NV
Iron, Dissolved	0.267	<	<	<
Lead	0.129	***860,000***	8.60	**32.25**
Lead, Dissolved	0.098	***653,333***	6.30	**24.50**
Magnesium	16.262	NV	NV	NV
Magnesium, Dissolved	16.215	NV	NV	NV
Manganese	0.119	1.78	2.38	<
Manganese, Dissolved	0.068	1.01	1.36	<
Mercury	0.0002 †	<	<	<
Mercury, Dissolved	0.0002 †	<	<	<
Molybdenum	0.050 †	6.67	NV	<
Molybdenum, Dissolved	0.050 †	6.67	NV	<
Nickel	0.682	**22.73**	6.82	<
Nickel, Dissolved	0.305	**10.17**	3.05	<
Nitrate as Nitrogen	15.561	6.48	1.56	<
Potassium	5.195	NV	NV	NV
Potassium, Dissolved	4.096	NV	NV	NV
Selenium	0.005 †	<	<	<
Selenium, Dissolved	0.005 †	<	<	<
Silica	26.401	NV	NV	NV
Silver	0.011 †	1.47	<	<
Silver, Dissolved	0.060 †	8.00	<	<
Sodium	59.450	NV	NV	NV
Sodium, Dissolved	60.433	NV	NV	NV
Sulfate	19.947	NV	<	NV
Thallium	0.056 †	NV	**28.00**	NV
Thallium, Dissolved	0.056 †	NV	**28.00**	NV
Uranium	0.002 †	<	<	<

Table 5.5. Factors of difference for the comparison of RGA background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values (continued)

Analyte	Background[a]	Factor[b] RBC[c]	MCL[d]	KDEP[e]
Inorganic Chemicals (mg/L) (continued)				
Uranium, Dissolved	0.002 †	<	<	<
Vanadium	0.134	**14.57**	NV	NV
Vanadium, Dissolved	0.134	**14.57**	NV	NV
Zinc	0.054	<	<	<
Zinc, Dissolved	0.049	<	<	<
Radionuclides (pCi/L)				
Gross Alpha	5.8	NV	<	NV
Gross Beta	13.8	NV	See footnote[f]	NV
Neptunium-237	0.8	6.15	See footnote[f]	NV
Plutonium-239	0.1	<	See footnote[f]	NV
Radium-226	0.6	4.62	<	NV
Radon-222	626	***447.14***	2.09	NV
Technetium-99	22.3	<	See footnote[f]	NV
Thorium-230	1.1	1.10	See footnote[f]	NV
Total Radium	1.3	**10.00**	<	NV
Uranium-234	0.7	<	<	NV
Uranium-235	0.3	<	<	NV
Uranium-238	0.7	1.13	<	NV

Notes:

Less than sign (<) indicates that background value is less than the comparison criterion. Therefore, the factor is less than 1.
Equal sign (=) indicates that the background value equals the comparison criterion.
NV indicates that a value is not available for the analyte.
Use of bold font indicates that the factor of difference exceeds 1 order of magnitude.
Use of bold, italicized font indicates that the factor of difference exceeds 10 orders of magnitude.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than the concentrations reported here.
[b] See Equation 6 for the derivation of the factor values.
[c] See Subsect. 4.1 for a discussion of the derivation of the RBCs.
[d] See Subsect 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.
[e] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.
[f] Factor could not be calculated because a definitive value is not available. See footnote l to Table 4.1.

Table 5.6. Factors of difference for the comparison of RGA background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

		Factor[b]		
Analyte	**Background[a]**	**RBC[c]**	**MCL[d]**	**KDEP[e]**
		Inorganic Chemicals (mg/L)		
Aluminum	1.64	1.09	8.20	<
Aluminum, Dissolved	0.201	<	1.01	<
Antimony	0.060[†]	***107.14***	**10.00**	4.00
Antimony, Dissolved	0.060[†]	***107.14***	**10.00**	4.00
Arsenic	0.005[†]	***142.86***	=	***131.58***
Arsenic, Dissolved	0.005[†]	***142.86***	=	***131.58***
Barium	0.202	2.02	<	<
Barium. Dissolved	0.179	1.79	<	<
Beryllium	0.004[†]	***400.00***	=	***250.00***
Beryllium, Dissolved	0.004[†]	***400.00***	=	***250.00***
Cadmium	0.010[†]	**15.15**	2.00	<
Cadmium, Dissolved	0.010[†]	**15.15**	2.00	<
Calcium	40.0	NV	NV	NV
Calcium, Dissolved	35.8	NV	NV	NV
Chloride	89.2	NV	<	NV
Chromium	0.134	**18.87**	1.34	<
Chromium, Dissolved	0.050[†]	7.04	<	<
Cobalt	0.045[†]	<	NV	NV
Cobalt, Dissolved	0.045[†]	<	NV	NV
Copper	0.034	<	<	<
Copper, Dissolved	0.018	<	<	<
Fluoride	0.245	2.69	<	<
Iron	3.72	**8.27**	**12.40**	NV
Iron, Dissolved	0.164	<	<	NV
Lead	0.250	***1,666,667***	**16.67**	**62.5**
Lead, Dissolved	0.250	***1,666,667***	**16.67**	**62.5**
Magnesium	15.7	NV	NV	NV
Magnesium, Dissolved	15.4	NV	NV	NV
Manganese	0.082	1.22	1.64	<
Manganese, Dissolved	0.048	<	<	<
Mercury	0.0002[†]	<	<	<
Mercury, Dissolved	0.0002[†]	<	<	<
Molybdenum	0.050[†]	6.67	NV	<
Molybdenum, Dissolved	0.050[†]	6.67	NV	<
Nickel	0.682	**22.73**	6.82	<
Nickel, Dissolved	0.305	**10.17**	3.05	<
Nitrate as Nitrogen	13.5	5.63	1.35	<
Potassium	4.47	NV	NV	NV
Potassium, Dissolved	3.70	NV	NV	NV
Selenium	0.005[†]	<	<	<
Selenium, Dissolved	0.005[†]	<	<	<
Silica	21.1	NV	NV	NV
Silver	0.011[†]	1.47	<	<
Silver, Dissolved	0.060[†]	8.00	<	<
Sodium	63.5	NV	NV	NV
Sodium, Dissolved	65.7	NV	NV	NV
Sulfate	19.1	NV	<	NV
Thallium	0.056[†]	NV	**28.00**	NV
Thallium, Dissolved	0.056[†]	NV	**28.00**	NV
Uranium	0.002[†]	<	<	<

Table 5.6. Factors of difference for the comparison of RGA background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values (continued)

Analyte	Background[a]	Factor[b]		
		RBC[c]	MCL[d]	KDEP[e]
Inorganic Chemicals (mg/L) (continued)				
Uranium, Dissolved	0.002 †	<	<	<
Vanadium	0.139	**15.11**	NV	NV
Vanadium, Dissolved	0.131	**14.24**	NV	NV
Zinc	0.025	<	<	<
Zinc, Dissolved	0.026	<	<	<
Radionuclides (pCi/L)				
Gross Alpha	2.36	NV	<	NV
Gross Beta	7.3	NV	See footnote[f]	NV
Neptunium-237	0.21	1.62	See footnote[f]	NV
Plutonium-239	0.03	<	See footnote[f]	NV
Radium-226	0.10	<	<	NV
Radon-222	555.3	***396.64***	1.85	NV
Technetium-99	10.8	<	See footnote[f]	NV
Thorium-230	0.54	<	See footnote[f]	NV
Total Radium	0.46	3.54	<	NV
Uranium-234	0.7	<	<	NV
Uranium-235	0.3	<	<	NV
Uranium-238	0.7	1.13	<	NV

Notes:

Less than sign (<) indicates that background value is less than the comparison criterion. Therefore, the factor is less than 1.
Equal sign (=) indicates that the background value equals the comparison criterion.
NV indicates that a value is not available for the analyte.
Use of bold font indicates that the factor of difference exceeds 1 order of magnitude.
Use of bold, italicized font indicates that the factor of difference exceeds 10 orders of magnitude.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than the concentrations reported here.
[b] See Equation 6 for the derivation of the factor values.
[c] See Subsect. 4.1 for a discussion of the derivation of the RBCs.
[d] See Subsect 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.
[e] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.
[f] Factor could not be calculated because a definitive value is not available. See footnote l to Table 4.1.

Table 5.7. Factors of difference for the comparison of McNairy Formation background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

Analyte	Background[a]	Factor[b]		
		RBC[c]	MCL[d]	KDEP[e]
		Inorganic Chemicals (mg/L)		
Aluminum	0.687	<	3.44	<
Aluminum, Dissolved	0.579	<	2.90	<
Antimony	0.060 †	***107.14***	**10.00**	400
Antimony, Dissolved	0.060 †	***107.14***	**10.00**	4.00
Arsenic	0.005 †	***142.86***	=	***131.58***
Arsenic, Dissolved	0.005 †	***142.86***	=	***131.58***
Barium	0.296	2.96	<	<
Barium. Dissolved	0.268	2.68	<	<
Beryllium	0.017 †	***1,700.00***	4.25	***1,062.50***
Beryllium, Dissolved	0.004 †	***400.00***	=	***250.00***
Cadmium	0.010 †	**15.15**	2.00	<
Cadmium, Dissolved	0.010 †	**15.15**	2.00	<
Calcium	38.858	NV	NV	NV
Calcium, Dissolved	38.829	NV	NV	NV
Chloride	19.708	NV	<	NV
Chromium	0.060 †	8.45	<	<
Chromium, Dissolved	0.050 †	7.04	<	<
Cobalt	0.096	1.05	NV	NV
Cobalt, Dissolved	0.045 †	<	NV	NV
Copper	0.057	<	<	<
Copper, Dissolved	0.013 †	<	<	<
Fluoride	0.330	3.63	<	<
Iron	18.360	**40.80**	**61.20**	NV
Iron, Dissolved	12.372	**27.49**	**41.24**	NV
Lead	0.050 †	***333,333***	3.33	**12.50**
Lead, Dissolved	0.050 †	***333,333***	3.33	**12.50**
Magnesium	13.418	NV	NV	NV
Magnesium, Dissolved	14.171	NV	NV	NV
Manganese	0.941	**14.04**	**18.82**	5.23
Manganese, Dissolved	0.894	13.34	17.88	4.97
Mercury	0.0002 †	<	<	<
Mercury, Dissolved	0.0002 †	<	<	<
Molybdenum	0.050 †	6.67	NV	<
Molybdenum, Dissolved	0.050 †	6.67	NV	<
Nickel	0.109 †	3.63	1.09	<
Nickel, Dissolved	0.050 †	1.67	<	<
Nitrate as Nitrogen	1.474	<	<	<
Potassium	55.752	NV	NV	NV
Potassium, Dissolved	51.205	NV	NV	NV
Selenium	0.005 †	<	<	<
Selenium, Dissolved	0.005 †	<	<	<
Silica	26.0	NV	NV	NV
Silver	0.050 †	6.67	<	<
Silver, Dissolved	0.050 †	6.67	<	<
Sodium	29.2	NV	NV	NV
Sodium, Dissolved	27.98	NV	NV	NV
Sulfate	28.9	NV	<	NV
Thallium	0.644	NV	***322.00***	NV
Thallium, Dissolved	0.056 †	NV	**28.00**	NV
Uranium	0.001 †	<	<	<

Table 5.7. Factors of difference for the comparison of McNairy Formation background concentrations derived over all observations against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values (continued)

		Factor[b]		
Analyte	**Background[a]**	**RBC[c]**	**MCL[d]**	**KDEP[e]**
		Inorganic Chemicals (mg/L) (continued)		
Uranium, Dissolved	0.001	<	<	<
Vanadium	0.126	**13.70**	NV	NV
Vanadium, Dissolved	0.126	**13.70**	NV	NV
Zinc	0.142	<	<	<
Zinc, Dissolved	0.116	<	<	<
Radionuclides (pCi/L)				
Gross Alpha	11.9	NV	<	NV
Gross Beta	144.5	NV	See footnote[f]	NV
Neptunium-237	0.5	3.85	See footnote[f]	NV
Plutonium-239	0.2	1.67	See footnote[f]	NV
Radium-226	1.2	9.23	<	NV
Radon-222	295	***210.71***	<	NV
Technetium-99	20.6	<	See footnote[f]	NV
Thorium-230	1.5	1.50	See footnote[f]	NV
Total Radium	0.7	5.38	<	NV
Uranium-234	0.3	<	<	NV
Uranium-235	0.2	<	<	NV
Uranium-238	0.3	<	<	NV

Notes:

Less than sign (<) indicates that background value is less than the comparison criterion. Therefore, the factor is less than 1.
Equal sign (=) indicates that the background value equals the comparison criterion.
NV indicates that a value is not available for the analyte.
Use of bold font indicates that the factor of difference exceeds 1 order of magnitude.
Use of bold, italicized font indicates that the factor of difference exceeds 10 orders of magnitude.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than the concentrations reported here.
[b] See Equation 6 for the derivation of the factor values.
[c] See Subsect. 4.1 for a discussion of the derivation of the RBCs.
[d] See Subsect. 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.
[e] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.
[f] Factor could not be calculated because a definitive value is not available. See footnote l to Table 4.1.

Table 5.8. Factors of difference for the comparison of McNairy Formation background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values

		Factor[b]		
Analyte	**Background[a]**	**RBC[c]**	**MCL[d]**	**KDEP[e]**
		Inorganic Chemicals (mg/L)		
Aluminum	0.75	<	3.75	<
Aluminum, Dissolved	0.587	<	2.94	<
Antimony	0.060[†]	***107.14***	**10.00**	4.00
Antimony, Dissolved	0.060[†]	***107.14***	**10.00**	4.00
Arsenic	0.005[†]	***142.86***	=	***131.58***
Arsenic, Dissolved	0.005[†]	***142.86***	=	***131.58***
Barium	0.265	2.65	<	<
Barium. Dissolved	0.266	2.66	<	<
Beryllium	0.017[†]	***1,700.00***	4.25	***1,062.50***
Beryllium, Dissolved	0.004[†]	***400.00***	=	***250.00***
Cadmium	0.010[†]	**15.15**	2.00	<
Cadmium, Dissolved	0.010[†]	**15.15**	2.00	<
Calcium	39.47	NV	NV	NV
Calcium, Dissolved	40.27	NV	NV	NV
Chloride	20.23	NV	<	NV
Chromium	0.060[†]	8.45	<	<
Chromium, Dissolved	0.050[†]	7.04	<	<
Cobalt	0.072	<	NV	NV
Cobalt, Dissolved	0.045[†]	<	NV	NV
Copper	0.033	<	<	<
Copper, Dissolved	0.013[†]	<	<	<
Fluoride	0.298	3.27	<	<
Iron	15.83	**35.18**	**52.77**	NV
Iron, Dissolved	9.446	**20.99**	**31.49**	NV
Lead	0.050[†]	***333,333***	3.33	**12.50**
Lead, Dissolved	0.050[†]	***333,333***	3.33	**12.50**
Magnesium	16.457	NV	NV	NV
Magnesium, Dissolved	16.533	NV	NV	NV
Manganese	0.729	**10.88**	**14.58**	4.05
Manganese, Dissolved	0.682	**10.18**	**13.64**	3.79
Mercury	0.0002[†]	<	<	<
Mercury, Dissolved	0.0002[†]	<	<	<
Molybdenum	0.050[†]	6.67	NV	<
Molybdenum, Dissolved	0.050[†]	6.67	NV	<
Nickel	0.109[†]	3.63	1.09	<
Nickel, Dissolved	0.050[†]	1.67	<	<
Nitrate as Nitrogen	1.43	<	<	<
Potassium	64.080	NV	NV	NV
Potassium, Dissolved	58.750	NV	NV	NV
Selenium	0.005[†]	<	<	<
Selenium, Dissolved	0.005[†]	<	<	<
Silica	29.4	NV	NV	NV
Silver	0.050[†]	6.67	<	<
Silver, Dissolved	0.050[†]	6.67	<	<
Sodium	24.92	NV	NV	NV
Sodium, Dissolved	25.90	NV	NV	NV
Sulfate	27.27	NV	<	NV
Thallium	0.255	NV	***127.50***	NV
Thallium, Dissolved	0.056[†]	NV	**28.00**	NV
Uranium	0.001[†]	<	<	<

Table 5.8. Factors of difference for the comparison of McNairy Formation background concentrations derived over averages within wells against RBCs, MCLs, and Commonwealth of Kentucky risk-based screening values (continued)

Analyte	Background[a]	Factor[b]		
		RBC[c]	MCL[d]	KDEP[e]
Inorganic Chemicals (mg/L) (continued)				
Uranium, Dissolved	0.001	<	<	<
Vanadium	0.119	**12.93**	NV	NV
Vanadium, Dissolved	0.107	**11.63**	NV	NV
Zinc	0.104	<	<	<
Zinc, Dissolved	0.080	<	<	<
Radionuclides (pCi/L)				
Gross Alpha	5.3	NV	<	NV
Gross Beta	125.4	NV	See footnote[f]	NV
Neptunium-237	0.13	=	See footnote[f]	NV
Plutonium-239	0.04	<	See footnote[f]	NV
Radium-226	0.29	2.23	<	NV
Radon-222	228.3	***163.07***	<	NV
Technetium-99	7.8	<	See footnote[f]	NV
Thorium-230	0.40	<	See footnote[f]	NV
Total Radium	0.36	2.77	<	NV
Uranium-234	0.3	<	<	NV
Uranium-235	0.2	<	<	NV
Uranium-238	0.3	<	<	NV

Notes:

Less than sign (<) indicates that background value is less than the comparison criterion. Therefore, the factor is less than 1.
Equal sign (=) indicates that the background value equals the comparison criterion.
NV indicates that a value is not available for the analyte.
Use of bold font indicates that the factor of difference exceeds 1 order of magnitude.
Use of bold, italicized font indicates that the factor of difference exceeds 10 orders of magnitude.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than the concentrations reported here.
[b] See Equation 6 for the derivation of the factor values.
[c] See Subsect. 4.1 for a discussion of the derivation of the RBCs.
[d] See Subsect. 4.2 and footnotes to Table 4.1 for a discussion of the source of the MCLs.
[e] See Subsect. 4.2 for a discussion of the source of the KDEP risk-based screening values.
[f] Factor could not be calculated because a definitive value is not available. See footnote l to Table 4.1.

- Analytes with McNairy Formation background concentrations derived qualitatively that exceed their RBC by less than 1 order of magnitude–chromium; chromium, dissolved; molybdenum; molybdenum, dissolved; nickel; nickel, dissolved; silver; and silver, dissolved.

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived quantitatively over all observations and that are greater than their RBCs are very similar to the RGA background concentrations that were derived quantitatively over averages within wells and that are greater than their RBCs. Additionally, the factor by which the background concentrations for each of these analytes exceed their RBC is similar. For RGA background concentrations derived over all observations, three RGA background concentrations exceed their RBCs by more than 2 or more orders of magnitude, seven RGA background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and eleven RGA background concentrations exceed their RBCs by less than 1 order of magnitude. For RGA background concentrations derived over averages within wells, three RGA background concentrations exceed their RBCs by more than 2 or more orders of magnitude, six RGA background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and nine RGA background concentrations exceed this RBCs by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived quantitatively that exceed their RBC by more than 2 orders of magnitude–lead; lead, dissolved; and radon-222.

- Analytes with RGA background concentration derived quantitatively that exceed their RBC by more than 1 but less than 2 orders of magnitude–chromium; iron; nickel; nickel, dissolved; vanadium; vanadium, dissolved; and total radium (derived over all observations only).

- Analytes with RGA background concentrations derived quantitatively that exceed their RBC by less than 1 order of magnitude–aluminum; barium; barium, dissolved; fluoride; manganese; manganese, dissolved (derived over all observations only); nitrate as nitrogen; neptunium-237; radium-226 (derived over all observations only); thorium-230 (derived over all observations only); total radium (derived over averages within well only), and uranium-238.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived quantitatively over all observations and over averages within well that exceed their RBCs are similar to those for the RGA. When placed in the groups used above, for values derived over all observations, one McNairy Formation background concentration is seen to exceed its RBC by more than 2 or more orders of magnitude, six McNairy Formation background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and nine McNairy Formation background concentrations exceed their RBCs by less than 1 order of magnitude. For values derived over averages within wells, one McNairy Formation background concentration is seen to exceed its RBC by more than 2 orders of magnitude, six McNairy Formation background concentrations exceed their RBCs by more than 1 but less than 2 orders of magnitude, and five McNairy Formation background concentrations exceed their RBCs by less than 1 order of magnitude. Analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their RBC by more than 2 orders of magnitude–radon-222.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their RBC by more than 1 but less than 2 orders of magnitude–iron; iron, dissolved; manganese; manganese, dissolved; vanadium; and vanadium, dissolved.

- Analytes with McNairy Formation background concentrations derived quantitatively that exceed their RBC by less than 1 order of magnitude–barium; barium, dissolved; cobalt (derived over all observations only); fluoride; neptunium-237 (derived over all observations only); plutonium-239 (derived over all observations only); radium-226; thorium-230 (derived over all observations only); and total radium.

5.1.68.2 Summary of comparisons to MCLs

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived qualitatively over all observations and that are greater than their MCLs are identical with the RGA background concentrations that were derived qualitatively over averages within wells and that are greater than their MCLs. Additionally, the factor by which the background concentrations for each of these analytes exceed their MCL is similar. For both methods of derivation, unlike comparisons against RBCs, no RGA background concentrations exceed their MCL by more than 2 or more orders of magnitude, four RGA background concentrations exceed their MCL by more than 1 but less than 2 orders of magnitude, and three RGA background concentrations exceed their MCLs by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived qualitatively that exceed their MCL by more than 2 orders of magnitude–none.

- Analytes with RGA background concentration derived qualitatively that exceed their MCL by more than 1 but less than 2 orders of magnitude– antimony; antimony, dissolved; thallium; and thallium, dissolved.

- Analytes with RGA background concentrations derived qualitatively that exceed their MCL by less than 1 order of magnitude–cadmium and cadmium, dissolved.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived qualitatively over all observations and over averages within well that exceed their MCL are similar to those for the RGA. When placed in the groups used above, no McNairy Formation background concentrations are seen to exceed their MCL by more than 2 or more orders of magnitude, three McNairy Formation background concentrations exceed their MCL by more than 1 but less than 2 orders of magnitude, and six McNairy Formation background concentrations exceed their MCL by less than 1 order of magnitude. Analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their MCL by more than 2 orders of magnitude–none.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their MCL by more than 1 but less than 2 orders of magnitude–antimony; antimony, dissolved; and thallium, dissolved.

- Analytes with McNairy Formation background concentrations derived qualitatively that exceed their MCL by less than 1 order of magnitude–beryllium; cadmium; cadmium, dissolved; lead; lead, dissolved; and nickel.

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived quantitatively over all observations and that are greater than their MCL are somewhat similar to the RGA background concentrations that were derived quantitatively over averages within wells and that are greater than their MCL. Additionally, the factor by which the background concentrations for each of these analytes exceed their MCL is similar. For RGA background concentrations derived over all observations, no RGA background concentrations exceed their MCL by more than 2 or more orders of magnitude, two RGA background concentrations exceed their MCL by more than 1 but less than 2 orders of magnitude, and ten RGA background concentrations exceed their MCL by less than 1 order of magnitude. For RGA background concentrations derived over averages within wells, no RGA background concentrations exceed their MCL by more than 2 or more orders of magnitude, three RGA background concentrations exceed their MCL by more than 1 but less than 2 orders of magnitude, and eight RGA background concentrations exceed their MCL by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived quantitatively that exceed their MCL by more than 2 orders of magnitude–none.

- Analytes with RGA background concentration derived quantitatively that exceed their MCL by more than 1 but less than 2 orders of magnitude–aluminum (derived over all observations only); iron; lead (derived over averages within wells only); lead, dissolved (derived over averages within wells only).

- Analytes with RGA background concentrations derived quantitatively that exceed their MCL by less than 1 order of magnitude–aluminum (derived over averages within wells only); aluminum, dissolved; chromium; lead (derived over all observations only); lead, dissolved (derived over all observations only); manganese; manganese, dissolved (derived over all observations only); nickel; nickel, dissolved; nitrate as nitrogen; radon-222.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived quantitatively over all observations and over averages within well that exceed their MCL are similar to those for the RGA. Additionally, the analytes that are greater than their MCL when derived over all observations are identical to those that are derived over averages within wells. When segregated into the groups used previously, one McNairy Formation background concentration is seen to exceed its MCL by more than 2 or more orders of magnitude, four McNairy Formation background concentrations exceed their MCL by more than 1 but less than 2 orders of magnitude, and two McNairy Formation background concentrations exceed their MCL by less than 1 order of magnitude. The analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their MCL by more than 2 orders of magnitude–thallium.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their MCL by more than 1 but less than 2 orders of magnitude–iron; iron, dissolved; manganese; and manganese, dissolved.

- Analytes with McNairy Formation background concentrations derived quantitatively that exceed their MCL by less than 1 order of magnitude–aluminum and aluminum, dissolved.

5.1.68.3 Summary of comparisons to KDEP risk-based screening values

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived qualitatively over all observations and that are greater than their KDEP risk-based screening value are identical with the RGA background concentrations that were derived qualitatively over averages within wells and that are greater than their KDEP risk-based screening value. Additionally, the factor by which the background concentrations for each of these analytes exceed their KDEP risk-based screening value is similar. For both methods of derivation, four RGA background concentrations exceed their KDEP risk-based screening value by more than 2 or more orders of magnitude, no RGA background concentrations exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude, and two RGA background concentrations exceed their KDEP risk-based screening value by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived qualitatively that exceed their KDEP risk-based screening value by more than 2 orders of magnitude–arsenic; arsenic, dissolved; beryllium; and beryllium, dissolved.

- Analytes with RGA background concentration derived qualitatively that exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude–none.

- Analytes with RGA background concentrations derived qualitatively that exceed their MCL by less than 1 order of magnitude–antimony and antimony, dissolved.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived qualitatively over all observations and over averages within well that exceed their KDEP risk-based screening value are similar to those for the RGA. When placed in the groups used above, four McNairy Formation background concentrations are seen to exceed their KDEP risk-based screening value by more than 2 or more orders of magnitude, two McNairy Formation background concentrations exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude, and two McNairy Formation background concentrations exceed their KDEP risk-based screening value by less than 1 order of magnitude. Analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their KDEP risk-based screening value by more than 2 orders of magnitude–arsenic; arsenic, dissolved; beryllium; and beryllium, dissolved.

- Analytes with McNairy Formation background concentration derived qualitatively that exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude–lead and lead, dissolved.

- Analytes with McNairy Formation background concentrations derived qualitatively that exceed their KDEP risk-based screening value by less than 1 order of magnitude–antimony and antimony, dissolved.

As shown in Tables 5.5 and 5.6, the RGA background concentrations that were derived quantitatively over all observations and that are greater than their KDEP risk-based screening value are identical to the RGA background concentrations that were derived quantitatively over averages within wells and that are greater than their MCL. Additionally, the factors by which the background concentrations exceed their KDEP risk-based screening value are similar. For RGA background concentrations derived over all observations and over averages within wells, no RGA background concentrations exceed their KDEP risk-based screening value by more than 2 or more orders of magnitude, two RGA background concentrations exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude, and no RGA background concentrations exceed their KDEP risk-based screening value by less than 1 order of magnitude. The analytes falling in each of these groups are summarized below.

- Analytes with RGA background concentration derived quantitatively that exceed their KDEP risk-based screening value by more than 2 orders of magnitude–none.

- Analytes with RGA background concentration derived quantitatively that exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude–lead and lead, dissolved.

- Analytes with RGA background concentrations derived quantitatively that exceed their KDEP risk-based screening value by less than 1 order of magnitude–none.

As shown in Tables 5.7 and 5.8, the analytes with McNairy Formation background concentrations derived quantitatively over all observations and over averages within well that exceed their KDEP risk-based screening value are similar to those for the RGA. Additionally, the analytes that are greater than their KDEP risk-based screening value when derived over all observations are identical to those that are derived over averages within wells. When segregated into the groups used previously, no McNairy Formation background concentration is seen to exceed its KDEP risk-based screening value by more than 2 or more orders of magnitude, no McNairy Formation background concentrations exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude, and two McNairy Formation background concentrations exceed their KDEP risk-based screening value by less than 1 order of magnitude. The analytes falling within each group are summarized below.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their KDEP risk-based screening value by more than 2 orders of magnitude–none.

- Analytes with McNairy Formation background concentration derived quantitatively that exceed their KDEP risk-based screening value by more than 1 but less than 2 orders of magnitude–none.

- Analytes with McNairy Formation background concentrations derived quantitatively that exceed their KDEP risk-based screening value by less than 1 order of magnitude–manganese and manganese, dissolved.

5.2 COMPARISON OF BACKGROUND CONCENTRATIONS TO VALUES CONTAINED IN EARLIER REPORTS AND FOUND IN THE OPEN LITERATURE

Tables comparing the background concentrations to values derived in earlier reports or to naturally occurring values found in the open literature are presented on the following pages. In Tables 5.9 and 5.10, the background concentrations derived for the RGA over all observations and over average concentrations within wells, respectively, are compared to these values. In Tables 5.11 and 5.12, the background concentrations derived for the McNairy Formation over all observations and over average concentrations within wells, respectively, are compared to values from the open literature values alone because background concentrations for the McNairy Formation have not been presented previously.

Earlier reports produced for the PGDP providing values are *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a), *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991), and *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995). Values cited as reference or background values in these reports were derived as follows:

- *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a). In this report, groundwater data were from six wells completed in the RGA. These wells were MW103, MW106, MW141, MW142, MW150, and MW199. (Note that these are the same wells used as background RGA wells in the current report. See Fig. 2.1 for their location.) The metric selected as the reference concentration was twice each analyte's average concentration.

Table 5.9. Comparison between RGA background concentrations over all observations derived in this report and background concentrations derived in the Tech Report, Site Investigation, and Moore Report or drawn from the open literature

Analyte	Background[a]	Source				Values Exceeded[f]
		Tech Report[b]	Site Investigation[c]	Moore Report[d]	Open Literature[e]	
Inorganic Chemicals (mg/L)						
Aluminum	2.189	2.19	8.880	NV	NV	None
Aluminum, Dissolved	0.311	NV	0.195	NV	0.0001 to 0.1	c, e
Antimony	0.060 †	0.111	ND	0.050	NV	None
Antimony, Dissolved	0.060 †	NV	0.027	NV	0.0001 to 0.1	c
Arsenic	0.005 †	0.011	ND	0.023	NV	None
Arsenic, Dissolved	0.005 †	NV	ND	NV	0.0001 to 0.1	None
Barium	0.235	0.286	0.210	0.15	NV	c, d
Barium, Dissolved	0.200	NV	0.195	NV	0.0001 to 0.1	c, e
Beryllium	0.004 †	0.009	ND	0.003	NV	d
Beryllium, Dissolved	0.004 †	NV	ND	NV	<0.001	e
Cadmium	0.010 †	0.021	ND	0.005	NV	None
Cadmium, Dissolved	0.010 †	NV	ND	NV	0.0001 to 0.1	None
Calcium	41.238	44.2	38.700	NV	NV	c
Calcium, Dissolved	38.166	NV	38.100	NV	1.0 to 1000	c
Chloride	91.021	68.6	NV	NV	1.0 to 1000	b
Chromium	0.144	0.131	0.031	0.040	NV	b, c, d
Chromium, Dissolved	0.050 †	NV	0.002	NV	0.0001 to 0.1	c
Cobalt	0.045 †	0.096	0.008	0.010	NV	c, d
Cobalt, Dissolved	0.045 †	NV	0.005	NV	0.0001 to 0.1	c
Copper	0.036	0.022	0.012	0.090	NV	b, c
Copper, Dissolved	0.020	NV	ND	NV	0.0001 to 0.1	c
Fluoride	0.270	0.354	NV	NV	0.01 to 10.0	None
Iron	5.030	5.06	16.400	NV	NV	None
Iron, Dissolved	0.267	NV	2.04	NV	0.01 to 10.0	None
Lead	0.129	0.104	0.004	0.015	NV	b, c, d
Lead, Dissolved	0.098	NV	ND	NV	0.0001 to 0.1	None
Magnesium	16.262	16.7	15.200	NV	NV	c
Magnesium, Dissolved	16.215	NV	15.0	NV	1.0 to 1000	c
Manganese	0.119	0.159	0.335	NV	NV	None
Manganese, Dissolved	0.068	NV	0.264	NV	0.0001 to 0.1	None
Mercury	0.0002 †	0.0004	ND	0.0002	NV	None
Mercury, Dissolved	0.0002 †	NV	ND	NV	NV	None
Molybdenum	0.050 †	0.100	NV	NV	NV	None
Molybdenum, Dissolved	0.050 †	NV	NV	NV	0.0001 to 0.1	None
Nickel	0.682	0.062	0.010	0.009	NV	b, c, d
Nickel, Dissolved	0.305	NV	0.005	NV	0.0001 to 0.1	c, e
Nitrate as Nitrogen	15.561	6.13	NV	NV	0.01 to 10.0	b, e
Potassium	5.195	6.18	8.510	NV	NV	None
Potassium, Dissolved	4.096	NV	8.850	NV	0.01 to 10.0	None
Selenium	0.005 †	0.009	0.003	0.001	NV	c, d
Selenium, Dissolved	0.005 †	NV	0.003	NV	0.0001 to 0.1	c
Silica	26.401	39.3	NV	NV	NV	None
Silver	0.011 †	0.004	ND	0.010	NV	b, d
Silver, Dissolved	0.060 †	NV	ND	NV	<0.001	e
Sodium	59.450	60.2	97.600	200	NV	None
Sodium, Dissolved	60.433	NV	98.300	NV	1.0 to 1000	None
Sulfate	19.947	19.9	NV	NV	1.0 to 1000	None
Thallium	0.056 †	0.108	ND	0.012	NV	d

Table 5.9. Comparison between RGA background concentrations over all observations derived in this report and background concentrations derived in the Tech Report, Site Investigation, and Moore Report or drawn from the open literature (continued)

Analyte	Background[a]	Source: Tech Report[b]	Source: Site Investigation[c]	Source: Moore Report[d]	Source: Open Literature[e]	Values Exceeded[f]
Inorganic Chemicals (mg/L) (continued)						
Thallium, Dissolved	0.056 †	NV	ND	NV	<0.001	e
Uranium	0.002 †	0.002	NV	NV	NV	None
Uranium, Dissolved	0.002 †	NV	NV	NV	0.0001 to 0.1	None
Vanadium	0.134	0.137	0.005	0.010	NV	c, d
Vanadium, Dissolved	0.134	NV	0.001	NV	0.0001 to 0.1	c, e
Zinc	0.054	0.027	0.116	0.6	NV	b
Zinc, Dissolved	0.049	NV	0.049	NV	0.0001 to 0.1	None
Radionuclides (pCi/L)						
Gross Alpha	5.8	NV	ND	NV	NV	c
Gross Beta	13.8	NV	19	NV	NV	None
Neptunium-237	0.8	NV	ND	NV	NV	c
Plutonium-239	0.1	NV	ND	NV	NV	c
Radium-226	0.6	NV	NV	NV	NV	None
Radon-222	626	NV	NV	NV	NV	None
Technetium-99	22.3	NV	ND	NV	NV	c
Thorium-230	1.1	1.41	0.26	NV	NV	c
Total Radium	1.3	0.938	NV	NV	NV	b
Uranium-234	0.7	1.21	0.53	NV	NV	c
Uranium-235	0.3	0.153	ND	NV	NV	b, c
Uranium-238	0.7	1.04	ND	NV	NV	c

Notes:

NV = No value reported.

ND = Value reported as detection limit in CH2M Hill 1992 (Table 4-2 or 4-3).

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] Values from *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a).

[c] Values from Tables 4-2 and 4-3 in *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991).

[d] Values from Table 9 in *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995). Although presented here as being for samples drawn from the RGA, Moore states that these background values are "maximum background concentrations in groundwater" at the PGDP.

[e] Values from lists presented in Table 4.2 in *Hydrogeology* (Davis and DeWiest 1966). Note, only dissolved concentrations are presented because total concentrations are highly dependent on methods of sample collection and sample preservation.

[f] Footnote labels attached to previous columns are used to identify values exceeded.

Table 5.10. Comparison between RGA background concentrations over averages within wells derived in this report and background concentrations derived in the Tech Report, Site Investigation, and Moore Report or drawn from the open literature

Analyte	Background[a]	Source				Values Exceeded[f]
		Tech Report[b]	Site Investigation[c]	Moore Report[d]	Open Literature[e]	
Inorganic Chemicals (mg/L)						
Aluminum	1.64	2.19	8.880	NV	NV	None
Aluminum, Dissolved	0.201	NV	0.195	NV	0.0001 to 0.1	c, e
Antimony	0.060 †	0.111	ND	0.050	NV	d
Antimony, Dissolved	0.060 †	NV	0.027	NV	0.0001 to 0.1	c
Arsenic	0.005 †	0.011	ND	0.023	NV	None
Arsenic, Dissolved	0.005 †	NV	ND	NV	0.0001 to 0.1	None
Barium	0.202	0.286	0.210	0.15	NV	d
Barium, Dissolved	0.179	NV	0.195	NV	0.0001 to 0.1	e
Beryllium	0.004 †	0.009	ND	0.003	NV	d
Beryllium, Dissolved	0.004 †	NV	ND	NV	<0.001	e
Cadmium	0.010 †	0.021	ND	0.005	NV	d
Cadmium, Dissolved	0.010 †	NV	ND	NV	0.0001 to 0.1	None
Calcium	40.0	44.2	38.700	NV	NV	c
Calcium, Dissolved	35.8	NV	38.100	NV	1.0 to 1000	None
Chloride	89.2	68.6	NV	NV	1.0 to 1000	b
Chromium	0.134	0.131	0.031	0.040	NV	b, c, d
Chromium, Dissolved	0.050 †	NV	0.002	NV	0.0001 to 0.1	c
Cobalt	0.045 †	0.096	0.008	0.010	NV	c, d
Cobalt, Dissolved	0.045 †	NV	0.005	NV	0.0001 to 0.1	c
Copper	0.034	0.022	0.012	0.090	NV	b, c
Copper, Dissolved	0.018	NV	ND	NV	0.0001 to 0.1	c
Fluoride	0.245	0.354	NV	NV	0.01 to 10.0	None
Iron	3.72	5.06	16.400	NV	NV	None
Iron, Dissolved	0.164	NV	2.04	NV	0.01 to 10.0	None
Lead	0.250	0.104	0.004	0.015	NV	b, c, d
Lead, Dissolved	0.250	NV	ND	NV	0.0001 to 0.1	c, e
Magnesium	15.7	16.7	15.200	NV	NV	c
Magnesium, Dissolved	15.4	NV	15.0	NV	1.0 to 1000	c
Manganese	0.082	0.159	0.335	NV	NV	None
Manganese, Dissolved	0.048	NV	0.264	NV	0.0001 to 0.1	None
Mercury	0.0002 †	0.0004	ND	0.0002	NV	None
Mercury, Dissolved	0.0002 †	NV	ND	NV	NV	None
Molybdenum	0.050 †	0.100	NV	NV	NV	None
Molybdenum, Dissolved	0.050 †	NV	NV	NV	0.0001 to 0.1	None
Nickel	0.682	0.062	0.010	0.009	NV	b, c, d
Nickel, Dissolved	0.305	NV	0.005	NV	0.0001 to 0.1	c, e
Nitrate as Nitrogen	13.5	6.13	NV	NV	0.01 to 10.0	b, e
Potassium	4.47	6.18	8.510	NV	NV	None
Potassium, Dissolved	3.70	NV	8.850	NV	0.01 to 10.0	None
Selenium	0.005 †	0.009	0.003	0.001	NV	c, d
Selenium, Dissolved	0.005 †	NV	0.003	NV	0.0001 to 0.1	c
Silica	21.1	39.3	NV	NV	NV	None
Silver	0.011 †	0.004	ND	0.010	NV	b, d
Silver, Dissolved	0.060 †	NV	ND	NV	<0.001	e
Sodium	63.5	60.2	97.600	200	NV	b
Sodium, Dissolved	65.7	NV	98.300	NV	1.0 to 1000	None
Sulfate	19.1	19.9	NV	NV	1.0 to 1000	None
Thallium	0.056 †	0.108	ND	0.012	NV	d

Table 5.10. Comparison between RGA background concentrations over averages within wells derived in this report and background concentrations derived in the Tech Report, Site Investigation, and Moore Report or drawn from the open literature (continued)

Analyte	Background[a]	Source: Tech Report[b]	Site Investigation[c]	Moore Report[d]	Open Literature[e]	Values Exceeded[f]
Inorganic Chemicals (mg/L) (continued)						
Thallium, Dissolved	0.056 †	NV	ND	NV	<0.001	e
Uranium	0.002 †	0.002	NV	NV	NV	None
Uranium, Dissolved	0.002 †	NV	NV	NV	0.0001 to 0.1	None
Vanadium	0.139	0.137	0.005	0.010	NV	b, c, d
Vanadium, Dissolved	0.131	NV	0.001	NV	0.0001 to 0.1	c, e
Zinc	0.025	0.027	0.116	0.6	NV	None
Zinc, Dissolved	0.026	NV	0.049	NV	0.0001 to 0.1	None
Radionuclides (pCi/L)						
Gross Alpha	2.36	NV	ND	NV	NV	c
Gross Beta	7.3	NV	19	NV	NV	None
Neptunium-237	0.21	NV	ND	NV	NV	c
Plutonium-239	0.03	NV	ND	NV	NV	c
Radium-226	0.10	NV	NV	NV	NV	None
Radon-222	555.3	NV	NV	NV	NV	None
Technetium-99	10.8	NV	ND	NV	NV	c
Thorium-230	0.54	1.41	0.26	NV	NV	c
Total Radium	0.46	0.938	NV	NV	NV	None
Uranium-234	0.7	1.21	0.53	NV	NV	c
Uranium-235	0.3	0.153	ND	NV	NV	b, c
Uranium-238	0.7	1.04	ND	NV	NV	c

Notes:

NV = No value reported.

ND = Value reported as detection limit in CH2M Hill 1992 (Table 4-2 or 4-3).

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] Values from *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant* (DOE 1994a).

[c] Values from Tables 4-2 and 4-3 in *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991).

[d] Values from Table 9 in *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995). Although presented here as being for samples drawn from the RGA, Moore states that these background values are “maximum background concentrations in groundwater” at the PGDP.

[e] Values from lists presented in Table 4.2 in *Hydrogeology* (Davis and DeWiest 1966). Note, only dissolved concentrations are presented because total concentrations are highly dependent on methods of sample collection and sample preservation.

[f] Footnote labels attached to previous columns are used to identify values exceeded.

Table 5.11. Comparison between McNairy Formation background concentrations over all observations derived in this report and background concentrations drawn from the open literature

Analyte	Background[a]	Open Literature[b]	Values Exceeded?
Inorganic Chemicals (mg/L)			
Aluminum	0.687	NV	No
Aluminum, Dissolved	0.579	0.0001 to 0.1	Yes
Antimony	0.060 †	NV	No
Antimony, Dissolved	0.060 †	0.0001 to 0.1	No
Arsenic	0.005 †	NV	No
Arsenic, Dissolved	0.005 †	0.0001 to 0.1	No
Barium	0.296	NV	No
Barium, Dissolved	0.268	0.0001 to 0.1	Yes
Beryllium	0.017 †	NV	No
Beryllium, Dissolved	0.004 †	<0.001	Yes
Cadmium	0.010 †	NV	No
Cadmium, Dissolved	0.010 †	0.0001 to 0.1	No
Calcium	38.858	NV	No
Calcium, Dissolved	38.829	1.0 to 1000	No
Chloride	19.708	1.0 to 1000	No
Chromium	0.060 †	NV	No
Chromium, Dissolved	0.050 †	0.0001 to 0.1	No
Cobalt	0.096	NV	No
Cobalt, Dissolved	0.045 †	0.0001 to 0.1	No
Copper	0.057	NV	No
Copper, Dissolved	0.013 †	0.0001 to 0.1	No
Fluoride	0.330	0.01 to 10.0	No
Iron	18.360	NV	No
Iron, Dissolved	12.372	0.01 to 10.0	Yes
Lead	0.050 †	NV	No
Lead, Dissolved	0.050 †	0.0001 to 0.1	No
Magnesium	13.418	NV	No
Magnesium, Dissolved	14.171	1.0 to 1000	No
Manganese	0.941	NV	No
Manganese, Dissolved	0.894	0.0001 to 0.1	Yes
Mercury	0.0002 †	NV	No
Mercury, Dissolved	0.0002 †	NV	No
Molybdenum	0.050 †	NV	No
Molybdenum, Dissolved	0.050 †	0.0001 to 0.1	No
Nickel	0.109 †	NV	No
Nickel, Dissolved	0.050 †	0.0001 to 0.1	No
Nitrate as Nitrogen	1.474	0.01 to 10.0	No
Potassium	55.752	NV	No
Potassium, Dissolved	51.205	0.01 to 10.0	Yes
Selenium	0.005 †	NV	No
Selenium, Dissolved	0.005 †	0.0001 to 0.1	No
Silica	36.0	NV	No
Silver	0.050 †	NV	No
Silver, Dissolved	0.050 †	<0.001	Yes
Sodium	29.2	NV	No
Sodium, Dissolved	27.98	1.0 to 1000	No
Sulfate	28.9	1.0 to 1000	No
Thallium	0.644	NV	No
Thallium, Dissolved	0.056 †	<0.001	Yes
Uranium	0.001 †	NV	No
Uranium, Dissolved	0.001	0.0001 to 0.1	No

Table 5.11. Comparison between McNairy Formation background concentrations over all observations derived in this report and background concentrations drawn from the open literature (continued)

Analyte	Background[a]	Open Literature[b]	Values Exceeded?
	Inorganic Chemicals (mg/L) (continued)		
Vanadium	0.126	NV	No
Vanadium, Dissolved	0.126	0.0001 to 0.1	Yes
Zinc	0.142	NV	No
Zinc, Dissolved	0.116	0.0001 to 0.1	Yes
Radionuclides (pCi/L)			
Gross Alpha	11.9	NV	No
Gross Beta	144.5	NV	No
Neptunium-237	0.5	NV	No
Plutonium-239	0.2	NV	No
Radium-226	1.2	NV	No
Radon-222	295	NV	No
Technetium-99	20.6	NV	No
Thorium-230	1.5	NV	No
Total Radium	0.7	NV	No
Uranium-234	0.3	NV	No
Uranium-235	0.2	NV	No
Uranium-238	0.3	NV	No

Notes:
NV = No value reported.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.
[b] Values from lists presented in Table 4.2 in *Hydrogeology* (Davis and DeWiest 1966). Note, only dissolved concentrations are presented because total concentrations are highly dependent on methods of sample collection and sample preservation.

Table 5.12. Comparison between McNairy Formation background concentrations over averages within wells derived in this report and background concentrations drawn from the open literature

Analyte	Background[a]	Open Literature[b]	Values Exceeded?
	Inorganic Chemicals (mg/L)		
Aluminum	0.75	NV	No
Aluminum, Dissolved	0.587	0.0001 to 0.1	Yes
Antimony	0.060 †	NV	No
Antimony, Dissolved	0.060 †	0.0001 to 0.1	No
Arsenic	0.005 †	NV	No
Arsenic, Dissolved	0.005 †	0.0001 to 0.1	No
Barium	0.265	NV	No
Barium, Dissolved	0.266	0.0001 to 0.1	Yes
Beryllium	0.017 †	NV	No
Beryllium, Dissolved	0.004 †	<0.001	Yes
Cadmium	0.010 †	NV	No
Cadmium, Dissolved	0.010 †	0.0001 to 0.1	No
Calcium	39.47	NV	No
Calcium, Dissolved	40.27	1.0 to 1000	No
Chloride	20.23	1.0 to 1000	No
Chromium	0.060 †	NV	No
Chromium, Dissolved	0.050 †	0.0001 to 0.1	No
Cobalt	0.072	NV	No
Cobalt, Dissolved	0.045 †	0.0001 to 0.1	No
Copper	0.033	NV	No
Copper, Dissolved	0.013 †	0.0001 to 0.1	No
Fluoride	0.298	0.01 to 10.0	No
Iron	15.83	NV	No
Iron, Dissolved	9.446	0.01 to 10.0	No
Lead	0.050 †	NV	No
Lead, Dissolved	0.050 †	0.0001 to 0.1	No
Magnesium	16.457	NV	No
Magnesium, Dissolved	14.533	1.0 to 1000	No
Manganese	0.729	NV	No
Manganese, Dissolved	0.682	0.0001 to 0.1	Yes
Mercury	0.0002 †	NV	No
Mercury, Dissolved	0.0002 †	NV	No
Molybdenum	0.050 †	NV	No
Molybdenum, Dissolved	0.050 †	0.0001 to 0.1	No
Nickel	0.109 †	NV	No
Nickel, Dissolved	0.050 †	0.0001 to 0.1	No
Nitrate as Nitrogen	1.43	0.01 to 10.0	No
Potassium	64.080	NV	No
Potassium, Dissolved	58.750	0.01 to 10.0	Yes
Selenium	0.005 †	NV	No
Selenium, Dissolved	0.005 †	0.0001 to 0.1	No
Silica	29.4	NV	No
Silver	0.050 †	NV	No
Silver, Dissolved	0.050 †	<0.001	Yes
Sodium	24.92	NV	No
Sodium, Dissolved	25.90	1.0 to 1000	No
Sulfate	27.27	1.0 to 1000	No
Thallium	0.255	NV	No
Thallium, Dissolved	0.056 †	<0.001	Yes
Uranium	0.001 †	NV	No
Uranium, Dissolved	0.001	0.0001 to 0.1	No

Table 5.12. Comparison between McNairy Formation background concentrations over averages within wells derived in this report and background concentrations drawn from the open literature (continued)

Analyte	Background[a]	Open Literature[b]	Values Exceeded?
Inorganic Chemicals (mg/L) (continued)			
Vanadium	0.119	NV	No
Vanadium, Dissolved	0.107	0.0001 to 0.1	Yes
Zinc	0.104	NV	No
Zinc, Dissolved	0.080	0.0001 to 0.1	No
Radionuclides (pCi/L)			
Gross Alpha	5.3	NV	No
Gross Beta	125.4	NV	No
Neptunium-237	0.13	NV	No
Plutonium-239	0.04	NV	No
Radium-226	0.29	NV	No
Radon-222	228.3	NV	No
Technetium-99	7.8	NV	No
Thorium-230	0.40	NV	No
Total Radium	0.36	NV	No
Uranium-234	0.3	NV	No
Uranium-235	0.2	NV	No
Uranium-238	0.3	NV	No

Notes:

NV = No value reported.

[a] Background concentrations marked with a dagger (†) were derived qualitatively because they were either never detected or were only detected at concentrations near their detection limit. Therefore, the actual background concentrations may be less than those reported here.

[b] Values from lists presented in Table 4.2 in *Hydrogeology* (Davis and DeWiest 1966). Note, only dissolved concentrations are presented because total concentrations are highly dependent on methods of sample collection and sample preservation.

- *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant* (CH2M Hill 1991). In this report, groundwater data were from six wells completed in both the RGA and the McNairy Formation. These wells were MW120, MW129, MW130, MW131, MW150, and MW196. (Note that MW120 is used as a McNairy Formation background well in the current report and that MW150 is used as a RGA background well in the current report. See Fig. 2.1 for their location. MW129, MW130, and MW131 are located in the same general area as MW120. However, these wells are completed in what is termed Terrace Gravels and not in either the RGA or McNairy Formation. Similarly, MW196 is completed in the Terrace Gravels. This well is located to the south of the plant.) The metric selected as the reference concentration was each analyte's maximum detected concentration.

- *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (Moore 1995). In this report, all RGA groundwater data previously collected at the PGDP were compiled and density plots were created. The values selected as the maximum background concentration in groundwater were determined from these plots.

5.2.1 Aluminum

RGA. When summarized over all observations and over averages within wells, the background concentrations for aluminum in water drawn from the RGA (2.189 and 1.64 mg/l, respectively) are less than the values reported earlier (Tech Report, 2.19 mg/l; Site Investigation, 8.880 mg/l). A value for aluminum is not available in the Moore Report, and, as discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for aluminum in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for aluminum in water drawn from the McNairy Formation are 0.687 and 0.75 mg/l, respectively. As noted above, no values are available for comparison.

5.2.2 Aluminum, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for aluminum, dissolved in water drawn from the RGA (0.311 and 0.201 mg/l, respectively) exceed value reported earlier in the Site Investigation (0.195 mg/l) and exceed the background range found in the open literature (0.0001 to 0.1 mg/l, respectively). Values for aluminum, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for aluminum, dissolved in water drawn from the McNairy Formation (0.579 and 0.587 mg/l, respectively) exceed the background range found in the open literature (0.0001 and 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.3 Antimony

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony in water drawn from the RGA (0.060 mg/l for both) are less than the value reported earlier in the Tech Report (0.111 mg/l) but greater than the value reported in the Moore Report (0.050 mg/l). Like the result derived here which is based upon a detection limit, the result for antimony was reported as a nondetect in the Site Investigation. Also, as discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not reported for antimony in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for antimony in water drawn from the McNairy Formation are 0.060 mg/l for both. As noted above, no values are available for comparison.

5.2.4 Antimony, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony, dissolved in water drawn from the RGA (0.060 mg/l for both) exceed the value reported earlier in the Site Investigation (0.027 mg/l) but are within the range found in the open literature (0.0001 to 0.1 mg/l). Values for antimony, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for antimony, dissolved in water drawn from the McNairy Formation (0.060 mg/l for both) falls within the background range found in the open literature (0.0001 and 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.5 Arsenic

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic in water drawn from the RGA (0.005 mg/l for both) are less than the values reported earlier in the Tech Report and the Moore Report (0.011 and 0.023 mg/l, respectively). Like the background result derived here which is based on a detection limit, the result for arsenic was reported as a nondetect in the Site Investigation. Also, as discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for arsenic in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic in water drawn from the McNairy Formation are 0.005 mg/l for both. As noted above, no values are available for comparison.

5.2.6 Arsenic, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic, dissolved in water drawn from the RGA (0.005 mg/l for both) are within the range found in the open literature (0.0001 to 0.1 mg/l) and, similar to the result in the Site Investigation, are set at the detection limit. Values for arsenic, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for arsenic, dissolved in water drawn from the McNairy Formation (0.005 mg/l for both) fall within the background range found in the open literature (0.0001 and 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.7 Barium

RGA. When summarized over all observations, the background concentration for barium in water drawn from the RGA (0.235 mg/l) is less than the value reported earlier in the Tech Report (0.286 mg/l) but is greater than the values reported in the Site Investigation and Moore Report (0.210 and 0.15 mg/l, respectively). However, when summarized over averages within wells, the background concentration for barium in water drawn from the RGA (0.202 mg/l) is less than the values reported in the Tech Report and the

Site Investigation (0.286 and 0.210 mg/l, respectively) but is greater than the value reported in the Moore Report (0.15 mg/l). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for barium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for barium in water drawn from the McNairy Formation are 0.296 and 0.265 mg/l, respectively. As noted above, no values are available for comparison.

5.2.8 Barium, Dissolved

RGA. When summarized over all observations, the background concentration for barium, dissolved in water drawn from the RGA (0.200 mg/l) is similar to the value in the Site Investigation (0.195 mg/l) and exceeds the range found in the open literature (0.0001 to 0.1 mg/l). When summarized over averages within wells, the background concentration for barium, dissolved in water drawn from the RGA (0.179 mg/l) is less than the value in the Site Investigation (0.195 mg/l) and exceeds the range found in the open literature (0.0001 to 0.1 mg/l). Values for barium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for barium, dissolved in water drawn from the McNairy Formation (0.296 and 0.266 mg/l, respectively) exceed the background range found in the open literature (0.0001 and 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.9 Beryllium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium in water drawn from the RGA (0.0.004 mg/l for both) are less than the value reported earlier in the Tech Report (0.009 mg/l) but are greater than the value reported in the Moore Report (0.003 mg/l). Also, similar to the result in the Site Investigation which reported the background concentration as a nondetect, the background value derived here is set at the detection limit. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for beryllium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium in water drawn from the McNairy Formation are 0.017 and 0.004 mg/l, respectively. As noted above, no values are available for comparison.

5.2.10 Beryllium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium, dissolved in water drawn from the RGA (0.004 mg/l for both) are similar to the value in the Site Investigation (i.e., "ND" or nondetect) in that the values derived here are based on a detection limit. However, the background concentrations are greater than the value reported in the open literature (<0.001 mg/l). Values for beryllium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for beryllium, dissolved in water drawn from the McNairy Formation (0.017 and 0.004 mg/l, respectively) exceed the background value found in the open literature (<0.001 mg/l). As noted earlier, no other values are available for comparison.

5.2.11 Cadmium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium in water drawn from the RGA (0.010 mg/l for both) are less than the value reported earlier in the Tech Report (0.0021 mg/l) but are greater than the value reported in the Moore Report (0.005 mg/l). Also, similar to the result in the Site Investigation which reported the background concentration as a nondetect, the background value derived here is set at the detection limit. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for cadmium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium in water drawn from the McNairy Formation are 0.010 mg/l for both. As noted above, no values are available for comparison.

5.2.12 Cadmium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium, dissolved in water drawn from the RGA (0.010 mg/l for both) are similar to the value in the Site Investigation (i.e., "ND" or nondetect) in that the values derived here are based on a detection limit. Also, the background concentrations are within the range of the values reported in the open literature (0.0001 to 0.1 mg/l). Values for cadmium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cadmium, dissolved in water drawn from the McNairy Formation (0.010 mg/l for both) are within the background range found in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.13 Calcium

RGA. When summarized over all observations and over averages within wells, the background concentrations for calcium in water drawn from the RGA (41.238 and 40.0 mg/l, respectively) are less than the value reported earlier in the Tech Report (44.2 mg/l) but are greater than the value reported in the Site Investigation (38.700 mg/l). A value is not available from the Moore Report. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for calcium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for calcium in water drawn from the McNairy Formation are 38.858 and 39.47 mg/l, respectively. As noted above, no values are available for comparison.

5.2.14 Calcium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for calcium, dissolved in water drawn from the RGA (38.166 and 35.8 mg/l, respectively) are similar to the value in the Site Investigation (38.100 mg/l). Also, the background concentrations are within the range of the values reported in the open literature (1.0 to 1000 mg/l). Values for calcium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for calcium, dissolved in water drawn from the McNairy Formation (38.829 and 40.27 mg/l, respectively) fall within the range of values reported in the open literature (1.0 to 1000 mg/l). As noted earlier, no other values are available for comparison.

5.2.15 Chloride

RGA. When summarized over all observations and over averages within wells, the background concentrations for chloride in water drawn from the RGA (91.021 and 89.2 mg/l, respectively) are greater than the value reported earlier in the Tech Report (68.6 mg/l) but fall within the range of values reported in the open literature (1.0 to 1000 mg/l). Values are not available from the Site Investigation and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for chloride in water drawn from the McNairy Formation (19.708 and 20.23 mg/l, respectively) fall within the range of values found in the open literature (1.0 to 1000 mg/l). As noted above, no other values are available for comparison.

5.2.16 Chromium

RGA. When summarized over all observations and over averages within wells, the background concentrations for chromium in water drawn from the RGA (0.144 and 0.134 mg/l, respectively) are greater than the values found in earlier reports (Tech Report, 0.131 mg/l; Site Investigation 0.031 mg/l; Moore Report 0.040 mg/l). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for chromium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium in water drawn from the McNairy Formation are 0.060 mg/l for both. As noted above, no values are available for comparison.

5.2.17 Chromium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium, dissolved in water drawn from the RGA (0.050 mg/l for both) are greater than the value in the Site Investigation (0.002 mg/l). However, the background concentrations are within the range of the values reported in the open literature (0.0001 to 0.1 mg/l). Values for chromium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for chromium, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) fall within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.18 Cobalt

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt in water drawn from the RGA (0.045 mg/l for both) are less than the value found in the Tech Report (0.096 mg/l) but are greater than the values found in the Site Investigation and the Moore Report (0.008 and 0.010 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for cobalt in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for cobalt in water drawn from the McNairy Formation are 0.096 and 0.072 mg/l, respectively. As noted above, no values are available for comparison.

5.2.19 Cobalt, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt, dissolved in water drawn from the RGA (0.045 mg/l for both) are greater than the value in the Site Investigation (0.005 mg/l). However, the background concentrations are within the range of the values reported in the open literature (0.0001 to 0.1 mg/l). Values for cobalt, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for cobalt, dissolved in water drawn from the McNairy Formation (0.045 mg/l for both) fall within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.20 Copper

RGA. When summarized over all observations and over averages within wells, the background concentrations for copper in water drawn from the RGA (0.036 and 0.034 mg/l, respectively) are greater than the values found in the Tech Report and Site Investigation (0.022 and 0.012 mg/l, respectively) but are less than the value found in the Moore Report (0.090 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for copper in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for copper in water drawn from the McNairy Formation are 0.057 and 0.033 mg/l, respectively. As noted above, no values are available for comparison.

5.2.21 Copper, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for copper, dissolved in water drawn from the RGA (0.020 and 0.018 mg/l, respectively) differ from the value in the Site Investigation ("ND" or nondetect) in that the background concentrations derived here are not based upon the detection limit. However, the background concentrations are within the range of the values reported in the open literature (0.0001 to 0.1 mg/l). Values for copper, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for copper, dissolved in water drawn from the McNairy Formation (0.013 mg/l for both) fall within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.22 Fluoride

RGA. When summarized over all observations and over averages within wells, the background concentrations for fluoride in water drawn from the RGA (0.270 and 0.245 mg/l, respectively) are less than the value reported earlier in the Tech Report (0.354 mg/l) but fall within the range of values reported in the open literature (0.01 to 10.0 mg/l). Values are not available from the Site Investigation and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for fluoride in water drawn from the McNairy Formation (0.330 and 0.298 mg/l, respectively) fall within the range of values found in the open literature (0.01 to 10.0 mg/l). As noted above, no other values are available for comparison.

5.2.23 Iron

RGA. When summarized over all observations and over averages within wells, the background concentrations for iron in water drawn from the RGA (5.030 and 3.72 mg/l, respectively) are less than the values found in the Tech Report and Site Investigation (5.06 and 16.400 mg/l, respectively). A value is not available in the Moore Report. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for iron in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for iron in water drawn from the McNairy Formation are 18.360 and 15.83 mg/l, respectively. As noted above, no values are available for comparison.

5.2.24 Iron, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for iron, dissolved in water drawn from the RGA (0.267 and 0.164 mg/l, respectively) are less than the value in the Site Investigation (2.04 mg/l). Also, the background concentrations are within the range of the values reported in the open literature (0.01 to 10.0 mg/l). Values for iron, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for iron, dissolved in water drawn from the McNairy Formation (12.372 and 9.446 mg/l, respectively) are near the upper end of the range of values reported in the open literature (0.01 to 10.0 mg/l). As noted earlier, no other values are available for comparison.

5.2.25 Lead

RGA. When summarized over all observations and over averages within wells, the background concentrations for lead in water drawn from the RGA (0.129 and 0.250 mg/l, respectively) are greater than the values found in earlier reports (Tech Report, 0.104 mg/l; Site Investigation, 0.004; Moore Report 0.015 mg/l). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for lead in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for lead in water drawn from the McNairy Formation are 0.050 mg/l for both. As noted above, no values are available for comparison.

5.2.26 Lead, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for lead, dissolved in water drawn from the RGA (0.098 and 0.250 mg/l, respectively) and unlike those reported in the Site Investigation ("ND" or nondetect) are not based upon a detection limit. The background level derived over all observations (0.098 mg/l) is similar to the upper end of the range of values found in the open literature (0.0001 to 0.1 mg/l), but the background level derived over averages within wells (0.250 mg/l) exceeds this range. Values for lead, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for lead, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) are within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.27 Magnesium

RGA. When summarized over all observations and over averages within wells, the background concentrations for magnesium in water drawn from the RGA (16.262 and 15.7 mg/l, respectively) are similar to values found in the Tech Report and Site Investigation (16.7 and 15.200 mg/l, respectively). A value was not available in the Moore Report. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for magnesium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for magnesium in water drawn from the McNairy Formation are 13.418 and 16.457 mg/l, respectively. As noted above, no values are available for comparison.

5.2.28 Magnesium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for magnesium, dissolved in water drawn from the RGA (16.215 and 15.4 mg/l, respectively) are similar to but greater than the value in the Site Investigation (15.0 mg/l). The background concentrations are within the range of the values reported in the open literature (1.0 to 1000 mg/l). Values for magnesium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for magnesium, dissolved in water drawn from the McNairy Formation (14.171 and 14.533 mg/l for both) are within the range of values reported in the open literature (1.0 to 1000 mg/l). As noted earlier, no other values are available for comparison.

5.2.29 Manganese

RGA. When summarized over all observations and over averages within wells, the background concentrations for manganese in water drawn from the RGA (0.119 and 0.082 mg/l, respectively) are less than values found in the Tech Report and Site Investigation (0.159 and 0.335 mg/l, respectively). A value was not available in the Moore Report. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for manganese in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for manganese in water drawn from the McNairy Formation are 0.941 and 0.729 mg/l, respectively. As noted above, no values are available for comparison.

5.2.30 Manganese, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for manganese, dissolved in water drawn from the RGA (0.068 and 0.048 mg/l, respectively) are less than the value in the Site Investigation (0.264 mg/l). The background concentrations are within the range of the values reported in the open literature (0.0001 to 0.1 mg/l). Values for manganese, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for manganese, dissolved in water drawn from the McNairy Formation (0.894 and 0.682 mg/l, respectively) fall outside the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.31 Mercury

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury in water drawn from the RGA (0.0002 mg/l for both) are less than value found in the Tech Report (0.004 mg/l) and equal to the value in the Moore Report (0.0002 mg/l). Also, like the value in the Site Investigation ("ND" or nondetect), the background concentrations derived here are based upon the detection limit. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for mercury in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury in water drawn from the McNairy Formation are 0.0002 mg/l for both. As noted above, no values are available for comparison.

5.2.32 Mercury, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury, dissolved in water drawn from the RGA (0.0002 mg/l for both), like that in the Site Investigation ("ND" or nondetect), are based upon a detection limit. Values for mercury, dissolved are not available for comparison in the Tech Report, the Moore Report, or open literature.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for mercury, dissolved in water drawn from the McNairy Formation are 0.0002 mg/l for both. A value from the open literature was not available for comparison.

5.2.33 Molybdenum

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum in water drawn from the RGA (0.50 mg/l for both) are less than value found in the Tech Report (0.100 mg/l). Values are not available in the Site Investigation and the Moore Report. Also, as discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for molybdenum in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum in water drawn from the McNairy Formation are 0.050 mg/l for both. As noted above, no values are available for comparison.

5.2.34 Molybdenum, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum, dissolved in water drawn from the RGA (0.050 mg/l for both) are within the range of values found in the open literature (0.0001 to 0.1 mg/l). Values for molybdenum, dissolved are not available in earlier reports.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for molybdenum, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) are within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.35 Nickel

RGA. When summarized over all observations and over averages within wells, the background concentrations for nickel in water drawn from the RGA (0.682 mg/l for both) are greater than the values found in earlier reports (Tech Report, 0.062 mg/l; Site Investigation, 0.010 mg/l; Moore Report, 0.009 mg/l). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for nickel in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for nickel in water drawn from the McNairy Formation are 0.109 mg/l for both. As noted above, no values are available for comparison.

5.2.36 Nickel, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for nickel, dissolved in water drawn from the RGA (0.305 mg/l for both) are greater than the value reported in the Site Investigation (0.005 mg/l) and outside the range of values found in the open literature (0.0001 to 0.1 mg/l). Values for nickel, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for nickel, dissolved in water drawn from the McNairy Formation (0.050 mg/l for both) are within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.37 Nitrate as Nitrogen

RGA. When summarized over all observations and over averages within wells, the background concentrations for nitrate as nitrogen in water drawn from the RGA (15.561 and 13.5 mg/l, respectively) are greater than the value reported earlier in the Tech Report (6.13 mg/l) and fall outside the range of values reported in the open literature (0.01 to 10.0 mg/l). Values are not available from the Site Investigation and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for nitrate as nitrogen in water drawn from the McNairy Formation (1.474 and 1.43 mg/l, respectively) fall within the range of values found in the open literature (0.01 to 10.0 mg/l). As noted above, no other values are available for comparison.

5.2.38 Potassium

RGA. When summarized over all observations and over averages within wells, the background concentrations for potassium in water drawn from the RGA (5.195 and 4.47 mg/l, respectively) are less than the values found in the Tech Report and Site Investigation (6.18 and 8.510 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for potassium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for potassium in water drawn from the McNairy Formation are 55.752 and 64.080 mg/l, respectively. As noted above, no values are available for comparison.

5.2.39 Potassium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for potassium, dissolved in water drawn from the RGA (4.096 and 3.70 mg/l, respectively) are less than the value reported in the Site Investigation (8.850 mg/l) and within the range of values found in the open literature (0.01 to 10.0 mg/l). Values for potassium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for potassium, dissolved in water drawn from the McNairy Formation (51.205 and 58.750, respectively) fall outside the range of values reported in the open literature (0.01 to 10.0 mg/l). As noted earlier, no other values are available for comparison.

5.2.40 Selenium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium in water drawn from the RGA (0.005 mg/l for both) are less than the value found in the Tech Report (0.009 mg/l) but greater than the values found in the Site Investigation and Moore Report (0.003 and 0.001 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for selenium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium in water drawn from the McNairy Formation are 0.005 mg/l for both. As noted above, no other values are available for comparison.

5.2.41 Selenium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium, dissolved in water drawn from the RGA (0.005 mg/l for both) are greater than the value reported in the Site Investigation (0.003 mg/l) but within the range of values found in the open literature (0.0001 to 0.1 mg/l). Values for selenium, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for selenium, dissolved in water drawn from the

McNairy Formation (0.050 mg/l for both) are within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.42 Silica

RGA. When summarized over all observations and over averages within wells, the background concentrations for silica in water drawn from the RGA (26.401 and 21.1 mg/l, respectively) are less than the value reported earlier in the Tech Report (39.3 mg/l). Values are not available from the Site Investigation, the Moore Report, or the open literature.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for silica in water drawn from the McNairy Formation are 36.0 and 29.4 mg/l, respectively. No values are available for comparison.

5.2.43 Silver

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver in water drawn from the RGA (0.011 mg/l for both) are greater than the values found in the Tech Report and Moore Report (0.004 and 0.010 mg/l, respectively). The value in the Site Investigation is reported as "ND" or nondetect. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for selenium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver in water drawn from the McNairy Formation are 0.050 mg/l for both. As noted above, no values are available for comparison.

5.2.44 Silver, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver, dissolved in water drawn from the RGA (0.060 mg/l for both) are similar to the value reported in the Site Investigation ("ND" or nondetect) in that the value derived here is also based upon a detection limit. The background concentrations fall outside the range of values found in the open literature (<0.001 mg/l). Values for silver, dissolved are not available in the Tech Report and the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for silver, dissolved in water drawn from the McNairy Formation (0.060 mg/l for both) fall outside the range of values reported in the open literature (<0.001 mg/l). As noted earlier, no other values are available for comparison.

5.2.45 Sodium

RGA. When summarized over all observations and over averages within wells, the background concentrations for sodium in water drawn from the RGA (59.450 and 63.5 mg/l, respectively) are similar to the value found in the Tech Report (60.2 mg/l) but less than the values found in the Site Investigation and Moore Report (97.600 and 200 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for sodium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for sodium in water drawn from the McNairy Formation are 29.2 and 24.92 mg/l, respectively. As noted above, no values are available for comparison.

5.2.46 Sodium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for sodium, dissolved in water drawn from the RGA (60.433 and 65.7 mg/l, respectively) are less than the value reported in the Site Investigation (98.300 mg/l). The background concentrations are within the range of values found in the open literature (1.0 to 1000 mg/l). Values for sodium, dissolved are not available in either the Tech Report or the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for sodium, dissolved in water drawn from the McNairy Formation (27.98 and 25.90 mg/l, respectively) are within the range of values reported in the open literature (1.0 to 1000 mg/l). As noted earlier, no other values are available for comparison.

5.2.47 Sulfate

RGA. When summarized over all observations and over averages within wells, the background concentrations for sulfate in water drawn from the RGA (19.947 and 19.1 mg/l, respectively) are similar to the value reported in the Tech Report (19.9 mg/l) and within the range of values found in the open literature (1.0 to 1000 mg/l). Values are not available from the Site Investigation or the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for sulfate in water drawn from the McNairy Formation are 28.9 and 27.27 mg/l, respectively. These values are within the range of values reported in the open literature (1.0 to 1000 mg/l). No other values are available for comparison.

5.2.48 Thallium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for thallium in water drawn from the RGA (0.056 mg/l for both) are less than the value found in the Tech Report (0.108 mg/l) but greater than the value reported in the Moore Report (0.012 mg/l). The background values are similar to those in the Site Investigation ("ND" or nondetect) in that the values derived here are also based upon a detection limit. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for thallium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for thallium in water drawn from the McNairy Formation are 0.644 and 0.255 mg/l, respectively. As noted above, no values are available for comparison.

5.2.49 Thallium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for thallium, dissolved in water drawn from the RGA (0.056 mg/l for both) are similar to the value reported in the Site Investigation ("ND" or nondetect) in that these values are also based upon a detection limit. The background concentrations fall outside the range of values found in the open literature (<0.001 mg/l). Values for thallium, dissolved are not available in either the Tech Report or the Moore Report.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for thallium, dissolved in water drawn from the McNairy Formation (0.056 mg/l for both) fall outside the range of values reported in the open literature (<0.001 mg/l). As noted earlier, no other values are available for comparison.

5.2.50 Uranium

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium in water drawn from the RGA (0.002 mg/l for both) are equal to the value found in the Tech Report (0.002 mg/l). Values are not available in either the Site Investigation or the Moore Report. Additionally, as discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for uranium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium in water drawn from the McNairy Formation are 0.001 mg/l for both. As noted above, no values are available for comparison.

5.2.51 Uranium, Dissolved

RGA. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium, dissolved in water drawn from the RGA (0.002 mg/l for both) fall within the range of values found in the open literature (0.0001 to 0.1 mg/l). Other values for uranium, dissolved are not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the qualitatively determined background concentrations for uranium, dissolved in water drawn from the McNairy Formation (0.001 mg/l for both) fall within the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.52 Vanadium

RGA. When summarized over all observations and over averages within wells, the background concentrations for vanadium in water drawn from the RGA (0.134 and 0.139 mg/l, respectively) are similar to the value found in the Tech Report (0.137 mg/l) but exceed the values found in the Site Investigation and the Moore Report (0.005 and 0.010 mg/l, respectively). As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for vanadium in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for vanadium in water drawn from the McNairy Formation are 0.126 and 0.119 mg/l, respectively. As noted above, no values are available for comparison.

5.2.53 Vanadium, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for vanadium, dissolved in water drawn from the RGA (0.134 and 0.131 mg/l, respectively) are greater than the value found in the Site Investigation (0.001 mg/l) and fall outside the range of values found in the open literature (0.0001 to 0.1 mg/l). Other values for vanadium, dissolved are not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for vanadium, dissolved in water drawn from the McNairy Formation (0.126 and 0.107 mg/l, respectively) fall outside the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.54 Zinc

RGA. When summarized over all observations and over averages within wells, the background concentrations for zinc in water drawn from the RGA (0.054 and 0.025 mg/l, respectively) are less than the values found in the Site Investigation and the Moore Report (0.116 and 0.6 mg/l, respectively). However, the background concentration derived over all observations (0.054 mg/l) is greater than the value reported in the Tech Report (0.027 mg/l), and the background concentration derived over averages within wells (0.025 mg/l) is less than the value reported in the Tech Report. As discussed in Chapt. 4, because inorganic chemical concentrations in unfiltered samples (i.e., total samples) are highly dependent upon sampling method and sample preparation, values from the open literature are not available for zinc in total samples.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for zinc in water drawn from the McNairy Formation are 0.142 and 0.104 mg/l, respectively. As noted above, no values are available for comparison.

5.2.55 Zinc, Dissolved

RGA. When summarized over all observations and over averages within wells, the background concentrations for zinc, dissolved in water drawn from the RGA (0.049 and 0.026 mg/l, respectively) are equal to and less than the value found in the Site Investigation (0.049 mg/l). The background concentrations are within the range of values found in the open literature (0.0001 to 0.1 mg/l). Other values for zinc, dissolved are not available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for zinc, dissolved in water drawn from the McNairy Formation (0.116 and 0.080 mg/l, respectively) are near the upper end of the range of values reported in the open literature (0.0001 to 0.1 mg/l). As noted earlier, no other values are available for comparison.

5.2.56 Gross Alpha

RGA. When summarized over all observations and over averages within wells, the background concentrations for gross alpha (5.8 and 2.36 pCi/l) differ from the value found in the Site Investigation ("ND" or nondetect). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for gross alpha are 11.9 and 5.3 pCi/l, respectively. No values are available for comparison.

5.2.57 Gross Beta

RGA. When summarized over all observations and over averages within wells, the background concentrations for gross beta (13.8 and 7.3 pCi/l) are less than the value found in the Site Investigation (19 pCi/l). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for gross beta are 144.5 and 125.4 pCi/l, respectively. No values are available for comparison.

5.2.58 Neptunium-237

RGA. When summarized over all observations and over averages within wells, the background concentrations for neptunium-237 (0.8 and 0.21 pCi/l) differ from that reported in the Site Investigation (“ND” or nondetect). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for neptunium-237 are 0.5 and 0.13 pCi/l, respectively. No values are available for comparison.

5.2.59 Plutonium-239

RGA. When summarized over all observations and over averages within wells, the background concentrations for plutonium-239 (0.1 and 0.03 pCi/l) differ from that reported in the Site Investigation (“ND” or nondetect). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for plutonium-239 are 0.2 and 0.04 pCi/l, respectively. No values are available for comparison.

5.2.60 Radium-226

RGA. When summarized over all observations and over averages within wells, the background concentrations for radium-226 are 0.6 and 0.10 pCi/l. No values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for radium-226 are 1.2 and 0.29 pCi/l, respectively. No values are available for comparison.

5.2.61 Radon-222

RGA. When summarized over all observations and over averages within wells, the background concentrations for radon-222 are 626 and 555.3 pCi/l. No values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for radon-222 are 295 and 228.3 pCi/l, respectively. No values are available for comparison.

5.2.62 Technetium-99

RGA. When summarized over all observations and over averages within wells, the background concentrations for technetium-99 (22.3 and 10.8 pCi/l) differ from that reported in the Site Investigation (“ND” or nondetect). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for technetium-99 are 20.6 and 7.8 pCi/l, respectively. No values are available for comparison.

5.2.63 Thorium-230

RGA. When summarized over all observations and over averages within wells, the background concentrations for thorium-230 (1.1 and 0.54 pCi/l) are similar to the small values reported in the Tech Report and the Site Investigation (1.41 and 0.26 pCi/l, respectively). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for thorium-230 are 1.5 and 0.40 pCi/l, respectively. No values are available for comparison.

5.2.64 Total Radium

RGA. When summarized over all observations and over averages within wells, the background concentrations for total radium (1.3 and 0.46 pCi/l) are similar to the small value reported in the Tech Report (0.938 pCi/l). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for total radium are 0.7 and 0.36 pCi/l, respectively. No values are available for comparison.

5.2.65 Uranium-234

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-234 (0.7 pCi/l for both) are similar to the small values reported in the Tech Report and the Site Investigation (1.21 and 0.53 pCi/l, respectively). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-234 are 0.3 pCi/l for both. No values are available for comparison.

5.2.66 Uranium-235

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-235 (0.3 pCi/l for both) are similar to the small values reported in the Tech Report and the Site Investigation (0.153 pCi/l and “ND” or nondetect, respectively). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-235 are 0.2 pCi/l for both. No values are available for comparison.

5.2.67 Uranium-238

RGA. When summarized over all observations and over averages within wells, the background concentrations for uranium-238 (0.7 pCi/l for both) are similar to the small values reported in the Tech Report and the Site Investigation (1.04 pCi/l and “ND” or nondetect, respectively). No other values are available for comparison.

McNairy Formation. When summarized over all observations and over averages within wells, the background concentrations for uranium-238 are 0.3 pCi/l for both. No values are available for comparison.

5.2.68 Summary of Comparisons Between Background Concentrations and Values Found in Earlier Reports and the Open Literature

Generally, the background values derived for this report are similar to those presented in the three reports released earlier by PGDP. Additionally, most background values derived for this report are within the ranges of values found in the open literature.

5.2.68.1 Summary of comparisons to values found in earlier reports

As discussed earlier, only RGA background concentrations are available in earlier reports. Therefore, only the RGA background concentrations are discussed in this section.

As shown in Table 5.9, for RGA background concentrations derived over all observations, 36 of the 67 background concentrations exceed one or more of the values found in earlier reports. Of the 36 values that exceed one or more values, 9 were derived qualitatively, and 27 were derived quantitatively. The analytes that exceed the values found in the earlier reports and their factors of difference are listed by report in the following. In these lists, those analytes with background concentrations derived qualitatively are labeled with a "†".

- Analytes with RGA background values that exceed the values listed in the Tech Report–chloride (1.3); chromium (1.1); copper (1.6); lead (1.2); **nickel (11)**; nitrate as nitrogen (2.5); silver† (2.75); zinc (2); total radium (1.4); and uranium-235 (2.0).

- Analytes with RGA background values that exceed the values listed in the Site Investigation–aluminum, dissolved (1.6); antimony, dissolved † (2.2); barium (1.1); barium, dissolved (1.0); calcium (1.1); calcium, dissolved (1.0); chromium (4.6); **chromium, dissolved† (25)**; cobalt † (5.6); cobalt, dissolved† (9); copper (3); copper, dissolved† (–); **lead (32)**; magnesium (1.1); magnesium, dissolved (1.1); **nickel (68)**; **nickel, dissolved (61)**; selenium† (1.7); selenium, dissolved† (1.7); **vanadium (26.8)**; ***vanadium, dissolved (130)***; gross alpha (–); neptunium-237 (–); plutonium-239 (–); technetium-99 (–); thorium-230 (4.2); uranium-234 (1.3); uranium-235 (–) ; and uranium-238 (–). (Factors of difference marked with a dash could not be calculated because these values as listed as "ND" in the Site Investigation.)

- Analytes with RGA background values that exceed the values listed in the Moore Report–barium (1.6); beryllium† (1.3); chromium (3.6); cobalt (4.5); lead (8.6); **nickel (68.2)**; selenium† (5); silver† (1.1); thallium† (4.7); and **vanadium (13.4)**.

As shown in Table 5.10, for RGA background concentrations derived over averages within well, 36 of the 67 background concentrations exceed one or more of the values found in earlier reports. Of the 36 values that exceed one or more values, 11 were derived qualitatively, and 25 were derived quantitatively. The analytes that exceed the values found in the earlier reports and their factors of difference are listed by report in the following. In these lists, those analytes with background concentrations derived qualitatively are labeled with a "†".

- Analytes with RGA background values that exceed the values listed in the Tech Report–chloride (1.3); chromium (1.0); copper (1.5); lead (2.4); **nickel (11)**; nitrate as nitrogen (2.2); silver† (2.8); sodium (1.1); vanadium (1.0); and uranium-235 (2.0).

- Analytes with RGA background values that exceed the values listed in the Site Investigation–aluminum, dissolved (1.0); antimony, dissolved† (2.2); calcium (1.0); chromium (4.3); **chromium, dissolved† (25)**; cobalt† (5.6); cobalt, dissolved† (9); copper (2.8); copper, dissolved (–); **lead (63)**; lead, dissolved (–); magnesium (1.0); magnesium, dissolved (1.0); **nickel (68.2)**; **nickel, dissolved (61)**; selenium†

(1.7); selenium, dissolved† (1.7); **vanadium (28)**; ***vanadium, dissolved (130)***; gross alpha (–); neptunium-237 (–); plutonium-239 (–); technetium-99 (–); thorium-230 (2.1); uranium-234 (1.3); uranium-235 (–); and uranium-238 (–). (Factors of difference marked with a dash could not be calculated because these values as listed as "ND" in the Site Investigation.)

- Analytes with RGA background values that exceed the values listed in the Moore Report–antimony† (1.2); barium (1.3); beryllium† (1.3); cadmium† (2); chromium (3.4); cobalt† (4.5); **lead (17)**; **nickel (75.8)**; selenium† (5); silver† (1.1); thallium† (4.7); and vanadium (14).

5.2.68.2 Summary of comparisons to values found in the open literature

As shown on Tables 5.9 and 5.10, the analytes with RGA background concentrations that exceed values from the open literature are similar over method of calculation. When calculated over all observations, 8 analytes have RGA background concentrations that exceed their open literature values. Of these, 3 were derived qualitatively, and 5 were derived quantitatively. When calculated over averages within wells, 9 analytes have RGA background concentrations that exceed their literature values. Of these, 3 were derived qualitatively, and 6 were derived quantitatively. The analytes with background concentrations that exceed their open literature values and their factor of difference are listed below. Note, the factor of difference for background concentrations calculated over all observations are listed first, and the factor of difference for background concentrations calculated over averages within wells are listed second.

- RGA background concentrations that were derived qualitatively that exceed their open literature values and their factor of difference–beryllium, dissolved (4; 4); silver, dissolved (60; 60); and thallium, dissolved (56; 56).

- RGA Formation background concentrations that were derived quantitatively that exceed their open literature values and their factor of difference–aluminum, dissolved (3.1; 2.0); barium, dissolved (2.0; 1.8); lead, dissolved (<1; 2.5); nickel, dissolved (3.1; 3.1); nitrate as nitrogen (1.6; 1.4); and vanadium, dissolved (1.3; 1.3).

As shown in Tables 5.11 and 5.12, the analytes with McNairy Formation background concentrations that exceed the values from the open literature are similar over method of calculation. When calculated over all observations, 10 analytes have McNairy background concentrations that exceed their open literature values. Of these, 3 were derived qualitatively, and 7 were derived quantitatively. When calculated over averages within wells, 8 analytes have McNairy background concentrations that exceed their open literature values. Of these, 3 were derived qualitatively, and 5 were derived quantitatively. The analytes with background concentrations that exceed their open literature values and their factor of difference are listed below. Note, the factor of difference for background concentrations calculated over all observations are listed first, and the factor of difference with background concentrations calculated over averages within wells are listed second.

- McNairy Formation background concentrations that were derived qualitatively that exceed their open literature values and their factor of difference–beryllium, dissolved (4; 4); silver, dissolved (50; 50); and thallium, dissolved (56; 56).

- McNairy Formation background concentrations that were derived quantitatively that exceed their open literature values and their factor of difference–aluminum, dissolved (5.8; 5.9); barium, dissolved (2.7; 2.7); iron, dissolved (1.2; <1); manganese, dissolved (8.9; 6.8); potassium, dissolved (5.1; 5.9); vanadium, dissolved (1.3; 1.1); and zinc, dissolved (1.2; <1).

5.3 UNCERTAINTIES AFFECTING BACKGROUND CONCENTRATIONS

This section presents issues of importance that users of the background concentrations should consider when applying the background concentrations derived in this report to site investigation samples. Lack of consideration of these issues (i.e., uncertainties) may lead to erroneous conclusions regarding the nature and extent of contamination found at the PGDP.

5.3.1 Data Set Uncertainties

Uncertainties with the data set that may have significant effects upon the background concentrations are primarily associated with the source and evaluation of the data. Specific uncertainties concerning the source of data are the selection of background wells, the methods of sample collection, and the methods of laboratory analysis. Specific uncertainties concerning the evaluation of the data are use of qualified data and adjustment of results to address anomalous values.

5.3.1.1 Selection of background wells

Wells providing data for the calculation of the background concentrations were selected from all monitoring wells at the PGDP by a group of experts that are familiar with the geology and hydrogeology at the PGDP. Each expert in the group had at least five years experience collecting and evaluating groundwater information at the PGDP, including information concerning contaminant release and migration. Criteria used by the group when selecting wells were distance from any known contaminant plumes, potential hydrological isolation (due to depth of well), and qualitative knowledge of past sampling results. Therefore, there is little uncertainty in the adequacy of the initial list of wells that were selected as background wells.

The uncertainty in the selection of background wells was further reduced by examining the data collected from each well to determine if the well had yielded groundwater samples containing site-related contaminants. In this evaluation, the contaminants that were deemed site-related were all organic compounds and technetium-99. Through this evaluation each of the seven RGA wells and seven of the nine McNairy Formation wells selected by the group of experts were determined to not be impacted by contaminant releases from the PGDP.

Some uncertainty also remains in the selection of the background wells because of the potential loss in well integrity over time. As was discussed earlier, several of the wells were installed in the late 1980s and early 1990s. However, all data used in deriving the background concentrations were taken from samples collected after January 1, 1993. There is a possibility that some loss in well integrity occurred over time due to physical degradation of the well structure, which may have led to greater concentrations of some inorganic chemicals in later samples. This uncertainty is especially important because significant well corrosion has recently been found in the liners of some wells installed within the same time period.

5.3.1.2 Methods of sample collection

As discussed in Chapt. 1, a primary reason for this study was to address a concern expressed by the regulatory community regarding the fact that previous lists of background concentrations had been determined using data from samples collected using methods not consistent with methods currently used in remedial investigations at the PGDP. To address this concern, all data used in this report were collected after January 1993; the date after which the method of sample collection from the background wells became consistent with the methods of sample collection currently used in remedial investigations. Therefore, there is little uncertainty in the methods of sample collection in regards to data comparability to ongoing projects. However, as demonstrated earlier in this chapter and in Appendix C, there is some uncertainty in regards to the effect of turbidity upon sample results. As shown, the concentrations of several naturally occurring inorganic chemicals in groundwater samples are significantly related to the levels of turbidity and dissolved solids in the samples. The inorganic chemicals showing a significant relationship to turbidity and dissolved solids vary by aquifer and are as follows.

- Inorganic chemicals in the RGA showing a significant relationship ($r > 0.50$) to turbidity– aluminum, calcium, iron, manganese, and vanadium.
- Inorganic chemicals in the RGA showing a significant relationship ($r > 0.50$) to dissolved solids– barium, calcium, chloride, magnesium, manganese, nitrate as nitrogen, sodium, sulfate, and vanadium.
- Inorganic chemicals in the McNairy Formation showing a significant relationship ($r > 0.50$) to turbidity–iron.
- Inorganic chemicals in the McNairy Formation showing a significant relationship ($r > 0.50$) to dissolved solids–calcium, chloride, magnesium.

These results indicate that it is important to consider the levels of turbidity and dissolved solids when using the background concentrations derived here with results from site samples. If this is done, then the level of uncertainty can be reduced significantly. Additionally, in an issue unrelated to the level of uncertainty in the background concentrations, these results indicate that results from filtered samples should be used in addition to results from total samples when interpreting the nature and extent of contamination in groundwater at the PGDP.

5.3.1.3 Methods of laboratory analysis

The methods used for laboratory analysis of groundwater samples used to derive the background concentrations are consistent with approved EPA procedures (SW 846) and consistent with procedures used for samples collected during remedial investigations. Therefore, there is little uncertainty due to the methods of analysis when using the background results with results from site samples. However, as discussed in Chapt. 3, there is an unknown level of uncertainty for those inorganic chemicals that had their background concentration determined qualitatively (i.e., Group 1 analytes). Generally, this uncertainty arises from having detection limits that exceed the concentration of chemicals found in any sample and using the minimum detection limit as the surrogate for the background concentration. These chemicals, listed by aquifer, are presented below.

- Inorganic chemicals in samples from the RGA that had their background concentrations determined qualitatively by selecting the minimum detection limit–antimony; antimony, dissolved; arsenic, dissolved; beryllium; beryllium, dissolved; cadmium, dissolved; cobalt; cobalt, dissolved; mercury; mercury, dissolved; molybdenum; molybdenum, dissolved; selenium; selenium, dissolved; silver; silver, dissolved; thallium; and uranium, dissolved.
- Inorganic chemicals in samples from the McNairy Formation that had their background concentrations determined qualitatively by selecting the minimum detection limit–antimony; antimony, dissolved; arsenic, dissolved; beryllium, dissolved; cadmium; cadmium, dissolved; chromium, dissolved; cobalt, dissolved; lead; lead, dissolved; mercury, dissolved; molybdenum; molybdenum, dissolved; nickel, dissolved; selenium; selenium, dissolved; silver, silver, dissolved; thallium, dissolved; and uranium, dissolved.

For these chemicals, it can be argued that any detection in a site sample, even one below the background concentrations selected in this report, should be considered a result above the background concentration. Such an approach would be consistent with that in the Site Investigation (CH2M Hill 1992) and would ensure that chemicals are not erroneously dismissed from the list of site-related contaminants. However, such an approach may also cause attention to be diverted from important site issues. In any case, there is considerable uncertainty in the background concentrations for the inorganic chemicals listed above, and this uncertainty should be considered when using the background concentrations derived in this report.

5.3.1.4 Use of qualified data

The approach used for qualified data in the derivation of the background concentrations is consistent with that used for data collected as part of remedial investigations and used to determine the nature and extent of contamination and the risk posed to human health and the environment by contamination at the PGDP. Therefore, there is little uncertainty in the use of the background concentrations to screen site samples because comparable approaches were used. However, the background concentrations derived here may be greater than those that are actually present in the environment because results reported for some samples may be higher than those actually present. This is especially true for all "Q" qualified results. (See Chapts. 2 and 3.) Generally, the use of such data yields results that are useful for remedial investigations at the PGDP but of limited use elsewhere. That is, as long as the background concentrations are used at the PGDP, the uncertainty due to the use of qualified data is not significant; however, if used elsewhere, the impact of this uncertainty could be significant.

5.3.1.5 Adjustment of results to address anomalous values

As discussed in Chapt. 2, data were evaluated to correct anomalous results and provide a data set that could be used to derive background concentrations that are representative of the RGA and McNairy Formation at the PGDP. Please see the material in Chapt. 2 for a full description of the reasons for and estimated effects of data adjustment. Overall, the net effect of the various adjustments was to produce a background data set with a range of values that is unlikely to exceed the range of values that may occur naturally. Therefore, the adjustments may have yielded data sets that do not encompass the upper end of all possible naturally occurring values and, ultimately, background concentrations that are underestimates of the real value. Generally, the uncertainty due to the adjustment of results to address anomalous values is insignificant if the concern is erroneously dismissing contamination but may be significant if the concern is erroneously declaring contamination when none is present. (Please see the discussion under Methods of Analysis in this subsection for a possible exception to this conclusion for analytes that were never detected.)

5.3.2 Method of Calculation

Uncertainties associated with the method of calculation that may have significant effects upon the background concentrations are primarily concerned with the consideration of the correlations between results, distribution assumptions, and use of the upper tolerance limit. Each of these are discussed in the following material.

5.3.2.1 Consideration of correlations between results

Like all environmental data, the groundwater data used in this report may be correlated both over time (temporal correlation) and over space (spatial correlation). Because data for analytes with quantitatively derived background concentrations were not sufficient to derive the correlation coefficients that are necessary to address these concerns, correlation effects were not considered when deriving the background values. However, the net effect of not considering temporal and spatial correlation is that the background concentrations derived here are unlikely to exceed the real concentrations in the environment. (See Gilbert 1987, page 35). Therefore, as with adjustments to address anomalous values, the uncertainty due to the lack of consideration of temporal and spatial correlation is insignificant if the concern is erroneously dismissing contamination but may be significant if the concern is erroneously declaring contamination when none is present. (Note, this concern is not important for background concentrations determined qualitatively.)

5.3.2.2 Distribution assumptions

For this work, the data set for each analyte with a quantitatively derived background value was assumed to be normally distributed, and no attempt was made to transform data. Generally, transformations were not made to simplify the calculations performed in this report and to increase the likelihood that the background concentrations are unlikely to exceed the real concentrations in the environment. (For example, if data are assumed to log normally distributed, then the background concentrations derived quantitatively would be greater.) Therefore, as with adjustments to address anomalous values and consideration of correlations between results, the uncertainty due to distribution assumptions is insignificant if the concern is erroneously dismissing contamination but may be significant if the concern is erroneously declaring contamination when none is present. Please note that this concern is not as great for the background concentrations derived quantitatively over averages within wells as it is for background concentrations derived over all observations. This is because as data are summarized over wells, the resulting averages are more likely to follow the normal distribution. (See discussion of the Central Limit Theorem in Gilbert 1987.) Additionally, note that this concern does not apply to background concentrations determined qualitatively.

5.3.2.3 Use of the upper tolerance limit

The background concentrations for analytes with quantitatively derived values in this report are the lesser of the 95% upper tolerance limit (95% UTL) and the maximum detected value. (See Chapt. 3.) The lesser of these parameters was selected as the background concentration to ensure that the value derived here is consistent with values derived in other background reports prepared for the PGDP (DOE 1996b and 1997) and to ensure that the background concentration is near the upper end of the range of naturally occurring values in the RGA and McNairy Formation at the PGDP. However, because the value selected as the background concentration for each analyte is near the upper end of the range of all possible background concentrations, some background concentrations exceed one or more comparison criteria. This observation makes it appear as if the data sets used to derive the background concentrations are not representative of the real background distributions or as if the background concentrations at the PGDP are high. To further examine this uncertainty, Tables 5.13 and 5.14 were prepared.

In Table 5.13, both the selected background value (i.e. "Background") derived over all observations and the average (i.e., "Mean") of the distribution of all RGA observations are compared to the RBC, MCL, KDEP risk-based screening value, and values from the open literature. As shown there, 9 of 32 quantitatively derived averages exceed their RBC versus 15 of 32 quantitatively derived background values, 6 of 32 averages exceed their MCL versus 11 of 32 background values, 2 of 32 averages and background values exceed their KDEP risk-based screening value, and 4 of 32 averages exceed their open literature value versus 12 of 32 background values. Therefore, the average values of the RGA background distributions are a better "fit" when compared to the various risk-based comparison criteria and to the open literature values.

In Table 5.14, both the selected background value (i.e., "Background") derived over all observations and the average (i.e., "Mean") of the distribution of all McNairy Formation observations are compared to the RBC, MCL, KDEP risk-based screening value, and values from the open literature. As shown there, 10 of 28 quantitatively derived average and background values exceed their RBC, 7 of 28 averages and background values exceed their MCL, 2 of 28 averages and background values exceed their KDEP risk-based screening value, and 9 of 28 averages versus 15 of 28 background values exceed their open literature values. Therefore, the average values of the McNairy Formation background distributions are a better "fit" when compared to the open literature values but not when compared to the other comparison criteria.

The results from Tables 5.13 and 5.14 indicate that the concentrations of the naturally occurring inorganic chemicals in background wells may, in fact, be elevated. Therefore, the following actions should be considered when applying the background concentrations to site concentrations.

- When preparing baseline risk assessments, the risk from the background concentrations (i.e., "background risk") should be presented in the risk assessment as the background risk may affect cleanup decisions; however, the risks from the naturally occurring substances should be calculated separately (EPA 1989a and 1992).

- When determining cleanup levels, the PGDP should consider (EPA 1992):

    1) Statutory limitations on addressing naturally occurring substances;
    2) Technical impracticability of cleaning up beyond background levels;
    3) Consideration of site use;
    4) Availability of alternative methods of protection; and
    5) Consistency with other regulatory programs.

Therefore, although there is some uncertainty in using the lesser of the maximum detected value and the 95% UTL as the background value, this uncertainty is overshadowed by the high background for some inorganic chemicals at the PGDP.

Table 5.13. Comparison of mean inorganic chemical concentrations derived over all observations from RGA background data against RBCs, MCLs, Commonwealth of Kentucky risk-based screening values, and open literature values

Analyte	Background[a]	Mean[b]	Criteria[c]			
			RBC	MCL	KDEP	Open Literature
Aluminum	2.189	0.638	1.5^{HI}	0.050 - 0.200	37	0.0001 - 0.1
Aluminum, Dissolved	0.311	0.166				
Barium	0.235	0.235	0.10^{HI}	2.000	2.6	0.0001 - 0.1
Barium. Dissolved	0.200	0.200				
Calcium	41.238	21.7	NV	NV	NV	1.0 - 1000
Calcium, Dissolved	38.166	21.6				
Chloride	91.021	37.1	NV	250	NV	1.0 - 1000
Chromium	0.144	0.069	0.0071^{HI}	0.100	0.18	0.0001 - 0.1
Chromium, Dissolved	NA	NA				
Copper	0.036	0.017	0.060^{HI}	1.3	1.4	0.0001 - 0.1
Copper, Dissolved	0.020	0.013				
Fluoride	0.270	0.163	0.091^{HI}	4.0	2.2	0.01 - 10.0
Iron	5.030	1.33	0.45^{HI}	0.3	NV	0.01 - 10.0
Iron, Dissolved	0.267	0.080				
Lead	0.129	0.088	0.00000015^{HI}	0.015	0.004	0.0001 - 0.1
Lead, Dissolved	0.098	0.097				
Magnesium	16.262	8.22	NV	NV	NV	1.0 - 1000
Magnesium, Dissolved	16.215	8.5				
Manganese	0.119	0.037	0.067^{HI}	0.050	0.18	0.0001 - 0.1
Manganese, Dissolved	0.068	0.019				
Nickel	0.682	0.147	0.030^{HI}	0.100	0.730	0.0001 - 0.1
Nickel, Dissolved	0.305	0.102				
Nitrate as Nitrogen	15.561	3.59	2.40^{HI}	10	58	0.01 - 10.0
Potassium	5.195	2.96	NV	NV	NV	0.01 - 10.0
Potassium, Dissolved	4.096	2.54				
Silica	26.401	19.0	NV	NV	NV	NV
Sodium	59.450	29.3	NV	NV	NV	1.0 - 1000
Sodium, Dissolved	60.433	29.4				
Sulfate	19.947	9.9	NV	500	NV	1.0 - 1000
Vanadium	0.134	0.065	0.0092^{HI}	NV	NV	0.0001 - 0.1
Vanadium, Dissolved	0.134	0.064				
Zinc	0.054	0.021	0.45^{HI}	5.0	11	0.0001 - 0.1
Zinc, Dissolved	0.049	0.017				

Notes:

Only analytes with background values that were derived quantitatively are listed.

Criteria are listed once for each analyte type (e.g., once for both aluminum and aluminum, dissolved) because the same criteria apply to both.

NA indicates that the comparison is not applicable because the background value was derived qualitatively.

NV indicates that a value was not available for this analyte.

[a] Only background values that were derived quantitatively are listed.
[b] Mean values taken from Table 2.2.
[c] RBCs, MCLs, and KDEP risk-based screening values taken from Table 4.1. Open literature values taken from Table 4.2.

Table 5.14. Comparison of mean inorganic chemical concentrations derived over all observations from McNairy Formation background data against RBCs, MCLs, Commonwealth of Kentucky risk-based screening values, and open literature values

Analyte	Background[a]	Mean[b]	Criteria[c]			
			RBC	MCL	KDEP	Open Literature
Aluminum	0.687	0.284	1.5^{HI}	0.050 - 0.200	37	0.0001 - 0.1
Aluminum, Dissolved	0.579	0.209				
Barium	0.296	0.155	0.10^{HI}	2.000	2.6	0.0001 - 0.1
Barium. Dissolved	0.268	0.143				
Calcium	38.858	22.6	NV	NV	NV	1.0 - 1000
Calcium, Dissolved	38.829	21.8				
Chloride	19.708	10.0	NV	250	NV	1.0 - 1000
Cobalt	0.096	0.055	0.0071^{HI}	0.100	0.18	0.0001 - 0.1
Cobalt, Dissolved	NA	NA				
Copper	0.057	0.019	0.060^{HI}	1.3	1.4	0.0001 - 0.1
Copper, Dissolved	NA	NA				
Fluoride	0.330	0.224	0.091^{HI}	4.0	2.2	0.01 - 10.0
Iron	18.360	7.37	0.45^{HI}	0.3	NV	0.01 - 10.0
Iron, Dissolved	12.372	5.05				
Magnesium	13.418	7.36	NV	NV	NV	1.0 - 1000
Magnesium, Dissolved	14.171	7.55				
Manganese	0.941	0.428	0.067^{HI}	0.050	0.18	0.0001 - 0.1
Manganese, Dissolved	0.894	0.399				
Nitrate as Nitrogen	1.474	1.04	2.40^{HI}	10	58	0.01 - 10.0
Potassium	55.752	16.07	NV	NV	NV	0.01 - 10.0
Potassium, Dissolved	51.205	13.2				
Silica	26.0	24.9	NV	NV	NV	NV
Sodium	29.2	20.6	NV	NV	NV	1.0 - 1000
Sodium, Dissolved	27.98	20.4				
Sulfate	28.9	15.67	NV	500	NV	1.0 - 1000
Thallium	0.644	0.143	NV	0.002	NV	<0.001
Thallium, Dissolved	NA	NA				
Vanadium	0.126	0.063	0.0092^{HI}	NV	NV	0.0001 - 0.1
Vanadium, Dissolved	0.126	0.065				
Zinc	0.142	0.043	0.45^{HI}	5.0	11	0.0001 - 0.1
Zinc, Dissolved	0.116	0.032				

Notes:

Only analytes with background values that were derived quantitatively are listed.

Criteria are listed once for each analyte type (e.g., once for both aluminum and aluminum, dissolved) because the same criteria apply to both.

NA indicates that the comparison is not applicable because the background value was derived qualitatively.

NV indicates that a value was not available for this analyte.

[a] Only background values that were derived quantitatively are listed.
[b] Mean values taken from Table 2.2.
[c] RBCs, MCLs, and KDEP risk-based screening values taken from Table 4.1. Open literature values taken from Table 4.2.

THIS PAGE INTENTIONALLY LEFT BLANK

6. BIBLIOGRAPHY

Allen, H. E., E. M. Perdue, and D. S. Brown. 1993. *Metals in Groundwater*. Lewis Publishers, Chelsea, MI.

Canter, L. W., R. C. Knox, and D. M. Fairchild. 1987. *Ground Water Quality Protection*. Lewis Publishers, Chelsea, MI.

CH2M Hill. 1991. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant*. KY/SUB/13B-97777C P-03/1991/1.

CH2M Hill. 1992. *Public Health and Ecological Assessment for the Paducah Gaseous Diffusion Plant.* Volume 6 of *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant*. KY/SUB/13B-97777C P-03/1991/1.

Davis, S. N., and R. J. M. DeWiest. 1966. *Hydrogeology*. John Wiley and Sons, New York.

DOE (Department of Energy). 1994. *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant*. DOE/OR/07-1286&D1.

DOE. 1996a. *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*. DOE/OR/07-1506&D1.

DOE. 1996b. *Background Concentrations and Human Health Risk-based Screening Criteria for Metals in Soil at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. DOE/OR/07-1417&D2.

DOE. 1997. *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. DOE/OR/07-1586&D2.

DOE. 1999. *Federal and State Guideline Values. Risk Assessment Information System* @ http://risk.lsd.ornl.gov/cgi-bin/guide/GUID_9709. Accessed September 1999.

EPA (Environmental Protection Agency). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, EPA/540/G-89/004, Office of Emergency and Remedial Response, Washington, D.C.

EPA. 1989a. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A, Baseline Risk Assessment*, OSWER Directive 9285.7-01a, Office of Emergency and Remedial Response, Washington, D.C.

EPA. 1991a. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part B, Development of Risk-based Preliminary Remediation Goals*, OSWER Directive 9285.7-01b, Office of Emergency and Remedial Response, Washington, D.C.

EPA. 1991b. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part C, Risk Evaluation of Remedial Alternatives*, OSWER Directive 9285.7-01c, Office of Emergency and Remedial Response, Washington, D.C.

EPA. 1992. *Options for Addressing High Background Levels of Hazardous Substances at CERCLA Sites. Draft Final Issue Paper*. Offices of Program Management and Emergency and Remedial Response, Washington, D.C. January 1992.

EPA. 1995a. *Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment*, Interim Guidance, Office of Health Assessment, Atlanta, GA, November 1995.

Gilbert. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold, New York.

KDEP. 1995. *Risk Assessment Guidance*. 401 KAR 100:050, October.

Matthess, G., and J. C. Harvey. 1982. *The Properties of Groundwater*. John Woley & Sons, New York.

Moore, G. K., 1995. *Inorganic Soil and Groundwater Chemistry Near Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. ORNL/TM-12897.

APPENDIX A

WELL SUMMARY INFORMATION

THIS PAGE INTENTIONALLY LEFT BLANK

Well Summary Information

This appendix presents, by well, the information used to verify the selection of the background wells used to derive the background concentrations for the Regional Gravel Aquifer and McNairy Formation. Table A.1 presents a summary of the information contained in the following portions of this appendix. Table A.2 is a directory that can be used to find this information.

Table A.1. Well information contained in Appendix A

Monitoring Well	Detail Sheet	Large Location Map	Construction Detail	Boring Log	Detail Location Map
			RGA Wells		
MW 103	X	X	X	X	NA
MW 106	X	X	X	X	NA
MW 141	X	X	X	X[a]	X
MW 142	X	X	X	X[a]	X
MW 150	X	X	X	X	NA
MW 199	X	X	X	X	X
			McNairy Wells		
MW 102	X	NA	X	X	NA
MW 120	X	X	X	X	X
MW 121	X	X	X	X	X
MW 122	X	X	X	X	X
MW 133	X	X	X	X	X
MW 140	X	X	X	X	X
MW 239	X	NA	NA	NA	NA
MW 247	X	NA	NA	NA	NA

Notes:
"X's" indicate that information is presented in Appendix A.
"NA" indicate that information was not available and is not presented in the appendix.

[a] Boring logs for MW141 and 142 were not available. However, a boring log for an adjacent deep well, MW140, was available. Therefore, the boring log for MW140 is presented in this appendix.

The following defines in more detail the information included for each well.

- Detail sheet–A concise summary that presents the well's location, installation date, screen depth, sampling dates, and construction information reference. In addition, a table of the potential plant-related chemical (organic compounds) and radionuclide contaminants (technetium-99 only) detected in the well is presented on each well's detail sheet. (Note, these detail sheets are also presented earlier in this document.)

- Large location map–A map presenting the location of the well in relation to the plant.

- Construction detail–A schematic presenting the details of the well's construction.

- Boring log–The soil boring log prepared during well installation.

- Detail location map–A map presenting the location of the well in relation to other wells (if the well is part of a well cluster) and other surface features.

Table A.2. Table of Contents for Appendix A

Summary of Sampling Times for RGA Background Wells Over All Analyte Types

Sampling Dates	RGA Sampling Locations					
	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199
1990, Q2			4/27/90	5/2/90	6/6/90	
1990, Q3			8/16/90	8/16/90	9/6/90	
1990, Q4						
1991, Q1			3/13/91	3/14/91	3/21/91	
1991, Q2						5/14/91 5/21/91
1991, Q3						
1991, Q4						
1992, Q1	2/28/92	2/14/92				
1992, Q2						
1992, Q3						
1992, Q4						
1993, Q1						
1993, Q2	5/26/93	6/7/93	5/26/93	5/26/93	6/23/93	5/27/93
1993, Q3	7/26/93	9/14/93	7/13/93	7/13/93	9/21/93	7/26/93
1993, Q4	10/14/93	12/6/93	10/21/93	10/21/93	12/15/93	10/25/93
1994, Q1	1/24/94	3/14/94	1/11/94	1/11/94	3/8/94	1/24/94
1994, Q2	4/20/94	6/20/94	4/27/94	4/27/94	6/13/94	4/25/94
1994, Q3	7/27/94	9/6/94	7/20/94	7/20/94	9/19/94	7/27/94
1994, Q4	10/5/94	10/10/94 12/12/94	10/10/94	10/10/94	12/15/94	10/11/94
1995, Q1	2/13/95	2/6/95		2/6/95	2/8/95	
1995, Q2						
1995, Q3						
1995, Q4						
1996, Q1	2/8/96	2/8/96		2/12/96	2/13/96	
1996, Q2						
1996, Q3						
1996, Q4						
1997, Q1	2/6/97	2/4/97		2/6/97	2/6/97	
1997, Q2	5/13/97					
1997, Q3						8/6/97
1997, Q4		11/12/97		11/6/97		

Note: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for RGA Background Wells when Analyses for One or More Inorganic Chemicals Were Performed

Sampling Dates	RGA Sampling Locations					
	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199
1990, Q2			4/27/90	5/2/90		
1990, Q3						
1990, Q4						
1991, Q1			3/13/91	3/14/91	3/21/91	
1991, Q2						5/14/91
1991, Q3						
1991, Q4						
1992, Q1						
1992, Q2						
1992, Q3						
1992, Q4						
1993, Q1						
1993, Q2	5/26/93	6/7/93	5/26/93	5/26/93	6/23/93	5/27/93
1993, Q3	7/26/93		7/13/93	7/13/93		7/26/93
1993, Q4	10/14/93		10/21/93	10/21/93		10/25/93
1994, Q1	1/24/94	3/14/94	1/11/94	1/11/94	3/8/94	1/24/94
1994, Q2	4/20/94		4/27/94	4/27/94		4/25/94
1994, Q3	7/27/94		7/20/94	7/20/94		7/27/94
1994, Q4	10/5/94	12/12/94	10/10/94	10/10/94		10/11/94
1995, Q1	2/13/95	2/6/95		2/6/95	2/8/95	
1995, Q2						
1995, Q3						
1995, Q4						
1996, Q1	2/8/96	2/8/96		2/12/96	2/13/96	
1996, Q2						
1996, Q3						
1996, Q4						
1997, Q1	2/6/97	2/4/97		2/6/97	2/6/97	
1997, Q2						
1997, Q3						8/6/97
1997, Q4		11/12/97		11/6/97		

Note: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for RGA Background Wells when Analyses for One or More Organic Compounds Were Performed

Sampling Dates	RGA Sampling Locations					
	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199
1990, Q2			4/27/90	5/2/90	6/6/90	
1990, Q3			8/16/90	8/16/90	9/6/90	
1990, Q4						
1991, Q1			3/13/91	3/14/91	3/21/91	
1991, Q2						5/14/97 5/21/91
1991, Q3						
1991, Q4						
1992, Q1	2/28/92	2/14/92				
1992, Q2						
1992, Q3						
1992, Q4						
1993, Q1						
1993, Q2	5/26/93	6/7/93	5/26/93	5/26/93	6/23/93	5/27/93
1993, Q3	7/26/93	9/14/93	7/13/93	7/13/93	9/21/93	7/26/93
1993, Q4	10/14/93	12/6/93	10/21/93	10/21/93	12/15/93	10/25/93
1994, Q1	1/24/94	3/14/94	1/11/94	1/11/94	3/8/94	1/24/94
1994, Q2		6/20/94	4/27/94	4/27/94	6/13/94	4/25/94
1994, Q3	7/27/94	9/6/94	7/20/94	7/20/94	9/19/94	7/27/94
1994, Q4	10/5/94	10/10/94 12/12/94	10/10/94	10/10/94	12/15/94	10/11/94
1995, Q1	2/13/95	2/6/95		2/6/95	2/8/95	
1995, Q2						
1995, Q3						
1995, Q4						
1996, Q1	2/8/96	2/8/96		2/12/96	2/13/96	
1996, Q2						
1996, Q3						
1996, Q4						
1997, Q1	2/6/97	2/4/97		2/6/97	2/6/97	
1997, Q2	5/13/97					
1997, Q3						8/6/97
1997, Q4		11/12/97		11/6/97		

Note: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for RGA Background Wells when Analyses for One or More Radionuclides Were Performed

Sampling Dates	RGA Sampling Locations					
	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199
1990, Q2			4/27/90	5/2/90	6/6/90	
1990, Q3			8/16/90	8/16/90	9/6/90	
1990, Q4						
1991, Q1			3/13/91	3/14/91	3/21/91	
1991, Q2						5/14/91 5/21/91
1991, Q3						
1991, Q4						
1992, Q1	2/28/92	2/14/92				
1992, Q2						
1992, Q3						
1992, Q4						
1993, Q1						
1993, Q2	5/26/93	6/7/93	5/26/93	5/26/93	6/23/93	5/27/93
1993, Q3	7/26/93	9/14/93	7/13/93	7/13/93	9/21/93	7/26/93
1993, Q4	10/14/93	12/6/93	10/21/93	10/21/93	12/15/93	10/25/93
1994, Q1	1/24/94	3/14/94	1/11/94	1/11/94	3/8/94	1/24/94
1994, Q2	4/20/94	6/20/94	4/27/94	4/27/94	6/13/94	4/25/94
1994, Q3	7/27/94	9/6/94	7/20/94	7/20/94	9/19/94	7/27/94
1994, Q4	10/5/94	10/10/94 12/12/94	10/10/94	10/10/94	12/15/94	10/11/94
1995, Q1	2/13/95	2/6/95		2/6/95	2/8/95	
1995, Q2						
1995, Q3						
1995, Q4						
1996, Q1	2/8/96	2/8/96		2/12/96	2/13/96	
1996, Q2						
1996, Q3						
1996, Q4						
1997, Q1	2/6/97	2/4/97		2/6/97	2/6/97	
1997, Q2	5/13/97					
1997, Q3						8/6/97
1997, Q4		11/12/97		11/6/97		

Note: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for McNairy Background Wells over All Analyte Types

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1989, Q4			12/1/89					
1990, Q1		2/27/90	2/24/90	2/21/90 2/22/90				
1990, Q2		4/20/90	4/19/90	4/30/90	5/3/90	5/2/90		
1990, Q3		8/20/90	8/14/90	8/15/90	8/15/90	8/17/90		
1990, Q4								
1991, Q1		2/28/91	3/25/91	3/11/91	3/1/91	3/14/91		
1991, Q2			4/30/91					
1991, Q3								
1991, Q4								
1992, Q1	2/28/92							
1992, Q2								
1992, Q3								
1992, Q4								
1993, Q1								
1993, Q2	5/26/93	5/25/93	6/3/93	6/1/93	6/2/93	5/26/93		
1993, Q3	7/26/93	7/12/93	9/21/93	9/20/93	9/13/93	7/13/93		
1993, Q4	10/14/93	10/26/93	12/27/93	12/7/93	12/16/93	10/21/93		
1994, Q1	1/24/94	1/25/94	3/29/94	3/21/94	3/2/94	1/11/94		
1994, Q2	4/26/94	4/20/94	6/8/94	6/8/94	6/7/94	4/27/94		
1994, Q3	7/28/94	7/19/94	9/7/94	9/21/94	9/12/94	7/20/94		
1994, Q4	10/5/94	10/24/94	12/1/94	12/5/94	12/19/94	10/10/94		
1995, Q1	3/21/95	2/8/95	2/9/95	2/9/95	3/27/95		3/29/95	3/27/95
1995, Q2	6/14/95			6/5/95			4/13/95 5/3/95 6/6/95	4/19/95 6/20/95
1995, Q3	9/18/95						7/24/95 8/9/95 9/26/95	7/19/95 8/22/95 9/20/95
1995, Q4	12/19/95						10/18/95 11/8/95 12/19/95	10/23/95 11/28/95 12/13/95
1996, Q1	2/8/96	2/22/96	2/22/96	2/8/96	2/12/96	2/12/96	1/23/96 2/15/96 3/20/96	1/22/96 2/22/96 3/25/96
1996, Q2							4/18/96 5/21/96 6/13/96	4/18/96 5/28/96 6/18/96

Summary of Sampling Times for McNairy Background Wells over All Analyte Types (Cont.)

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1996, Q3							7/25/96 8/6/96 9/10/96	7/18/96 8/13/96 9/17/96
1996, Q4							10/31/96 11/20/96 12/11/96	10/2/96 11/12/96 12/10/96
1997, Q1	2/6/97	2/6/97	2/6/97	2/6/97	2/10/97	2/6/97	1/23/97 2/17/97 3/18/97	1/24/97 2/17/97 3/20/97
1997, Q2							4/15/97 5/20/97 6/12/97	4/10/97 5/20/97 6/18/97
1997, Q3							7/10/97 8/14/97 9/15/97	7/24/97 8/11/97 9/17/97
1997, Q4		11/11/97	11/11/97	11/11/97	11/12/97	11/6/97	10/16/97	10/23/97 11/25/97

Notes: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for McNairy background Wells when Analyses for One or More Inorganic Chemicals Were Performed

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1989, Q4								
1990, Q1		2/27/90	2/24/90	2/21/90 2/22/90				
1990, Q2		4/20/90	4/19/90	4/30/90	5/3/90	5/2/90		
1990, Q3		8/20/90	8/14/90	8/15/90		8/17/90		
1990, Q4								
1991, Q1		2/28/91	3/25/91	3/11/91	3/1/91	3/14/91		
1991, Q2								
1991, Q3								
1991, Q4								
1992, Q1								
1992, Q2								
1992, Q3								
1992, Q4								
1993, Q1								
1993, Q2	5/26/93	5/25/93	6/3/93	6/1/93	6/2/93	5/26/93		
1993, Q3	7/26/93	7/12/93				7/13/93		
1993, Q4	10/14/93	10/26/93				10/21/93		
1994, Q1	1/24/94	1/25/94	3/29/94	3/21/94	3/2/94	1/11/94		
1994, Q2	4/26/94	4/20/94				4/27/94		
1994, Q3	7/28/94	7/19/94				7/20/94		
1994, Q4	10/5/94	10/24/94				10/10/94		
1995, Q1	3/21/95	2/8/95	2/9/95	2/9/95	3/27/95		3/29/95	3/27/95
1995, Q2	6/14/95			6/5/95			4/13/95 5/3/95 6/6/95	4/19/95 6/20/95
1995, Q3	9/18/95						7/24/95 8/9/95 9/26/95	7/19/95 8/22/95 9/20/95
1995, Q4	12/19/95						10/18/95 11/8/95 12/19/95	10/23/95 11/28/95 12/13/95
1996, Q1	2/8/96	2/22/96	2/22/96	2/8/96	2/12/96	2/12/96	1/23/96 2/15/96 3/20/96	1/22/96 2/22/96 3/25/96
1996, Q2							4/18/96 5/21/96 6/13/96	4/18/96 5/28/96 6/18/96

Summary of Sampling Times for McNairy background Wells when Analyses for One or More Inorganic Chemicals Were Performed (Cont.)

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1996, Q3							7/25/96 8/6/96 9/10/96	7/18/96 8/13/96 9/17/96
1996, Q4							10/31/96 11/20/96 12/11/96	10/2/96 11/12/96 12/10/96
1997, Q1	2/6/97	2/6/97	2/6/97	2/6/97	2/10/97	2/6/97	1/23/97 2/17/97 3/18/97	1/24/97 2/17/97 3/20/97
1997, Q2							4/15/97 5/20/97 6/12/97	4/10/97 5/20/97 6/18/97
1997, Q3							7/10/97 8/14/97 9/15/97	7/24/97 8/11/97 9/17/97
1997, Q4		11/11/97	11/11/97	11/11/97	11/12/97	11/6/97	10/16/97	10/23/97

Notes: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for McNairy Background Wells when Analyses for One or More Organic Compounds Were Performed

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1989, Q4								
1990, Q1		2/27/90	2/24/90	2/21/90 2/22/90				
1990, Q2		4/20/90	4/19/90	4/30/90	5/3/90	5/2/90		
1990, Q3		8/20/90	8/14/90	8/15/90	8/15/90	8/17/90		
1990, Q4								
1991, Q1		2/28/91	3/25/91	3/11/91	3/1/91	3/14/91		
1991, Q2			4/30/91					
1991, Q3								
1991, Q4								
1992, Q1	2/28/92							
1992, Q2								
1992, Q3								
1992, Q4								
1993, Q1								
1993, Q2	5/26/93	5/25/93		6/1/93	6/2/93	5/26/93		
1993, Q3	7/26/93	7/12/93	9/21/93	9/20/93	9/13/93	7/13/93		
1993, Q4	10/14/93	10/26/93	12/27/93	12/7/93		10/21/93		
1994, Q1	1/24/94	1/25/94	3/29/94	3/21/94	3/2/94	1/11/94		
1994, Q2	4/26/94	4/20/94	6/8/94	6/8/94	6/7/94	4/27/94		
1994, Q3	7/28/94	7/19/94	9/7/94	9/21/94	9/12/94	7/20/94		
1994, Q4	10/5/94	10/24/94	12/1/94	12/5/94		10/10/94		
1995, Q1	3/21/95	2/8/95	2/9/95	2/9/95	3/27/95		3/29/95	3/27/95
1995, Q2	6/14/95			6/5/95			4/13/95 5/3/95 6/6/95	4/19/95 6/20/95
1995, Q3	9/18/95						7/24/95 8/9/95 9/26/95	7/19/95 8/22/95 9/20/95
1995, Q4	12/19/95						10/18/95 11/8/95 12/19/95	10/23/95 11/28/95 12/13/95
1996, Q1	2/8/96	2/22/96	2/22/96	2/8/96	2/12/96	2/12/96	1/23/96 2/15/96 3/20/96	1/22/96 2/22/96 3/25/96
1996, Q2							4/18/96 5/21/96 6/13/96	4/18/96 5/28/96 6/18/96

Summary of Sampling Times for McNairy Background Wells when Analyses for One or More Organic Compounds Were Performed (Cont.)

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1996, Q3							7/25/96 8/6/96 9/10/96	7/18/96 8/13/96 9/17/96
1996, Q4							10/31/96 12/11/96	10/2/96 11/12/96 12/10/96
1997, Q1	2/6/97	2/6/97	2/6/97	2/6/97	2/10/97	2/6/97	1/23/97 2/17/97 3/18/97	1/24/97 2/17/97 3/20/97
1997, Q2							4/15/97 5/20/97 6/12/97	4/10/97 5/20/97 6/18/97
1997, Q3							7/10/97 8/14/97 9/15/97	7/24/97 8/11/97 9/17/97
1997, Q4		11/11/97	11/11/97	11/11/97	11/12/97	11/6/97	10/16/97	10/23/97 11/25/97

Notes: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of Sampling Times for McNairy Background Wells when Analyses for One or More Radionuclides Were Performed

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1989, Q4			12/1/89					
1990, Q1		2/27/90	2/24/90	2/22/90				
1990, Q2		4/20/90	4/19/90	4/30/90	5/3/90	5/2/90		
1990, Q3		8/20/90	8/14/90	8/15/90	8/15/90	8/17/90		
1990, Q4								
1991, Q1		2/28/91	3/25/91	3/11/91	3/1/91	3/14/91		
1991, Q2			4/30/91					
1991, Q3								
1991, Q4								
1992, Q1	2/28/92							
1992, Q2								
1992, Q3								
1992, Q4								
1993, Q1								
1993, Q2	5/26/93	5/25/93		6/1/93	6/2/93	5/26/93		
1993, Q3	7/26/93	7/12/93	9/21/93	9/20/93	9/13/93	7/13/93		
1993, Q4	10/14/93	10/26/93	12/27/93	12/7/93		10/21/93		
1994, Q1	1/24/94	1/25/94	3/29/94	3/21/94	3/2/94	1/11/94		
1994, Q2	4/26/94	4/20/94	6/8/94	6/8/94	6/7/94	4/27/94		
1994, Q3	7/28/94	7/19/94	9/7/94	9/21/94	9/12/94	7/20/94		
1994, Q4	10/5/94	10/24/94	12/1/94	12/5/94		10/10/94		
1995, Q1	3/21/95	2/8/95	2/9/95	2/9/95	3/27/95		3/29/95	3/27/95
1995, Q2	6/14/95			6/5/95			4/13/95 5/3/95 6/6/95	4/19/95 6/20/95
1995, Q3	9/18/95						7/24/95 8/9/95 9/26/95	7/19/95 8/22/95 9/20/95
1995, Q4	12/19/95						10/18/95 11/8/95 12/19/95	10/23/95 11/28/95 12/13/95
1996, Q1	2/8/96	2/22/96	2/22/96	2/8/96	2/12/96	2/12/96	1/23/96 2/15/96 3/20/96	1/22/96 2/22/96 3/25/96
1996, Q2							4/18/96 5/21/96 6/13/96	4/18/96 5/28/96 6/18/96

Summary of Sampling Times for McNairy Background Wells when Analyses for One or More Radionuclides Were Performed (Cont.)

Sampling Dates	McNairy Sampling Locations							
	102	120	121	122	133	140	239	247
1996, Q3							7/25/96 8/6/96 9/10/96	7/18/96 8/13/96 9/17/96
1996, Q4							10/31/96 12/11/96	10/2/96 11/12/96 12/10/96
1997, Q1	2/6/97	2/6/97	2/6/97	2/6/97	2/10/97	2/6/97	1/23/97 2/17/97 3/18/97	1/24/97 2/17/97 3/20/97
1997, Q2							4/15/97 5/20/97 6/12/97	4/10/97 5/20/97 6/18/97
1997, Q3							7/10/97 8/14/97 9/15/97	7/24/97 8/11/97 9/17/97
1997, Q4		11/11/97	11/11/97	11/11/97	11/12/97	11/6/97	10/16/97	10/23/97 11/25/97

Notes: Analyte list varies between samples.
Quarters when samples were not collected are left blank.

Summary of RGA Background Wells

MW 103

Location - South of Plant; South of C-743 parking lot
N (-3500.84) E (-6252.14)
Date Installed - November 19, 1991
Screened Depth - Deep RGA
Top - 79.5 ft bgs
Bottom - 90 ft bgs
Dates Sampled (Data available) - Q1 92; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97; Q2 97
Construction Information Reference - Groundwater Monitoring Phase III
Potential Contaminant Summary -

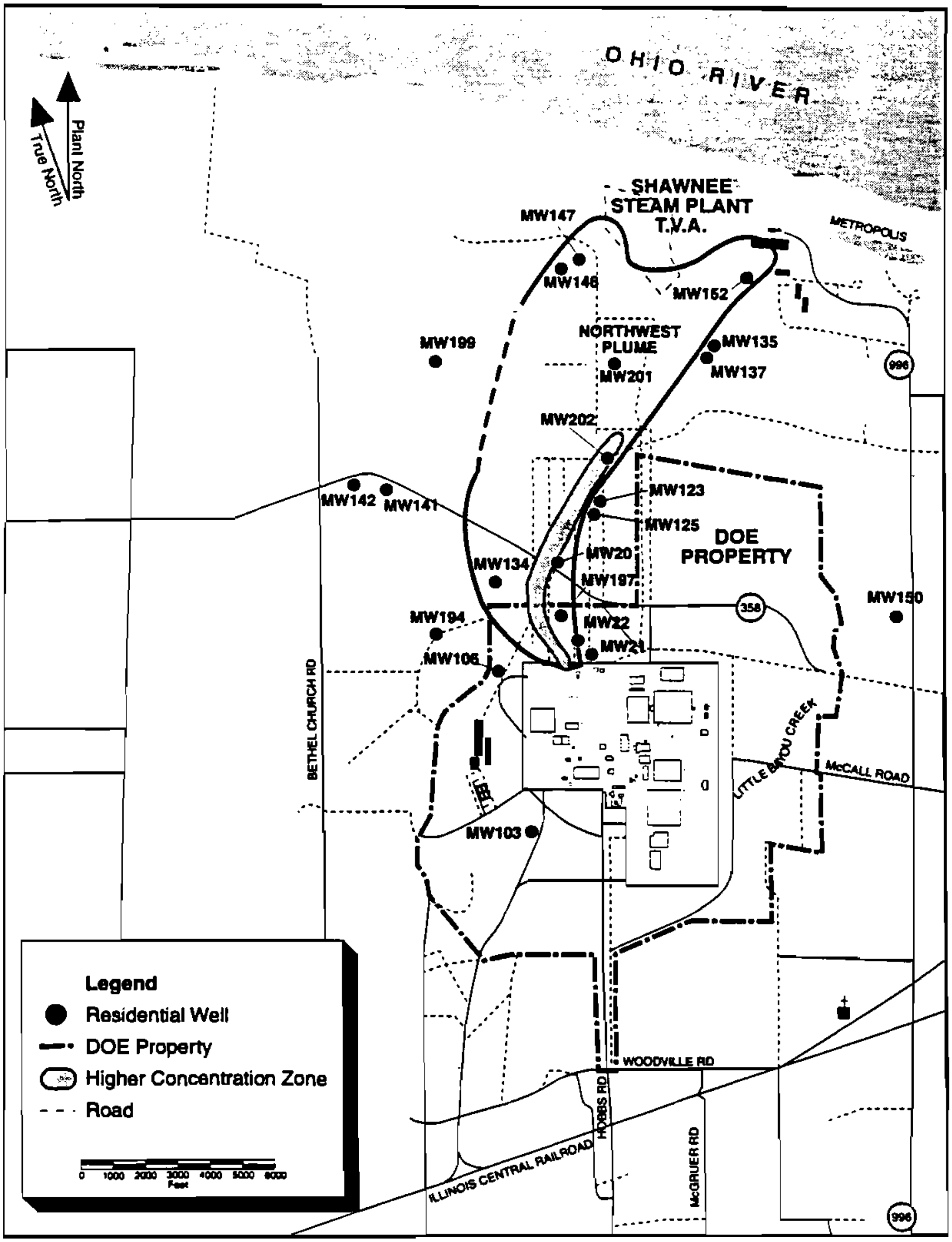
Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
cis-1,2-dichloroethene	1.8	NA	5/13/97	5327-97
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	5	93	5/26/93	5178-93
^{99}Tc	13	34	7/26/93	5944-93
^{99}Tc	12	19	10/14/93	7299-93
^{99}Tc	10	45	1/24/94	4272-94
^{99}Tc	20	18	7/27/94	6026-94
^{99}Tc	18	20	10/5/94	6774-94
^{99}Tc	13	10	2/8/96	5285-96
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
None	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	10	75.5	67 - 104	mg/L
Depth to Water	12	55.81	50.78 - 60.65	feet
Dissolved Organic Carbon	1	<1	NA	mg/L
Dissolved Oxygen	11	2.96	1.97 - 4.02	mg/L
Dissolved Solids	10	104.2	75 - 136	mg/L
pH	39	6.0	5.6 - 6.4	SU
Specific Conductance	36	167.1	155 - 209	umhos/cm
Temperature	12	59.0	56 - 62	F
Total Organic Carbon	30	<1	< 1 - < 1	mg/L
Total Suspended Solids	2	<4	< 4 - < 4	mg/L
Turbidity	9	2.5	0.35 - 5	NTU

Notes: NA = Entry not applicable or not available.



OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
NORTHWEST PLUME
MW199
MW135
MW137
MW201
MW202
MW123
MW125
MW142
MW141
DOE PROPERTY
MW134
MW20
MW197
MW150
MW194
MW22
MW21
MW106
MW103
358
996
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
WOODVILLE RD
HOBBS RD
McGRUER RD
ILLINOIS CENTRAL RAILROAD
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
0 1000 2000 3000 4000 5000 6000
Feet

MONITORING WELL NO. 103

MONITORING WELL COORDINATES S3500.84,W6252.14

INSTALLATION DATE 11-19-91

MATERIAL SPECIFICATIONS

A. STAINLESS STEEL CASING:

2-INCH DIAMETER,TYPE 316,SCHEDULE 5S STAINLESS STEEL PIPE,IN ACCORDANCE WITH ASTM A-312. THREADED,FLUSH JOINTS.

B. PROTECTIVE CASING:

6-INCH DIAMETER,SEAMLESS SCHEDULE 40, ASTM A-53 CARBON STEEL PIPE.

C. BENTONITE PELLET SEAL:

FREE FLOWING,HIGH-SWELLING,SODIUM-BASED, WYOMING-TYPE BENTONITE.

D. GRAVEL FILTER PACK:

100% BY WEIGHT PASSING A No.4 US STANDARD SIEVE AND NO MORE THAN 5% BY WEIGHT PASSING A No.50 US STANDARD SIEVE, WITH A UNIFORMITY COEFFICIENT OF TWO OR LESS.

E. WELL SCREEN:

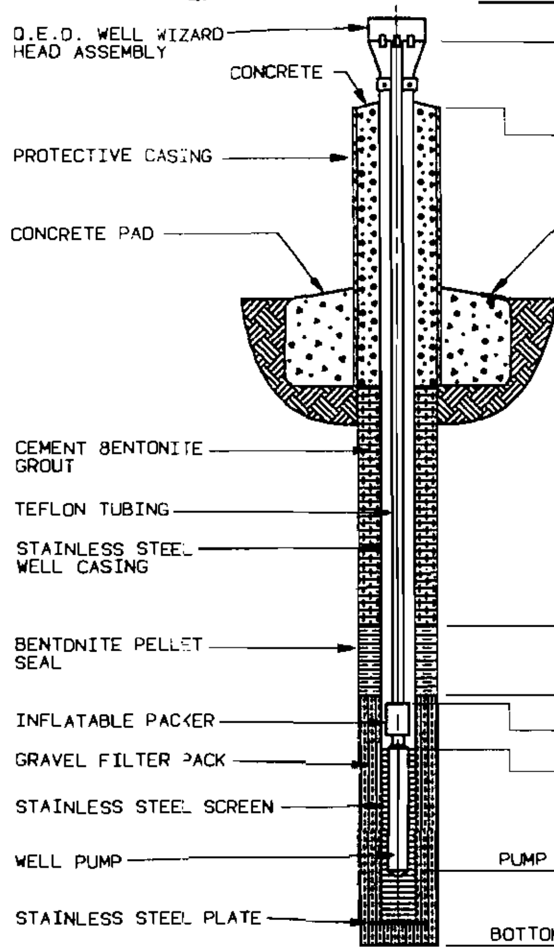
2-INCH DIAMETER, 10-FEET LONG, TYPE 316 STAINLESS STEEL, WIRE WOUND, WITH A 0.010-SLOT SIZE.

F. INFLATABLE PACKER:

D.E.D. ENVIRONMENTAL SYSTEMS, INC., "PURGE MISER" MODEL 4200.

G. WELL PUMP:

D.E.D. ENVIRONMENTAL SYSTEMS, INC., "WELL WIZARD" MODEL T-1200.



	± VERTICAL	ELEVATION
HEAD PLATE	2.80	385.22
TOP OF PROTECTIVE CASING	2.06	384.48
GROUND SURFACE	0.0	382.42
TOP OF BENTONITE PELLET SEAL	-75.0	307.4
TOP OF GRAVEL FILTER PACK	-77.0	305.4
TOP OF INFLATABLE PACKER	-77.0	305.4
TOP OF 10' S.S. SCREEN	-79.5	302.9
PUMP INTAKE	-84.0	298.4
BOTTOM OF GRAVEL FILTER PACK	-90.0	292.4

A-19

NOT TO SCALE

REV. NO.	ISSUE / REVISION DESCRIPTION	DRW	CHK	SECT	DEPT	PE	REQ	CA	SAFETY	SECURITY	FIRE	H PHY	DIS HY	ENVIR	QE	P.J./MMES	
0	ORIGINAL ISSUE/FOR ESO 16905	X	X	X	X	X	X	X								X	A-E
	CHANGE CONTROL PROCEDURE EP-C-18	REVISION OR ISSUE APPROVALS															DOE

DRAWING APPROVALS		DATE
DRW		
RED	K L Holt	11/92
CHK		
SECT		
DEPT		
PE		
PEDH		
PJ/MMES		
REQUESTER		
A-E		
DOE		

MARTIN MARIETTA — MARTIN MARIETTA ENERGY SYSTEMS, INC.
operated for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC-05-84OR21400
Oak Ridge, Tennessee • Paducah, Kentucky

GROUNDWATER MONITORING PHASE III, AS BUILT, MONITORING WELL NO. 103

1	48	49	50	PLANT	BLDG	FL	SHEET	OF
3	C	G	N	PGDP	.	.	.	.

SCALE N.T.S. | ID 16905 | C5B-16905 SK17

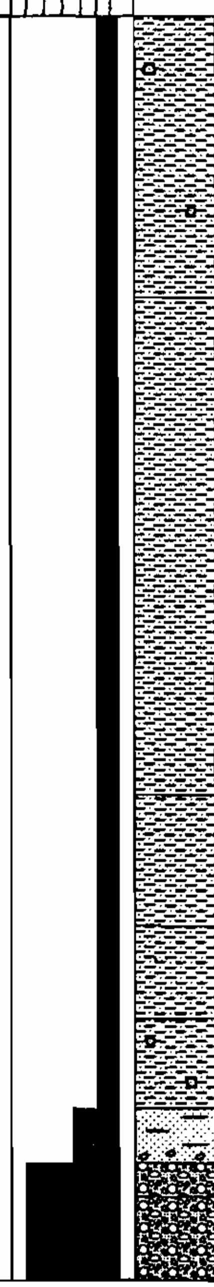
[Page left blank]

BORING NO.: S-18	PAGE 1 OF 5
SUBSURFACE BORING LOG	

PROJECT: AZ-054, GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -3489.1
SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' center) to 142'
DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B E Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)
0.0				
		S-18-1	2.7	NA
-5.0	5.0			
		S-18-2	5.0	NA
-10.0	10.0			
		S-18-3	1.6	NA
-15.0	15.0			
		S-18-4	3.7	NA
-20.0	20.0			
		S-18-5	3.9	NA
-25.0	25.0			
		S-18-6	4.5	NA
-30.0	30.0			

GRAIN SIZE PLOT / SECTION PROFILE



LITHOLOGIC DESCRIPTION / COMMENTS

SILT: occ pbl, tr cl, yelsh-br (10YR 5/4) (Fill)

SILT: cly to tr cl, tr woody material, lgt gr (10YR 6/1) to gr (10YR 5/1) (Fill)

SILT tr cl, moist-wet, br (10YR 5/3) (Fill??)

SILT: dk br (10YR 3/3) w/ abund blk (poss carb) material, lower contact is sharp (Fill??)

SILT: tr cl, yelsh-br (10YR 5/6), occ pbl

SAND: (85%), f-m, mod srtd, rndd, slty, yelsh-rd (5YR 5/8) and gr (5YR 7/1), sl gvly at bottom

GRAVEL: (50%) well rndd, cly, rdsh-br (5YR 4/4)

GRAVEL: (60%), poorly srtd, well rndd, sdy (20%), f, slty, tr cl, yelsh-rd (5YR 5/8)

BORING NO.: S-18	PAGE 2 OF 5

SUBSURFACE BORING LOG

PROJECT: AZ-054, GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -3489.1
SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' center) to 142'
DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B E Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	LITHOLOGIC DESCRIPTION / COMMENTS
-30.0	30.0				SAND (85%), m-c, well rndd, mod well srtd, sl gvly (10%), tr slt, yelsh-rd (5YR 5/8)
		S-18-7	3.6	NA	SAND (60%), m-c, rndd, mod well srtd, gvly (35%), hematite and poss manganese oxide stn, tr slt, rdsh-br (2.5YR 4/4)
-35.0	35.0				SILT sdy (40%), f, tr cl, br (7.5YR 5/6)
		S-18-8	5.0	NA	GRAVEL (40%), rndd, sdy (30%), m-c, poorly srtd, slty, cly, br (7.5YR 5/4)
-40.0	40.0				SAND (60%), m-c, mod well srtd, gvly (35%), tr slt, moist, rd (2.5YR 4/6), sharp lower contact
					SAND: (80%), f, well srtd, slty, cly, moist, rd (2.5 YR 4/6)
		S-18-9	4.0	NA	CLAYEY SILT: sl sdy (15%), vf, br (7.5YR 5/6) w/ strks of lgt gr (7.5YR 7/1)
-45.0	45.0				SAND (50%), vf-f, qtz, mod well srtd, slty, cly, occ pbl, moist to wet, sm blk carb material from 49'-50', predom brsh-yel (10YR 6/6) w/ sm lgt gr (10YR 7/2)
		S-18-10	5.0	NA	
-50.0	50.0				
		S-18-11	5.0	NA	CLAYEY SILT: sdy (20-40%), vf-f, occ pbl, moist-wet, predom brsh-yel (10YR 6/8) w/ strks of lgt gr (10YR 7/1), tr org material
-55.0	55.0				
		S-18-12	5.0	NA	
-60.0	60.0				

BORING NO.: S-18	PAGE 3 OF 5
SUBSURFACE BORING LOG	

PROJECT: AZ-054 GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -3489 1
SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' centerl to 142'
DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B E Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	LITHOLOGIC DESCRIPTION / COMMENTS
-60.0	60.0				do
		S-18-13	5.0	NA	
					SAND: (50%), vf-m, poorly srtd, v cly, slty, tr gvl, dk yelsh-br (10YR 4/6) and gr (10YR 6/1)
-65.0	65.0				SAND: (85%), m-c, well srtd, slty, interbedded w/ silt, cly, sdy(30%) f-m, yelsh-br (10YR 5/8) w/ sm gr
		S-18-14	5.0	NA	SILTY CLAY sdy (30%), vf-m, poorly srtd, predom gr (10YR 6/1) w/ sm yelsh-br, tr blk carb material
-70.0	70.0				SAND: (50%) vf-f, well srtd, slty, cly, yelsh-br (10YR 5/6) and gr (10YR 7/1)
		S-18-15	5.0	NA	CLAYEY SILT tr sd (5%), f, yelsh-br (10YR 5/6) mott gr (10YR 7/1), stiff
-75.0	75.0				SAND: (90%) f, well srtd, slty, yelsh-br (10YR 5/6) and gr (10YR 7/1)
					CLAYEY SILT sl sdy (10%), vf-f, lgt gr (10YR 7/1), occ pbl
		S-18-16	4.6	NA	SAND (80%), vf-f, wll srtd, sl slty, tr gvl, yelsh-br (10YR 5/6) and gr (10YR 7/1)
					GRAVEL (50%), sdy (30%), f-c, poorly srtd, sl slty, gr (10YR 7/1), wet
-80.0	80.0				GRAVEL: (60%) poorly srtd, sub rndd, abund cht and sltst frags, sdy (35%), mstly c, sm m-vc, sub rndd, mod srtd, tr slt, br (7.5YR 5/4), sm rd (hematite?) stn, wet
		S-18-17	1.2	NA	
	82.5				
-85.0	85.0				SAND (50%) mostly c, sm m-vc, sub ang to sub rndd, gvly (45%), poorly srtd, tr slt, yelsh-br (10YR 5/6), sm rdsh stn, tr blk (poss org) material, wet
		S-18-18	1.4	33-45-36-29 (81)	
	87.0				
					SILTY CLAY: tr blk (poss carb) material, predom gr (10YR 5/1) w/ brsh-yel (10YR 6/8) slt along fract, dry, v stiff
-90.0	90.0				

BORING NO.: S-18	PAGE 4 OF 5
SUBSURFACE BORING LOG	

PROJECT: AZ-054 GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -3489.1
SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' centerl to 142'
DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B E Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
-90.0	90.0–92.0	S-18-19	2.0	5-14-15-22 (29)			do
-95.0							
-100.0	100.0–102.0	S-18-20	2.0	14-16-23-27 (39)			CLAY: sl slty, mic, blk (2.5Y 2/0), stiff to v stiff
-105.0							
-110.0	110.0–112.0	S-18-21	2.0	9-17-23-26 (40)			CLAY: sl slty, sl mic, dry to moist, blk (5Y 2.5/1), poss glauc, v stiff
-115.0							
-120.0	120.0						

BORING NO.: S-1B	PAGE 5 OF 5

SUBSURFACE BORING LOG

PROJECT: AZ-054, GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -3489.1
SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' center) to 142'
DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B E. Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
-120.0	120.0–122.0	S-18-22	2.0	12-24-25-31 (49)			do
-125.0							SILTY CLAY mic, glau, blk (5Y 2.5/1), v stiff, w/ thin partings of sd, vf-f, well srtd, sub rndd, tr glauc, mic, sm pyr cmt, sd is lgt gr (5Y 7/1)
-130.0	130.0–132.0	S-18-23	2.0	15-21-27-83 (48)			
-135.0							SAND: (90-95%), f, sub rndd, well srtd, tr slt, tr mic, gr (2.5Y 5/0) to dk gr (2.5Y 4/0), mass, predom qtz, wet
-140.0	140.0–142.0	S-18-24	2.0	8-13-36-REF (49)			TD = 142'
-145.0							
-150.0							

[Page left blank]

Summary of RGA Background Wells

MW 106

Location - Northwest corner of plant
N (-8438.90) E (990.93)

Date Installed - November 13, 1991

Screened Depth - Middle RGA
Top - 62 ft bgs
Bottom - 75 ft bgs

Dates Sampled (Data available) - Q1 92; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94 (2); Q1 95; Q1 96; Q1 97; Q4 97

Construction Information Reference - Groundwater Monitoring Phase III

Potential Contaminant Information -

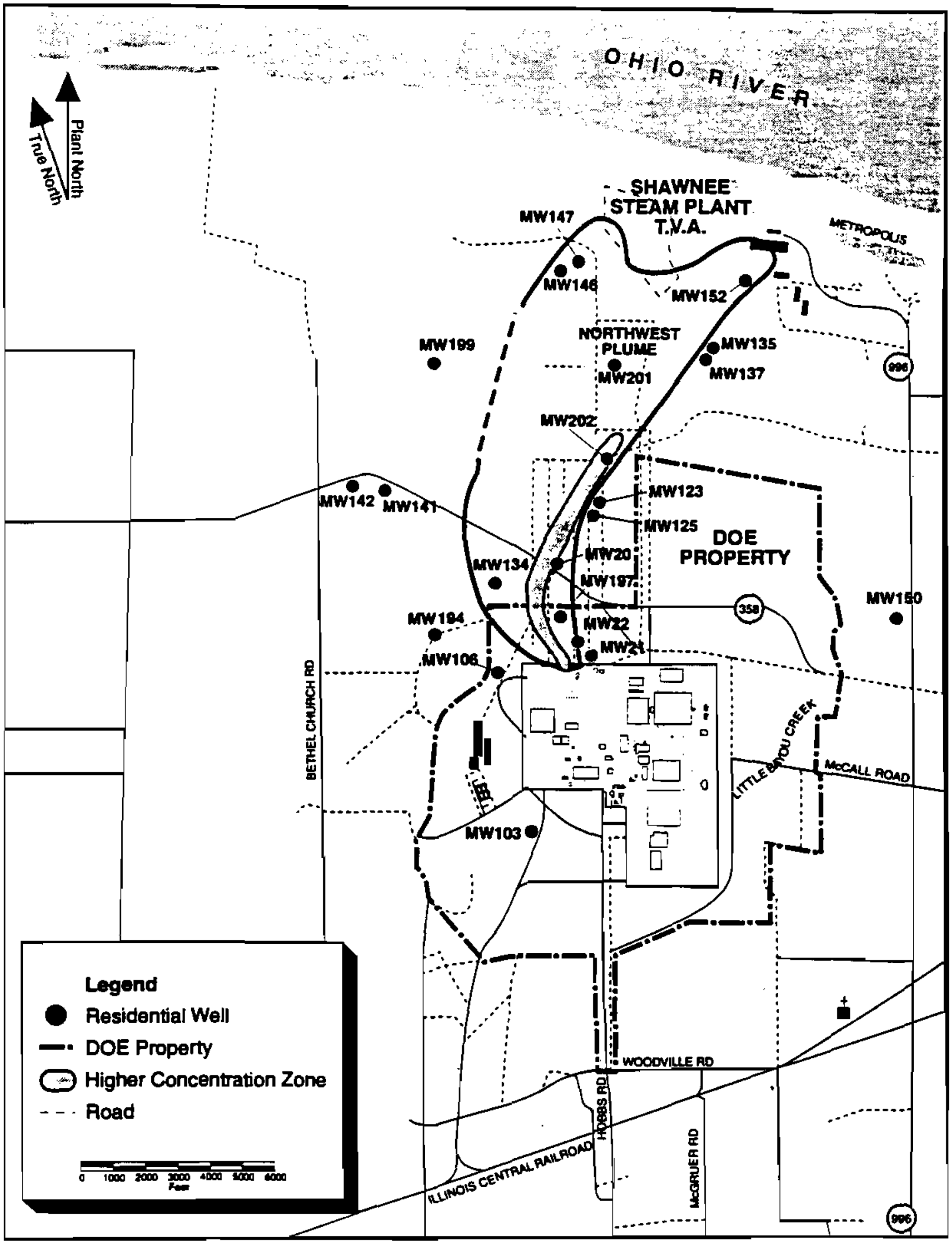
Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
Trichloroethene	1 XJX	NA	3/14/94	4697-94
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples, ordered by date of collection)				
^{99}Tc	12	21	2/14/92	4477-92
^{99}Tc	29	23	6/7/93	5322-93
^{99}Tc	25	19	9/14/93	6579-93
^{99}Tc	10	24	12/6/93	7862-93
^{99}Tc	3	6	3/14/94	4697-94
^{99}Tc	11	21	6/20/94	5513-94
^{99}Tc	1	2	9/6/94	6640-94
^{99}Tc	5	17	10/10/94	6782-94
^{99}Tc	7	6	12/12/94	7272-94
^{99}Tc	5	7	2/6/95	5444-95
^{99}Tc	1	10	2/8/96	5289-96
^{99}Tc	5	11	2/4/97	5138-97
^{99}Tc	6	12	11/12/97	5788-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
None	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	3	86.3	77 - 100	mg/L
Depth to Water	12	41.99	36.39 - 49.61	feet
Dissolved Oxygen	12	5.38	3.49 - 6.37	mg/L
Dissolved Solids	3	157	145 - 171	mg/L
pH	42	6.1	5.9 - 6.5	SU
Specific Conductance	42	287.8	278 - 310	umhos/cm
Temperature	12	58.6	57.3 - 60.4	F
Total Organic Carbon	12	< 1	< 1 - < 1	mg/L
Turbidity	10	39.3	5.3 - 200	NTU

Notes: NA = Entry not applicable or not available.


OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
NORTHWEST PLUME
MW199
MW135
MW137
MW201
MW202
MW142
MW141
MW123
MW125
DOE PROPERTY
MW134
MW20
MW197
MW150
358
996
MW194
MW22
MW21
MW106
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
MW103
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
0 1000 2000 3000 4000 5000 6000
Feet
WOODVILLE RD
HOBBS RD
McGRUER RD
ILLINOIS CENTRAL RAILROAD
996

MONITORING WELL NO. 106

MONITORING WELL COORDINATES N990.93. W8438.90

INSTALLATION DATE 11-13-91

MATERIAL SPECIFICATIONS

A. STAINLESS STEEL CASING:

2-INCH DIAMETER, TYPE 316, SCHEDULE 5S STAINLESS STEEL PIPE, IN ACCORDANCE WITH ASTM A-312. THREADED, FLUSH JOINTS.

B. PROTECTIVE CASING:

6-INCH DIAMETER, SEAMLESS SCHEDULE 40, ASTM A-53 CARBON STEEL PIPE.

C. BENTONITE PELLET SEAL:

FREE FLOWING, HIGH-SWELLING, SODIUM-BASED, WYOMING-TYPE BENTONITE.

D. GRAVEL FILTER PACK:

100% BY WEIGHT PASSING A No.4 US STANDARD SIEVE AND NO MORE THAN 5% BY WEIGHT PASSING A No.50 US STANDARD SIEVE, WITH A UNIFORMITY COEFFICIENT OF TWO OR LESS.

E. WELL SCREEN:

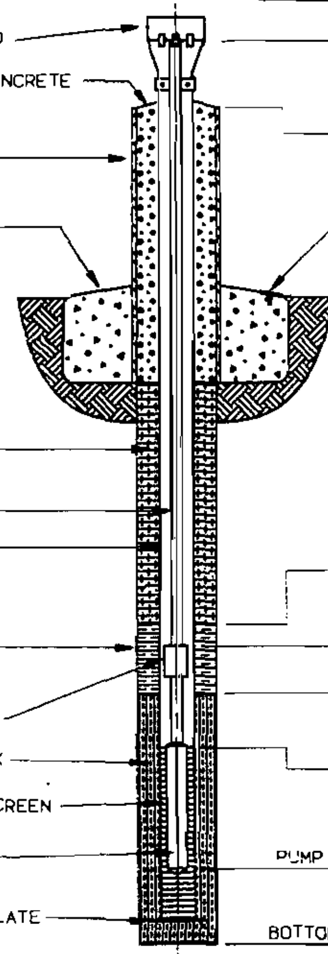
2-INCH DIAMETER, 10-FEET LONG, TYPE 316 STAINLESS STEEL, WIRE WOUND, WITH A 0.010-SLOT SIZE.

F. INFLATABLE PACKER:

Q.E.D. ENVIRONMENTAL SYSTEMS, INC., "PURGE MISER" MODEL 4200.

G. WELL PUMP:

Q.E.D. ENVIRONMENTAL SYSTEMS, INC., "WELL WIZARD" MODEL T-1200.



	± VERTICAL	ELEVATION
HEAD PLATE	3.06	369.35
TOP OF PROTECTIVE CASING	2.42	368.71
GROUND SURFACE	0.0	366.29
TOP OF BENTONITE PELLET SEAL	-58.0	308.3
TOP OF INFLATABLE PACKER	-59.5	306.8
TOP OF GRAVEL FILTER PACK	-61.5	304.8
TOP OF 10' S.S. SCREEN	-62.0	304.3
PUMP INTAKE	-66.5	299.8
BOTTOM OF GRAVEL FILTER PACK	-75.0	291.3

NOT TO SCALE

A-29

REV. NO.	ISSUE / REVISION DESCRIPTION	DRW	CHK	SECT	DEPT	PE	RED		SAFETY	SECURITY	FIRE	H PHY	IND HY	OTHER	QC	PJ MMES
0	ORIGINAL ISSUE/FOR ESO 16905	X	X	X	X	X	X									X

CHANGE CONTROL PROCEDURE EP-C-18 — REVISION OR ISSUE APPROVALS

DRAWING APPROVALS		DATE
DRW		
RED	[signature]	1/92
CHK		
SECT		
DEPT		
PE		
PEDH		
PJ/MMES		
REQUESTER		
A-E		
DOE		

MARTIN MARIETTA — MARTIN MARIETTA ENERGY SYSTEMS, INC.
operated for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC-05-84OR21400
Oak Ridge, Tennessee • Paducah, Kentucky

GROUNDWATER MONITORING PHASE III, AS BUILT, MONITORING WELL NO. 106

1	48	49	50	PLANT	BLDG	FL	SHEET	OF	TYPE S / CLASS U
3	C	G	N	PGDP	.	.	.	.	

SCALE	ED	DRAWING NO.		REV
N.T.S.	16905	C5B-16905	SK19	0

[Page left blank]

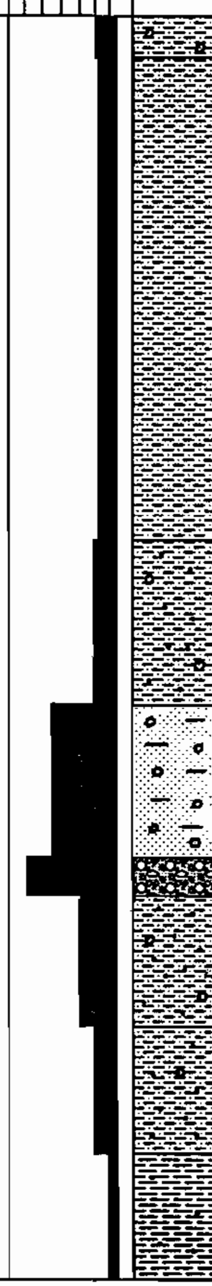
BORING NO.: S-22	PAGE 1 OF 3

SUBSURFACE BORING LOG

PROJECT: AZ-054, GW Monitoring Phase 3 LOCATION: EAST: -8437.7 NORTH: 980.6
SURF. ELEV.: 366.4 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 60' and mud rotary to 85'
DATE STARTED: 10/29/91 DATE FINISHED: 10/31/91 LOGGER: J.L. Clausen

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)
0.0				
		S-22-1	4.0	NA
-5.0	5.0			
		S-22-2	3.5	NA
-10.0	10.0			
		S-22-3	5.0	NA
-15.0	15.0			
		S-22-4	4.2	NA
-20.0	20.0			
		S-22-5	4.7	NA
-25.0	25.0			
		S-22-6	5.0	NA
-30.0	30.0			

GRAIN SIZE PLOT (CLY, SLT, VF, F, M, C, VC, GVL, CBL) / SECTION PROFILE



LITHOLOGIC DESCRIPTION / COMMENTS

SILT: root, organic, occ pbl, br (10YR 2/2)

SILT: sl cly, root struct, v stiff, lgt buff mott yel (10YR 7/2)

SILT: sl cly, sl sdy (10%) vf, occ pbl, tan (2.5YR 7/2)

SAND: (50%), m-c, rndd, mod srtd, slty, sl gvly (10%), brn to tan (7.5YR 5/4)

GRAVEL: (80%), sl sdy (20%), buff mott orsh-rd (7.5YR 7/3)

SILT: sdy (45%) f-m, rndd, tr pbl (5%), buff mott orsh-rd (7.5YR 7/3)

SILT: sdy (40%) f, rnd, mod srtd, occ pbl, stiff, lgt buff, mott orsh-rd (5YR 7/1)

CLAY: sl slty, sl sdy (10%) vf, rndd, well srtd, stiff, tan to gr mott yel (5YR 7/1)

BORING NO.: S-22	PAGE 2 OF 3

SUBSURFACE BORING LOG

PROJECT: AZ-054 GW Monitoring Phase 3 LOCATION: EAST: -8437.7 NORTH: 980.6
SURF. ELEV.: 366.4 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 60' and mud rotary to 85'
DATE STARTED: 10/29/91 DATE FINISHED: 10/31/91 LOGGER: J.L. Clausen

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	LITHOLOGIC DESCRIPTION / COMMENTS
-30.0	30.0				do
		S-22-7	5.0	NA	
					CLAY: sl slty, sl sdy (20%) vf, rnd, well srtd, stiff, lgt mott orsh-rd (10YR 7/2)
-35.0	35.0				
		S-22-8	5.0	NA	
-40.0	40.0				
					CLAY: sl slty, tr pbl, stiff, sl sdy (20%) f from 45'-47,' lam, orsh-rd w/ gr (7.5YR 6/8)
		S-22-9	5.0	NA	
-45.0	45.0				
		S-22-10	5.0	NA	
-50.0	50.0				SAND: (60-90%) vf-m, mod srtd, subang, sl slty to slty, tr mic, soft, occ pbl, lgt gr (10YR 8/1) to brsh-yel to rdsh-yel w/ wht lam (7.5YR 7/8)
		S-22-11	5.0	NA	
-55.0	55.0				
		S-22-12	3.2	NA	
-60.0	60.0				

GRAIN SIZE PLOT: CL, VF, F, M, C, VC, G
SECTION PROFILE

BORING NO.: S-22	PAGE 3 OF 3

SUBSURFACE BORING LOG

PROJECT: AZ-054, GW Monitoring Phase 3 LOCATION: EAST: -8437.7 NORTH: 980.6
SURF. ELEV.: 366.4 DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 60' and mud rotary to 85'
DATE STARTED: 10/29/91 DATE FINISHED: 10/31/91 LOGGER: J.L. Clausen

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
-60.0	60.0–62.0	S-22-13	1.8	21-58-72-79 (130)			GRAVEL (80%) sl sdy (20%) vc, rndd, well srtd, rdsh-br (7.5YR 5/8)
-65.0	65.0–67.0	S-22-14	1.6	36-58-74-96 (132)			
-70.0	70.0–72.0	S-22-15	1.3	27-39-25-31 (64)			
-75.0	75.0–77.0	S-22-16	0.3	29-REF			
-80.0	80.0–82.0	S-22-17	1.8	16-54-43-45 (97)			SAND (80%) vf, tr slt, sl cly, ang, well srtd, lgt gr (10YR 7/1), sm or (2.5YR 8/3) sd lyrs, interbedded w/ clay, br
-85.0	85.0–87.0	S-22-18	1.5	12-40-47-41 (87)			
							TD = 87'
-90.0							

[Page left blank]

Summary of RGA Background Wells

MW 141

Location - Northwest of Plant; Private property near Ogden Landing Road and Big Bayou Creek; Well Cluster 4
N (6544.69) E (-12173.02)

Date Installed - April 9 to 11, 1990

Screened Depth - Deep RGA
Top - 79 ft bgs
Bottom - 80 ft bgs

Dates Sampled (Data available) - Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94

Construction Information Reference - Technical Memorandum No. 5 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)

Potential Contaminant Information -

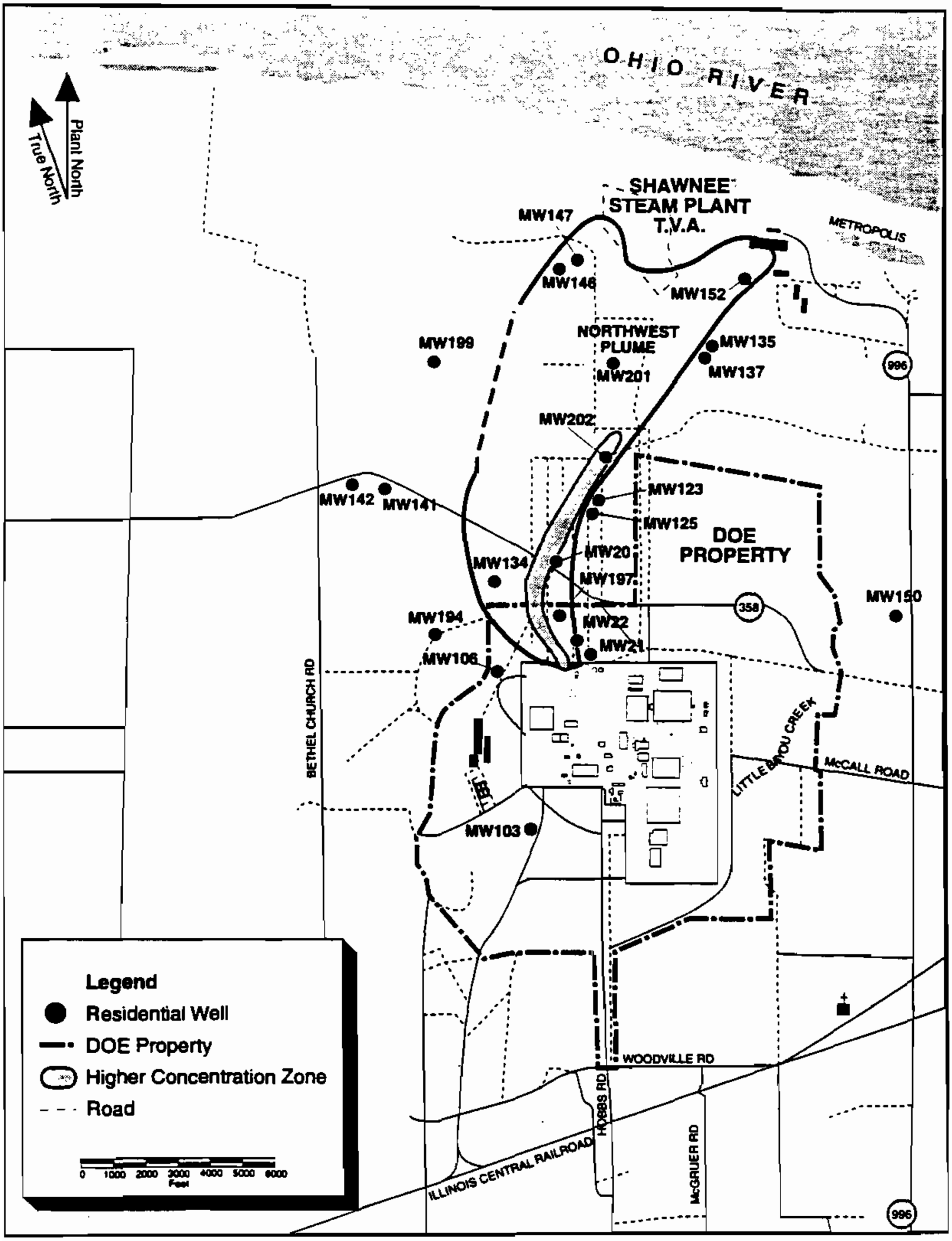
Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
bis(2-ethylhexyl)phthalate	5 J	NA	4/27/90	CH200429-00000
Pyrene	3 J	NA	3/13/91	CH210011-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Te	-0.23	1.49	3/13/91	CH210011-00000
^{99}Te	8	35	5/26/93	6080-93
^{99}Tc	1	3	7/13/93	6092-93
^{99}Tc	7	33	10/21/93	7085-93
^{99}Tc	15	20	1/11/94	4229-94
^{99}Tc	0	14	7/20/94	6054-94
^{99}Tc	8	24	10/10/94	6868-94
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
None	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.

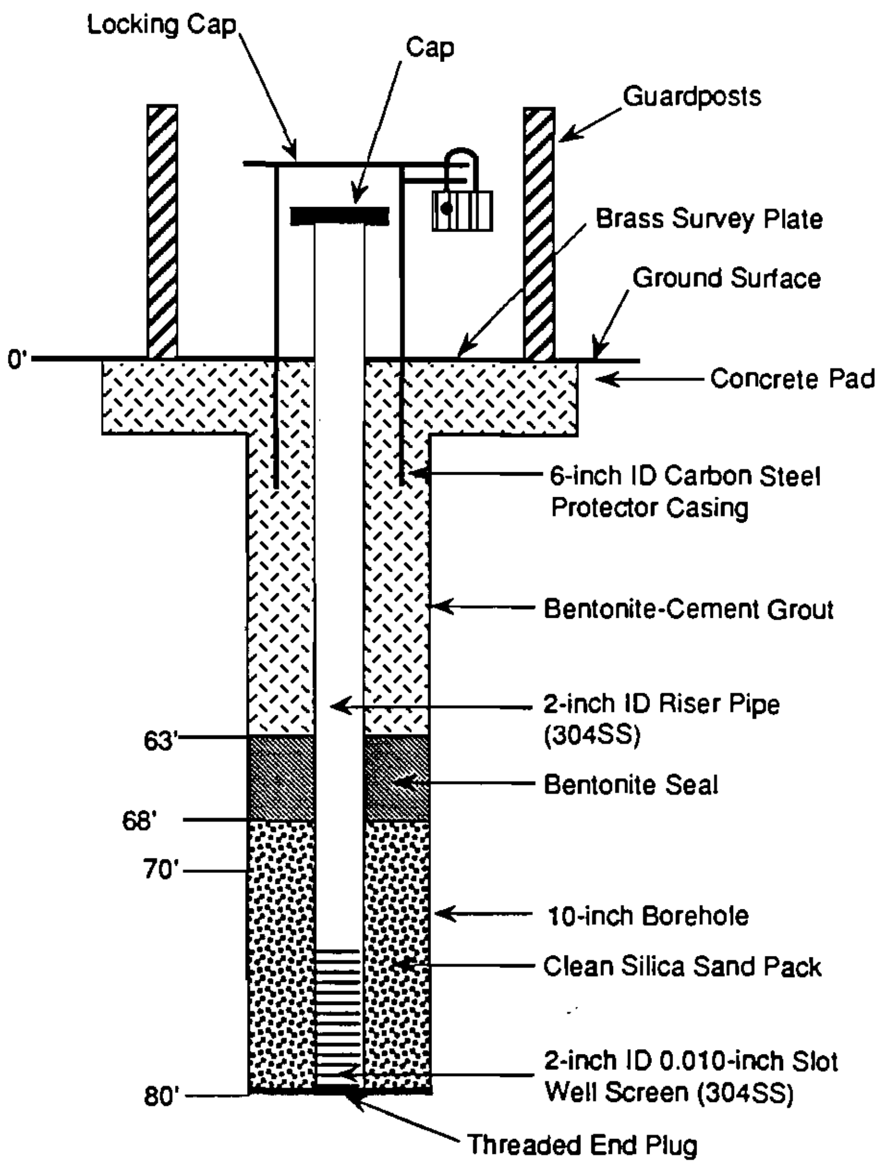
Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	7	92.6	88 - 104	mg/L
Depth to Water	7	16.5	10.64 - 20.75	feet
Dissolved Oxygen	7	4.65	3.95 - 5.35	mg/L
Dissolved Solids	7	196.1	186 - 217	mg/L
Hardness as CaCO3, Dissolved	1	109	NA	g/L CaCO
pH	28	6.1	6 - 6.2	SU
Specific Conductance	28	356.0	346 - 374	umhos/cm
Temperature	7	58.6	58 - 59	F
Total Organic Carbon	25	< 1	< 1 - 1	mg/L
Turbidity	7	15.4	2.9 - 35	NTU

Notes: NA = Entry not applicable or not available.


OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
MW199
NORTHWEST PLUME
MW201
MW135
MW137
MW202
MW142
MW141
MW123
MW125
DOE PROPERTY
MW134
MW20
MW197
MW150
MW194
MW22
MW21
MW106
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
MW103
WOODVILLE RD
HOBBS RD
McGRUER RD
ILLINOIS CENTRAL RAILROAD
996
358
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
0 1000 2000 3000 4000 5000 6000
Feet

Well 141
Well without
Isolation Casing



Well 141 Construction Details

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 1 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2	4157	2.0'	3-3-4-5 (7)	SILT, YELLOWISH GRAY (10 YR 4/2), BROWN, MOIST, FIRM, MOTTLED (BLACK ORGANIC SPOTS), LOW PLASTICITY, (ML)	BACKGROUND= HNU=0 PPM RAD=52 CPM HNU=0 PPM RAD=44 CPM
2	2-4		2.0'	3-3-3-3 (6)	SILT, SAME AS ABOVE, DAMP, (ML)	START DRILLING 1100 HNU=0 PPM RAD=34 CPM
4	4-6		1.75'	2-2-2-2 (4)	SILT, SAME AS ABOVE, (ML), CHANGING TO SILTY SAND, YELLOWISH BROWN (10 YR 4/2), DAMP, VERY LOOSE, FINE-MEDIUM, WELL GRADED, (SM)	HNU=0 PPM RAD=46 CPM
6	6-8	4158	1.75'	2-2-2-2 (4)	POORLY GRADED SAND WITH SILT, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY LOOSE, MEDIUM SUBROUNDED GRAINS, MOSTLY QUARTZ, (SP-SM)	HNU=0 PPM RAD=36 CPM
8	8-10		0'		NO SAMPLE, EXTREMELY LOOSE	HNU=0 PPM RAD=36 CPM
10	10-12			3-10-20-18 (30)	WELL GRADED GRAVEL WITH SILT AND SAND, MODERATE REDDISH BROWN (10 R 4/6), WET, MEDIUM DENSE, SUBANGULAR GRAINS, (GW-GM)	HNU=0 PPM RAD=40 CPM
12	12-14	4159	2.0'	12-18-18-13 (34)	WELL GRADED GRAVEL WITH SAND, MODERATE REDDISH BROWN (10 R 4/6), STREAKS OF GRAY (N7), WET, DENSE, SUBANGULAR TO SUBROUNDED GRAINS, (GW)	HNU=0 PPM RAD=36 CPM
14	14-16		1.5'	2-3-4-9 (7)	WELL GRADED GRAVEL WITH SAND AS ABOVE, CHANGING TO FAT CLAY, GREENISH GRAY (5 GY 6/1), MOIST, STIFF, PLASTIC, (CH)	HNU=0 PPM RAD=60 CPM
16	16-18		1.5'	7-10-14-22 (24)	FAT CLAY, GREENISH GRAY (5 GY 6/1), WITH MODERATE REDDISH BROWN STREAKS, DAMP, VERY STIFF, CHANGING TO GRAVEL, (CH)	HNU=0 PPM RAD=42 CPM
18	18-20	4160	2.0'	8-12-15-14 (27)	FAT CLAY, GREENISH GRAY (5 GY 6/1), CHANGING TO SILTY CLAY (DARK YELLOWISH BROWN (10 YR 4/2), DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=44 CPM
20	20-22		1.5'	5-7-10-12 (17)	SILTY CLAY WITH SAND, MODERATE REDDISH BROWN (10 YR 4/6) WITH GRAY (N7) STREAKS, DAMP, VERY STIFF, GRAINS OF DARK MINERALS, QUARTZ, SOME PEBBLES, (CL-ML)	HNU=0 PPM RAD=60 CPM
22	22-24		2.0'	5-12-13-17 (25)	FAT CLAY, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY STIFF, PLASTIC WITH STREAKS OF SILTY CLAY WITH SAND, LIGHT GRAY (N8), (CH)	HNU=0 PPM RAD=42 CPM
24	24-26	4161	1.75'	9-10-25-29 (35)	SILTY CLAY, MODERATE REDDISH BROWN, MOIST, STIFF, (CL-ML); CHANGING TO SILTY SAND, LIGHT GRAY (N8) MOTTLED ORGANIC STAINING (BLACK), DAMP, DENSE, IRON OXIDE, FINE, POORLY GRADED, (SW-SM)	HNU=0 PPM RAD=52 CPM
26	26-28		1.75'	5-12-11-16 (23)	SILTY SAND, SAME AS ABOVE, (SW-SM), CHANGING TO SANDY SILTY CLAY, MOTTLED AS ABOVE, DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=34 CPM
28	28-30			9-22-22-25 (44)	SILTY SAND WITH CLAY, MODERATE REDDISH BROWN (10 YR 4/6) MOTTLED, MOIST, DENSE, FINE-MEDIUM, (SP-SM), CHANGING TO SAND, LIGHT GRAY (N8) MOTTLED, MOIST, IRON OXIDE, ORGANIC, (SW)	HNU=0 PPM RAD=32 CPM STOP DRILLING 1620 3/20/90
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 2 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION ____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE ____ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32		1.0'	15-18-12-17 (28)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY (N7), AND MODERATE RED BROWN (10 YR 4/6) MOIST, MEDIUM DENSE, (GW), CHANGING TO SANDY SILT, LIGHT GRAY, DAMP, VERY STIFF, (ML)	RESUME DRILLING 3/21/90, 0800 HNU=0 PPM RAD=28 CPM
32	32-34	4164	2.0'	25-72-107-180 (179)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY AND MODERATE RED BROWN, MOIST, VERY DENSE, COARSE, (GW)	HNU=0 PPM RAD=34 CPM
34	34-36		1.8'	22-18-63-80 (81)	SAME AS ABOVE, (GW)	HNU=0 PPM RAD=22 CPM
36	36-38		1.2'	38-61-51-52 (112)	POORLY GRADED SAND WITH CLAY, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-VERY COARSE; TOP 4": WITH VERY FINE-COARSE GRAVEL, 4-14": WITH SOME CLAY, (SP-SC)	HNU=0 PPM RAD=32 CPM
38	38-40	4165	1.6'	12-15-38-39 (53)	SAME AS ABOVE, LESS CLAY, SUBROUNDED TO SUBANGULAR, QUARTZ, TRACE MICA AND FERRO-MAGNESIUM MINERALS, (SP-SC)	0905 HNU=0 PPM RAD=20 CPM
40	40-42		1.8'	15-16-26-29 (42)	SAME AS ABOVE, SOME CLAYEY SAND IN LOWER 4", (SP-SC)	0912 HNU=0 PPM RAD=40 CPM
42	42-44		1.6'	12-34-40-50 (74)	SAME AS ABOVE, BOTTOM 6": FINE-COARSE GRAVEL, (SP-SC)	0922 HNU=8 PPM RAD=40 CPM
44	44-46	4166	1.7'	19-24-32-38 (56)	TOP 12": SAME AS ABOVE; BOTTOM 8": WELL GRADED GRAVEL WITH SAND, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, VERY COARSE SAND, MOSTLY FINE-MEDIUM GRAVEL, SUBANGULAR-SUBROUNDED, (GP)	1016 HNU=0 PPM RAD=26 CPM
46	46-48		2.0'	12-27-27-29 (54)	WELL GRADED SAND, DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-COARSE, SUBANGULAR-SUBROUNDED, (SW)	1028 HNU=0 PPM RAD=20 CPM
48	48-50		2.0'	23-29-31-41 (60)	SAME AS ABOVE; BOTTOM 4" GRADED TO VERY FINE GRAVEL, (SW)	1040 HNU=0 PPM RAD=36 CPM
50	50-52	4167	2.0'	15-27-28-33 (55)	SAME AS ABOVE	1107 HNU=0 PPM RAD=28 CPM
52	52-54		2.0'	33-65-55-50 (120)	SAME AS ABOVE, TOP 12": WITH VERY FINE GRAVEL, (SW)	1115 HNU=0 PPM RAD=24 CPM
54	54-56		2.0'	28-34-41-40 (75)	SAME AS ABOVE, (SW)	HNU=0 PPM RAD=36 CPM
56	56-58	4168	1.5'	24-40-12-11 (52)	TOP 6" SAME AS ABOVE; BOTTOM 12": POORLY GRADED GRAVEL AND SAND, SAME COLOR, WET, MEDIUM-VERY COARSE SAND, SUBANGULAR-SUBROUNDED, SOME SILT, (GP)	1405 HNU=0 PPM RAD=32 CPM
58	58-60			13-16-10-11 (26)	NO RECOVERY	
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 3 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		0'	13-26-65-60 (91)	NO RECOVERY	NEW LOGGER: B. COCKE
62	62-64	4169	1.8'	330/6"	POORLY GRADED SAND WITH GRAVEL, DARK YELLOW ORANGE (10 YR 6/6) AND LIGHT GRAY (N8), MOIST, VERY DENSE, SUBANGULAR-SUBROUNDED, MEDIUM-ROUNDED GRAVEL, (SP)	HNU=0 PPM RAD=32 CPM * NOTE: CHANGE TO 300# HAMMER
64	64-66		2.0'	20-14-15-30 (29)	SAME AS ABOVE, DENSE, (SP)	HNU=0 PPM RAD=22 CPM STOP DRILLING 1600
66	66-68		2.0'	20-13-15-52 (28)	WELL GRADED SAND, GRAYISH ORANGE (10 YR 7/4), WET, MEDIUM DENSE, FINE-MEDIUM, SUBANGULAR, (SW)	0822 HNU=0 PPM RAD=28 CPM RESUME DRILLING 3/22/90
68	68-70	4171	2.0'	48-41-19-35 (60)	SAME AS ABOVE, BOTTOM 6": FINER SAND, (SW)	0846 HNU=0 PPM RAD=30 CPM
70	70-72			20-13-18-33 (31)	SAME AS ABOVE, (SW)	0910 HNU=0 PPM RAD=36 CPM OBTAIN SAMPLE
72	72-74		2.0'	37-47-60-50 (107)	SAME AS ABOVE, (SW)	0925 HNU=0 PPM RAD=28 CPM DRILLER CONDITION THE BOREHOLE BY RUNNING AUGER UP AND DOWN
74	74-76	4172	2.0'	20-19-16-20 (35)	SAME AS ABOVE, (SW)	1035 HNU=0 PPM RAD=32 CPM
76	76-78			4-6-7-7 (13)	SAME AS ABOVE, MEDIUM DENSE, (SW)	1410 HNU=0 PPM RAD=36 CPM NEW LOGGER B. COCKE OBTAIN SAMPLE 4172 & DUPLICATE 4173
78	78-80			2-3-5-7 (8)	ELASTIC SILT, LIGHT GRAY (N7), MOIST, FIRM, PLASTIC, STREAKS OF MODERATE REDDISH BROWN (10 R 4/6), IRON OXIDES, (MH)	1445 HNU=0 PPM RAD=46 CPM
80	80-82	4174		3-5-7-7 (12)	SAME AS ABOVE, STIFF, SMALL INTERBEDDED LAYERS OF GRAVEL, WELL-GRADED, DARK REDDISH BROWN, (MH)	1530 HNU=0 PPM RAD=50 CPM
82	82-84			4-3-3-5 (6)	SAME AS ABOVE, (MH)	1558 HNU=0 PPM RAD=
84	84-86		1.8'	3-4-5-5 (9)	SAME AS ABOVE, (MH)	0834 HNU=0 PPM RAD=44 CPM RESUME DRILLING/SAMPLING 3/25/90, 0800
86	86-88	4176	2.0'	4-4-3-5 (7)	ELASTIC SILT, SAME AS ABOVE, WITH THIN INTERBEDDED SAND WITH SILT, GRAYISH ORANGE (10 YR 7/4), MEDIUM, POORLY GRADED, WET, SUBANGULAR-ANGULAR GRAINS, <10% DARK MINERALS, MOSTLY QUARTZ	0850 HNU=0 PPM RAD=58 CPM
88	88-90		2.0'	3-3-2-3 (5)	ELASTIC SILT, LIGHT GRAY (N7) STREAKED WITH MEDIUM GRAY (N5), MOIST, FIRM, PLASTIC, WITH INTERBEDDED SAND, GRAYISH ORANGE (10 YR 7/4) AS ABOVE, (MH)	0912 HNU=0 PPM RAD=38 CPM SAMPLE COMPOSITED 0918
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 4 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	90-92		2.0'	4-4-8-10 (12)	SAME AS ABOVE, CHANGING TO FAT CLAY WITH SILT, MEDIUM GRAY (N5), MOIST, STIFF, INTERBEDDED COARSE SAND AND GRAVEL, GRAYISH ORANGE, (CH-MH)	1020 HNU=0 PPM RAD=36 CPM
92	92-94	4177	1.9'	4-4-5-4 (9)	FAT CLAY WITH SILT, SAME AS ABOVE, (CH-MH), CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, STIFF, (CH)	1035 HNU=0 PPM RAD=34 CPM
94	94-96			4-4-5-6 (9)	SAME AS ABOVE, (CH)	1103 HNU=0 PPM RAD= STOP DRILLING 1145, SAMPLE COMPOSITED 1110
96	96-97.6					CASING SET @ 97 RESUMED SAMPLING 4/5/90, 1010 HNU=0 PPM RAD=136 CPM SAMPLE 4178=SHELBY TUBE SAMPLE
98	97.6-99.6	4178	2.0'	N/A	WELL GRADED SAND, MEDIUM-COARSE, CHERTY, (SW)	
100	99.6-101					
102	101-103	4179		5-7-10-11 (17)	ELASTIC SILT, MEDIUM DARK GRAY (N4), DAMP, MICACEOUS, VERY STIFF, (MH)	1050 HNU=0 PPM RAD=40 CPM 300# HAMMER
104	103-106					
106	106-108	4180		6-20-17-28 (37)	WELL GRADED SAND, LIGHT GRAY (N7), MOIST, DENSE, FINE-MEDIUM, SUBANGULAR, <5% DARK MINERALS, <1% MICACEOUS; (SW); CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), DAMP, HARD, (CH)	1405 HNU=0 PPM RAD=32 CPM
108	108-111					
110						
112	111-113	4181	1.75'	6-18-12-29 (30)	WELL GRADED SAND, LIGHT GRAY (N7) TO MEDIUM GRAY (N8), MOIST, MEDIUM DENSE, VERY FINE-MEDIUM, <5%, DARK RED, 5-10% MICA, SUBANGULAR, (SW)	1450 HNU=0 PPM RAD=48 CPM
114	113-116					
116	116-118	4182	2.0'	3-7-8-16 (15)	SILTY SAND, LIGHT TO MEDIUM GRAY (N7-N4), MOIST TO DAMP, MEDIUM DENSE, FINE TO MEDIUM, MANY THIN LAYERS, 15-40% SILT, 5-10% MICA, (SM)	1530 HNU=0 PPM RAD=28 CPM
118						
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 5 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
122	121-123	4183	2.0'	17-8-10-17 (18)	SILTY SAND, SAME AS ABOVE, 10-25% SILT (SM); CHANGING TO WELL GRADED SAND WITH SILT, LIGHT GRAY (N7), MOIST, MEDIUM DENSE, VERY FINE TO MEDIUM, MICACEOUS, 5% SILT, (SW-SM)	HNU=0 PPM RAD=40 CPM STOPPED DRILLING 1620
124						
126	126-128	4185	1.5'	8-21-18-20 (39)	POORLY GRADED SAND, MEDIUM LIGHT GRAY (N6), MOIST-WET, DENSE, FINE, 3% DARK MINERALS, 3% MICA, (SP)	RESUMED SAMPLING 4/6/90, 0830, 300# HAMMER HNU=0 PPM RAD=39 CPM 0900
128						
130						
132	131-133	4186	1.75'	8-17-35-96 (52)	SAME AS ABOVE, FINE-MEDIUM, (SP); CHANGING TO FAT CLAY, VERY HARD, MICACEOUS, BROWNISH BLACK @ 133.5', (CH)	1020 HNU=0 PPM RAD=
134						
136	136-138	4187	2.0'	10-9-15-16 (24)	POORLY GRADED SAND, SAME AS ABOVE, MEDIUM DENSE, CONTAINS TWO 4" SEAMS OF FAT CLAY AS ABOVE, (SP)	1100 HNU=0 PPM RAD=40 CPM
138						
140						
142	141-143	4188		4-10-21-23 (31)	FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, VERY STIFF, MICACEOUS, (CH); CHANGING TO POORLY GRADED SAND, SAME AS ABOVE, (SP)	1530 HNU=0 PPM RAD=48 CPM STOPPED DRILLING 1535 TD OF BORING 143'

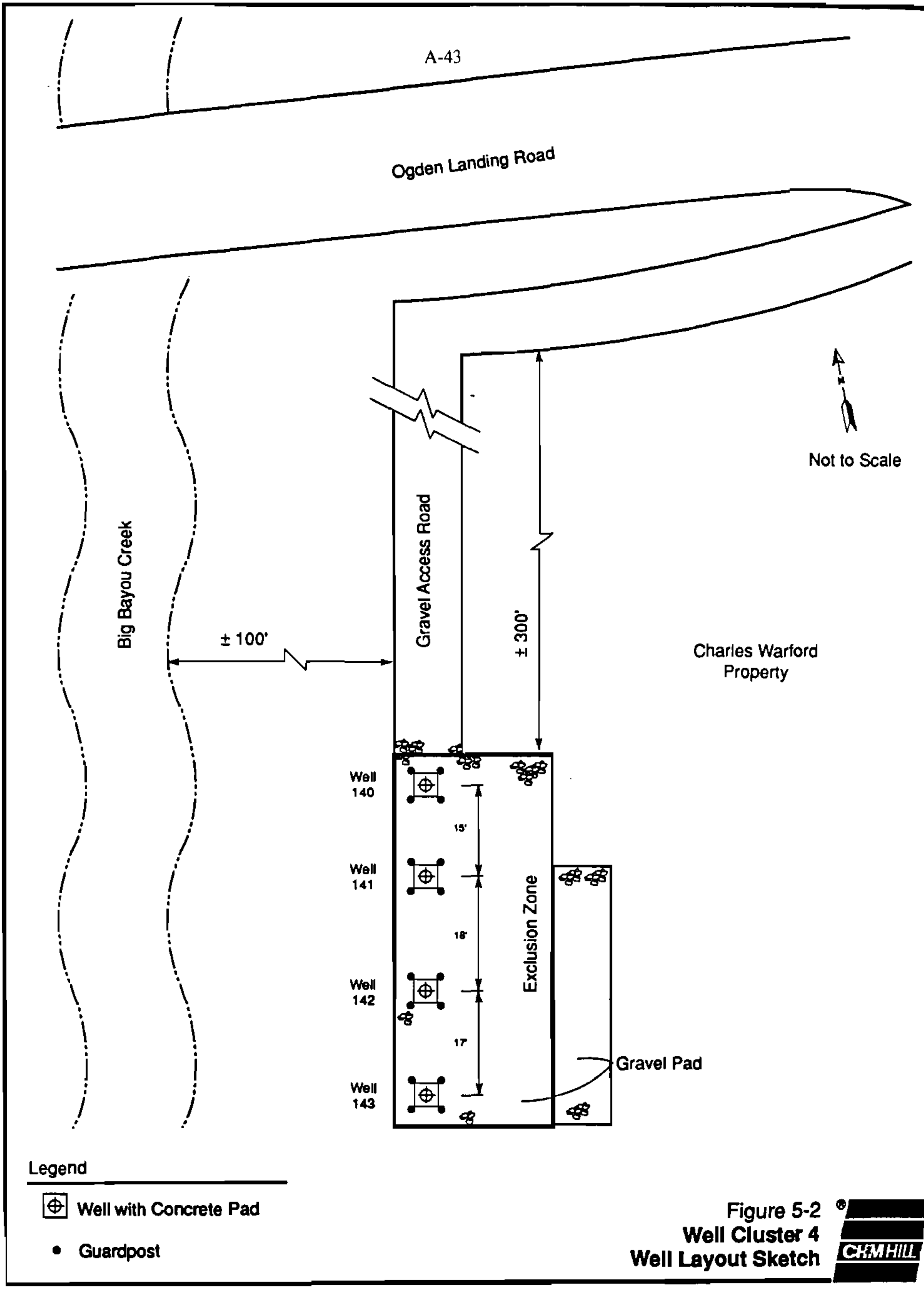


Figure 5-2
Well Cluster 4
Well Layout Sketch

[Page left blank]

Summary of RGA Background Wells

MW 142

Location - Northwest of Plant; Private property near Ogden Landing Road and Big Bayou Creek; Well Cluster 4
N (6529.75) E (-12162.411)

Date Installed - April 16 to 17, 1990

Screened Depth - Shallow RGA
Top - 42.5 ft bgs
Bottom - 52.5 ft bgs

Dates Sampled (Data available) - Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97; Q4 97

Construction Information Reference - Technical Memorandum No. 5 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)

Potential Contaminant Information -

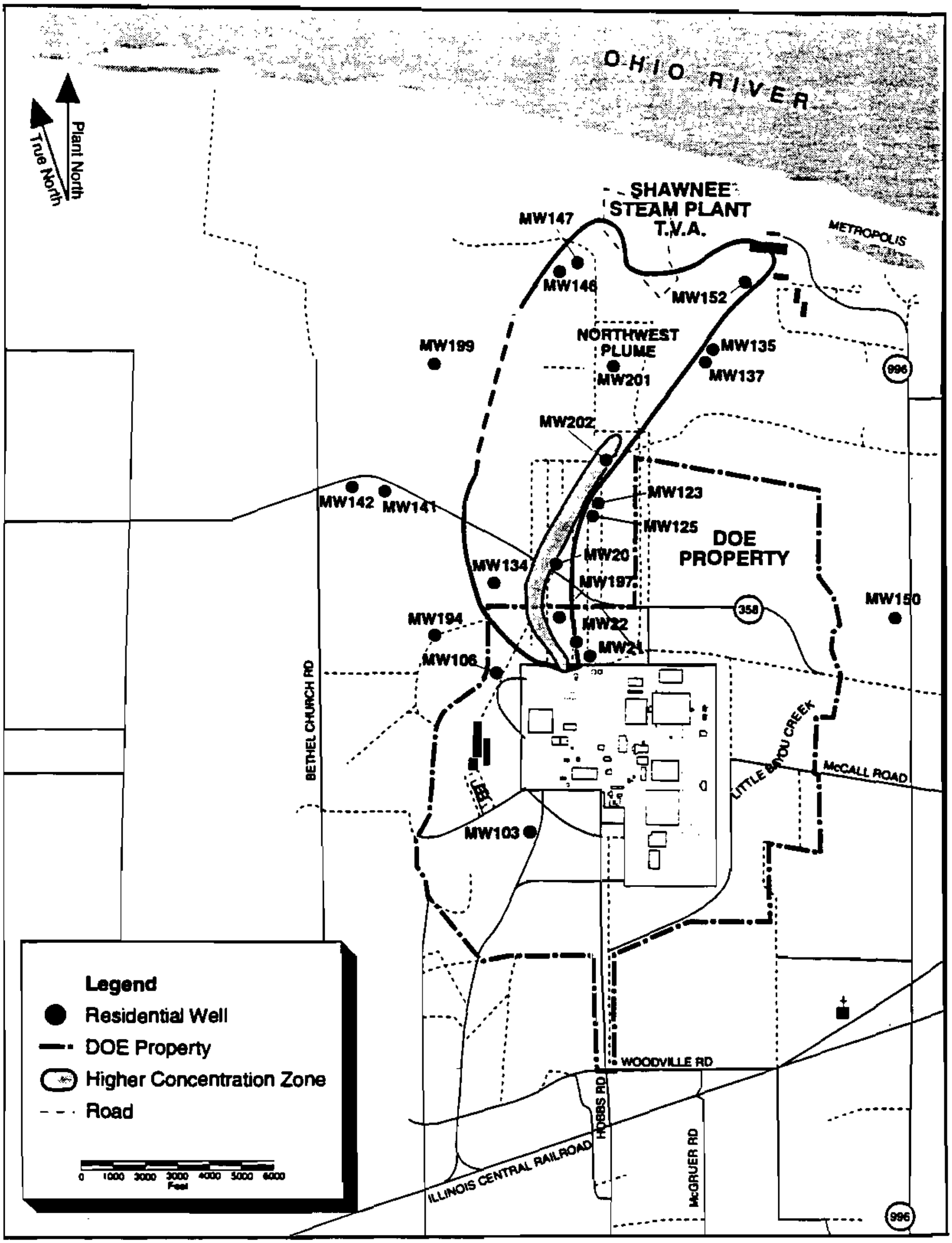
Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
Toluene	1 J	NA	8/16/90	CH200674-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	-1.6	1.59	3/14/91	CH210012-00000
^{99}Tc	9	6	5/26/93	6084-93
^{99}Tc	0	16	7/13/93	6096-93
^{99}Tc	0	13	10/21/93	7089-93
^{99}Tc	10	19	1/11/94	4233-94
^{99}Tc	1	1	7/20/94	6058-94
^{99}Tc	8	17	10/10/94	6872-94
^{99}Tc	16	19	2/6/95	5464-95
^{99}Tc	3	10	2/12/96	5317-96
^{99}Tc	10	12	11/6/97	5797-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of colleetion)				
^{99}Tc	-0.2	1.49	3/14/91	CH210012-DIS

Notes: NA = Entry not applicable or not available.

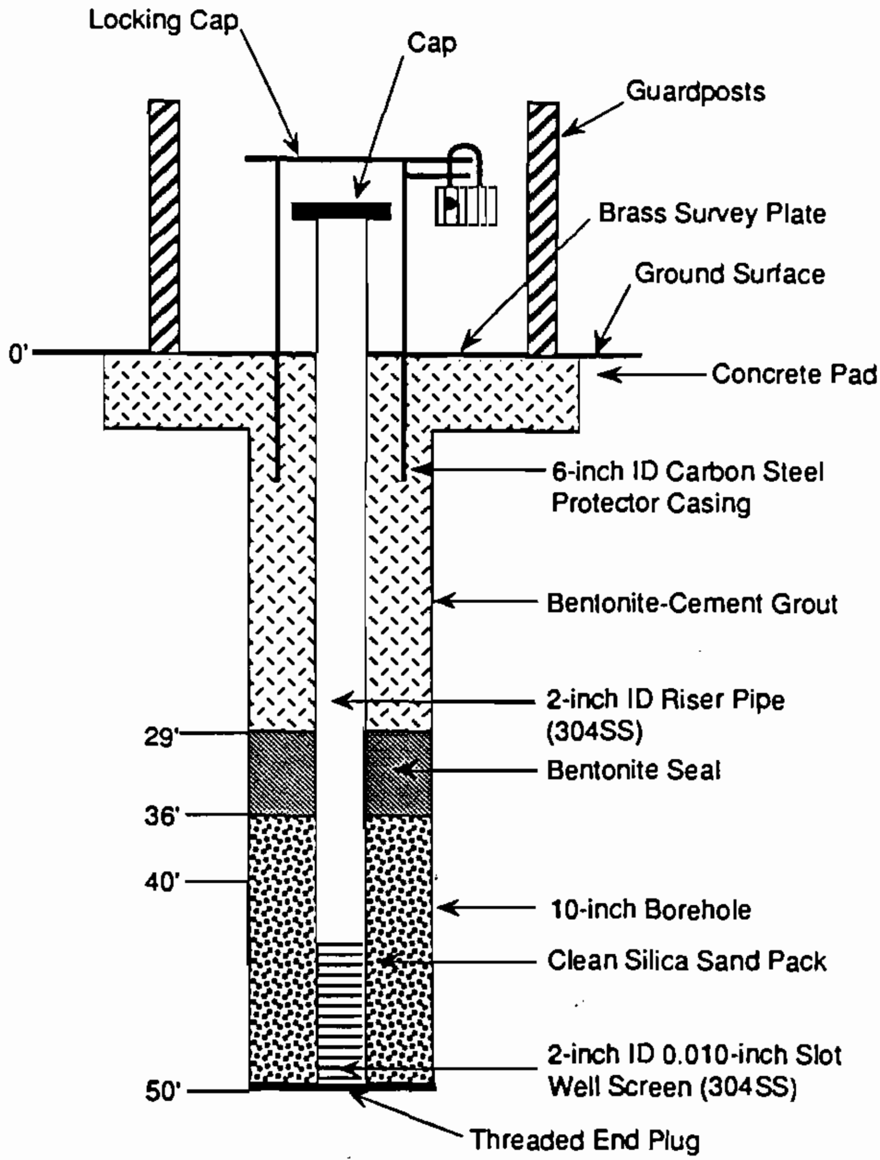
Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	10	78.4	74 - 83	mg/L
Depth to Water	11	17.8	10.8 - 22.24	feet
Dissolved Oxygen	11	5.66	4.2 - 6.91	mg/L
Dissolved Solids	10	199.6	155 - 221	mg/L
Hardness as CaCO3, Dissolved	1	85.2	NA	g/L CaCO
pH	38	5.93	5.8 - 6	SU
Specific Conductance	38	372	352 - 383	umhos/cm
Temperature	11	58.3	57 - 60	F
Total Organic Carbon	33	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	4.5	4 - 5	mg/L
Turbidity	9	5.73	1.6 - 18	NTU

Notes: NA = Entry not applicable or not available.


OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
MW199
NORTHWEST PLUME
MW201
MW135
MW137
996
MW202
MW142
MW141
MW123
MW125
DOE PROPERTY
MW134
MW20
MW197
358
MW150
MW194
MW22
MW21
MW106
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
MW103
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
0 1000 2000 3000 4000 5000 6000
Feet
WOODVILLE RD
HOBBS RD
ILLINOIS CENTRAL RAILROAD
McGRUER RD
996

Well 142
Well without
Isolation Casing



Well 142 Construction Details

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 1 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2		2.0'	3-3-4-5 (7)	SILT, YELLOWISH GRAY (10 YR 4/2), BROWN, MOIST, FIRM, MOTTLED (BLACK ORGANIC SPOTS), LOW PLASTICITY, (ML)	BACKGROUND- HNU-0 PPM RAD-52 CPM HNU-0 PPM RAD-44 CPM
2	2-4	4157	2.0'	3-3-3-3 (6)	SILT, SAME AS ABOVE, DAMP, (ML)	START DRILLING 1100 HNU-0 PPM RAD-34 CPM
4	4-6		1.75'	2-2-2-2 (4)	SILT, SAME AS ABOVE, (ML), CHANGING TO SILTY SAND, YELLOWISH BROWN (10 YR 4/2), DAMP, VERY LOOSE, FINE-MEDIUM, WELL GRADED, (SM)	HNU-0 PPM RAD-48 CPM
6	6-8		1.75'	2-2-2-2 (4)	POORLY GRADED SAND WITH SILT, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY LOOSE, MEDIUM SUBROUNDED GRAINS, MOSTLY QUARTZ, (SP-SM)	HNU-0 PPM RAD-36 CPM
8	8-10	4158	0'		NO SAMPLE, EXTREMELY LOOSE	HNU-0 PPM RAD-36 CPM
10	10-12			3-10-20-16 (30)	WELL GRADED GRAVEL WITH SILT AND SAND, MODERATE REDDISH BROWN (10 R 4/6), WET, MEDIUM DENSE, SUBANGULAR GRAINS, (GW-GM)	HNU-0 PPM RAD-40 CPM
12	12-14		2.0'	12-18-18-13 (34)	WELL GRADED GRAVEL WITH SAND, MODERATE REDDISH BROWN (10 F 4/6), STREAKS OF GRAY (N7), WET, DENSE, SUBANGULAR TO SUBROUNDED GRAINS, (GW)	HNU-0 PPM RAD-36 CPM
14	14-16	4159	1.8'	2-3-4-9 (7)	WELL GRADED GRAVEL WITH SAND AS ABOVE, CHANGING TO FAT CLAY, GREENISH GRAY (5 GY 6/1), MOIST, STIFF, PLASTIC, (CH)	HNU-0 PPM RAD-60 CPM
16	16-18		1.8'	7-10-14-22 (24)	FAT CLAY, GREENISH GRAY (5 GY 6/1), WITH MODERATE REDDISH BROWN STREAKS, DAMP, VERY STIFF, CHANGING TO GRAVEL, (CH)	HNU-0 PPM RAD-42 CPM
18	18-20		2.0'	8-12-15-14 (27)	FAT CLAY, GREENISH GRAY (5 GY 6/1), CHANGING TO SILTY CLAY (DARK YELLOWISH BROWN (10 YR 4/2), DAMP, VERY STIFF, (CL-ML)	HNU-0 PPM RAD-44 CPM
20	20-22	4160	1.8'	5-7-10-12 (17)	SILTY CLAY WITH SAND, MODERATE REDDISH BROWN (10 YR 4/6) WITH GRAY (N7) STREAKS, DAMP, VERY STIFF, GRAINS OF DARK MINERALS, QUARTZ, SOME PEBBLES, (CL-ML)	HNU-0 PPM RAD-60 CPM
22	22-24		2.0'	5-12-13-17 (25)	FAT CLAY, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY STIFF, PLASTIC WITH STREAKS OF SILTY CLAY WITH SAND, LIGHT GRAY (N8), (CH)	HNU-0 PPM RAD-42 CPM
24	24-26		1.75'	9-10-25-29 (35)	SILTY CLAY, MODERATE REDDISH BROWN, MOIST, STIFF, (CL-ML); CHANGING TO SILTY SAND, LIGHT GRAY (N8) MOTTLED ORGANIC STAINING (BLACK), DAMP, DENSE, IRON OXIDE, FINE, POORLY GRADED, (SW-SM)	HNU-0 PPM RAD-52 CPM
26	26-28	4161	1.75'	5-12-11-16 (23)	SILTY SAND, SAME AS ABOVE, (SW-SM), CHANGING TO SANDY SILTY CLAY, MOTTLED AS ABOVE, DAMP, VERY STIFF, (CL-ML)	HNU-0 PPM RAD-34 CPM
28	28-30			9-22-22-25 (44)	SILTY SAND WITH CLAY, MODERATE REDDISH BROWN (10 YR 4/6) MOTTLED, MOIST, DENSE, FINE-MEDIUM, (SP-SM), CHANGING TO SAND, LIGHT GRAY (N8) MOTTLED, MOIST, IRON OXIDE, ORGANIC, (SW)	HNU-0 PPM RAD-32 CPM STOP DRILLING 1620 3/20/90
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 2 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32	4164	1.0'	15-16-12-17 (28)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY (N7), AND MODERATE RED BROWN (10 YR 4/6) MOIST, MEDIUM DENSE, (GW), CHANGING TO SANDY SILT, LIGHT GRAY, DAMP, VERY STIFF, (ML)	RESUME DRILLING 3/21/90, 0800 HNU=0 PPM RAD=28 CPM
32	32-34		2.0'	25-72-107-180 (179)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY AND MODERATE RED BROWN, MOIST, VERY DENSE, COARSE, (GW)	HNU=0 PPM RAD=34 CPM
34	34-36		1.8'	22-18-63-80 (81)	SAME AS ABOVE, (GW)	HNU=0 PPM RAD=22 CPM
36	36-38	4165	1.2'	38-61-51-52 (112)	POORLY GRADED SAND WITH CLAY, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-VERY COARSE; TOP 4": WITH VERY FINE-COARSE GRAVEL, 4-14": WITH SOME CLAY, (SP-SC)	HNU=0 PPM RAD=32 CPM
38	38-40		1.8'	12-15-38-39 (53)	SAME AS ABOVE, LESS CLAY, SUBROUNDED TO SUBANGULAR, QUARTZ, TRACE MICA AND FERRO-MAGNESIUM MINERALS, (SP-SC)	0905 HNU=0 PPM RAD=20 CPM
40	40-42		1.8'	15-16-26-29 (42)	SAME AS ABOVE, SOME CLAYEY SAND IN LOWER 4", (SP-SC)	0912 HNU=0 PPM RAD=40 CPM
42	42-44	4166	1.8'	12-34-40-50 (74)	SAME AS ABOVE, BOTTOM 6": FINE-COARSE GRAVEL, (SP-SC)	0922 HNU=8 PPM RAD=40 CPM
44	44-46		1.7	19-24-32-38 (56)	TOP 12": SAME AS ABOVE; BOTTOM 8": WELL GRADED GRAVEL WITH SAND, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, VERY COARSE SAND, MOSTLY FINE-MEDIUM GRAVEL, SUBANGULAR-SUBROUNDED, (GP)	1016 HNU=0 PPM RAD=26 CPM
46	46-48		2.0'	12-27-27-29 (54)	WELL GRADED SAND, DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-COARSE, SUBANGULAR-SUBROUNDED, (SW)	1028 HNU=0 PPM RAD=20 CPM
48	48-50	4167	2.0'	23-29-31-41 (60)	SAME AS ABOVE; BOTTOM 4" GRADED TO VERY FINE GRAVEL, (SW)	1040 HNU=0 PPM RAD=36 CPM
50	50-52		2.0'	15-27-28-33 (55)	SAME AS ABOVE	1107 HNU=0 PPM RAD=28 CPM
52	52-54		2.0'	33-65-55-50 (120)	SAME AS ABOVE, TOP 12": WITH VERY FINE GRAVEL, (SW)	1115 HNU=0 PPM RAD=24 CPM
54	54-56	4168	2.0'	28-34-41-40 (75)	SAME AS ABOVE, (SW)	HNU=0 PPM RAD=36 CPM
56	56-58		1.5'	24-40-12-11 (52)	TOP 6" SAME AS ABOVE; BOTTOM 12": POORLY GRADED GRAVEL AND SAND, SAME COLOR, WET, MEDIUM-VERY COARSE SAND, SUBANGULAR-SUBROUNDED, SOME SILT, (GP)	1405 HNU=0 PPM RAD=32 CPM
58	58-60			13-16-10-11 (26)	NO RECOVERY	
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 3 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		0'	13-26-65-60 (91)	NO RECOVERY	NEW LOGGER: B. COCKE
62	62-64	4169	1.8'	330/6"	POORLY GRADED SAND WITH GRAVEL, DARK YELLOW ORANGE (10 YR 6/6) AND LIGHT GRAY (N8), MOIST, VERY DENSE, SUBANGULAR-SUBROUNDED, MEDIUM-ROUNDED GRAVEL. (SP)	HNU=0 PPM RAD=32 CPM * NOTE: CHANGE TO 300# HAMMER
64	64-66		2.0'	20-14-15-30 (29)	SAME AS ABOVE, DENSE. (SP)	HNU=0 PPM RAD=22 CPM STOP DRILLING 1600
66	66-68		2.0'	20-13-15-52 (28)	WELL GRADED SAND, GRAYISH ORANGE (10 YR 7/4), WET, MEDIUM DENSE, FINE-MEDIUM, SUBANGULAR. (SW)	0822 HNU=0 PPM RAD=28 CPM RESUME DRILLING 3/22/90
68	68-70	4171	2.0'	48-41-19-35 (60)	SAME AS ABOVE, BOTTOM 6": FINER SAND. (SW)	0846 HNU=0 PPM RAD=30 CPM
70	70-72			20-13-18-33 (31)	SAME AS ABOVE. (SW)	0910 HNU=0 PPM RAD=36 CPM OBTAIN SAMPLE
72	72-74		2.0'	37-47-60-50 (107)	SAME AS ABOVE. (SW)	0925 HNU=0 PPM RAD=26 CPM DRILLER CONDITION THE BOREHOLE BY RUNNING AUGER UP AND DOWN
74	74-76	4172	2.0'	20-19-18-20 (35)	SAME AS ABOVE. (SW)	1035 HNU=0 PPM RAD=32 CPM
76	76-78			4-6-7-7 (13)	SAME AS ABOVE, MEDIUM DENSE. (SW)	1410 HNU=0 PPM RAD=36 CPM NEW LOGGER B. COCKE OBTAIN SAMPLE 4172 & DUPLICATE 4173
78	78-80			2-3-5-7 (8)	ELASTIC SILT, LIGHT GRAY (N7), MOIST, FIRM, PLASTIC, STREAKS OF MODERATE REDDISH BROWN (10 R 4/6), IRON OXIDES. (MH)	1445 HNU=0 PPM RAD=46 CPM
80	80-82	4174		3-5-7-7 (12)	SAME AS ABOVE, STIFF, SMALL INTERBEDDED LAYERS OF GRAVEL, WELL-GRADED, DARK REDDISH BROWN. (MH)	1530 HNU=0 PPM RAD=50 CPM
82	82-84			4-3-3-5 (6)	SAME AS ABOVE. (MH)	1558 HNU=0 PPM RAD=
84	84-86		1.8'	3-4-5-5 (9)	SAME AS ABOVE. (MH)	0834 HNU=0 PPM RAD=44 CPM RESUME DRILLING/SAMPLING 3/25/90, 0800
86	86-88	4176	2.0'	4-4-3-5 (7)	ELASTIC SILT, SAME AS ABOVE, WITH THIN INTERBEDDED SAND WITH SILT, GRAYISH ORANGE (10 YR 7/4), MEDIUM, POORLY GRADED, WET, SUBANGULAR-ANGULAR GRAINS, <10% DARK, MINERALS, MOSTLY QUARTZ	0850 HNU=0 PPM RAD=58 CPM
88	88-90		2.0'	3-3-2-3 (5)	ELASTIC SILT, LIGHT GRAY (N7) STREAKED WITH MEDIUM GRAY (N5), MOIST, FIRM, PLASTIC, WITH INTERBEDDED SAND, GRAYISH ORANGE (10 YR 7/4) AS ABOVE. (MH)	0912 HNU=0 PPM RAD=38 CPM SAMPLE COMPOSITED 0918
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 4 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	90-92		2.0'	4-4-8-10 (12)	SAME AS ABOVE, CHANGING TO <u>FAT CLAY WITH SILT</u>, MEDIUM GRAY (N5), MOIST, STIFF, INTERBEDDED COARSE SAND AND GRAVEL, GRAYISH ORANGE, (CH-MH)	1020 HNU=0 PPM RAD=36 CPM
92	92-94	4177	1.9'	4-4-5-4 (9)	<u>FAT CLAY WITH SILT</u>, SAME AS ABOVE, (CH-MH), CHANGING TO <u>FAT CLAY</u>, BROWNISH BLACK (5 YR 2/1), MOIST, STIFF, (CH)	1035 HNU=0 PPM RAD=34 CPM
94	94-96			4-4-5-6 (9)	SAME AS ABOVE, (CH)	1103 HNU=0 PPM RAD= STOP DRILLING 1145, SAMPLE COMPOSITED 1110
96	96-97.6					CASING SET @ 97' RESUMED SAMPLING 4/5/90, 1010 HNU=0 PPM RAD=136 CPM SAMPLE 4178=SHELBY TUBE SAMPLE
98	97.6-99.6	4178	2.0'	N/A	<u>WELL GRADED SAND</u>, MEDIUM-COARSE, CHERTY, (SW)	
00	99.6-101					
102	101-103	4179		5-7-10-11 (17)	<u>ELASTIC SILT</u>, MEDIUM DARK GRAY (N4), DAMP, MICACEOUS, VERY STIFF, (MH)	1050 HNU=0 PPM RAD=40 CPM 300# HAMMER
104	103-106					
106	106-108	4180		8-20-17-28 (37)	<u>WELL GRADED SAND</u>, LIGHT GRAY (N7), MOIST, DENSE, FINE-MEDIUM, SUBANGULAR, <5% DARK MINERALS, <1% MICACEOUS; (SW); CHANGING TO <u>FAT CLAY</u>, BROWNISH BLACK (5 YR 2/1), DAMP, HARD, (CH)	1405 HNU=0 PPM RAD=32 CPM
108	108-111					
110						
112	111-113	4181	1.75'	8-18-12-29 (30)	<u>WELL GRADED SAND</u>, LIGHT GRAY (N7) TO MEDIUM GRAY (N8), MOIST, MEDIUM DENSE, VERY FINE-MEDIUM, <5%, DARK RED, 5-10% MICA, SUBANGULAR, (SW)	1450 HNU=0 PPM RAD=48 CPM
114	113-116					
116	116-118	4182	2.0'	3-7-8-16 (15)	<u>SILTY SAND</u>, LIGHT TO MEDIUM GRAY (N7-N4), MOIST TO DAMP, MEDIUM DENSE, FINE TO MEDIUM, MANY THIN LAYERS, 15-40% SILT, 5-10% MICA, (SM)	1530 HNU=0 PPM RAD=28 CPM
118						
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 5 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
122	121-123	4183	2.0'	17-8-10-17 (18)	SILTY SAND, SAME AS ABOVE, 10-25% SILT (SM); CHANGING TO WELL GRADED SAND WITH SILT, LIGHT GRAY (N7), MOIST, MEDIUM DENSE, VERY FINE TO MEDIUM, MICACEOUS, 5% SILT, (SW-SM)	HNU=0 PPM RAD=40 CPM STOPPED DRILLING 1620
124						
126	126-128	4185	1.5'	8-21-18-20 (39)	POORLY GRADED SAND, MEDIUM LIGHT GRAY (N6), MOIST-WET, DENSE, FINE, 3% DARK MINERALS, 3% MICA, (SP)	RESUMED SAMPLING 4/6/90, 0830, 300# HAMMER HNU=0 PPM RAD=39 CPM 0900
128						
130						
132	131-133	4186	1.75'	8-17-35-96 (52)	SAME AS ABOVE, FINE-MEDIUM, (SP); CHANGING TO FAT CLAY, VERY HARD, MICACEOUS, BROWNISH BLACK @ 133.5', (CH)	1020 HNU=0 PPM RAD=
134						
136	136-138	4187	2.0'	10-9-15-16 (24)	POORLY GRADED SAND, SAME AS ABOVE, MEDIUM DENSE, CONTAINS TWO 4" SEAMS OF FAT CLAY AS ABOVE, (SP)	1100 HNU=0 PPM RAD=40 CPM
138						
140						
142	141-143	4188		4-10-21-23 (31)	FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, VERY STIFF, MICACEOUS, (CH); CHANGING TO POORLY GRADED SAND, SAME AS ABOVE, (SP)	1530 HNU=0 PPM RAD=48 CPM STOPPED DRILLING 1535 TD OF BORING 143'

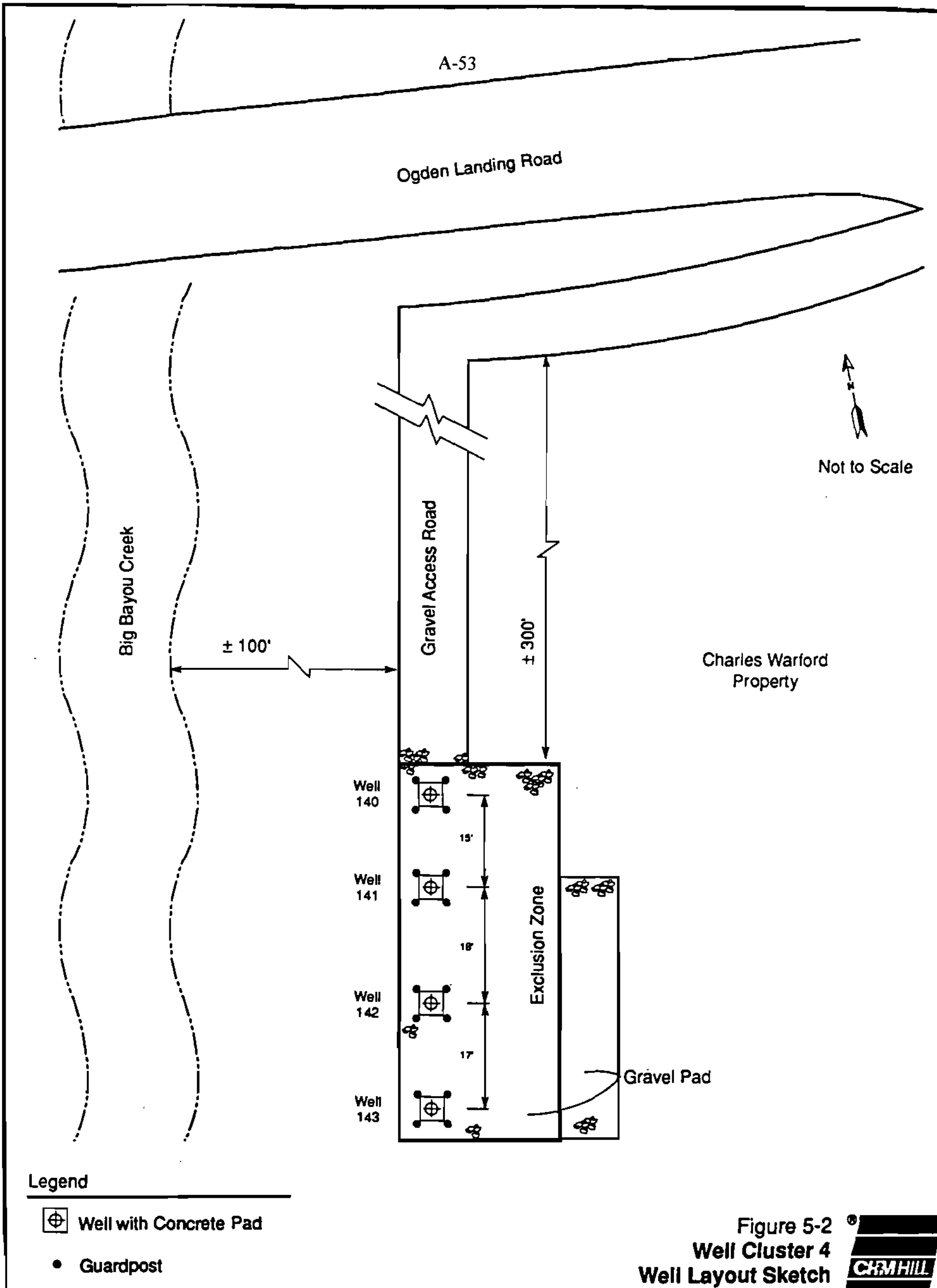


Figure 5-2
Well Cluster 4
Well Layout Sketch

[Page left blank]

Summary of RGA Background Wells

MW 150

Location - East of Plant; Private property near Metropolis Lake Road; Well Cluster 10 (?)
N (2239.80) E (-4652.86)

Date Installed - 8/10/90

Screened Depth - Deep RGA
Top - 66 ft bgs
Bottom - 96 ft bgs

Dates Sampled (Data available) - Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97

Construction Information Reference - Technical Memorandum No. 5 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)

Potential Contaminant Information -

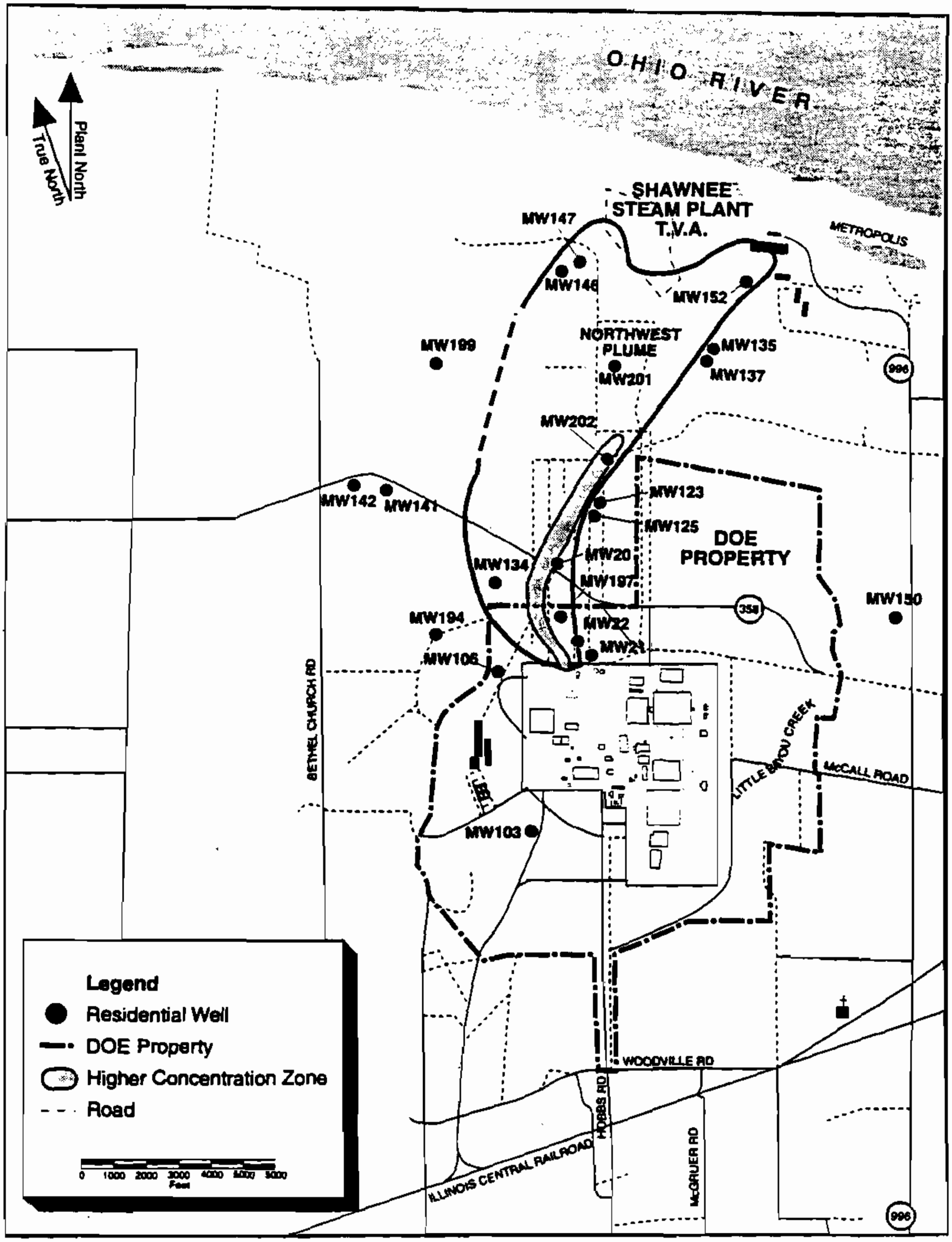
Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
Toluene	23	NA	9/6/90	CH200691-00000
Toluene	12	NA	9/6/90	CH200692-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	0.9	2.12	3/21/91	CH210030-00000
^{99}Tc	19	20	6/23/93	5650-93
^{99}Tc	18	19	9/21/93	6764-93
^{99}Tc	10	18	12/15/93	7724-93
^{99}Tc	2	4	3/8/94	4789-94
^{99}Tc	8	42	6/13/94	5578-94
^{99}Tc	4	6	9/19/94	6501-94
^{99}Tc	15	21	12/15/94	7366-94
^{99}Tc	22	19	2/8/95	5468-95
^{99}Tc	6	10	2/13/96	5321-96
^{99}Tc	4	11	2/6/97	5148-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
^{99}Tc	-0.77	1.97	3/21/91	CH210030-DIS

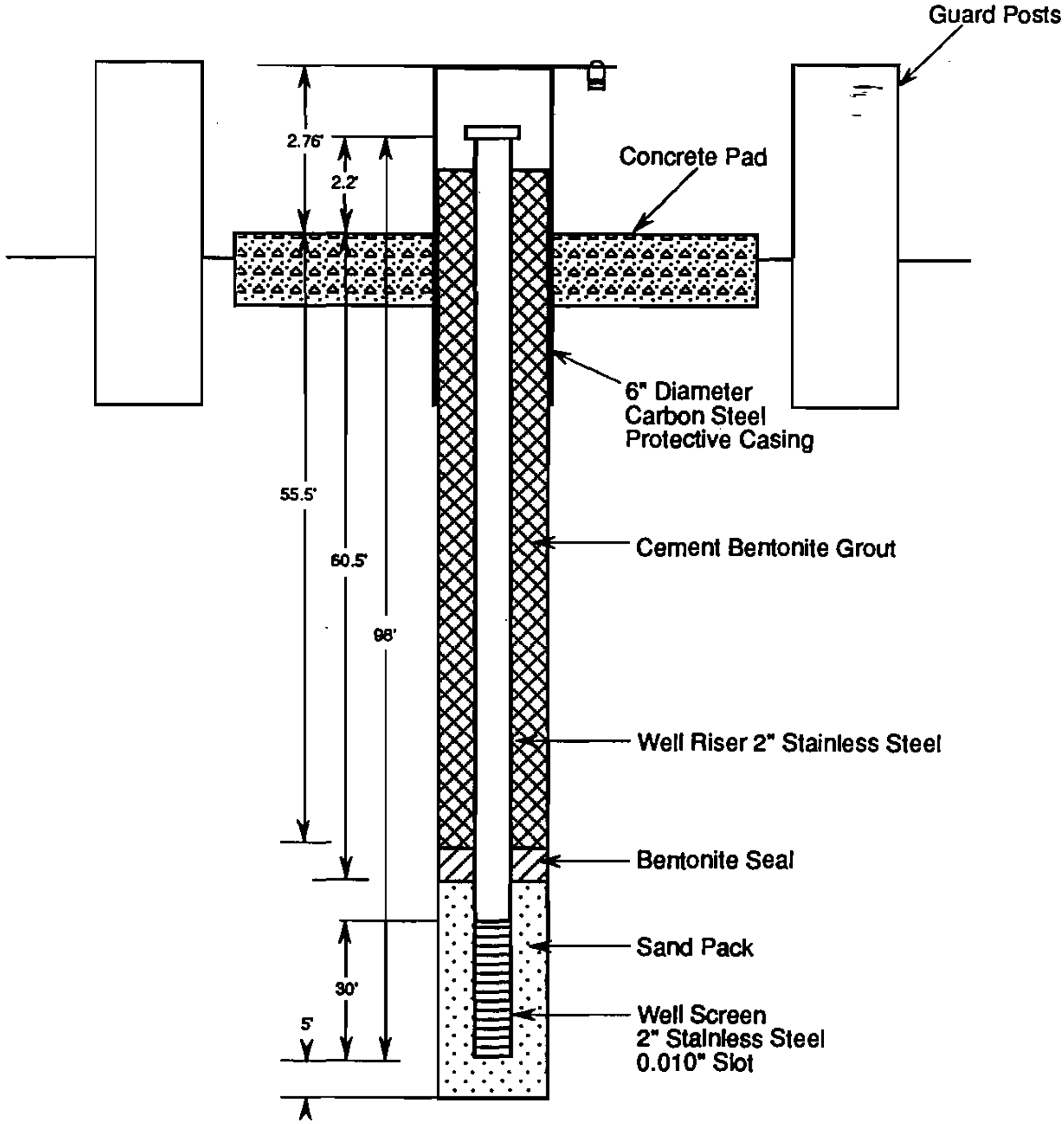
Notes: NA = Entry not applicable or not available.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	5	138.6	128 - 157	mg/L
Depth to Water	10	48.86	44.09 - 53.34	feet
Dissolved Oxygen	10	2.55	1.6 - 4.46	mg/L
Dissolved Solids	5	374.2	358 - 385	mg/L
pH	38	6.0	5.9 - 6.2	SU
Specific Conductance	38	641.8	344 - 719	umhos/cm
Temperature	10	57.9	56 - 59	F
Total Organic Carbon	17	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	65.5	12 - 119	mg/L
Turbidity	9	16.1	5 - 40	NTU

Notes: NA = Entry not applicable or not available.


OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
MW199
NORTHWEST PLUME
MW135
MW137
MW201
MW202
MW123
MW125
MW142
MW141
DOE PROPERTY
MW134
MW20
MW197
MW150
MW194
MW22
MW21
MW106
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
MW103
358
996
WOODVILLE RD
HOBBS RD
McGRUER RD
ILLINOIS CENTRAL RAILROAD
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
0 1000 2000 3000 4000 5000 6000
Feet



Note: Not to Scale

MW–150 Construction Diagram

CH2M HILL

PROJECT NUMBER	BORING NUMBER
SED 28178.FI	W 150 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-10, Back of Jone's Property

ELEVATION —— DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV Rig; Hollow Stem Auger 4-1/2" ID

WATER LEVEL AND DATE ____ START 8/10/90 FINISH 8/10/90 LOGGER R. Johns

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS. TESTS AND INSTRUMENTATION
0						BEGAN DRILLING @ 0710
5	5.0–7.0	S-1	0.8	11-15-14-20 (29)	LEAN CLAY, (CL), SILTY, TRACE FINE SAND, TAN TO BURNT ORANGE MOTTLED, DRY, VERY STIFF	HNU = <1 PPM RAD = 30-40 CPM = BKGD SAMPLE NO.4468
10	10.0–12.0	S-2	1.5	6-10-10-18 (20)	LEAN CLAY, (CL), SAME AS ABOVE , BURNT RED MOTTLING	HNU = BKGD RAD = BKGD SAMPLE NO.4469
15	15.0–17.0	S-3	1.8	8-14-16-16 (30)	LEAN CLAY, (CL), SAME AS ABOVE, GRAY WITH BURNT ORANGE MOTTLING	HNU = BKGD RAD = BKGD SAMPLE NO.4470
20	20.0–22.0	S-4	2.0	6-12-16-25 (28)	SILT, (ML), LIGHT GRAY WITH BURNT ORANGE MOTTLE, DRY, VERY STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4471
25	25.0–27.0	S-5	2.0	9-12-17-14 (29)	LEAN CLAY, (CL), ZONES OF SILTY SAND, (SM), LIGHT BROWN AND GRAY WITH BURNT ORANGE MOTTLED, DRY, VERY STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4472
30						

PROJECT NUMBER	BORING NUMBER
SED 28178.FI	W 150 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-10, Back of Jone's Property
ELEVATION — DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV Rig; Hollow Stem Auger 4-1/2" ID
WATER LEVEL AND DATE START 8/10/90 FINISH 8/10/90 LOGGER R. Johns

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	32.0	S-6	2.0	7-13-18-15 (31)	SILT, (ML), SOME FINE SAND, SOME CLAY, LIGHT GRAY/TAN WITH BURNT ORANGE MOTTLE, DRY, VERY STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4473
	35.0					
35	37.0	S-7	1.8	9-15-19-20 (34)	LEAN CLAY, (CL), TRACE FINE SAND, LIGHT BROWN WITH BURNT ORANGE MOTTLE, DRY, HARD	HNU = BKGD RAD = BKGD SAMPLE NO.4474
	40.0					39' GRINDING AUGERS, SMOKE COMING OUT OF HOLE
40	42.0	S-8	1.0	19-100/6"	TOP 0.8': LEAN CLAY, (CL), SAME AS ABOVE BOTTOM 0.2': SILT, (ML), LIGHT BROWN, TRACE FINE SAND, DRY, HARD	HNU = BKGD RAD = BKGD SAMPLE NO.4475
	45.0					
45	47.0	S-9	2.0	9-13-13-15 (26)	LEAN CLAY, (CL), TRACE FINE SAND, FEW PIECES OF 1/8" ROUNDED GRAVEL, LIGHT BROWN WITH BURNT ORANGE MOTTLE, MOIST, VERY STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4476
	50.0					49' SMOKE FROM HOLE
50	52.0	S-10	2.0	11-15-13-9 (28)	TOP 0.5': SILT WITH GRAVEL, (ML), GRAVEL IS ROUNDED LIGHT BROWN WITH ORANGE MOTTLE, MOIST, MEDIUM DENSE, MIDDLE 0.8': SILTY SAND, (SM), LIGHT BROWN, MOIST, MEDIUM DENSE BOTTOM: LEAN CLAY, (CL), MODERATE PLASTICITY, LIGHT GRAY/BROWN, MOIST, STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4477
	55.0					
55	57.0	S-11	2.0	7-10-19-29 (29)	TOP 0.7': LEAN CLAY, (CL), MODERATE PLASTICITY, LIGHT BROWN, MOIST, MEDIUM STIFF BOTTOM 1.3': POORLY GRADED SAND, (SP), TRACE SILT, FINE, LIGHT BROWN, MOIST, MEDIUM DENSE	HNU = BKGD RAD = BKGD SAMPLE NO.4478
60						

PROJECT NUMBER	BORING NUMBER
SED 28178.FI	W 150 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-10, Back of Jones' Property

ELEVATION —— DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV Rig; Hollow Stem Auger 4-1/2" ID

WATER LEVEL AND DATE ____ START 8/10/90 FINISH 8/10/90 LOGGER R. Johns

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING ~~RATE~~, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	62.0	S-12	0.6	1-12-15-50/5"	POORLY GRADED SAND, (SP), MEDIUM TO COARSE, LIGHT BROWN, WET, MEDIUM DENSE TIP OF SPOON: POORLY GRADED GRAVEL, (GP), SUBANGULAR, 1/8", LIGHT BROWN, WET, MEDIUM DENSE	HNU = BKGD RAD = BKGD SAMPLE NO.4479
	65.0					
65	67.0	S-13	1.5	15-29-10-35 (39)	POORLY GRADED GRAVEL, (GP), SOME FINES, 1/16" TO 1/4" GRAVEL, LIGHT BROWN, WET, DENSE	HNU = BKGD RAD = BKGD SAMPLE NO.4480
	70.0					
70	72.0	S-14	1.8	17-24-42-39 (66)	POORLY GRADED GRAVEL, (GP)	HNU = BKGD RAD = BKGD SAMPLE NO.4481
	75.0					
75	77.0	S-15	1.2	15-47-44-40 (91)		HNU = BKGD RAD = BKGD SAMPLE NO.4482
	80.0					
80	82.0	S-16	1.0	24-49-68-71 (117)		HNU = BKGD RAD = BKGD SAMPLE NO.4483
	85.0					
85	87.0	S-17	1.0	6-14-21-36 (35)	TOP 0.5': POORLY GRADED SAND, (SP), MEDIUM, SOME SILT, LIGHT BROWN, WET, MEDIUM DENSE BOTTOM: POORLY GRADED GRAVEL, (GP), GRAVEL IS ANGULAR, FROM 1/16" TO 3/4", BROWN, WET, MEDIUM DENSE	HNU = BKGD RAD = BKGD SAMPLE NO.4484
90						

PROJECT NUMBER	BORING NUMBER
SED 28178.FI	W 150 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-10, Back of Jones' Property
ELEVATION — DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV Rig; Hollow Stem Auger 4-1/2" ID
WATER LEVEL AND DATE START 8/10/90 FINISH 8/10/90 LOGGER R. Johns

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	92.0	S-18	1.0	13-11-45-33 (56)	TOP 0.5': POORLY GRADED GRAVEL, (GP), SOME CLAY, GRAVEL IS ANGULAR = 1/2" MAXIMUM SIZE, DARK BROWN, WET, VERY DENSE BOTTOM: POORLY GRADED GRAVEL WITH SAND, (GP), GRAVEL IS SAME AS ABOVE, SAND IS MEDIUM TO FINE, LIGHT BROWN, WET, VERY DENSE	HNU = BKGD RAD = BKGD SAMPLE NO.4485
	95.0					
95	97.0	S-19	1.5	8-32-38-44 (70)	TOP 0.8': POORLY GRADED GRAVEL WITH SAND, (GP),MEDIUM BROWN, GRAVEL UP TO 1", ANGULAR, WET, VERY DENSE BOTTOM: POORLY GRADED SAND WITH GRAVEL, (SP), LIGHT BROWN, WET, VERY DENSE, COARSE	HNU = BKGD RAD = BKGD SAMPLE NO.4486
	100.0					
100	102.0	S-20	1.0	22-20-32-51 (52)	TOP 0.5': SILTY SAND, (SM), MEDIUM, LIGHT BROWN, WET, MEDIUM DENSE BOTTOM 0.5': LEAN CLAY, (CL), DARK GRAY, MODERATELY PLASTIC, MOIST, STIFF	HNU = BKGD RAD = BKGD SAMPLE NO.4487
						END OF BORING @ 102'

[Page left blank]

Summary of RGA Background Wells

MW 199

Location -Northwest of Plant; North of Ogden Landing Road: Well Cluster 19
N (10090.1) E (-10076.6)

Date Installed - May 8, 1991

Screened Depth - Shallow RGA
Top - 57 ft bgs
Bottom - 62 ft bgs

Dates Sampled (Dates available) - Q2 91; Q2 93; Q3 93; Q4 93: Q1 94; Q2 94; Q3 94; Q4 94; Q3 97

Construction Information Reference - Technieal Memorandum No. 5 in *Results of the Site Investigation, Phase II at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/SUB/13B-97777C P-03/1991/1; April 1992)

Potential Contaminant Information -

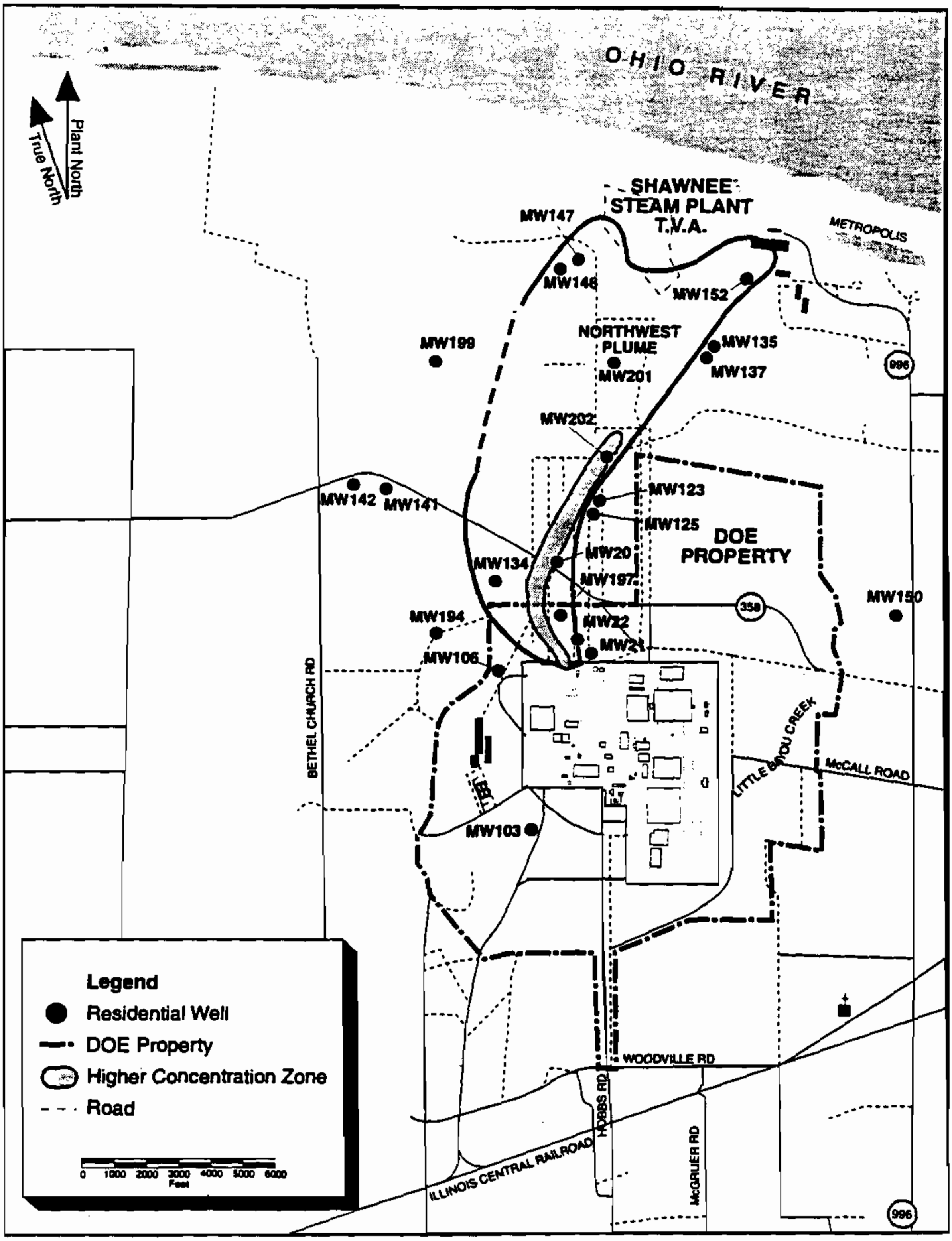
Compound	Detected Concentration	Detection Error (Rad only)	Date of Colleetion	Sample ID
Organic Compounds (all; μg/l)				
bis(2-ethylhexyl)phthalate	6 J	NA	5/14/91	CH210240-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	-2.3	3.1	5/14/91	CH210240-00000
^{99}Tc	4	6	5/27/93	5170-93
^{99}Tc	0	14	7/26/93	5984-93
^{99}Tc	7	20	10/25/93	7311-93
^{99}Tc	4	21	4/25/94	5260-94
^{99}Tc	24	20	7/27/94	6074-94
^{99}Tc	10	18	10/11/94	6888-94
^{99}Tc	3	12	8/6/97	5558-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of colleetion)				
^{99}Tc	0.4	1.2	5/14/91	CH210240-DIS
^{99}Tc	-1.3	2.06	5/21/91	CH210250-DIS

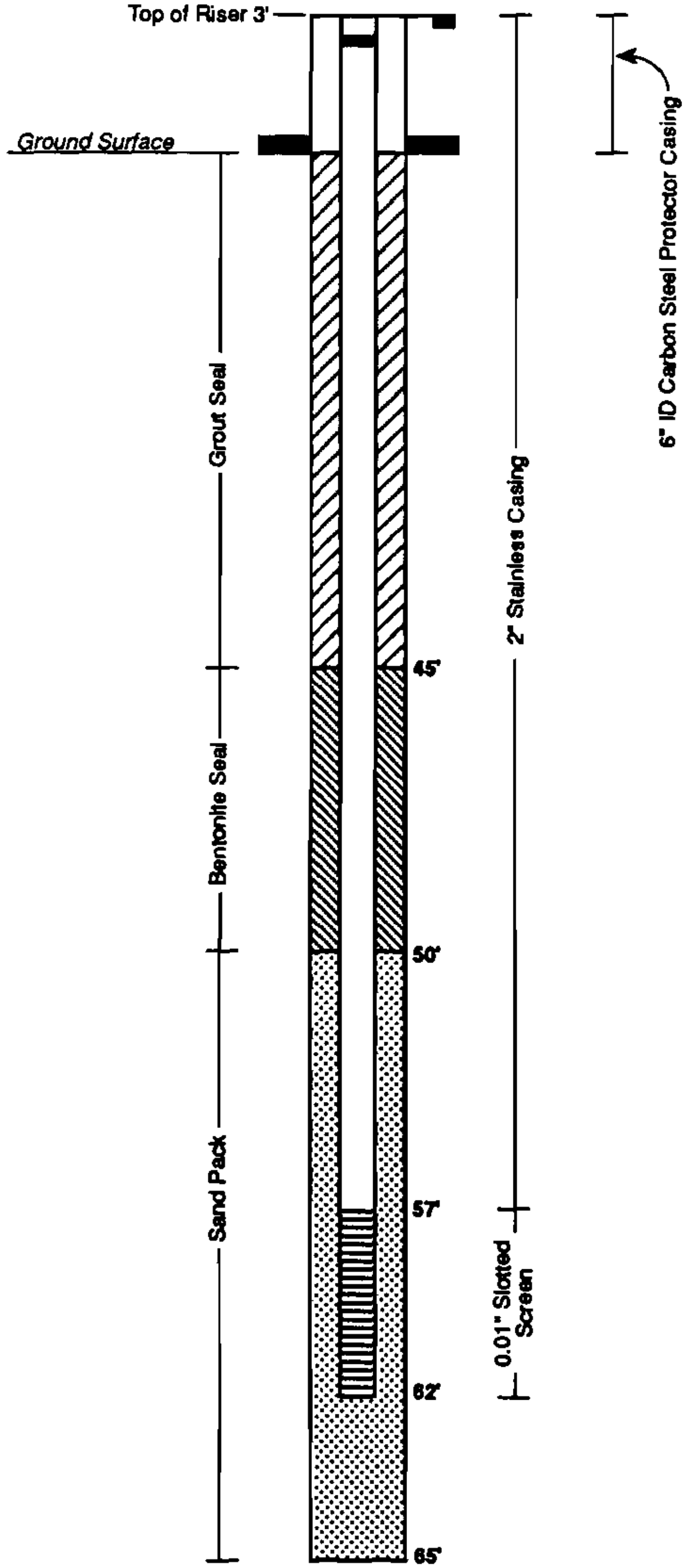
Notes: NA = Entry not applicable or not available.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	8	117.1	111 - 123	mg/L
Depth to Water	8	29.7	23.3 - 34.07	feet
Dissolved Oxygen	8	4.91	4.2 - 6.92	mg/L
Dissolved Solids	8	217.9	175 - 233	mg/L
pH	29	6.24	6.1 - 6.4	SU
Specific Conductance	29	388.7	379 - 402	umhos/cm
Temperature	8	58.8	57 - 64.5	F
Total Organic Carbon	25	< 1	< 1 - 1	mg/L
Total Suspended Solids	1	119	NA	mg/L
Turbidity	7	43.0	8.3 - 172	NTU

Notes: NA = Entry not applicable or not available.


OHIO RIVER
Plant North
True North
SHAWNEE STEAM PLANT T.V.A.
METROPOLIS
MW147
MW146
MW152
NORTHWEST PLUME
MW199
MW135
MW137
MW201
MW202
MW123
MW125
MW142
MW141
DOE PROPERTY
MW20
MW134
MW197
MW150
MW194
MW22
MW21
MW106
BETHEL CHURCH RD
LITTLE BAYOU CREEK
McCALL ROAD
MW103
Legend
Residential Well
DOE Property
Higher Concentration Zone
Road
WOODVILLE RD
HOBBS RD
McGRUER RD
ILLINOIS CENTRAL RAILROAD
0 1000 2000 3000 4000 5000 6000
Feet



WELL CONSTRUCTION DETAILS
MW199

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW199	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of Ogden Landing Road

ELEVATION 353.87 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/8/91 FINISH 5/8/91 LOGGER G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					GRAVEL PAD (= 0.3')		Bkgd: HNu=0 ppm; Rad=30 cpm
	0-5	5' Continuous	1.3	N/A	LEAN CLAY (CL), light brown (5 YR 6/4) with light gray (N7), mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 4.0 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), grayish orange pink (5 YR 7/2) with light gray (N7), mottling and black (N1) streaking, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 3.75 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm2
15	15-20	5' Continuous	5.0	N/A	2.6' : LEAN CLAY (CL), same as above 1.5' : WELL SORTED SAND (SW), moderate red (5 R 5/4), moist 0.9' : LEAN CLAY W/SAND (CL), light brown (5 YR 6/4), moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 for CL
20	20-25	5' Continuous	5.0	N/A	1.9' : LEAN CLAY W/SAND (CL), same as above 3.1' : LEAN CLAY (CL), light brown (5 YR 6/4), moist, very stiff, light gray (N7) mottling		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2 for lower CL
25	25-30	5' Continuous	4.3	N/A	LEAN CLAY (CL), same as above except stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 1.75 kg/cm2
30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW199	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of Ogden Landing Road

ELEVATION 353.87 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/8/91 FINISH 5/8/91 LOGGER G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	3.5	N/A	1.0' : LEAN CLAY (CL), moderate brown (5 YR 4/4), moist, very stiff 2.5' : LEAN CLAY (CL), light brown (5 YR 6/4) with moderate red (5 R 4/6) and light gray (N7) mottling, moist hard		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2 (top) P.P. = >4.5 kg/cm^2 (bottom)
35	35-40	5' Continuous	4.3	N/A	LEAN CLAY (CL), same as above. Small percent of gravel at bottom 0.4'; well rounded chert		HNu = 0 ppm Rad = 30 cpm P.P. = >4.5 kg/cm^2
40	40-45	5' Continuous	1.7	N/A	WELL SORTED SAND W/GRAVEL (SW), light brown (5 YR 5/6) with moderate red (5 R 4/6) mottling, moist, subangular gravel, medium to coarse grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
45	45-50	5' Continuous	3.9	N/A	WELL SORTED SAND (SW), moderate red (5 R 5/4), wet, medium to fine grained sand		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
50	50-55	5' Continuous	4.7	N/A	Top 3' : WELL SORTED SAND (SW), same as above WELL GRADED GRAVEL (GW), medium brown (5 YR 4/4), wet, well rounded chert gravel		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
55	55-60	5' Continuous	1.4	N/A	WELL GRADED GRAVEL (GW), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = N/A Sampler wet out of hole
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW199	SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION North of Ogden Landing Road

ELEVATION 353.87 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig: 7-3/4" OD CME Augers: 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 5/8/91 FINISH 5/8/91 LOGGER G.Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	0.0	N/A	No Recovery		HNu = 0 ppm Rad = 30 cpm P.P. = N/A No recovery due to large gravel
65					End of Boring		

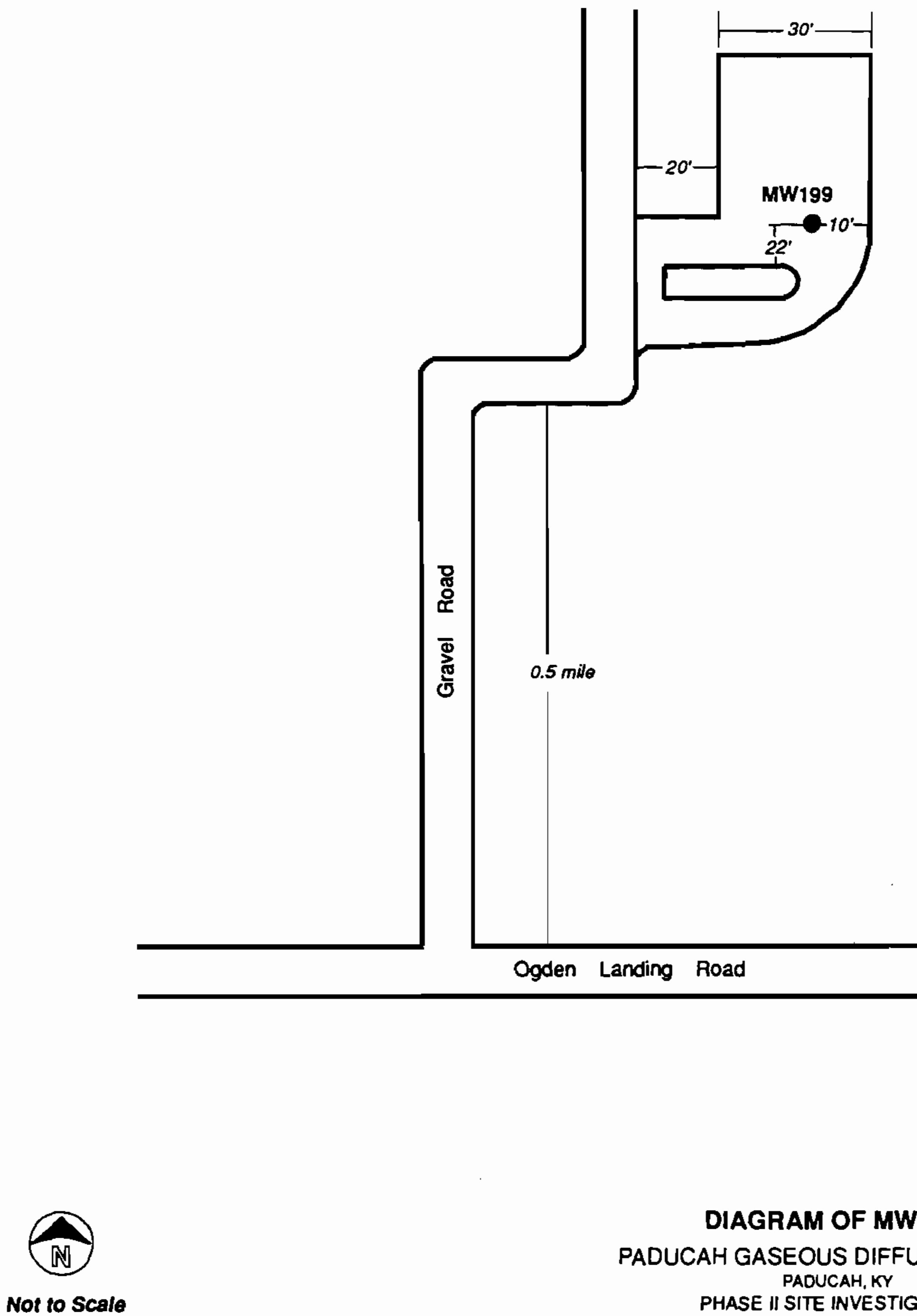


DIAGRAM OF MW199

PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KY
PHASE II SITE INVESTIGATION

[Page left blank]

Summary of McNairy Background Wells

MW 102

Location - South of Plant; South of C-743 parking lot
N (-3502.5), E (-6267.3)
Date Installed - Dec. 12, 1991
Screened Depth - Upper McNairy
Top - 136 ft bgs
Bottom - 146 ft bgs
Dates Sampled (Data available) - Q 1 92; Q 2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95 Q2 95; Q3 95; Q4 95; Q1 96; Q1 97
Construction Information Reference - Groundwater Monitoring Phase III
Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
NONE	NA	NA	NA	NA
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	9	18	5/26/93	5174-93
^{99}Tc	9	27	7/26/93	5940-93
^{99}Tc	9	37	10/14/93	7295-93
^{99}Tc	6	37	1/24/94	4268-94
^{99}Tc	23	19	4/26/94	5183-94
^{99}Tc	17	21	10/5/94	6770-94
^{99}Tc	4	22	3/21/95	5619-95
^{99}Tc	10	10	6/14/95	6592-95
^{99}Tc	2	10	9/18/95	7467-95
^{99}Tc	5	10	2/8/96	5281-96
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
NONE	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	13	94	71 - 102	mg/L
Depth to Water	14	55.38	50.95 - 59.95	feet
Dissolved Oxygen	13	0.97	0.17 - 2.94	mg/L
Dissolved Solids	13	157	32 - 185	mg/L
pH	50	6.1	5.9 - 6.3	SU
Specific Conductance	49	276	251 - 295	umhos/cm
Temperature	14	59.1	56 - 61	F
Total Organic Carbon	45	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	13	4 - 21	mg/L
Turbidity	12	19.7	3.4 - 38	NTU

Notes: NA = Entry not applicable or not available.

[Page left blank]

Summary of McNairy Background Wells

MW 120

Location - Southeast of Plant; Well Cluster 1
N(-5880.16), E (-1489.08)
Date Installed - November 13, 1989
Screened Depth - Deep McNairy
Top - 160 ft bgs
Bottom - 170 ft bgs
Dates Sampled (Data available) - Q1 90; Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97; Q4 97
Construction Information Reference - Technical Memorandum No. 4 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)
Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
bis(2-ethylhexyl)phthalate	210	NA	2/27/90	CH200300-00000
Ethylbenzene	2 J	NA	4/20/90	CH200414-00000
Toluene	5	NA	4/20/90	CH200414-00000
Xylene	12	NA	4/20/90	CH200414-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	11	NR	2/27/90	732-90
^{99}Tc	3	7	2/27/90	CH200300-00000
^{99}Tc	11	14	4/20/90	CH200414-00000
^{99}Tc	2.6	2.03	2/28/91	CH210107-00000
^{99}Tc	5	40	5/25/93	5088-93
^{99}Tc	8	28	7/12/93	5900-93
^{99}Tc	12	21	10/26/93	7065-93
^{99}Tc	3	18	4/20/94	4991-94
^{99}Tc	4	19	7/19/94	6034-94
^{99}Tc	21	20	2/8/95	5448-95
^{99}Tc	11	11	2/6/97	5143-97
^{99}Tc	1	12	11/11/97	5793-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
^{99}Tc	NONE	NA	NA	NA

Notes: NA = Entry not applicable or not available; NR = Value not reported in data set.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	10	122	73 - 142	mg/L
Depth to Water	11	58.66	55.62 - 61.31	feet
Dissolved Oxygen	11	1.38	0.29 - 5.53	mg/L
Dissolved Solids	10	188	163 - 222	mg/L
Hardness as CaCO3	1	196	NA	g/L CaCO
Hardness as CaCO3, Dissolved	1	126	NA	g/L CaCO
pH	38	6.7	6.5 - 6.9	SU
Specific Conductance	38	307	290 - 327	umhos/cm
Temperature	11	60.3	57 - 65	F
Total Organic Carbon	30	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	25	14 - 35	mg/L
Turbidity	8	10.9	5 - 20	NTU

Notes: NA = Entry not applicable or not available.

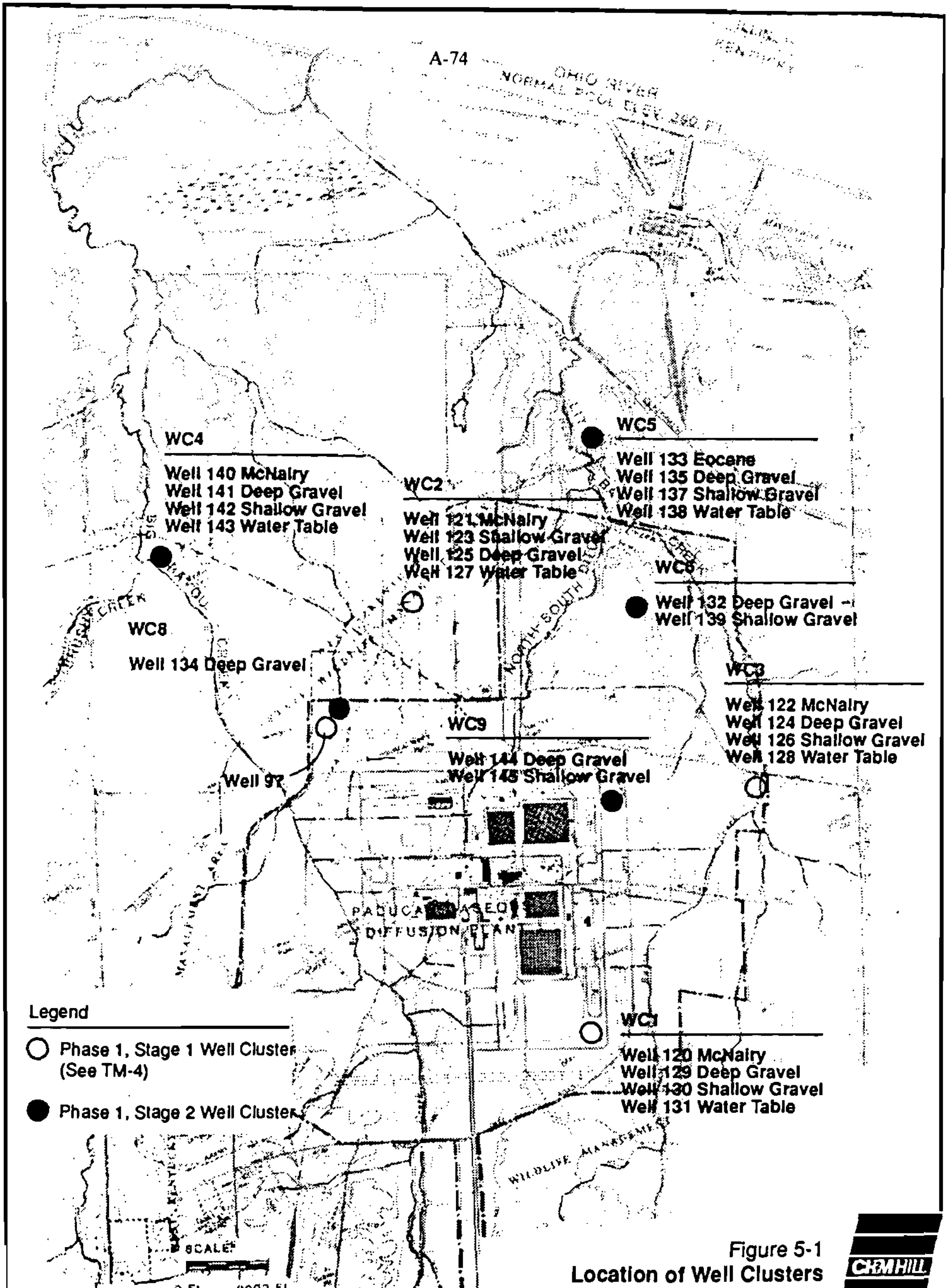
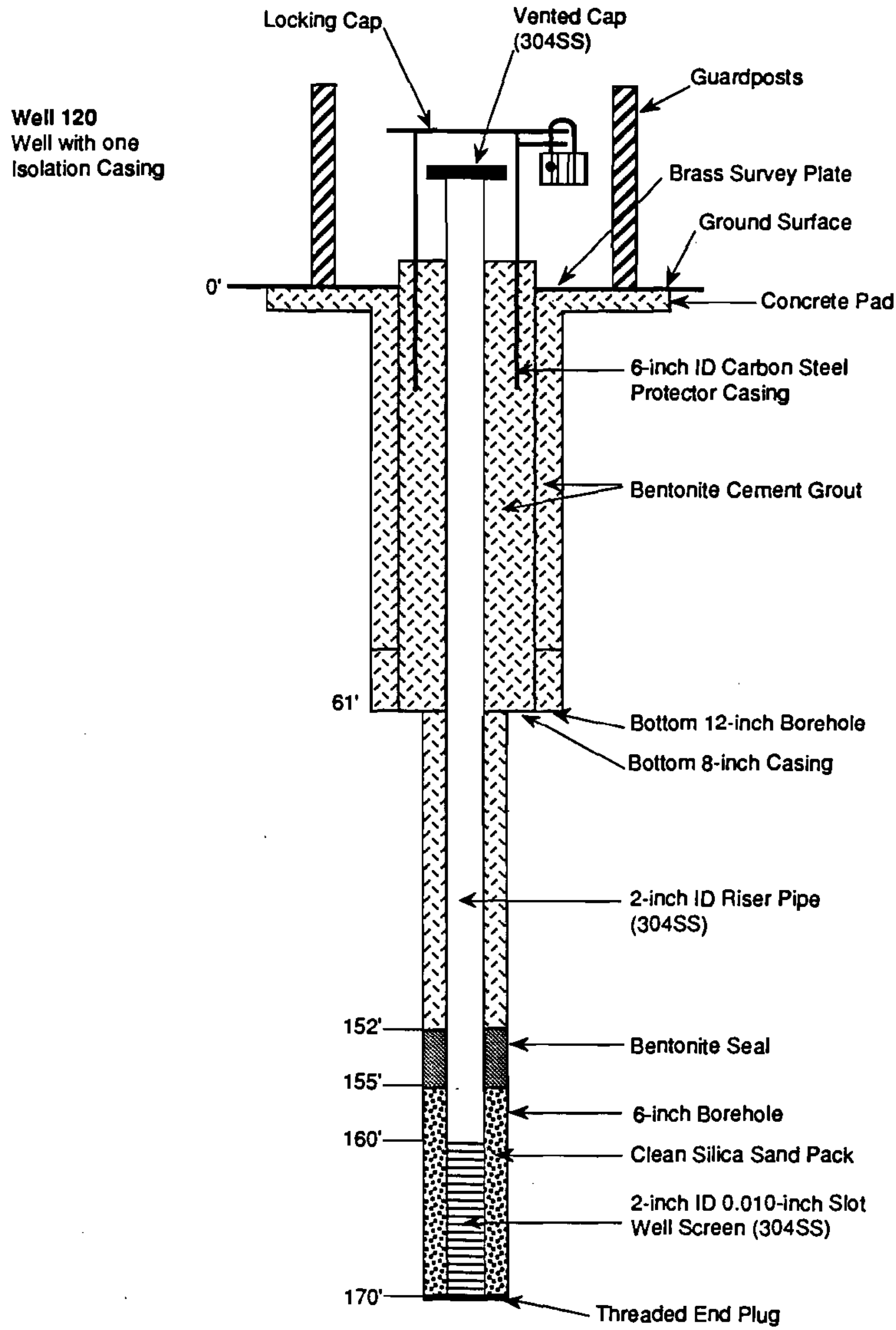


Figure 5-1
Location of Well Clusters

CH2M HILL



Well 120 Construction Details
Paducah GDP, Kentucky

CH2M HILL

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 1 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT B-53 Mobile Drill, 6-inch ID Hollow Stem

WATER LEVEL AND DATE Static—26 Ft. START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2	4010	1.6'	3-5-9-10 (14)	CLAYEY SILT, LIGHT BROWN-GRAY, (5 YR 6/4), DAMP, STIFF, WITH ROOT TRACES THROUGH-OUT SAMPLE	USING 140 LB. HAMMER WITH HOIST
2	2-4	4010	1.8'	10-20-20-25 (40)	SILTY CLAY, GRAY (N7), WITH RUST AND BLACK MOTTLING, DAMP, HARD, WITH ROOT TRACES	HEADSPACE #4010—NOT ABOVE BACKGROUND
4	4-6	4010	1.6'	15-15-15-20 (30)	SAME AS ABOVE, ALSO PLASTIC	TIME 15:30
8	6-8	4011	2.0'	8-10-15-15 (25)	SAME AS ABOVE, VERY STIFF	
8	8-10	4011	2.0'	15-15-18-19 (33)	SAME, VERY FINE SAND 0-5% VISIBLE IN SUNLIGHT	HEADSPACE #4011—NOT ABOVE BACKGROUND
10	10-12	4011	2.0'	7-9-8-13 (17)	SILTY CLAY, GREENISH GRAY, (5 YR 6/4), MOIST, VERY STIFF, PLASTIC, WITH RUST MOTTLING AND BLACK ORGANIC NODULES	COLLECTED RAD SCREEN OVER FIRST FIRST 12 FT. 16:00
12	12-14	4012	1.5'	16-16-21-18 (37)	SILTY CLAY, GRAY, (N7), DAMP, HARD, PLASTIC, WITH RUST MOTTLING, A ONE-INCH LAYER OF ORGANIC MATERIAL IN SAMPLE	11/19/89 09:35
14	14-16	4012	2.0'	16-13-16-19 (29)	SAME AS ABOVE, VERY STIFF	HEADSPACE #4012—NOT ABOVE BACKGROUND
16	16-18	4012	2.0'	6-11-17-26 (28)	SILTY SAND, GRAY, MEDIUM DENSE, WITH SOME RUST MOTTLING, SAND IS FINE TO VERY FINE WITH ~5% PEA-SIZED GRAVEL	INTO UPPER CONTINENTAL DEPOSITS 10:20
18	16-20	4013	2.0'	12-22-30-33 (52)	SAND, GRAY, (N7), MOIST, VERY DENSE, SLIGHTLY SILTY, WELL SORTED 60% VERY FINE—10% MEDIUM SANDS ~ 5% GRAVEL	HEADSPACE #4013—NOT ABOVE BACKGROUND
20	20-22	4013	2.0'	5-10-15-22 (25)	SAND, GRAY, (N7), MEDIUM DENSE WITH LITTLE RUST MOTTLING, SLIGHTLY SILTY, SAND IS FINE, 5% PEA-SIZED GRAVEL	
22	22-23	4013	1.0'	16-50/5	SAND AND SILT, GRAY, (N7), DAMP, VERY DENSE, FINE SAND WITH BLUE AND PINK INCLUSIONS OF SILT	RIG CHATTERING BETWEEN 22 AND 24 FT. 11:10
24	24-26	4014	1.5'	42-43-47-42 (90)	FINE SAND, GRAY, (N7), MOIST, VERY DENSE, SLIGHTLY SILTY, 10% SAND IS MEDIUM GRAINED, PINK SILTY INCLUSIONS	WET SPOON AT ~26 FT.
26	26-28	4014	2.0'	11-13-13-16 (26)	FINE SAND, BROWN, (5 YR 4/4), MOIST, MEDIUM DENSE, SLIGHTLY SILTY WITH STREAKS OF REDDISH, PLASTIC SANDY SILTS	HEADSPACE #4014—NOT ABOVE BACKGROUND WATER LEVEL AT 22 FT. AFTER SAMPLING TO 30 FT.
28	28-30	4014	1.7'	9-17-28-29 (45)	FINE SAND, BROWN, (5 YR 4/4), MOIST, DENSE, WITH STREAKS OF RED AND GRAY SANDY SILTS GRADING INTO SILTY SAND	ISOLATED GRAVEL—VERY DRY AND CHALKY, VERY HARD
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 2 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-53 Mobile Drill, 6-inch ID Hollow Stem
WATER LEVEL AND DATE Static—16 Ft., after hitting gravels START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32	4015	1.6'	13-17-17-21 (34)	SANDY SILT, LIGHT GRAY, MOIST, HARD, SAND IS FINE TO MEDIUM GRAINED (<5%)	HEADSPACE #4015—NOT ABOVE BACKGROUND
32	32-34	4015	2.0'	17-15-21-24 (36)	SAME AS ABOVE, WITH RED STREAKS; OVER 0.4 FT. SAND, WET, DENSE, FINE TO VERY FINE	16:10 11/19/89
34	34-34.5	4015	0.4'	50/5	SAND, BROWN, (5 YR. 5/6), WET, VERY DENSE, FINE	DRILLER FELT HE WAS BANGING ON A ROCK LOWER CONTINENTAL DEPOSITS
36	36-38	4017	1.9'	21-27-20-50 (47)	SAND AND GRAVEL, BROWN, (5 YR. 5/6), WET, DENSE, WELL SORTED SAND, MEDIUM-COARSE GRAINED WITH 20% GRAVEL TO 3/4-INCH	
38	38-40	4017	1.6'	42-50-5-6 (55)	GRAVEL AND SAND, BROWN, (10R 4/0), VERY DENSE, COARSE SAND WITH GRAVEL UP TO 1-INCH; OVER 0.5 FT. CLAYEY SAND AND GRAVEL, REDDISH, MEDIUM DENSE	COBBLE 3½-INCH IN DIAMETER AND ½-INCH THICK BROUGHT TO SURFACE
40	40-42	4017	2.0	21-33-38-50/5 (71)	CLAYEY SAND AND GRAVEL (N9), AS ABOVE; OVER 1.2 FT. SAND WHITE, VERY DENSE, POORLY SORTED, MEDIUM GRAINED, WITH 5% GRAVEL TO 1/2-INCH	HEADSPACE #4017—NOT ABOVE BACKGROUND 09:50 11/20/89
42						*SMOOTH DRILLING WITH SOME CHATTERING AT 42 TO 44 FT. PROBABLY IN SANDS
44						TRYING TO GET THROUGH RGA TODAY
46	46-48	4018	2.0'	19-50-41-38 (91)	GRAVEL AND SAND, BROWN, (5 YR. 4/4), VERY DENSE, GRAVEL TO 1-INCH WITH MEDIUM TO COARSE GRAINED SANDS	HEADSPACE #4018—NOT ABOVE BACKGROUND
48						10:40 ROUGH DRILLING! CENTER PLUG IS STUCK IN AUGERS AS SANDS ARE HEAVING
50	50-52	NONE	0.4'	25-21-19-17 (40)	GRAVEL AND SAND, DENSE, WELL SORTED, 70% GRAVEL AND 30% MEDIUM TO COARSE GRAINED SAND, 1½-INCH GRAVEL STUCK IN SAMPLER-EASY DRILLING	15:45 12/5/89 USING ROTARY WASH DRILLING AT ~51½ FT., PROBABLY OUT OF GRAVEL
52						
54	54-56	4021	2.0'	6-8-27-50 (35)	CLAYEY SILT, GRAY, (N6), DAMP, STIFF TO HARD, WITH ORANGE MOTTLING, FRACTURES EASILY	
56		4021				HEADSPACE #4021—NOT ABOVE BACKGROUND
58	58-59.5	4021	1.4'	24-42-50/5	CLAYEY SILT, GRAYISH BLACK, (N2), HARD, MICACEOUS, FRACTURES IN CONCHOIDAL PATTERNS	10:00 12/6/89
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 3 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60						MOVE LONGYEAR 44 RIG ONTO SITE, SET SURFACE CASING TO 61 FT.
63	63-65		1.5'		CLAY, DARK GRAY, (N3) TO BLUISH, (5 Pb 3/2), DRY, MICACEOUS, VERY STICKY	DROVE SHELBY TUBE 1/16/90
65						
68	68-70	4022	2.0'	3-2-1-5 (3)	SAME AS ABOVE, SOFT	USING 300 LIB. HAMMER ON A SAND LINE 15:15 1/16/90
70						
73	73-75	4023	1.9'	7-10-12-14 (22)	SAME AS ABOVE, VERY STIFF, WITH 2-INCH INTERVAL OF VERY FINE SAND THAT WAS DRY	08:15 1/17/90
75						SLOW DRILLING, DRILLING MUD, THICKENS EASILY AND MUST BE DILUTED ABOUT EVERY 10 FT.
78	78-80	4025 4026	1.9'	1-5-10-16 (15)	CLAY, DARK GRAY, (N3), DRY, STIFF, SLIGHTLY SILTY,STICKY, MICACEOUS	10:00
80						
83	83-85	4027	1.6'	8-10-12 (22)	SAME AS ABOVE, VERY STIFF	NO HEADSPACE ANALYSIS DONE 11:00
85						
88	88-90	4028	2.0'	2-8-12-14 (20)	SAME AS ABOVE, WITH SEVERAL VERY THIN (1/4-INCH) INTERVALS OF GRAY VERY FINE SANDS	14:00 1/17/90
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 4 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90						
93	93-95	4024	1.3'	1-2-6-8 (8)	SILTY CLAY, GRAY, (N7), DRY, FIRM, SIMILAR TO ABOVE CLAY, SLIGHTLY MICACEOUS	08:10 1/18/90
95						
98	98-100	4031	1.9'	6-9-9 (18)	SAME AS ABOVE, VERY STIFF, WITH GREATER % OF MICA	11:00 WEIGHT OF RODS ALLOWING SPOON TO ONLY BE DRIVEN 18 FT.
100						
103	103-105	4032	0.9'	3-4-12-14 (16)	SAME AS ABOVE, WITH VARYING AMOUNTS OF MICA	14:15 DRILLING MUD, IS THICKENING VERY FAST, EVERY 5-10 FT.
105						
108	108-110	4033	2.0'	2-2-4-7 (6)	SAME AS ABOVE, FIRM	15:45
110						
113	113-115	4034	1.8'	4-11-16 (27)	SAME AS ABOVE, VERY STIFF	10:45 1/19/90
115						
118	118-120	4035	2.0'	8-16-18 (34)	SAME AS ABOVE, HARD	14:40
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 5 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
123	123-125	4036	2.0'	4-11-12 (33)	SILTY CLAY, GRAY, (N7), DRY, HARD, MICACEOUS	16:00 1/19/90
125						
128	128-130	4038	1.8'	6-7-14 (21)	SAME AS ABOVE, DRY, VERY STIFF, WITH OCCASIONAL LENSES OF VERY FINE GRAY SAND, ≈1/8-INCH THICK	0:900 1/20/90
130						
133	133-135	4039	1.9'	2-3-22 (25)	SILTY CLAY, GRAY, (N7), DRY, VERY STIFF, MICACEOUS	10:15
135						
138	138-140	4040 4041	2.0'	4-9-17 (26)	SAME AS ABOVE	13:45
140						
143	143-145	4042	1.6'	5-7-13 (21)	SILTY CLAY, GRAY, (N7), STIFF TO VERY STIFF,OVER 0.5 FT, SANDY CLAY WITH 15-25% VERY FINE SAND IN THE SAME SILTY CLAY MATRIX	15:15 DRILLER NOTES CHANGE IN DRILLING BEHAVIOR
145						RAD SCREENING
148	148-150	4043	1.9'	6-9-11 (20)	SILTY CLAY, GRAY, (N7), VERY STIFF, WITH VERTICAL FRACTURES (SECONDARY) WITH WHITE FILLINGS, MICACEOUS	16:00 30 PPM ABOVE BACKGROUND
150						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 6 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150						
153	153-155	4045	2.0'	1-2-6-8 (8)	SAME AS ABOVE, SLIGHTLY MOIST, FIRM, LESS MICA THAN ABOVE	11:20 1/21/90
155						DRILLER NOTES CHANGE IN RIG'S BEHAVIOR
158	158-160	4046	1.8'	6-9-9 (16)	SILTY CLAY, DARK GRAY, (N3), VERY STIFF, (NO MICA), WITH LENSES OF LIGHT GRAY-WHITE, VERY FINE, POORLY SORTED SAND; SANDS ARE MOIST	08:15 1/22/90
160						
163	163-164	4047	0.6'	50-50/2	SAND, SALT AND PEPPER COLORED, MOIST TO WET, VERY DENSE, FINE, POORLY SORTED, WITH ~5-10% GLAUCONITE	10:15
164						
168	168-169		0.6'	45-50/3	SAME AS ABOVE	13:30
169						TD OF BORING
172					FOUR WELLS SET AT THIS SITE SCREENED INTERVALS 160-170 44½-49½ 34½-39½ 20-30	

SEF28178.TM

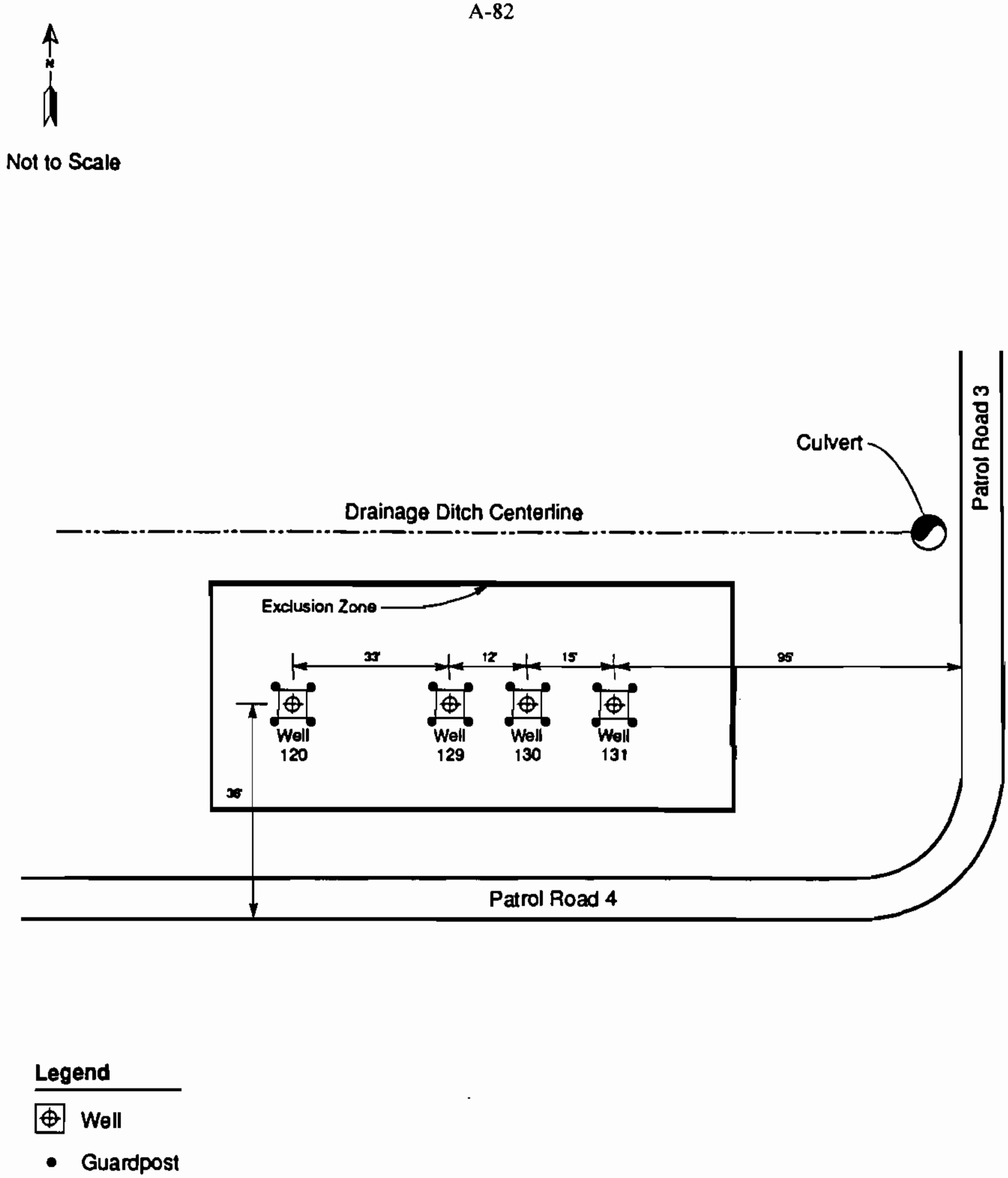


Figure 4-2
Well Cluster 1
Well Layout Sketch

CH2M HILL

Summary of McNairy Background Wells

MW 121

Location - Northwest of Plant; Well Cluster 2
N (6161.5), E (-5677.7)
Date Installed - November 14, 1989
Screened Depth - Deep McNairy
Top - 200 ft bgs
Bottom - 210 ft bgs
Dates Sampled (Data available) - Q4 89; Q1 90; Q2 90; Q3 90; Q1 91; Q2 91; Q2 93; Q3 93; Q4 93; Q1 94 Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97; Q4 97
Construction Information Reference - Technical Memorandum No. 4 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)
Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
4-Nitrophenol	15 J	NA	2/24/90	CH200304-00000
Acetone	320 BEJ	NA	4/19/90	CH200419-00000
bis(2-ethylhexyl)phthalate	300 BJ	NA	2/24/90	CH200304-00000
bis(2-ethylhexyl)phthalate	170 BJ	NA	4/19/90	CH200304-00000
Di-n-butylphthalate	2 J	NA	2/24/90	CH200304-00000
Trichloroethene	2	NA	3/29/94	4864-94
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	2	NR	2/24/90	719-90
^{99}Tc	3.1	1.4	3/25/91	CH210001-00000
^{99}Tc	4	10	9/21/93	6658-93
^{99}Tc	15	20	12/27/93	7782-93
^{99}Tc	9	33	3/29/94	4864-94
^{99}Tc	27	23	6/8/94	5517-94
^{99}Tc	8	21	9/7/94	6453-94
^{99}Tc	7	18	2/9/95	5452-95
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
^{99}Tc	0.64	1.41	4/30/91	CH210180-DIS

Notes: NA = Entry not applicable or not available.
NR = Value not reported in data set.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	4	124	78 - 155	mg/L
Depth to Water	9	51.57	48.39 - 53.75	feet
Dissolved Oxygen	9	1.30	0.35 - 3.5	mg/L
Dissolved Solids	4	196.25	163 - 251	mg/L
Hardness as CaCO3	2	64.5	51 - 78	g/L CaCO
Hardness as CaCO3, Dissolved	1	103	NA	g/L CaCO
pH	30	9.03	6.4 - 11.3	SU
Specific Conductance	34	548.4	301 - 1058	umhos/cm
Temperature	9	58.3	54 - 62	F
Total Organic Carbon	12	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	137.5	21 - 254	mg/L
Turbidity	8	109.6	22 - 184	NTU

Notes: NA = Entry not applicable or not available.

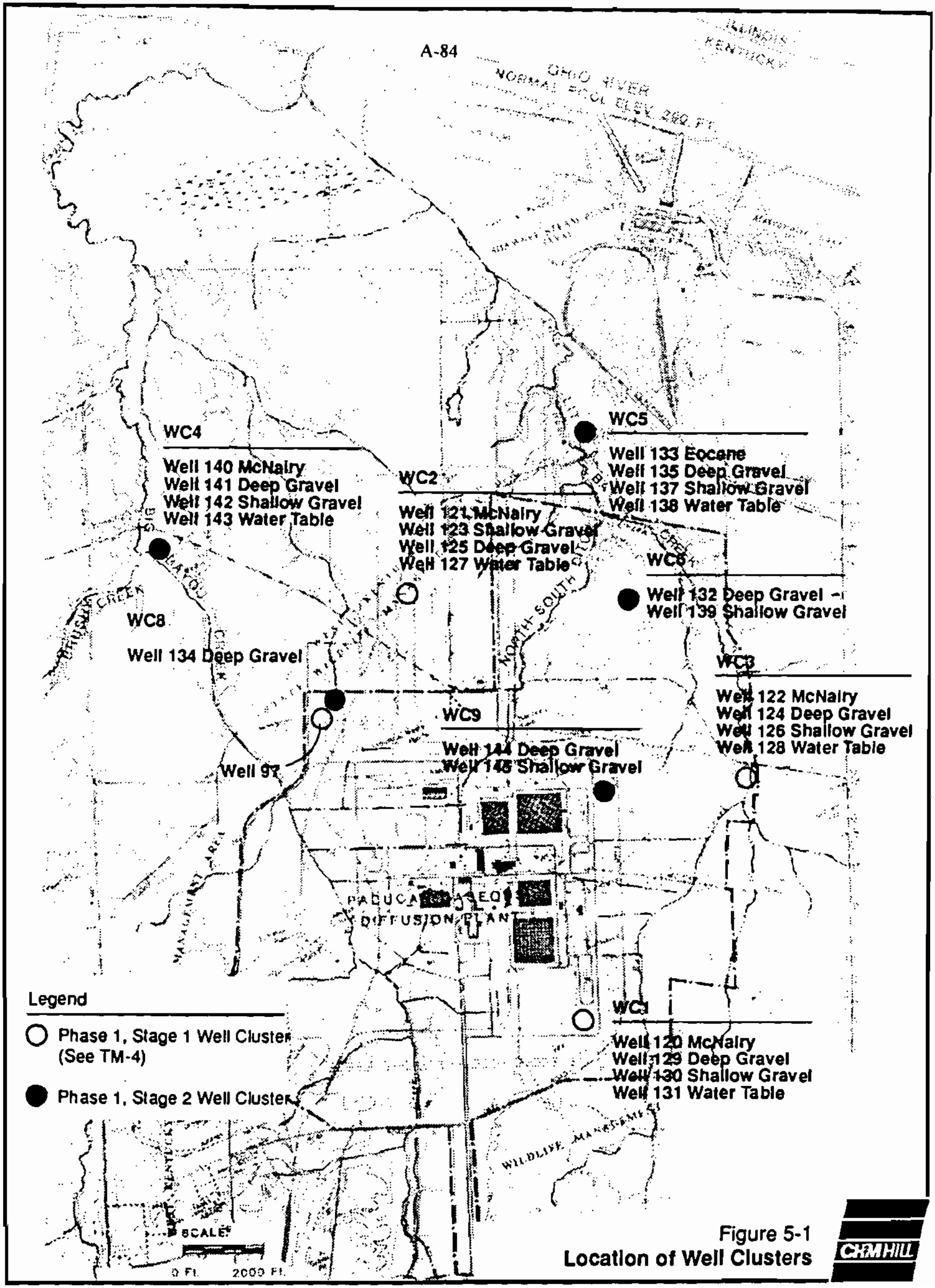
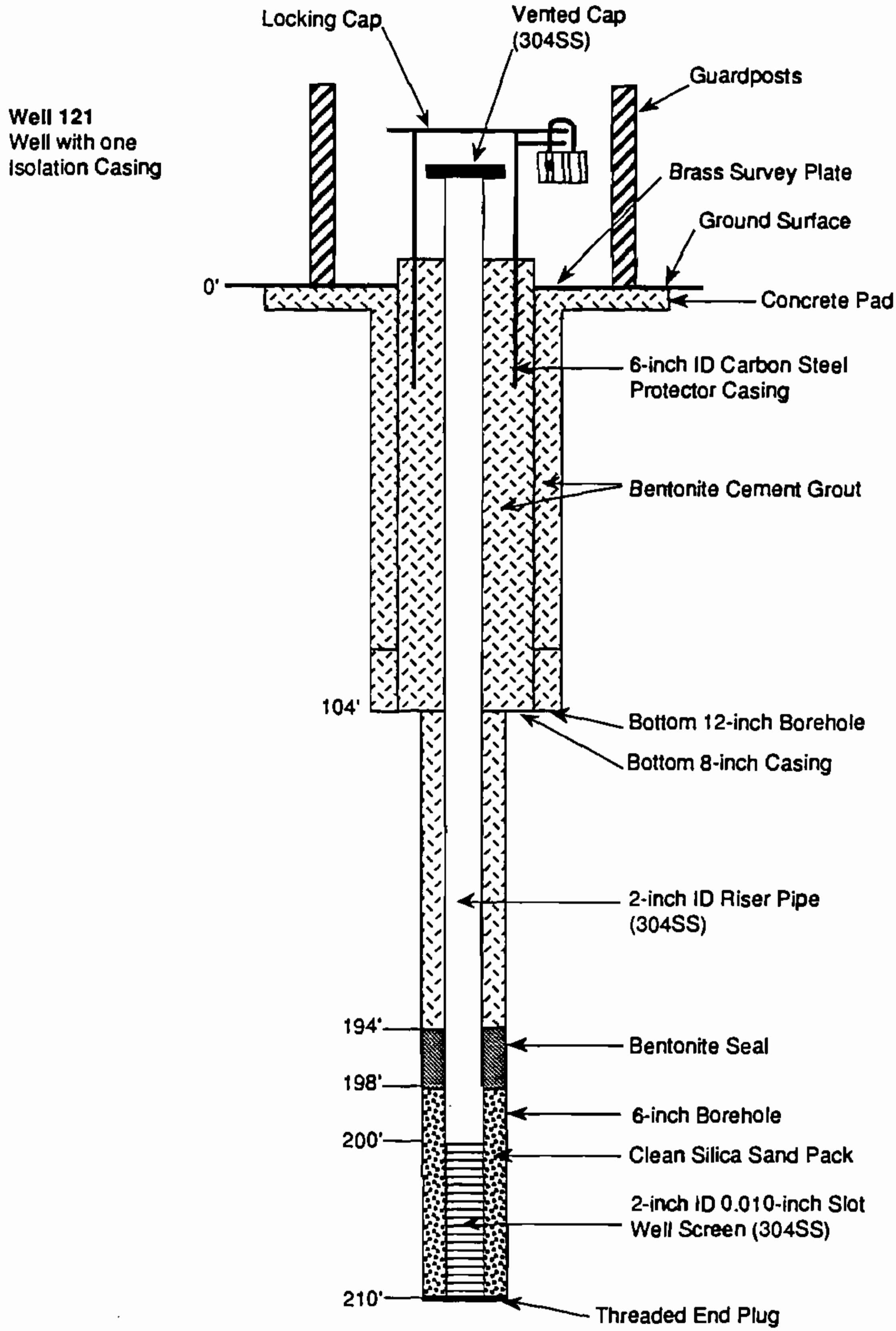


Figure 5-1
Location of Well Clusters



Well 121 Construction Details

Paducah GDP, Kentucky

CH2M HILL

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 1 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57 ATV
WATER LEVEL AND DATE ______ START 11/14/89 FINISH 1/6/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2		1.1'	1-3-4-5 (7)	SANDY CLAY, PINK YELLOWISH BROWN, (10 YR. 6/2), DAMP, FIRM, MEDIUM TO COARSE SAND SIZE, ROOTS AT TOP	BEGIN DRILLING 11/14/89 AT 13:22
2	2-4	4050	1.6'	4-5-7-7 (12)	SAME AS ABOVE, STIFF, INCREASED SAND VERSUS CLAY, (40% SAND)	HNU = 0.0 PPM
4	4-6		1.2'	6-8-10-10 (18)	FAT CLAY WITH SAND, MODERATE YELLOWISH BROWN TO DARK YELLOWISH BROWN, (10YR. 5/4), VERY STIFF, (CH)	MINOR IRON STAINING OF CLAY DRILLING RATE SMOOTH
6	6-8		1.3'	3-7-9-11 (16)	SAME AS ABOVE	
8	8-10	4051	1.7'	8-9-10-11 (19)	SILTY CLAY, DARK YELLOWISH ORANGE, (10 YR. 6/6), MOIST, VERY STIFF, TRACE SAND (10%), PLASTIC, (CH)	HNU = 0.0 PPM
10	10-12		1.7'	2-5-6-8 (11)	CLAYEY SAND, DARK YELLOWISH BROWN, (10YR. 4/2), MOIST, MEDIUM DENSE, (50%/50%), ORGANIC STAINING, ROOTS, TRACE SILT, (SC)	
12	12-14		1.8'	8-10-10-11 (20)	SANDY CLAY, LIGHT BROWN TO PALE YELLOWISH BROWN, (5 YR. 5/6), VERY STIFF, TRACE SILT, (CL)	MINOR ORGANIC MATERIAL
14	14-16	4052	1.2'	11-13-12-12 (25)	SILTY CLAY, LIGHT BROWN TO PALE YELLOWISH BROWN, (5 YR. 5/6) TO (10 YR. 6/2), VERY STIFF, TRACE SAND, (CL)	
16	16-18		1.9'	4-7-10-11 (17)	SAME AS ABOVE	ENDED DRILLING AT 16:40
18	18-20		1.1'	4-6-10-12 (16)	SAME AS ABOVE, INCREASING SAND CONTENT	RESUMED DRILLING 11/15/89 AT 08:19
20	20-22	4053	1.8'	2-5-7-9 (12)	SILTY CLAY, PALE YELLOWISH BROWN, (10 YR. 6/2), STIFF, TRACE MEDIUM SAND	IRON STAINING IN SANDS
22	22-24		2.0'	10-11-12-15 (23)	SAME AS ABOVE, MOIST, VERY STIFF, MORE PLIABLE	
24	24-26		1.2'	15-13-16-17 (29)	SAME AS ABOVE, VERY STIFF, NOT PLIABLE	END DRILLING AT 10:56
26	26-28	4054	2.0'	3-7-9-17 (16)	SILTY CLAY, GRAYISH ORANGE PINK TO YELLOWISH GRAY, (5 YR. 7/2), MOIST TO WET, VERY STIFF	RESUMED DRILLING 11/16/89 AT 08:14 ENCOUNTERED WATER TABLE AT 26 TO 28 FT.
28	28-30		2.0'	4-15-15-18 (30)	SAME AS ABOVE, WET, HARD, TRACE SAND LENSES	
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 2 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32	4054	2.0'	3-4-7-9 (11)	SAME AS ABOVE, WET, STIFF, TOP 0.3 FT. BLACK ORGANIC STAINING	HNU = 0.0 PPM
32	32-34	4055	1.6'	12-14-17-17 (31)	SILTY CLAY, MODERATE REDDISH BROWN, (10 R 3/4), HARD, TRACE SAND	UPPER CONTINENTAL DEPOSITS
34	34-36		1.9'	14-15-16-16 (31)	SAME AS ABOVE, LAYERED COLOR CHANGES BETWEEN PALE YELLOWISH BROWN AND REDDISH BROWN	ISOLATED BLACK ORGANIC SEAMS
36	36-38		1.8'	4-8-16-22 (24)	SAME AS ABOVE, PALE YELLOWISH BROWN ABOVE REDDISH BROWN, VERY STIFF	
38	38-40	4056	1.4'	10-25-23-27 (48)	SAME AS ABOVE, HARD, ISOLATED COBBLE	
40	40-42		2.0	3-7-9-10 (16)	SAME AS ABOVE, VERY STIFF, ISOLATED COBBLE	HNU = 0.0 PPM
42	42-44	4057	1.5'	12-14-16-18 (32)	SAME AS ABOVE, HARD, NO COBBLE	
44	44-46	4058	1.8'	11-15-14-14 (29)	SAME AS ABOVE, VERY STIFF, POCKETS OF LIGHT GRAY CLAY, WITH TRACE OF MEDIUM SAND	HNU = 0.0 PPM
46	46-48		1.8'	6-8-12-14 (20)	SAME AS ABOVE	
48	48-50		1.7'	10-12-15-17 (27)	SAME AS ABOVE, THIN ORGANIC SEAM	
50	50-52	4059	2.0'	6-8-9-16 (17)	CLAYEY SILT WITH SAND, REDDISH BROWN, (10R 4/6), VERY STIFF, MICACEOUS, ORGANIC SEAMS, (OL)	
52	52-54		1.3'	11-14-15-15 (29)	SAND WITH SILT, REDDISH BROWN, (10R 4/6), MEDIUM DENSE, WELL GRADED, FINE TO COARSE, MICACEOUS, (80-20%) (SM)	HNU = 0.0 PPM
54	54-56		1.5'	15-22-34-23 (56)	SAME AS ABOVE, VERY DENSE, FINE TO MEDIUM SAND SIZE	ENDED DRILLING AT 10:29
56	56-58	4060	1.3'	4-5-13-5 (18)	SANDY CLAY, REDDISH BROWN, (10R 6/4), MOIST, STIFF, PLIABLE; OVER 1.0 FT. SAND, MEDIUM DENSE, MEDIUM COARSE	RESUMED DRILLING 11/17/89 AT 08:14
58	58-60		2.0'	32-50/3"	SAND, REDDISH BROWN, MOIST, VERY DENSE, MICACEOUS; OVER 1.0 FT. GRAVEL, VERY DENSE, MIDDLE: GRAY CLAY LENS	LOWER CONTINENTAL DEPOSITS
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 3 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62	4060	1.9'	7-32-50/5"	SAND, REDDISH BROWN, VERY DENSE, MEDIUM COARSE; OVER 0.4 FT. GRAVEL (1/2-1/4-INCH DIAMETER), MICACEOUS, (75% SAND/25% GR)	
62	62-64		1.7'	5-9-16-18 (25)	0.95 FT. SAND, LIGHT BROWN, (5 YR. 5/6), MEDIUM DENSE, MICACEOUS; OVER GRAVEL, MODERATE BROWN, (5 YR. 4/4), SUBROUNDED	
64	64-66	4061	1.3'	4-12-28-50/5" (40)	SAME AS ABOVE, DENSE, GRAVEL CONTENT INCREASED VERSUS SAND, (60% GRAVEL-40% SAND)	
66	66-68		1.6'	19-23-24-40 (47)	SAME AS ABOVE	ENDED DRILLING AT 15:14
68	68-70		1.3'	11-16-33-24 (49)	SAND, DARK YELLOWISH ORANGE, (10 YR. 6/6), WET, DENSE, MEDIUM COARSE, WELL GRADED	RESUMED DRILLING 11/20/89 AT 10:43
70	70-72	4062	1.4'	8-19-34-36 (53)	SAME AS ABOVE, VERY WET, VERY DENSE; OVER 0.5 FT. GRAVEL (66% SAND/34% GRAVEL)	HNU = 0.0 PPM HP210 = 38 CPM
72	72-74		1.1'	8-17-27-26 (44)	SANDY GRAVEL, DARK YELLOWISH ORANGE, (10 YR. 6/6), DENSE, (1/8-1/2-INCH DIAMETER) (80% GRAVEL/20% SAND)	DRILLING ENDED AT 11:53
74	74-76		1.2'	23-19-50/5"	SAME AS ABOVE, WET, VERY DENSE, SAND CONTENT INCREASING (50% GRAVEL/50% SAND)	DRILLING BEGINNING 11/27/89 AT 07:39
76	76-78	4064	1.1'	9-38-50/5"	SAME AS ABOVE, WET, (80% GRAVEL/20% COARSE SAND)	
78	78-80		2.0'	12-14-25-50/5" (39)	SAME AS ABOVE, DENSE, WITH 0.35 FT. PALE YELLOWISH BROWN, (10 YR. 6/2), CLAYEY SAND LENS AT CENTER	HNU = 0.0 PPM
80	80-82		1.3'	14-25-33-31 (58)	SAME AS ABOVE, VERY DENSE, NO CLAYEY SAND, VERY LARGE (18-IN. TO 1-IN. DIAMETER) COBBLES, GRAVEL	
82	82-84	4065	1.5'	11-18-38-46 (56)	0.60 FT. SAND, DARK YELLOWISH ORANGE, (10 YR. 6/6), MOIST TO WET, VERY DENSE, FINE TO MEDIUM; OVER GRAVEL, CHERT	RED STAINING IN SANDS
84	84-86		1.6'	8-13-27-38 (40)	SANDY GRAVEL, MODERATE YELLOWISH BROWN, (10 YR. 5/4), MOIST, DENSE, MEDIUM TO COARSE, (80% GR/20% SAND)	RED IRON STAINING
86	86-88		2.0'	3-12-43-50/4" (55)	SAME AS ABOVE, VERY DENSE	HNU = 0.0 PPM HP210 = 33 CPM
88	88-90	4066	1.3'	4-12-27-50/5" (39)	CLAY, GRAYISH ORANGE PINK, (5YR. 7/2); AND SILTY SAND, LIGHT BROWN, (5YR. 5/6) TO VERY PALE ORANGE (10YR. 8/2), DENSE, FINE TO MEDIUM	EOCENE SAND AND CLAY RED IRON STAINING
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 4 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57 ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	90-92	4066	1.6'	4-1-5-9 (6)	INTERBEDDED CLAY, PALE BROWN, (5 YR. 5/2) TO GRAYISH ORANGE PINK, (5 YR. 7/2); FIRM AND SAND, LIGHT BROWN, (5 YR. 5/6) TO VERY PALE ORANGE, (10YR. 8/2),LOOSE, MICACEOUS, BELOW GRAVEL	66% SAND/CLAY BELOW 33% GRAVEL
92						AUGERED 92-95 FT. DRILLER DESCRIBES 3 FT. ZONE AS CLAY UNIT
93						
95	95-97	4067	2.0'	2-4-7-10 (11)	SILTY CLAY, YELLOWISH BROWN (10YR. 2/2) TO OLIVE BLACK,MOIST, STIFF, MICACEOUS, WITH INTERBEDDED CLAY AND SAND IN TOP 0.5 FT.	PORTERS CREEK CLAY
97						
98						
100	100-102	4068	2.0'	2-5-13-19 (18)	SILTY CLAY, DUSKY YELLOWISH BROWN, (10 YR. 2/2), VERY STIFF, MICACEOUS	ENDED DRILLING AT 16:25
102						
103						
105	105-107		0.3		SHELBY TUBE WAS COLLAPSED ON THE BOTTOM, COULD NOT GET TO SOIL FOR CLASSIFICATION	12/11/89 RESUMED DRILLING AT 15:10 TOOK SHELBY TUBE SAMPLE AT 15.55 ON 12/11/89. SHELBY WAS PUSHED 2 FT., VERY HARD TO PUSH QUIT FOR THE DAY AT 17:00
107	107-109	4074 1.9'	1.9'	39-27-47-99 (74)	LEAN CLAY WITH SAND, DUSKY YELLOWISH BROWN, (10YR. 2/2), MOIST, HARD, MICACEOUS, 15-20% SAND, (CL)	BEGIN DRILLING AT 11:00 ON 12/13/89
109						QUIT FOR THE DAY AT 15:30 on 12/13/89
110	110-112	4075	0.9'	39-57-50/3"	CLAYEY SAND, DUSKY YELLOWISH BROWN, (10 YR. 2/2), MOIST, VERY DENSE, SLIGHT PLASTICITY, 20-40% P200, SOME SMALL BLACK WOODCHIPS, (SC)	RESUMED DRILLING 12/14/89 AT 13:40
112						
113						
115	115-117	4078	0.2	270/5"	POORLY GRADED SAND WITH SILT, DUSKY YELLOWISH BROWN, (10 YR. 2/2), MOIST, VERY DENSE, 5-12% P200, THE VERY TIP OF SPOON HAD LEAN CLAY, STRATIGRAPHY SEEMS TO BE ALTERNATING SAND AND CLAY, (SP-SM)	
117						
118						
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 5 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant

ELEVATION DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Mud Rotary (7⁷/₈-inch O.D.) Longyear 44

WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER Nielsen

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120–122	120-122	4079	1.0'	30-100/16"	POORLY GRADED SAND WITH SILT, LIGHT BLUISH GRAY, (5B 7/1), MOIST, VERY DENSE, QUARTZ SAND, VERY FINE TO FINE, 5-12% P200, (SP-SM)	RESUMED DRILLING 12/18/89 AT 13:45 SWITCHED TO 300 LB. HAMMER AT 120 FT.
125–127	125-127	4081	0.8'	54-66/6"	SAME AS ABOVE, (SP-SM)	WHILE DRILLING TO 125 FT. DRILLER INDICATED HE LOST SOME CIRCULATION, LOSS WAS VERY MINOR
130–132	130-132	4082	0.9'	36-46-24 (70)	INTERBEDDED POORLY GRADED SAND AND SANDY CLAY, POORLY GRADED SAND (80%), LIGHT GRAY, (N7), MOIST, VERY DENSE, QUARTZ SAND, FINE, 0-5% P200, (SP) SANDY CLAY (20%), DUSKY YELLOWISH BROWN (10YR 4/2) SLIGHT PLASTICITY, 20-40% SAND (CL)	QUIT FOR DAY AT 126 FT. AT 16.05 ON 12/18/89 RESUMED DRILLING AT 13:40 ON 12/19/89
135–137	135-137	4084	2.0'	3-6-8-10 (14)	ELASTIC SILT, DUSKY YELLOWISH BROWN, (10YR 2/2), MOIST, STIFF, NON PLASTIC, VERY VERY THIN LENSES OF QUARTZ SAND THROUGHOUT SAMPLE, (ML)	QUIT FOR DAY AT 135 FT. AT 15:45 ON 12/19/89 RESUMED DRILLING AT 11:00 ON 12/20/89 QUIT FOR DAY AT 137 FT. AT 12:30 ON 12/20/89
140–142	140-142	4085	2.0'	16-21-38-50/3" (59)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, SLIGHTLY PLASTIC, VERY THIN LENSES OF QUARTZ SAND THROUGHOUT SAMPLE, (ML)	SWITCHED TO 140 LB. HAMMER AT 140 FT. RESUMED DRILLING AT 09:20 ON 1/3/90
145–147	145-147	4086	2.0'	23-42-50/4"	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, MODERATELY PLASTIC, VERY THIN LENSES OF QUARTZ SAND, MICACEOUS, (ML)	SWITCHED BACK TO 300 LB. HAMMER AT 145 FT. AFTER INITIALLY DRILLING WITH 140 LB. HAMMER. FINISHED DRIVING SAMPLE WITH 300 LB.
150						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 6 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mud Rotary (7⅞-inch O.D.) Longyear 44
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER Brungard

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150	150-152	4087	2.0'	5-8-12-40 (20)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, SLIGHTLY PLASTIC, STIFF, HIGHER PERCENTAGE OF THIN SAND SEAMS THAN ABOVE, MICACEOUS, (ML)	USING 300 LB. HAMMER
152						
155	155-157	4088	2.0'	5-11-28-50 (39)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, HARD, SLIGHTLY PLASTIC, HIGHER PERCENTAGE OF THIN SAND SEAMS, UPPER 0.8' SATURATED, DOES NOT HAVE SAND LAMINATIONS, MICACEOUS, (ML)	END DRILLING FOR THE DAY 16:00 1/3/90 RESUME DRILLING 08:00 ON 1/4/90
157						
160	160-162	4089	2.0'	WOR-4-7-15 (11)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, SLIGHTLY PLASTIC, HIGH PERCENTAGE OF THIN SAND SEAMS, MICACEOUS, (ML)	
162						
165	165-167	4090	2.0'	WOR-3-9-21 (12)	INTERBEDDED ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, SLIGHTLY PLASTIC, MICACEOUS, (ML); AND POORLY GRADED SAND, WHITE, FINE, LAMINATIONS, 30-40% SAND, (SP)	TOP OF SAMPLE WAS WET, PROBABLY DUE TO DRILLING MUD DRILLER INDICATED A CHANGE IN DRILLING AT 167 FT.
167						
170	170-172	4091	2.0	2-1-5-7 (6)	CLAYEY SILT, OLIVE BLACK, (5Y 2/1), MOIST, FIRM, MODERATELY PLASTIC, (MH)	
172						
175	175-177	4092	2.0'	6-12-17-18 (29)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, MODERATELY PLASTIC, MICACEOUS, THIN SEAMS OF WHITE FINE SAND, (ML)	END DRILLING FOR THE DAY 16:10 ON 1/4/90
177						
180						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 7 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mud Rotary ($7^3/_8$-inch O.D.) Longyear 44
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER Brungard

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
180	180-182	4093	2.0'	WOR-5-8-7 (13)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, THIN SEAMS OF WHITE FINE SAND, (ML)	USING 300 LB. HAMMER
182						
185	185-187	4094	2.0'	WOR-5-7-11 (12)	CLAYEY SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, THIN SEAMS OF WHITE FINE SAND AT BOTTOM OF SAMPLE, (MH)	
187						
190	190-192	4095	2.0'	WOR-5-7-17 (12)	ELASTIC SILT AND SAND, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, LARGE NUMBER OF THIN WHITE FINE SAND SEAMS, (ML-SP)	
192						
195	195-197	4096	2.0'	WOR-5-7-15 (12)	ELASTIC SILT, OLIVE BLACK, WET, STIFF, MODERATELY PLASTIC, FEW SEAMS OF SATURATED FINE SAND, MICACEOUS, (ML)	THE SAMPLE FROM 200 TO 202 FT. IS APPARENTLY FROM 198 TO 200 FT. IN ACTUALITY.
197						
200	200-202	4097	2.0'	3-1-3-3 (4)	ELASTIC SILT, OLIVE BLACK, (5Y 2/1), WET, SOFT, MODERATELY PLASTIC, (ML)	THE DRILLER REPORTED ROUGH DRILLING AT ABOUT 200.5 FT. THE DRILLING REPORTEDLY BECAME EASIER WITH DEPTH
202						
205	205-206.2	4098	1.2'	23-75-50/2"	POORLY GRADED SILTY SAND, LIGHT GRAY, (N7), WET, VERY DENSE, VERY FINE, (SP-SM)	
207						
210						TD OF BORING 211.5 FT.

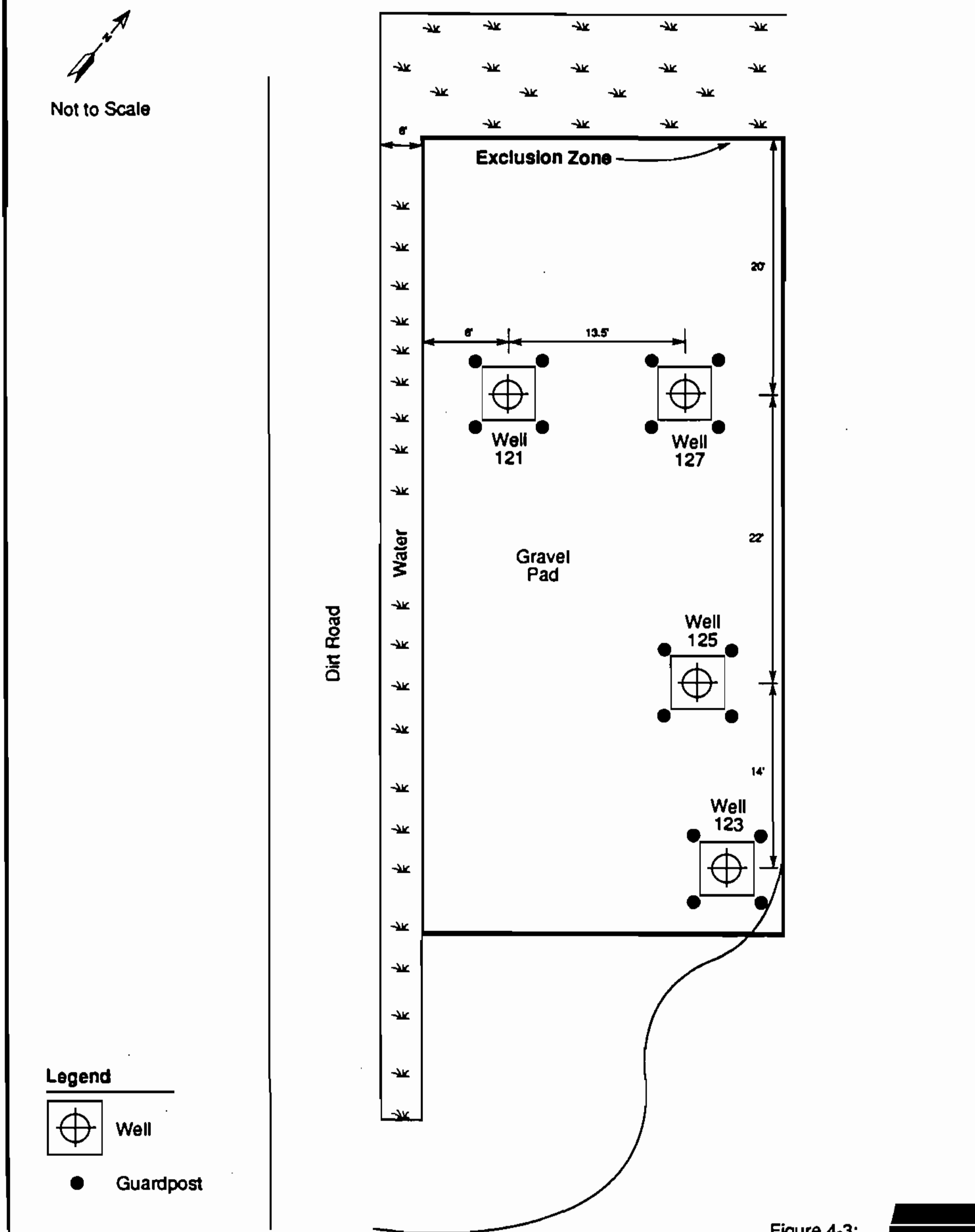


Figure 4-3:
Well Cluster 2
Well Layout Sketch

CH2M HILL

[Page left blank]

Summary of McNairy Background Wells

MW 122

Location - East of Plant; Well Cluster 3
N (717.1), E (1876.2)
Date Installed - November 18, 1989
Screened Depth - Middle McNairy
Top - 148 ft bgs
Bottom - 158 ft bgs
Dates Sampled (Data available) - Q1 90; Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q2 95; Q1 96; Q1 97; Q4 97
Construction Information Reference - Technical Memorandum No. 4 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)
Potential Contaminant Information -

Compound	Deteeted Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
bis(2-ethylhexyl)phthalate	189 BJ	NA	4/30/90	CH200423-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	8	NR	2/22/90	707-90
^{99}Tc	3	NR	4/30/90	1547-90
^{99}Tc	5.9	3.2	3/11/91	CH210005-00000
^{99}Tc	5	34	6/1/93	5246-93
^{99}Tc	17	19	9/20/93	6662-93
^{99}Tc	15	23	12/7/93	7786-93
^{99}Tc	11	31	6/8/94	5521-94
^{99}Tc	13	17	9/21/94	6457-94
^{99}Tc	20	20	2/9/95	5456-95
^{99}Tc	11	11	6/5/95	6596-95
^{99}Tc	2	10	2/8/96	5301-96
^{99}Tc	1	11	2/6/97	5145-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
^{99}Tc	-0.16	2.23	3/11/91	CH210005-DIS

Notes: NA = Entry not applicable or not available.
NR = Value not reported in data set.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	6	151	142 - 165	mg/L
Depth to Water	12	38.27	33.46 - 41.18	feet
Dissolved Oxygen	12	2.04	0.4 - 11.31	mg/L
Dissolved Solids	6	192.8	154 - 270	mg/L
Hardncss as CaCO3	1	127	NA	g/L CaCO
Hardncss as CaCO3, Dissolved	1	147	NA	g/L CaCO
pH	42	6.51	5.7 - 7	SU
Specific Conductance	42	326.8	301 - 422	umhos/em
Temperature	12	58.2	56 - 60	F
Total Organic Carbon	20	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	14.5	4 - 25	mg/L
Turbidity	9	21.2	6.5 - 61	NTU

Notes: NA = Entry not applicable or not available.

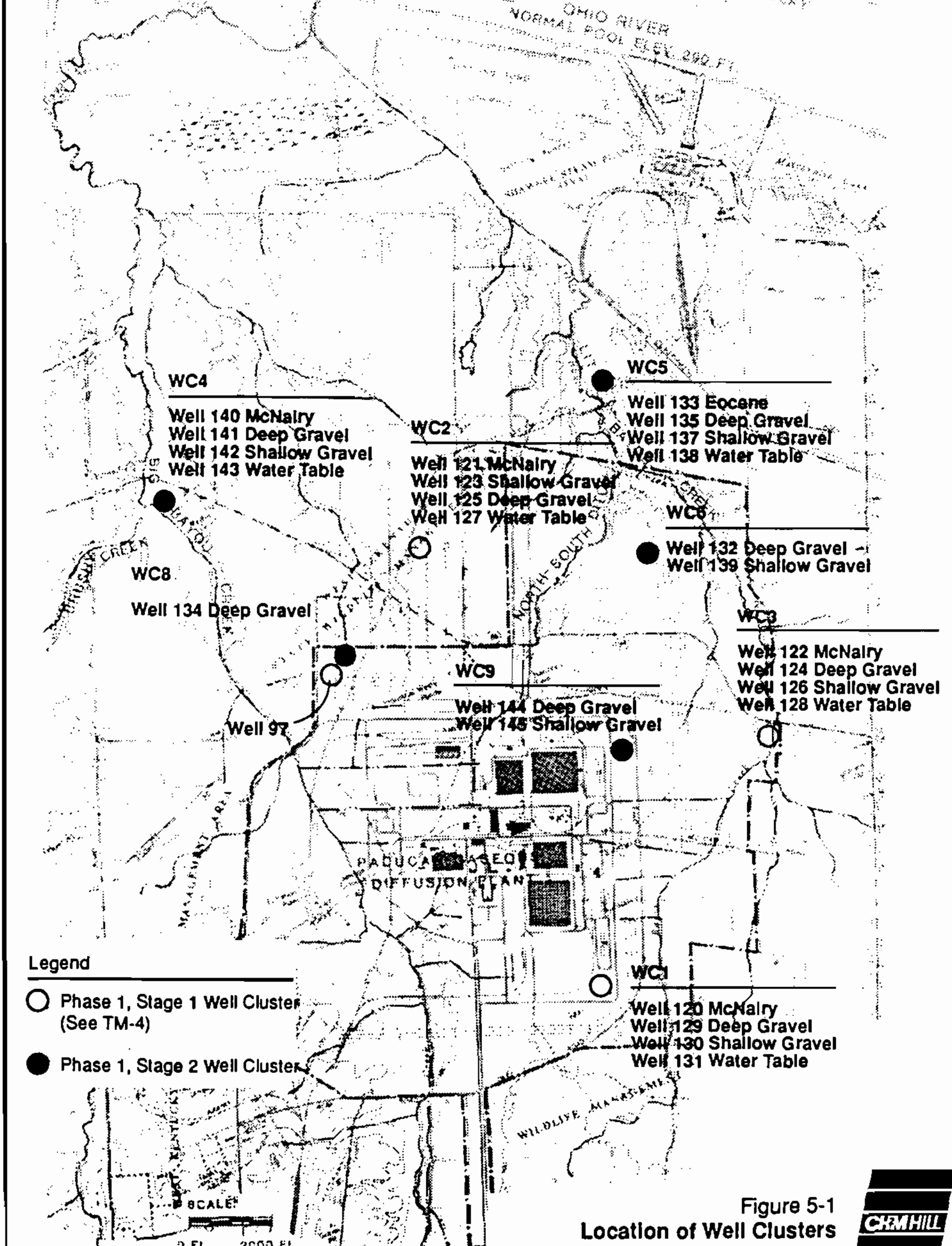
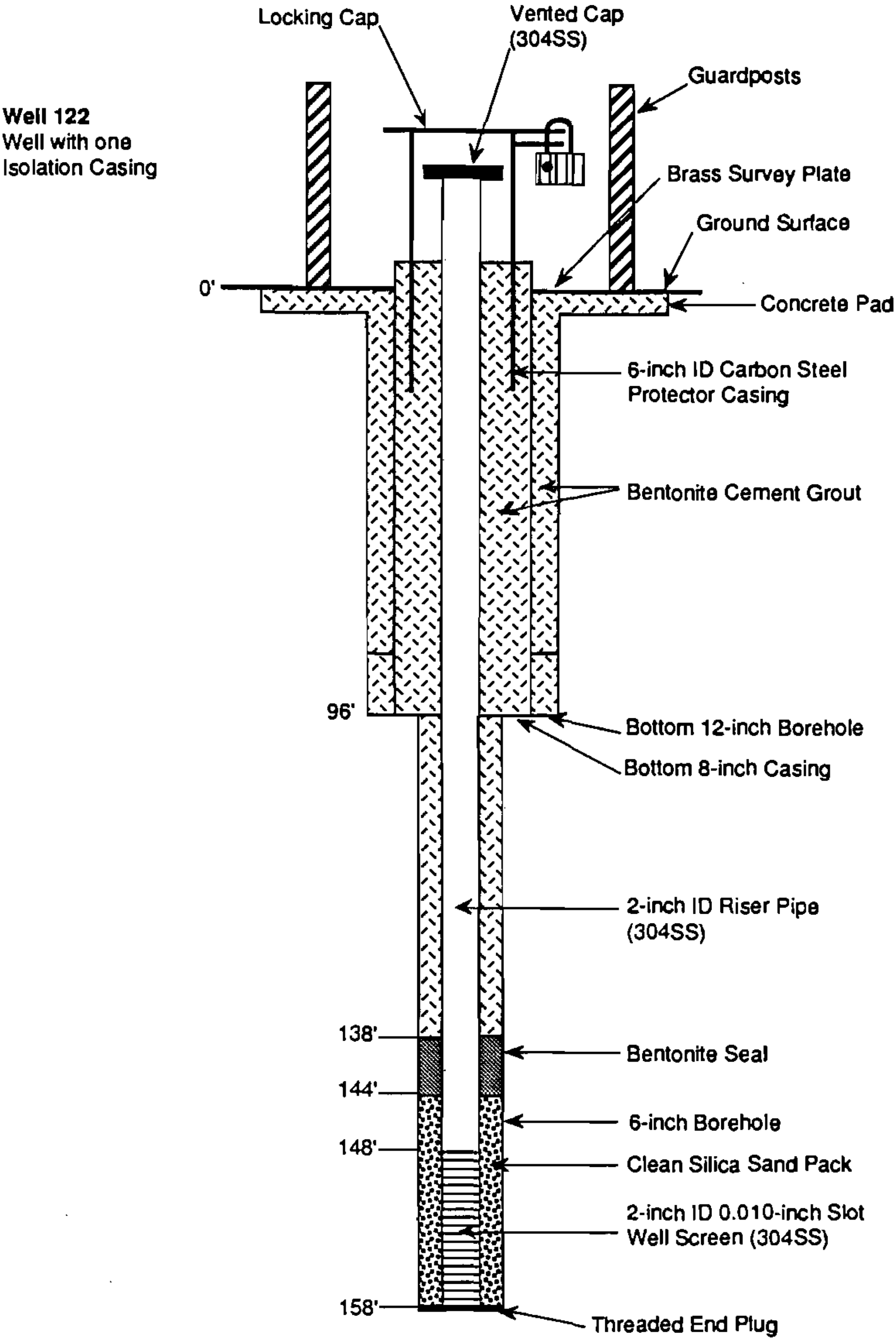


Figure 5-1
Location of Well Clusters

CH2M HILL



Well 122 Construction Details

Paducah GDP, Kentucky

CH2M HILL

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 1 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT ______

WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER MK Dwyer

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2		1.0'	2-2-3-4 (5)	SILTY CLAY, DARK YELLOWISH BROWN, (10 YR 4/2), MOIST, FIRM, HOMOGENEOUS, SLIGHTLY PLASTIC, (CL)	HNU = 0 PPM HP 260 = BACKGROUND
2	2-4	4100	1.3'	10-12-14-18 (26)	SILTY CLAY, MODERATELY YELLOWISH BROWN, (10 YR 5/4), MOIST, VERY STIFF, SOME MOTTLING, MEDIUM PLASTICITY, (CL)	SAME READINGS
4	4-6		2.0'	7-7-10-13 (17)	SILTY CLAY, PALE YELLOWISH BROWN, (10YR 6/2), MOIST, VERY STIFF, IRON RICH LAYERING, MINOR ORGANICS, LOW PLASTICITY, (CL)	
6	6-8		1.7'	8-8-10-8 (18)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10YR 5/4), AND LIGHT GRAY, (N7), MOIST (7-8) TO WET (6-7), VERY STIFF, IRON RICH LAYERING, LOW PLASTICITY, (CL)	
8	8-10	4101	1.7'	7-7-10-10 (17)	SILTY CLAY, SAME AS ABOVE, HOMOGENEOUS, (8-9), IRON RICH MOTTLING, (9-10), (CL)	HNU = 0 PPM HP 260 = BACKGROUND (30 CPM)
10	10-12		1.5'	12-14-14-15 (28)	SILTY CLAY, SAME AS ABOVE, MOTTLING THROUGHOUT, (CL)	
12	12-14		1.9'	4-7-7-9 (14)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10 YR 5/4), AND GRAY (N7) (13.5-14.0FT), DAMP, STIFF, IRON RICH LAYERS, 20 % FINE SAND 12.5 - 13.5 FT. (CL)	HNU = 0 PPM HP 260 = 30 CPM (BACKGROUND)
14	14-16	4102	2.0'	5-9-13-13 (22)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10 YR 5/4), MOIST, VERY STIFF, HOMOGENEOUS, (CL); OVER SAND, YELLOWISH GRAY, (5Y 5/1), DRY, MEDIUM DENSITY, FINE SAND, TRACE SILT, IRON RICH MOTTLING THROUGHOUT, (SM)	
16	16-18		2.0'	8-9-9-12 (18)	SILTY CLAY, SAME AS (14-15 FT.) FROM 16-16.5FT.; OVER SANDY CLAY, YELLOWISH GRAY, (5Y 8/10), MOIST, VERY STIFF, 20% SAND, IRON RICH MOTTLING THROUGHOUT, (CL)	SAME READINGS
18	18-20		1.6'	8-11-11-12 (22)	SILTY CLAY AND SANDY CLAY, MODERATE YELLOWISH BROWN, (10YR 5/4), 18.4-18.5 FT. AND YELLOWISH GRAY, (5Y 8/1) 18.8-20 FT., MOIST, VERY STIFF, SOME IRON RICH LAYERS, LOW PLASTICITY, 25% FINE SAND, (CL)	HNU = 0 PPM HP 260 = 30 CPM (BACKGROUND)
20	20-22	4103	1.9'	9-10-12-12 (22)	SANDY CLAY, LIGHT GRAY, (N7), DAMP TO MOIST, VERY STIFF, IRON STAINED LAYERING AND INCLUSIONS, LOW PLASTICITY, (40% SAND), WITH 3-4" FINE SAND LAYERS, (CL)	
22	22-24		0.4'	6-6-11-13 (17)	SILTY CLAY, YELLOWISH GRAY, (5Y 8/1), MOIST, VERY STIFF, HOMOGENEOUS, LOW-MEDIUM PLASTICITY, (CL)	16:15 END SAMPLING
24	24-26		2.0'	6-6-8-9 (14)	SILTY CLAY, LIGHT BROWN AND GRAY, (5 YR 5/6), (N7), (15%), MOIST, STIFF, IRON STAINING AND MOTTLING THROUGHOUT, LOW PLASTICITY, SOME FINE SAND, (CL)	SAMPLE #4104 IS EQUIPMENT BLANK TAKEN ON 11/18/89
26	26-28	4105	2.0'	7-10-10-13 (20)	SILTY CLAY, LIGHT BROWN AND GRAY, (5 YR 5/6), (N7), MOIST, MEDIUM DENSITY, VERY STIFF, IRON STAINING AND MOTTLING, LOW PLASTICITY, WITH LAYERS OF WELL SORTED FINE SAND (.2 FT.), (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
28	28-30		1.6'	8-8-9-11 (17)	SANDY CLAY LIGHT BROWN AND GRAY, (5YR 5/6) (N7), MOIST, VERY STIFF, IRON STAINING AND MOTTLING, TRACE SUBROUNDED PEBBLES, WITH SILT AND FINE SAND (30%), WELL GRADED, (CL)	
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 2 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD

WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER MK Dwyer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32		2.0'	8-7-7-9 (14)	SILTY CLAY, PALE YELLOWISH BROWN, (10YR 6/2), STIFF, IRON RICH LAYERING AND MOTTLING, TRACE SUBROUNDED PEBBLES AT 30-30.2 FT., LOW PLASTICITY, TRACE FINE SAND (10%), (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
32	32-34	4106	1.6'	6-6-8-12 (14)	SILTY CLAY, LIGHT BROWN, (5YR 5/6), AND PALE YELLOWISH BROWN, (10 YR 6/2), MOIST, STIFF, IRON RICH, MOTTLED, THIN PEBBLE LAYERS AT 34 FT., LOW PLASTICITY, SOME FINE SAND, (CL)	
34	34-36		1.9'	14-15-16-16 (31)	SILTY CLAY, SAME AS 32-34 FT., HARD, TRACE SUBROUNDED (1-IN.) PEBBLES	
36	36-38		2.0'	10-7-7-9 (14)	SANDY CLAY, PALE YELLOWISH BROWN (10YR 6/2) AND LIGHT BROWN, (5YR 5/6), MOIST, STIFF, MOTTLED, LOW PLASTICITY, FINE GRAINED SAND (30%), WITH SILT, (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
38	38-40	4107	1.8'	12-12-14-16 (26)	SANDY CLAY, LIGHT BROWN, (5YR 5/6) AND LIGHT GRAY (N7), MOIST, VERY STIFF, MOTTLED, LOW PLASTICITY, WITH FINE GRAINED SAND (39-39.5 FT.), (CL)	
40	40-42		1.9'	13-14-14-16 (28)	SILTY CLAY, LIGHT BROWN, (5YR 5/6), AND LIGHT GRAY, (N7), MOIST, VERY STIFF, MOTTLED, LOW PLASTICITY, SOME FINE SAND, (30%), (CL)	
42	42-44		1.8'	8-6-6-9 (12)	CLAYEY SILT, LIGHT BROWN, STIFF, OCCASIONAL MOTTLING, (ML); OVER SILTY CLAY, (43-44 FT.), LIGHT GRAY, (N7), (CL)	HNU = 0 PPM HP 260 = BACKGROUND
44	44-46	4108	1.0'	7-5-9-11 (14)	SILTY CLAY, SAME AS ABOVE, 10% FINE SAND, (CL)	
46	46-48		1.7'	5-7-7-12 (14)	CLAYEY SAND, LIGHT BROWN, (5YR 5/6), MOIST TO WET, MEDIUM DENSITY, STIFF, POORLY GRADED, MICACEOUS, FINE GRAINED, 20% CLAY (SC)	
48	46-50		1.8'	6-8-9-14 (17)	SILTY CLAY, LIGHT BROWN (5YR 5/6), MOIST, VERY STIFF, HOMOGENEOUS, MICACEOUS, 10 % FINE SAND, (SC)	SAMPLE #4109 EQUIPMENT BLANK ON BOWL USED TO COMPOSITE #4110
50	50-52	4110	1.0'	7-10-13-15 (23)	SILTY CLAY, SAME AS ABOVE	
52	52-54		1.8'	3-5-5-8 (10)	SANDY CLAY, (15% SILT), LIGHT BROWN, (5YR 5/6), MOIST TO WET, STIFF, HOMOGENEOUS, (10-30%) FINE SAND, (SC)	
54	54-56		1.7'	8-11-14-16 (25)	SILTY SAND, LIGHT BROWN, (5YR 5/6), MOIST TO WET, MEDIUM DENSITY, HOMOGENEOUS, (10-20%) SILT, (SM); OVER 0.5 FT. SILTY GRAVEL, MODERATE BROWN, (5 YR 4/4), (1/4-3/4-IN.) ANGULAR TO SUBANGULAR, (GM)	SAMPLE 56-58 FT: GRAVEL MOSTLY QUARTZ, 1-INCH ANGULAR, MODERATE RED, (5R 4/6), 1/4-INCH SUB-ANGULAR MODERATE RED BROWN, (10R 4/6)
56	56-58	4111	1.8'	16-21-24-26 (45)	SILTY GRAVEL, (40-50%) GRAVEL, LIGHT BROWN, (5YR 5/6), MOIST TO WET, DENSE (20-40%) COARSE TO FINE SAND, (10R 4/6); (10-20%) SILT, (GM)	
58 60	58-60		1.7'	13-16-21-25 (37)	SILTY GRAVEL, SAME AS ABOVE, (GM)	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 3 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER Dwyer/Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		0.8'	8-10-19-6 (29)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, GRADING TO WELL ROUNDED, (GM)	
62	62-64	4112	1.1'	11-16-18-18 (34)	SILTY GRAVEL, SAME AS ABOVE, DENSE, (GM)	
64	64-66		0.7'	9-13-16-21 (29)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, (GM)	
66						
68						
70	70-72	4113	1.2'	13-16-18-23 (34)	SILTY GRAVEL, SAME AS ABOVE, DENSE, (GM)	
72	72-74		1.1'	8-11-13-13 (24)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, (GM)	
74	74-76	4114	1.0'	7-13-19-30 (32)	GRAVEL WITH SAND, PALE YELLOW ORANGE (10YR 8/6), TO DARK YELLOW ORANGE, (10YR 6/6), DENSE, WELL SORTED, 50-60% COARSE SAND, (GW)	
76	76-78		1.9'	9-12-21-26 (33)	GRAVEL WITH SAND, (50-60%), LOOSE, MODERATE YELLOW BROWN, (10YR 5/4), TO DARK YELLOW ORANGE, (10YR 6/6), DENSE, UP TO 1/4-INCH, POORLY SORTED, 50-60% SAND, (GW)	
78	78-80	4115	1.2'	11-14-19-21 (33)	SAND WITH GRAVEL, SAME AS ABOVE, 70% SAND, (SW); OVER I-IN. SAND, MEDIUM GRAY, (NS), DENSE, COARSE, (SW-SP)	
80						
82						DRILLER NOTES GRAVEL WITH LARGE COBBLES
84						
86	85-87		0.7'	15-15-24-22 (39)	SAND WITH GRAVEL, AS ABOVE, 40% GRAVEL, 50-55% COARSE, POORLY SORTED SAND, 5-10% FINE SAND/SILT, (SW)	
88	87-89	4117	0.8'	12-12-25-19 (37)	SAND WITH GRAVEL, AS ABOVE, WITH 30% GRAVEL, 60% SAND, AND 10% FINE SAND, (SW)	
90	89-91		0.3'	9-9-39-12	SAND WITH GRAVEL, AS ABOVE, (SW)	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 4 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 11 3/4-inch OD

WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90–91	89-91	4117	0.3'	9-9-39-12 (48)	SAND WITH GRAVEL, SAME AS ABOVE, (SW)	
92–94						DRILLER REPORTS LITH. CHANGE NO CHATTER AND MORE PRESSURE REQUIRED-CLAY
96	95-97	4118	1.8'	20-20-28-31 (48)	LEAN CLAY, DARK GRAY, (N3), DRY, HARD, LOW PLASTIC, HOMOGENEOUS, FINE LAMINAE STRUCTURE, (CL)	
98						
100	98.5-100.5	4119	1.6'	not Hammered	LEAN CLAY, AS ABOVE , (CL)	SAMPLE TAKEN USING KELLY, NOT HAMMER
102–104						
106	105.5-107.5	4120	2.0'	12-14-12-16 (26)	LEAN CLAY, AS ABOVE, SLIGHTLY MOIST, VERY STIFF, WITH 5% FINE SAND, SLIGHTLY PLASTIC, (CL)	
108	108-110	4121	2.0'	12-18-18-14 (34)	LEAN CLAY, AS ABOVE, HARD, (CL)	
110–112						WATER IN DRILL STRING SAMPLE MOIST
114	113-115	4122	2.0'	10-14-11-12 (25)	SANDY CLAY, OLIVE BLACK, (5Y 2/1), 10-15% FINE SAND, DRY TO SLIGHTLY MOIST, VERY STIFF, MEDIUM PLASTIC, MICACEOUS, 10-15% FINE SAND, (CL)	
116						
118–120	118-120	4123	2.0'	9-11-12-16 (23)	SANDY CLAY, AS ABOVE, WITH INTERBEDDED SAND, MEDIUM GRAY, (N5), DRY TO MOIST, FINE TO WELL SORTED, (1/16-1/2-IN. LENSES), (CL)	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 5 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120	120-122	4123	2.0'	6-10-10-13 (20)	SANDY CLAY, AS ABOVE, WITH MOIST TO WET 40-50% SAND, LENSES UP TO 1-INCH, (CL)	
122						
124	123-125	4124	1.9'	9-12-16-20 (28)	SANDY CLAY, AS ABOVE, 30-40% SAND, (CL)	
126						
128	128-130	4125	2.0'	11-12-14-16 (26)	SANDY CLAY, AS ABOVE, WITH LAYERS UP TO 1-INCH, (CL)	
130						
132						
134	133-135	4126	1.7'	7-11-14-17 (25)	SANDY CLAY, AS ABOVE, (CL)	
136						
138	138-140	4127	1.9'	6-12-16-23 (30)	SANDY CLAY, AS ABOVE, MOIST, WITH 4-INCH SAND LAYER NEAR 139 FT., (CL)	
140						
142						
144	143-145	4128	1.2'	23-32 Refusal	SAND, MEDIUM GRAY, (N2-N3), WET TO MOIST, VERY DENSE, MEDIUM GRAINED, WELL SORTED, CLEAN, (SP)	REFUSAL AT 144 FT. AUGERED THERE WITH NO PROBLEM
146						
148	148-150	4129	1.3'	9-14-21-33 (35)	SANDY CLAY, AS ABOVE, 138-140 FT., (CL) OVER SAND, AS ABOVE 143-145 FT., MEDIUM DENSE, (SP)	
150						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 6 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD

WATER LEVEL AND DATE ______ START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150	150-152	4129	0.1'	5-5-15-15 (20)	SAND, AS ABOVE, (SP)	
152						
154	153-155	4130	2.0'	9-11-18-25 (29)	SANDY CLAY AS ABOVE, (138-140), MOIST, VERY STIFF, (CL)	
156	155-157		1.2'	7-9-12-15 (21)	SAND, AS ABOVE, (143-145), (SP); OVER SANDY CLAY, AS ABOVE, (138-140), (CL)	
158						TD OF BORING 156 FT.
160						

SEF28178.TM

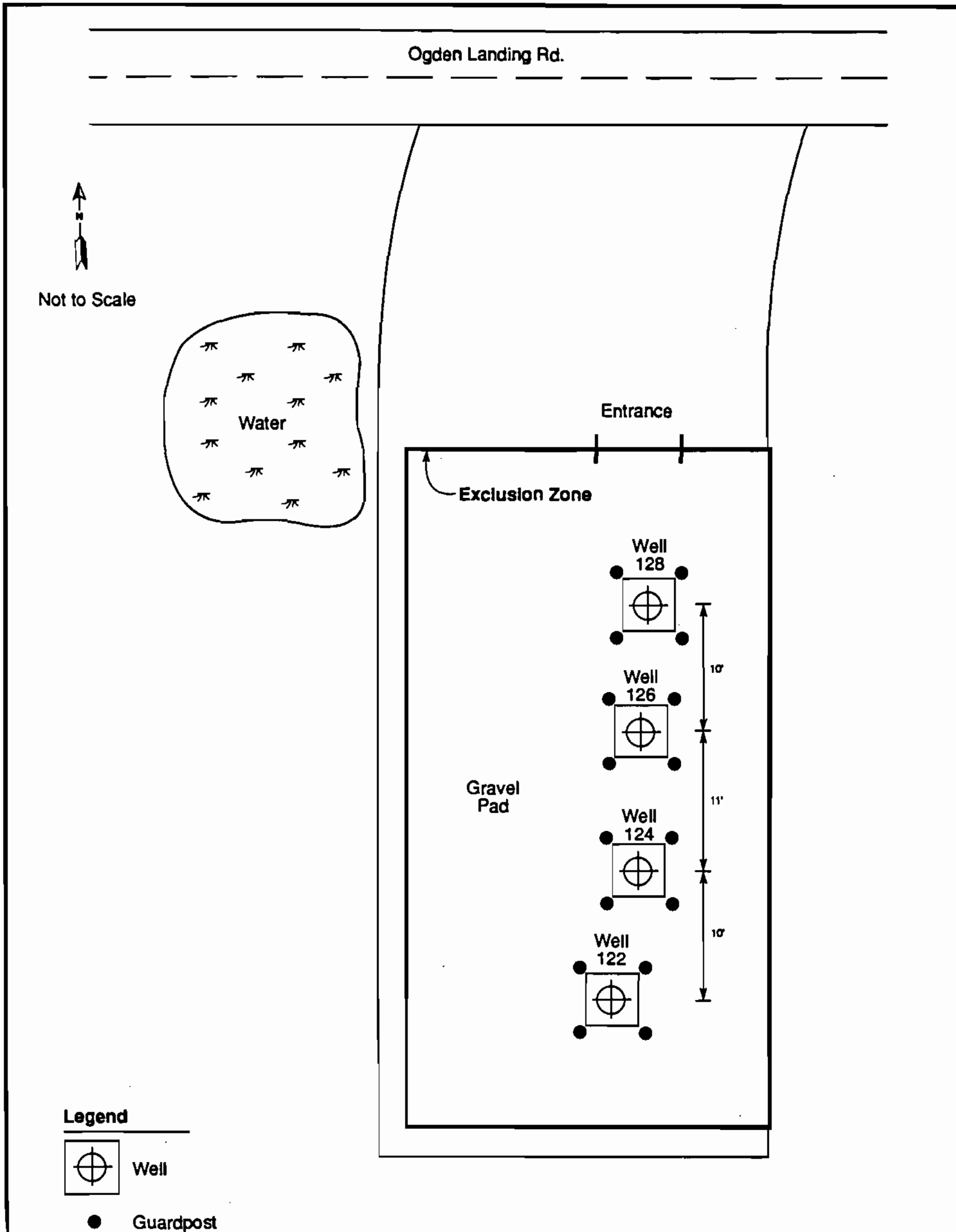


Figure 4-4
Well Cluster 3
Well Layout Sketch

CH2M HILL

Summary of McNairy Background Wells

MW 133

Location - Northeast of Plant; TVA property at Little Bayou Creek; Well Cluster 5
N (9124.7), E (-1715.7)

Date Installed - February 25, 1990

Screened Depth - Shallow McNairy
Top - 80 ft bgs
Bottom - 90 ft bgs

Dates Sampled (Data available) - Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 95; Q1 96; Q1 97; Q4 97

Construction Information Reference - Technical Memorandum No. 5 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)

Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
bis(2-ethylhexyl)phthalate	230 BJ	NA	5/3/90	CH200432-00000
Carbon disulfide	2 J	NA	8/15/90	CH200676-00000
Chloroform	1 J	NA	5/3/90	CH200432-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	1	NR	5/3/90	1549-90
^{99}Tc	9	6	5/3/90	CH200432-00000
^{99}Tc	-1.2	1.86	3/1/91	CH210014-00000
^{99}Tc	4	12	6/2/93	5282-93
^{99}Tc	22	22	9/13/93	6740-93
^{99}Tc	13	26	3/2/94	4761-94
^{99}Tc	9	20	6/7/94	5611-94
^{99}Tc	3	6	9/12/94	6648-94
^{99}Tc	8	25	3/27/95	5460-95
^{99}Tc	3	10	2/12/96	5305-96
^{99}Tc	-2	0	11/12/97	5789-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
NONE	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.
NR = Value not reported in data set.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	3	198.7	183 - 208	mg/L
Depth to Water	11	13.28	9.45 - 16.89	feet
Dissolved Oxygen	9	3.06	1.57 - 4.39	mg/L
Dissolved Solids	3	266	258 - 277	mg/L
Hardness as CaCO3, Dissolved	1	178	NA	g/L CaCO
pH	30	6.5	6.3 - 6.7	SU
Specific Conductance	30	452.0	408 - 472	umhos/cm
Temperature	9	59.4	55 - 67.3	F
Total Organic Carbon	12	< 1	< 1 - < 1	mg/L
Turbidity	7	5.9	1.5 - 22	NTU

Notes: NA = Entry not applicable or not available.

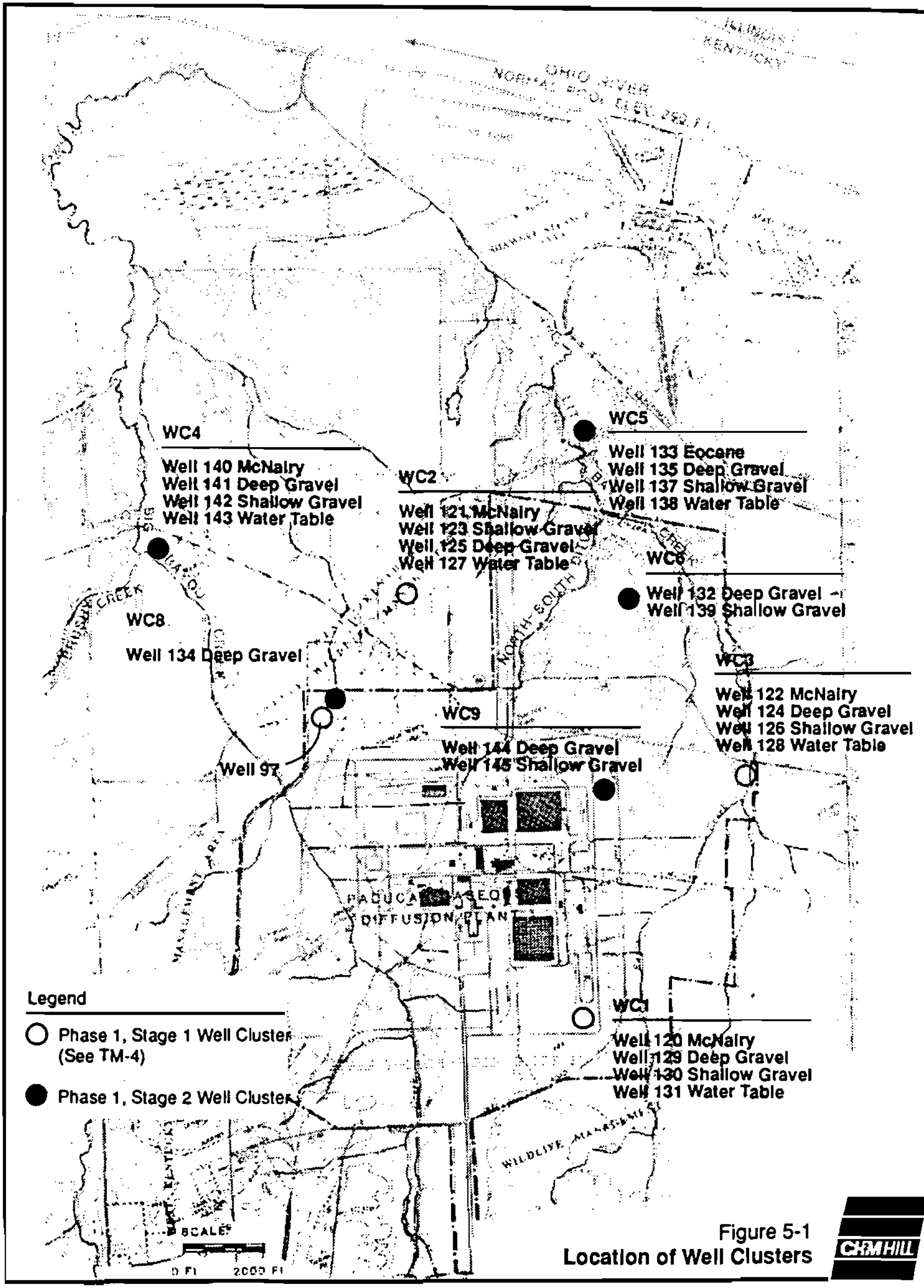
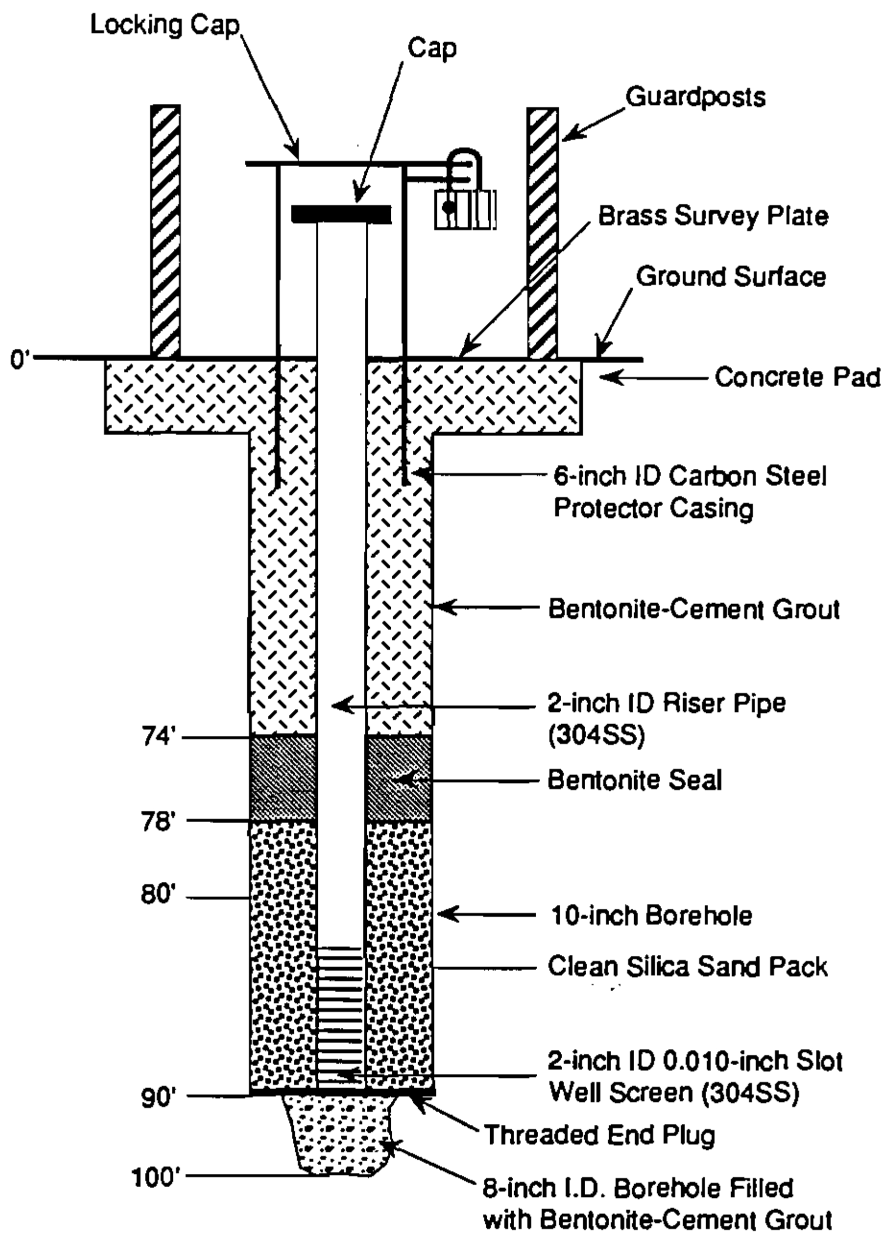


Figure 5-1
Location of Well Clusters

Well 133
Well without
Isolation Casing



Well 133 Construction Details

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 133 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC5-NE of Plant: TVA property at Little Bayou Cr.
ELEVATION ________ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 with 3-1/2" OD Hollow Stem Augers
WATER LEVEL AND DATE ________ START 2/25/90 FINISH 2/28/90 LOGGER T. Rachal

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS. TESTS AND INSTRUMENTATION
0	0-2		1.3'	3-3-3-4 (6)	TOP 0.1': POORLY GRADED SAND, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, MEDIUM-FINE GRAINED, (SP); BOTTOM 1.2': SILT DARK YELLOWISH BROWN, MOIST, FIRM, TRACE WOOD CHUNKS, (ML)	2/25/90 0847 DRILLING BEGINS HNU-0 PPM RAD-56 CPM
2	2-4	4501	1.3'	2-2-2-2 (4)	ELASTIC SILT, MODERATE YELLOWISH BROWN (10 YR 5/4), MOIST, SOFT, APPARENT COHESION, (MH)	0850 HNU-0 PPM RAD-40 CPM
4	4-6		1.55'	6-9-10-8 (19)	SILTY SAND, MODERATE YELLOWISH BROWN (10 YR 5/4), MOIST, MEDIUM DENSE, FINE-GRAINED, POORLY GRADED, (SM)	0850 HNU-0 PPM RAD-52 CPM
6	6-8		1.8'	8-8-10-12 (18)	TOP 0.2': ELASTIC SILT, MODERATE YELLOWISH BROWN (10 YR 5/4), MOIST, SOFT, (MH); BOTTOM 1.6': SILTY SAND, SAME AS ABOVE, MOIST -WET, MEDIUM DENSE, TRACE BLACK (N1) NODULES, (SM)	0854 HNU-0 PPM RAD-46 CPM
8	8-10	4502	2.0'	6-8-10-9 (18)	TOP 1.2': POORLY GRADED SAND, LIGHT BROWN (5 YR 5/4), MOIST, MEDIUM DENSE, FINE GRAINED, TRACE BLACK (N1) STREAKS, TRACE SILT (SP); BOTTOM 0.8': SILT, LIGHT GRAY (N7), MOIST, VERY STIFF, TRACE FINE SAND, (ML)	0858 HNU-0 PPM RAD-50 CPM
10	10-12		1.7'	4-6-9-12 (15)	TOP 0.3': SILT WITH SAND, LIGHT GRAY (N7), MOIST, FIRM, ≈15% SAND, POORLY GRADED, TRACE MEDIUM-GRAINED SAND, (ML); BOTTOM 1.4': SILT, LIGHT GRAY (N7), MOIST, STIFF, TRACE LIGHT BROWN (5 YR 5/6) STREAKS, (ML)	0917 HNU-0 PPM RAD-40 CPM
12	12-14		2.0'	14-15-16-18 (31)	TOP 0.8': SILTY SAND, GRAYISH ORANGE (10 YR 5/4), WET, DENSE, FINE-GRAINED, POORLY GRADED (SM); BOTTOM 1.2': SILT, SAME AS ABOVE, 1/4"-1/2" LIGHT BROWN (5 YR 5/6) STREAKS, (ML)	0920 HNU-0 PPM RAD-36 CPM
14	14-16	4503	1.4'	11-11-8-9 (19)	SILT, SAME AS ABOVE, 1/4" LIGHT BROWN (5 YR 6/4) STREAKS, VERY STIFF, (ML)	0934 HNU-0 PPM RAD-36 CPM 0938 DRILLERS STOP TO WRAP UP SPOONS TO GIVE TO BEATTY FOR ?
16	16-18		2.0'	8-6-7-6 (13)	SAME AS ABOVE, 1/4"-2" STREAKS, LIGHT BROWN (5 YR 5/6), STIFF, TRACE FINE-GRAINED SAND, (ML)	0953 DRILLERS CONTINUE 0956 HNU-0 PPM RAD-36 CPM
18	18-20		1.9'	13-15-12-12 (27)	SAME AS ABOVE, VERY STIFF, (ML)	1008 HNU-0 PPM RAD-42 CPM 1013 DRILLERS STOP TO FIX CABLE
20	20-22	4504	2.0'	5-8-10-12 (18)	TOP 0.9': ELASTIC SILT, LIGHT GRAY (N7) WITH 1/4" STREAKS LIGHT BROWN (5 YR 5/6) MOIST-WET, STIFF, (MH); BOTTOM 1.1': SILT WITH SAND, LIGHT GRAY (N7), MOIST, VERY STIFF, ≈20% FINE SAND, (ML)	1030 TATUM, WILSON TAKE BREAK; HNU-0 PPM 1035 CABLE FIXED RAD-28 PPM 1058 DRILLING BEGINS 1102 DRILLER REPORTS 5' WATER ON RODS 1104 DRILLERS STOP FOR LUNCH 1315 DRILLING BEGINS
22	22-24		1.7	6-7-7-6 (14)	TOP 0.5': SILT WITH SAND, SAME AS ABOVE, MODERATE YELLOWISH BROWN (10 YR 5/4) WITH MOTTLED MEDIUM GRAY (N5), (ML); BOTTOM 1.2': SILT WITH CLAY, FAT, MODERATE YELLOWISH BROWN (10 YR 5/4) WITH MEDIUM GRAY (N5), MOIST, STIFF, (MH)	1321 HNU-0 PPM RAD-32 CPM
24	24-26		0.8'	6-6-6-8 (12)	SILT, DARK YELLOWISH ORANGE (10 YR 6/6), VERY WET, STIFF TRACE FINE SAND, (ML)	1328 HNU-0 PPM RAD-32 CPM "GUMBO" (SOUPY) SOIL IN SS
26	26-28	4505	1.9'	7-6-6-10 (12)	ELASTIC SILT, DARK YELLOWISH ORANGE (10 YR 6/6) WITH MOTTLED MEDIUM LIGHT GRAY (N6) AND LIGHT OLIVE GRAY (5 Y 6/1), MOIST, STIFF, (MH)	1340 HNU-0 PPM RAD-34 CPM DRILLER REPORTS OF "GUMBO" SOUPY SOIL IN HOLE
28	28-30		1.75'	7-14-15-13 (29)	TOP .75': ELASTIC SILT, SAME AS ABOVE, (MH); BOTTOM 1.0': SILT WITH SAND, LIGHT GRAY (N7) WITH LIGHT BROWN (5 YR 5/6) STREAKS, MOIST-WET, VERY STIFF, ≈15% FINE SAND; BOTTOM 0.1': LIGHT BROWN (5 YR 5/6) WITH MOTTLED DARK YELLOWISH ORANGE (10 YR 6/6), (ML)	1358 HNU-0 PPM RAD-44 CPM
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 133 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC5-NE of Plant; TVA property at Little Bayou Cr.
ELEVATION ____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 with 3-1/2" OD Hollow Stem Augers
WATER LEVEL AND DATE ____ START 2/25/90 FINISH 2/28/90 LOGGER T. Rachal

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32		1.8'	10-10-10-4 (20)	TOP 1.0': ELASTIC SILT, SAME AS ABOVE, TRACE FINE SAND (MH); MIDDLE 0.4': POORLY-GRADED SAND, LIGHT GRAY (N7), MOIST, FINE-GRAINED, ~70% SILT (SP); BOTTOM 0.4' WELL GRADED GRAVEL WITH SILT AND SAND, LIGHT GRAY (N7), WET, ~70% FINE-MEDIUM GRAINED GRAVEL, ANGULAR, ~15% SILT, ~15% FINE-GRAINED SAND, (GW-GM)	1420 HNU-0 PPM RAD-34 CPM BACKGROUND RAD. 42
32	32-34	4506	1.95'	7-15-18-25 (33)	TOP 0.8': SILT, MODERATE YELLOWISH BROWN (10 YR 5/4), MOIST, STIFF, TRACE MEDIUM LIGHT GRAY (N6), STREAKS, (ML); MIDDLE 0.8': POORLY-GRADED SAND, SAME AS ABOVE (SP); BOTTOM 0.45' SILT WITH GRAVEL, MODERATE YELLOWISH BROWN (10 YR 5/4) WITH MEDIUM LIGHT GRAY STREAKS (N6), ~80% SILT, ~20% FINE-MEDIUM GRAVEL, TRACE COARSE SAND, (ML)	1430 HNU-0 PPM RAD-35 CPM
34	34-36		2.0'	7-47-57-50 (104)	TOP 1.05': SILT WITH SAND, DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY SOFT, ~15% FINE SAND, <10% MEDIUM-GRAINED GRAVEL SUBANGULAR, (ML); BOTTOM 0.95': WELL-GRADED GRAVEL WITH SILT, MODERATE YELLOW BROWN (10 YR 5/4) WITH MEDIUM LIGHT GRAY (N6), MOIST, ~75% GRAVEL, FINE-MEDIUM GRAINED ANGULAR-SUBROUNDED, ~25% SILT, GRAVEL FRAGMENTS, (GW-GM)	1440 HNU-0 PPM RAD-22 CPM
36	36-38		2.0'	10-15-18-23 (33)	TOP 1.5': SILTY SAND, VERY PALE ORANGE (10 YR 8/2), MOIST, DENSE, FINE-GRAINED, POORLY GRADED, (SM); BOTTOM 0.5': WELL-GRADED GRAVEL WITH SILT, LIGHT BROWN, (5 YR 5/6), MOIST, LOOSE, ~85% GRAVEL, FINE-MEDIUM GRAINED, ANGULAR-SUBANGULAR, ~15% SILT (GW-GM)	1457 HNU-0 PPM RAD-42 CPM
38	38-40	4507	2.0'	8-14-23-20 (37)	TOP 1.3': SILTY SAND, SAME AS ABOVE (SM); BOTTOM 0.7': WELL-GRADED GRAVEL, SAME AS ABOVE, TRACE FINE-GRAINED SAND, (GW-GM)	1530 DRILLING BEGINS 1538 HNU-0 PPM RAD-44 CPM
40	40-42		1.35'	20-27-29-25 (56)	WELL-GRADED GRAVEL WITH SILT AND SAND, LIGHT BROWN (5 YR 5/6), MOIST, VERY DENSE, 70% GRAVEL, FINE-COARSE GRADED, VERY ANGULAR-SUBROUNDED, ~15% SILT, ~15% MEDIUM SAND, (GW-GM)	1608 HNU-0 PPM RAD-34 CPM HP SHUT DOWN, RIG LEAKING GASOLINE
42	42-44		2.0'	10-15-18-22 (33)	TOP 1.0': POORLY-GRADED SAND WITH SILT, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, MEDIUM-DENSE, FINE-GRAINED, ~15% SILT (SP-SM); MIDDLE 0.7': WELL-GRADED SAND WITH SILT, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, DENSE, MEDIUM-COARSE, ~15% SILT <10% MEDIUM-GRAINED SUBANGULAR GRAVEL (SW-SM), BOTTOM 0.3': WELL-GRADED GRAVEL WITH SILT AND SAND, SAME AS ABOVE, DARK YELLOWISH BROWN (10 YR 4/2), (GW-GM)	2/26/90 0834 DRILLING BEGINS 0852 HNU-0 PPM RAD-44 CPM
44	44-46	4508	2.0'	20-31-25-33 (56)	TOP 1.0': ELASTIC SILT, MODERATE BROWN, (5 YR 4/4) WITH MOTTLED MEDIUM LIGHT GRAY (N6), MOIST, HARD, (MH); BOTTOM 1.0': WELL-GRADED GRAVEL WITH SILT AND SAND, SAME AS ABOVE, DARK YELLOWISH ORANGE (10 YR 6/6), (GW-GM)	0910 HNU-0 PPM RAD-46 CPM
46	46-48		2.0'	10-18-29-38 (47)	TOP 1.3': WELL-GRADED SAND WITH SILT, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, DENSE, ~15% SILT (SW-SM) FINE-MEDIUM-GRAINED; BOTTOM 0.7': WELL-GRADED GRAVEL WITH SILT AND SAND, SAME AS ABOVE LIGHT BROWN (5 YR 5/6), (GW-GM)	0921 HNU-0 PPM RAD-54 CPM
48	48-50		2.0'	8-7-11-15 (18)	TOP 0.6': WELL-GRADED GRAVEL WITH SILT, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, SUBROUNDED-SUB ANGULAR, FINE-COARSE GRAINED, (GW-GM); BOTTOM 1.4': FAT CLAY AND SILT, LIGHT GRAY (N7), MEDIUM GRAY (N5) AND LIGHT BROWN (5 YR 5/6) AND WHITE (N9), MOIST, VERY STIFF, ~30% SILT LENSES, (CH-ML)	0951 MECHANIC FIXED GAS TANK 1005 DRILLING BEGINS 1014 HNU-BACKGROUND, 0 PPM RAD-BACKGROUND, 38 CPM
50	50-52	4509	2.0'	13-33-27-25 (60)	SILTY SAND WITH GRAVEL, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, VERY DENSE, ~75% SAND, POORLY GRADED, FINE-GRAINED, ~15% FINE-MEDIUM GRAVEL, SUBANGULAR-SUBROUNDED, <10% FAT CLAY, MEDIUM LIGHT-MEDIUM GRAY (N6-N7), (SM)	1029 HNU-0 PPM RAD-56 CPM
52	52-54		2.0'	20-21-19-27 (40)	TOP 0.5': FAT CLAY AND SILT, MEDIUM LIGHT GRAY (N6) AND WHITE (N9), MOIST, HARD, ~70% CLAY, ~30% SILT, (CH-ML); BOTTOM 1.5' SILTY SAND, DARK YELLOWISH ORANGE (10 YR 6/6), DAMP, DENSE, FINE-GRAINED, POORLY GRADED, TRACE MEDIUM GRAVEL, LIGHT BROWN, (5 YR 5/6), (SM)	1041 HNU-0 PPM RAD-46 CPM
54	54-56		2.0'	0-13-15-15 (28)	TOP 0.8': SILTY SAND, SAME AS ABOVE, NO GRAVEL, (SM); BOTTOM 1.2': INTERBEDDED SILT AND ELASTIC SILT, MEDIUM LIGHT GRAY (N6) WITH MOTTLED, VERY LIGHT GRAY (N8) AND WHITE (N9), MOIST, VERY STIFF, (ML-MH)	1100 HP SHUT DOWN HOLE DUE TO 15% LEL RDG, CREW WAITING UNTIL HOLE VENTED (34.5'), POSSIBLY METHANE HNU-0 PPM 1121 RDG. 10% (HAS TO BE ↑ 10%)
56	56-58	4511	2.0'	13-20-30-30 (50)	TOP 1.5': SILTY SAND, SAME AS ABOVE, (SM); BOTTOM 0.5': SILT AND ELASTIC SILT, SAME AS ABOVE, (ML-MH)	1335 DRILLING BEGINS 1343 HNU-0 PPM RAD-38 CPM
58	58-60		1.7'	25-26-18-18 (44)	SILTY SAND, SAME AS ABOVE, TRACE MEDIUM LIGHT GRAY, LENTICULAR SILT, (SM)	1405 HNU-0 PPM RAD-46 CPM 1413 DRILLERS STOP TO DRAIN GAS TANK 1456 DRILLING BEGINS
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 133 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC5-NE of Plant; TVA property at Little Bayou Cr.
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 with 3-1/2" OD Hollow Stem Augers
WATER LEVEL AND DATE ______ START 2/25/90 FINISH 2/28/90 LOGGER T. Rachal

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		2.0'	6-6-7-12 (13)	ELASTIC SILT, MEDIUM LIGHT GRAY (N6) WITH LIGHT BROWN (5 YR 5/6) LAMINAE AND MOTTLING, MOIST, STIFF, TRACE MEDIUM GRAY (N5) CLAY, TRACE COARSE-GRAINED SAND, (MH)	1605 HNU=0 PPM RAD=46 CPM
62	62-64	4512	1.8'	7-7-9-11 (16)	TOP 0.6': SILTY SAND, DARK YELLOWISH ORANGE (10 YR 6/6), MOIST, MEDIUM DENSE, FINE-GRAINED, (SM); BOTTOM 1.2': ELASTIC SILT, SAME AS ABOVE, LIGHT GRAY (N7) WITH LIGHT BROWN (5 YR 6/6) MOTTLING AND LAMINAE, STIFF, (MG)	1616 HNU=0 PPM RAD=52 CPM
64	64-66		2.0'	6-6-6-10 (16)	ELASTIC SILT, SAME AS ABOVE, (MH)	1626 HNU=0 PPM RAD=34 CPM 1636 DRILLING ENDS FOR DAY
66	66-68		2.0'	5-6-6-11 (16)	ELASTIC SILT, SAME AS ABOVE, LIGHT OLIVE GRAY (5 Y 6/1) WITH MOTTLED LIGHT BROWN (5 YR 6/6), (MH)	2/27/90, 0840 DRILLING BEGINS 0853 HNU=0 PPM RAD=40 CPM
68	68-70	4514	1.9'	7-8-8-9 (16)	ELASTIC SILT, SAME AS ABOVE, PALE YELLOWISH BROWN (10 YR 6/2) WITH LIGHT BROWN POCKETS (5 YR 5/6), (MH)	0910 HNU=0 PPM RAD=32 CPM
70	70-72		2.0'	5-6-6-8 (12)	ELASTIC SILT, SAME AS ABOVE, (MH)	0959 HNU=0 PPM RAD=56 CPM
72	72-74		2.0'	7-8-8-11 (16)	ELASTIC SILT, DUSKY YELLOWISH BROWN WITH LIGHT BROWN AND PINKISH (10 YR 2/2) (5 YR 5/6) GRAY (5 YR 8/1) SILT POCKETS, MOIST, STIFF, (MH)	1014 DRILLERS TAKE BREAK (RAIN CONTINUING) 1050 DRILLING BEGINS 1100 HNU=0 PPM RAD=46 CPM
74	74-76	4515	2.0'	7-9-10-14 (19)	ELASTIC SILT, SAME AS ABOVE, MEDIUM DARK GRAY (N4) WITH PINKISH GRAY (5 YR 8/1), SILT POCKETS, TRACE LIGHT BROWN (5 YR 5/6) SILT POCKETS, (MH)	1111 HNU=0 PPM RAD=54 CPM
76	76-78		2.0'	6-6-7-9 (13)	ELASTIC SILT, SAME AS ABOVE, WHITE (N9) AND PINKISH GRAY (5 YR 8/1) LAMINAE, (MH)	1133 HNU=0 PPM RAD=32 CPM 1143 DRILLERS STOP FOR LUNCH
78	78-80		2.0'	12-21-37-52 (58)	ELASTIC SILT, MEDIUM DARK GRAY (N4) GRADING INTO YELLOWISH GRAY (5 Y 8/1) WITH MOTTLED GRAYISH ORANGE (10 YR 7/4), DAMP-MOIST, HARD, (MH)	1348 DRILLING BEGINS 1357 HNU=0 PPM RAD=46 CPM
80	80-82	4516	2.0'	11-16-22-32 (38)	TOP1.1': POORLY GRADED SAND WITH SILT, PALE YELLOWISH ORANGE (10 YR 8/6), MOIST, DENSE, FINE-GRAINED, <=15% SILT (SP-SM); BOTTOM 0.9': ELASTIC SILT AND SILT, MEDIUM DARK GRAY (N4) AND YELLOWISH GRAY (5 Y 8/1) WITH LIGHT BROWN (5 YR 5/6) POCKETS, DAMP-MOIST, HARD, TRACE FINE GRAVEL, SUBROUNDED, (MH-ML)	1419 HNU=0 PPM RAD=46 CPM
82	82-84		1.5'	20-31-27-32 (58)	TOP 0.8': POORLY GRADED SAND WITH SILT, SAME AS ABOVE, (SP-SM); BOTTOM 0.7': ELASTIC SILT AND SILT, SAME AS ABOVE, MODERATE RED (5 YR 4/6) LAMINAE IN BOTTOM 0.2', (MH-ML)	1437 HNU=0 PPM RAD=56 CPM
84	84-86	4517	2.0'	19-28-42-45 (70)	POORLY GRADED SAND WITH SILT, PALE YELLOWISH ORANGE (10 YR 8/6) , MOIST, VERY DENSE, =15% SILT, (SP-SM)	1524 HNU=0 PPM RAD=42 CPM
86	86-88		2.0'	14-16-18-39 (34)	SAME AS ABOVE, DENSE, (SP-SM)	1602 HNU=0 PPM RAD=42 CPM DRILLING ENDS FOR DAY
88	88-90	4519	2.0'	50-50-75-95 (125)	SILTY SAND, PALE YELLOWISH ORANGE (10 YR 8/6) WITH VERY LIGHT GRAY (N8) SILT LENSES, =0.5' THICK, DAMP, HARD, =30% SILT, (SM)	2/28/90, 0757 DRILLING BEGINS 0827 DRILLERS BEGIN USING 300# HAMMER 0846 HNU=0 PPM RAD=24 CPM
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 133 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC5-NE of Plant; TVA property at Little Bayou Cr.
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 with 3-1/2" OD Hollow Stem Augers
WATER LEVEL AND DATE START 2/25/90 FINISH 2/28/90 LOGGER T. Rachal

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	90-92	4519	2.0'	14-31-65-75 (96)	SANDY SILT, DARK YELLOWISH ORANGE (10 YR 6/6) WITH VERY LIGHT GRAY (N8), POCKETS AND MEDIUM LIGHT GRAY, (N6) AND DARK GREENISH GRAY (5 GY 4/1) STREAKS 1/8"-1/4" THICK, MOIST, HARD, ~10% FINE SAND, (ML)	0913 HNU-0 PPM RAD-22 CPM DRILLERS HAVING PROBLEMS PULLING RODS
92	92-94		1.8'	21-22-22-13 (44)	TOP 1.05': SILT, DARK YELLOWISH ORANGE (10 YR 6/6), WITH LIGHT BROWN (5 YR 5/6) POCKETS, DAMP, HARD, (ML); BOTTOM 0.75': SILT, DARK GRAY (N3) WITH VERY LIGHT GRAY (N8) POCKETS, DAMP, HARD, (ML)	0939 HNU-0 PPM RAD-52 CPM 0945 DRILLERS STOP FOR BREAK
94	94-96	4520	2.0'	7-7-9-11 (16)	TOP 1.9': SILT, DARK YELLOWISH ORANGE, (10 YR 6/6) WITH VERY LIGHT GRAY (N8) POCKETS, MOIST, VERY STIFF, TRACE FINE SAND (ML); BOTTOM 0.1': SILT, DARK GRAY (N3) WITH VERY LIGHT GRAY (N8) POCKETS, WET, VERY STIFF, (ML)	1024 DRILLING BEGINS 1047 HNU-0 PPM RAD-32 CPM
96	96-98		1.8'	9-9-9-10 (18)	SAME AS ABOVE, (ML)	1112 HNU-0 PPM RAD-42 CPM
98	98-100		2.0'	4-7-9-12 (16)	TOP 1.2': SILT AND ELASTIC SILT, PALE YELLOWISH ORANGE (10 YR 8/6) WITH DARK YELLOWISH ORANGE (10 YR 6/6) STREAKS AND MEDIUM DARK GRAY (N4), DARK GRAY (N3), MOIST, STIFF, (ML-MH); BOTTOM 0.8': ELASTIC SILT, MEDIUM DARK GRAY (N4), DARK GRAY (N3) WITH MOTTLED LIGHT GRAY (N7), DAMP, VERY STIFF, (MH)	1138 HNU-0 PPM RAD-32 CPM 1142 DRILLERS STOP FOR LUNCH TD OF BORING 100'
100						

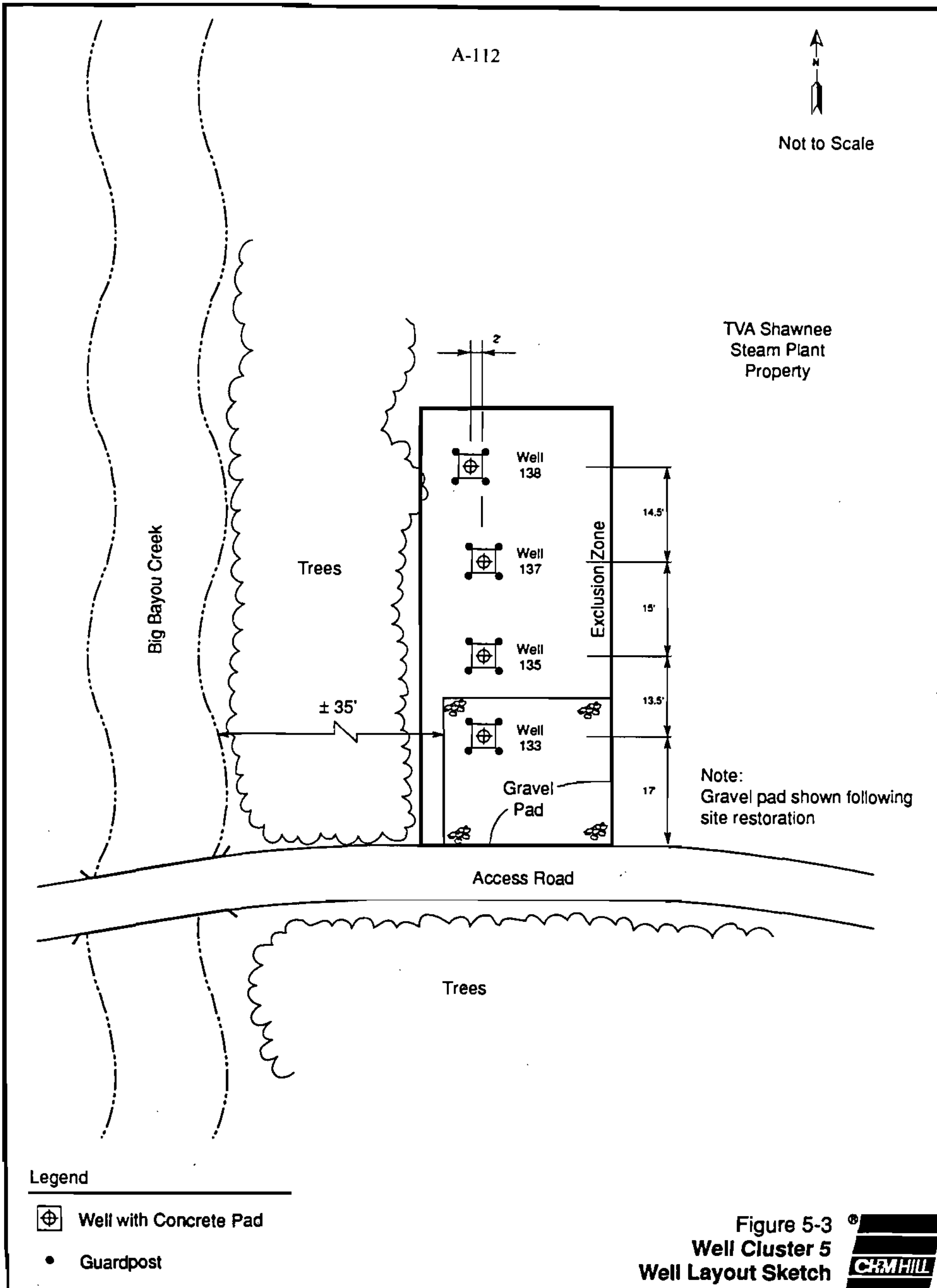


Figure 5-3
Well Cluster 5
Well Layout Sketch

Summary of McNairy Background Wells

MW 140

Location - Northwest of Plant; Private property near Ogden Landing Road and Big Bayou Creek; Well Cluster 4
N (6558.5), E (-12179.2)

Date Installed - March 20, 1990

Screened Depth - Middle McNairy
Top - 138 ft bgs
Bottom - 148 ft bgs

Dates Sampled (Data available) - Q2 90; Q3 90; Q1 91; Q2 93; Q3 93; Q4 93; Q1 94; Q2 94; Q3 94; Q4 94; Q1 96; Q1 97; Q4 97

Construction Information Reference - Technical Memorandum No. 5 in *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (KY/ER-4; March 1991)

Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
Benzene	1 J	NA	5/2/90	CH200428-00000
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	4	NR	5/2/90	1551-90
^{99}Tc	-0.67	1.74	3/14/91	CH210009-00000
^{99}Tc	0.043	1.59	3/14/91	CH210010-DUP
^{99}Tc	10	31	5/26/93	6004-93
^{99}Tc	4	11	7/13/93	6088-93
^{99}Tc	4	9	10/21/93	7081-93
^{99}Tc	5	16	1/11/94	4225-94
^{99}Tc	6	38	10/10/94	6864-94
^{99}Tc	0	11	2/6/97	5146-97
^{99}Tc	13	11	11/6/97	5796-97
Radionuclides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
^{99}Tc	-0.77	1.37	3/14/91	CH210009-DIS
^{99}Tc	-0.97	1.59	3/14/91	CH210010-DUPDI

Notes: NA = Entry not applicable or not available.
NR = Value not reported in data set.

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	9	123.1	91 - 164	mg/L
Depth to Water	10	20.29	15.63 - 22.67	feet
Dissolved Oxygen	10	0.711	0.14 - 2.2	mg/L
Dissolved Solids	9	157.2	18 - 232	mg/L
Hardness as CaCO3, Dissolved	1	172	NA	g/L CaCO
pH	34	6.3	6.1 - 6.6	SU
Specific Conductance	34	310.8	242 - 390	umhos/cm
Temperature	10	58.7	57 - 62	F
Total Organic Carbon	29	< 1	< 1 - 1	mg/L
Total Suspended Solids	2	17	13 - 21	mg/L
Turbidity	8	45.1	8.4 - 82	NTU

Notes: NA = Entry not applicable or not available.

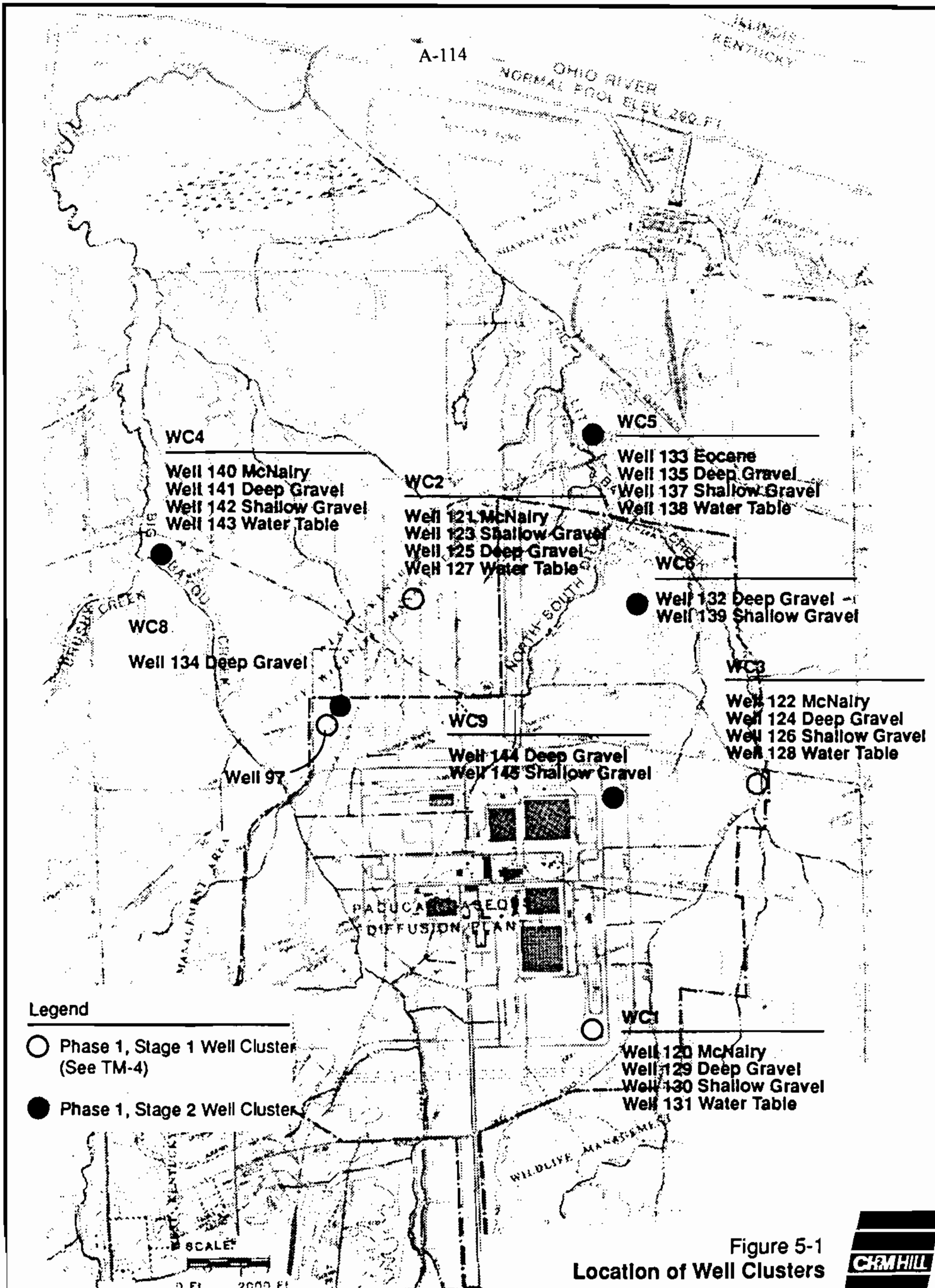
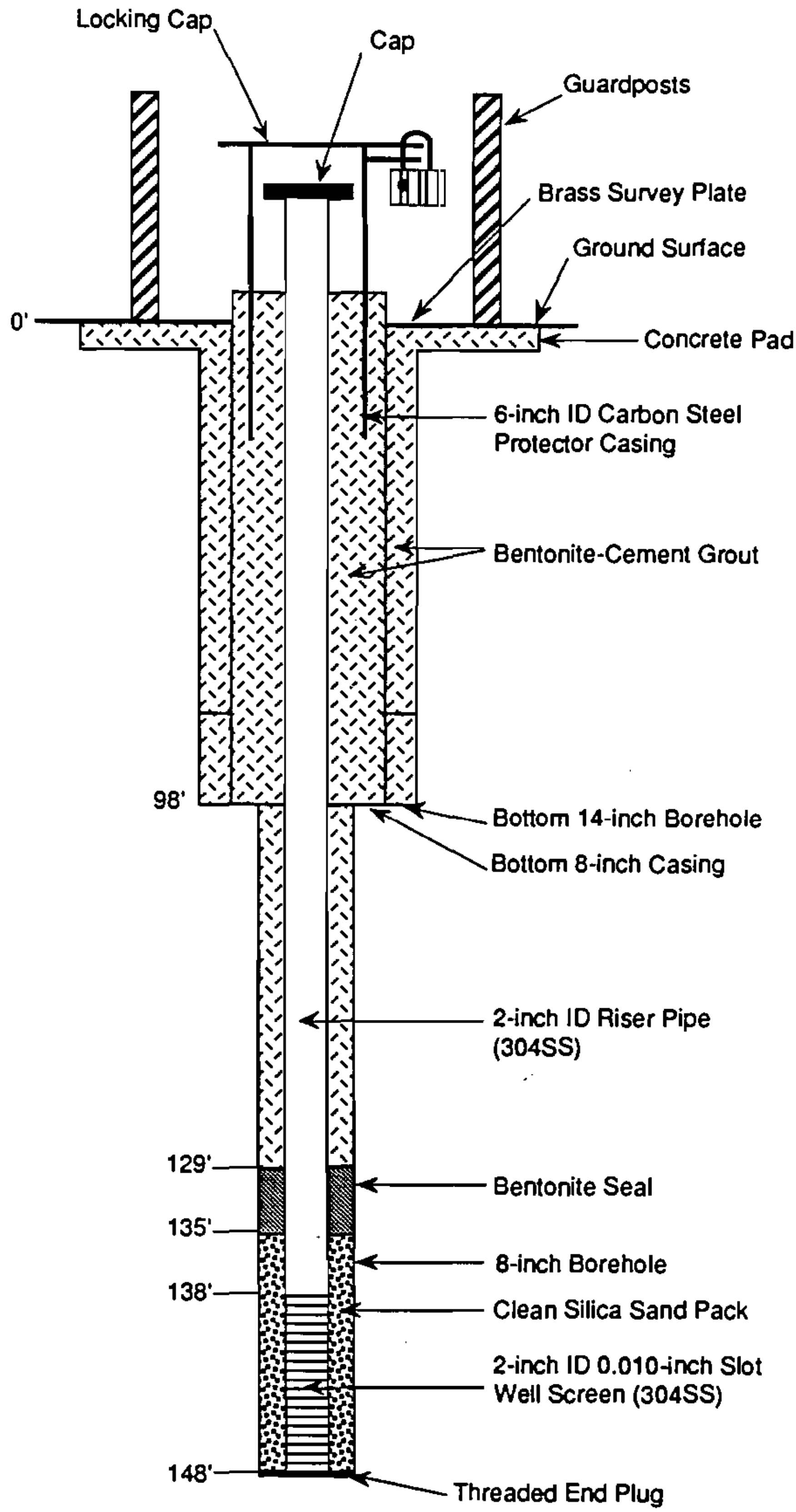


Figure 5-1
Location of Well Clusters

Well 140
Well with one
Isolation Casing



Well 140 Construction Details

CH2M HILL

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 1 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2	4157	2.0'	3-3-4-5 (7)	SILT, YELLOWISH GRAY (10 YR 4/2), BROWN, MOIST, FIRM, MOTTLED (BLACK ORGANIC SPOTS), LOW PLASTICITY, (ML)	BACKGROUND= HNU=0 PPM RAD=52 CPM HNU=0 PPM RAD=44 CPM
2	2-4		2.0'	3-3-3-3 (6)	SILT, SAME AS ABOVE, DAMP, (ML)	START DRILLING 1100 HNU=0 PPM RAD=34 CPM
4	4-6		1.75'	2-2-2-2 (4)	SILT, SAME AS ABOVE, (ML), CHANGING TO SILTY SAND, YELLOWISH BROWN (10 YR 4/2), DAMP, VERY LOOSE, FINE-MEDIUM, WELL GRADED, (SM)	HNU=0 PPM RAD=46 CPM
6	6-8	4158	1.75'	2-2-2-2 (4)	POORLY GRADED SAND WITH SILT, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY LOOSE, MEDIUM SUBROUNDED GRAINS, MOSTLY QUARTZ, (SP-SM)	HNU=0 PPM RAD=36 CPM
8	8-10		0'		NO SAMPLE, EXTREMELY LOOSE	HNU=0 PPM RAD=38 CPM
10	10-12			3-10-20-16 (30)	WELL GRADED GRAVEL WITH SILT AND SAND, MODERATE REDDISH BROWN (10 R 4/6), WET, MEDIUM DENSE, SUBANGULAR GRAINS, (GW-GM)	HNU=0 PPM RAD=40 CPM
12	12-14	4159	2.0'	12-18-18-13 (34)	WELL GRADED GRAVEL WITH SAND, MODERATE REDDISH BROWN (10 F 4/6), STREAKS OF GRAY (N7), WET, DENSE, SUBANGULAR TO SUBROUNDED GRAINS, (GW)	HNU=0 PPM RAD=38 CPM
14	14-16		1.8'	2-3-4-9 (7)	WELL GRADED GRAVEL WITH SAND AS ABOVE, CHANGING TO FAT CLAY, GREENISH GRAY (5 GY 6/1), MOIST, STIFF, PLASTIC, (CH)	HNU=0 PPM RAD=60 CPM
16	16-18		1.8'	7-10-14-22 (24)	FAT CLAY, GREENISH GRAY (5 GY 6/1), WITH MODERATE REDDISH BROWN STREAKS, DAMP, VERY STIFF, CHANGING TO GRAVEL, (CH)	HNU=0 PPM RAD=42 CPM
18	18-20	4160	2.0'	8-12-15-14 (27)	FAT CLAY, GREENISH GRAY (5 GY 6/1), CHANGING TO SILTY CLAY (DARK YELLOWISH BROWN (10 YR 4/2), DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=44 CPM
20	20-22		1.8'	5-7-10-12 (17)	SILTY CLAY WITH SAND, MODERATE REDDISH BROWN (10 YR 4/6) WITH GRAY (N7) STREAKS, DAMP, VERY STIFF, GRAINS OF DARK MINERALS, QUARTZ, SOME PEBBLES, (CL-ML)	HNU=0 PPM RAD=60 CPM
22	22-24		2.0'	5-12-13-17 (25)	FAT CLAY , DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY STIFF, PLASTIC WITH STREAKS OF SILTY CLAY WITH SAND, LIGHT GRAY (N8), (CH)	HNU=0 PPM RAD=42 CPM
24	24-26	4161	1.75'	9-10-25-29 (35)	SILTY CLAY , MODERATE REDDISH BROWN, MOIST, STIFF, (CL-ML); CHANGING TO SILTY SAND , LIGHT GRAY (N8) MOTTLED ORGANIC STAINING (BLACK), DAMP, DENSE, IRON OXIDE, FINE, POORLY GRADED, (SW-SM)	HNU=0 PPM RAD=52 CPM
26	26-28		1.75'	5-12-11-16 (23)	SILTY SAND , SAME AS ABOVE, (SW-SM), CHANGING TO SANDY SILTY CLAY, MOTTLED AS ABOVE, DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=34 CPM
28	28-30			9-22-22-25 (44)	SILTY SAND WITH CLAY, MODERATE REDDISH BROWN (10 YR 4/6) MOTTLED, MOIST, DENSE, FINE-MEDIUM, (SP-SM), CHANGING TO SAND, LIGHT GRAY (N8) MOTTLED, MOIST, IRON OXIDE, ORGANIC, (SW)	HNU=0 PPM RAD=32 CPM STOP DRILLING 1620 3/20/90
30						

A

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 2 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION)
30	30-32		1.0'	15-18-12-17 (28)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY (N7), AND MODERATE RED BROWN (10 YR 4/6) MOIST, MEDIUM DENSE, (GW), CHANGING TO SANDY SILT, LIGHT GRAY, DAMP, VERY STIFF, (ML)	RESUME DRILLING 3/21/90, 0800 HNU=0 PPM RAD=28 CPM
32	32-34	4164	2.0'	25-72-107-180 (179)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY AND MODERATE RED BROWN, MOIST, VERY DENSE, COARSE, (GW)	HNU=0 PPM RAD=34 CPM
34	34-36		1.8'	22-18-63-80 (81)	SAME AS ABOVE, (GW)	HNU=0 PPM RAD=22 CPM
36	36-38		1.2'	38-61-51-52 (112)	POORLY GRADED SAND WITH CLAY, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-VERY COARSE; TOP 4": WITH VERY FINE-COARSE GRAVEL, 4-14": WITH SOME CLAY, (SP-SC)	HNU=0 PPM RAD=32 CPM
38	38-40	4165	1.8'	12-15-38-39 (53)	SAME AS ABOVE, LESS CLAY, SUBROUNDED TO SUBANGULAR, QUARTZ, TRACE MICA AND FERRO-MAGNESIUM MINERALS, (SP-SC)	0905 HNU=0 PPM RAD=20 CPM
40	40-42		1.8'	15-16-26-29 (42)	SAME AS ABOVE, SOME CLAYEY SAND IN LOWER 4", (SP-SC)	0912 HNU=0 PPM RAD=40 CPM
42	42-44		1.8'	12-34-40-50 (74)	SAME AS ABOVE, BOTTOM 6": FINE-COARSE GRAVEL, (SP-SC)	0922 HNU=8 PPM RAD=40 CPM
44	44-46	4166	1.7'	19-24-32-36 (56)	TOP 12": SAME AS ABOVE; BOTTOM 6": WELL GRADED GRAVEL WITH SAND, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, VERY COARSE SAND, MOSTLY FINE-MEDIUM GRAVEL, SUBANGULAR-SUBROUNDED, (GP)	1016 HNU=0 PPM RAD=26 CPM
46	46-48		2.0'	12-27-27-29 (54)	WELL GRADED SAND, DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-COARSE, SUBANGULAR-SUBROUNDED, (SW)	1028 HNU=0 PPM RAD=20 CPM
48	48-50		2.0'	23-29-31-41 (60)	SAME AS ABOVE; BOTTOM 4" GRADED TO VERY FINE GRAVEL, (SW)	1040 HNU=0 PPM RAD=36 CPM
50	50-52	4167	2.0'	15-27-28-33 (55)	SAME AS ABOVE	1107 HNU=0 PPM RAD=28 CPM
52	52-54		2.0'	33-65-55-50 (120)	SAME AS ABOVE, TOP 12": WITH VERY FINE GRAVEL (SW)	1115 HNU=0 PPM RAD=24 CPM
54	54-56		2.0'	28-34-41-40 (75)	SAME AS ABOVE, (SW)	HNU=0 PPM RAD=36 CPM
56	56-58	4168	1.5'	24-40-12-11 (52)	TOP 8" SAME AS ABOVE; BOTTOM 12": POORLY GRADED GRAVEL AND SAND, SAME COLOR, WET, MEDIUM-VERY COARSE SAND, SUBANGULAR-SUBROUNDED, SOME SILT, (GP)	1405 HNU=0 PPM RAD=32 CPM
56	58-60			13-16-10-11 (26)	NO RECOVERY	
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 3 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd

ELEVATION ________ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler

WATER LEVEL AND DATE ________ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		0'	13-28-65-60 (91)	NO RECOVERY	NEW LOGGER: B. COCKE
62	62-64	4169	1.8'	330/6"	POORLY GRADED SAND WITH GRAVEL, DARK YELLOW ORANGE (10 YR 6/6) AND LIGHT GRAY (N8), MOIST, VERY DENSE, SUBANGULAR-SUBROUNDED; MEDIUM-ROUNDED GRAVEL. (SP)	HNU=0 PPM RAD=32 CPM * NOTE: CHANGE TO 300# HAMMER
64	64-66		2.0'	20-14-15-30 (29)	SAME AS ABOVE, DENSE, (SP)	HNU=0 PPM RAD=22 CPM STOP DRILLING 1600
66	66-68		2.0'	20-13-15-52 (28)	WELL GRADED SAND, GRAYISH ORANGE (10 YR 7/4), WET, MEDIUM DENSE, FINE-MEDIUM, SUBANGULAR, (SW)	0822 HNU=0 PPM RAD=28 CPM RESUME DRILLING 3/22/90
68	68-70	4171	2.0'	48-41-19-35 (60)	SAME AS ABOVE, BOTTOM 6": FINER SAND, (SW)	0846 HNU=0 PPM RAD=30 CPM
70	70-72			20-13-18-33 (31)	SAME AS ABOVE, (SW)	0910 HNU=0 PPM RAD=36 CPM OBTAIN SAMPLE
72	72-74		2.0'	37-47-60-50 (107)	SAME AS ABOVE, (SW)	0925 HNU=0 PPM RAD=26 CPM DRILLER CONDITION THE BOREHOLE BY RUNNING AUGER UP AND DOWN
74	74-76	4172	2.0'	20-19-18-20 (35)	SAME AS ABOVE, (SW)	1035 HNU=0 PPM RAD=32 CPM
76	76-78			4-6-7-7 (13)	SAME AS ABOVE, MEDIUM DENSE, (SW)	1410 HNU=0 PPM RAD=36 CPM NEW LOGGER B. COCKE OBTAIN SAMPLE 4172 & DUPLICATE 4173
78	78-80			2-3-5-7 (8)	ELASTIC SILT, LIGHT GRAY (N7), MOIST, FIRM, PLASTIC, STREAKS OF MODERATE REDDISH BROWN (10 R 4/6), IRON OXIDES, (MH)	1445 HNU=0 PPM RAD=46 CPM
80	80-82	4174		3-5-7-7 (12)	SAME AS ABOVE, STIFF, SMALL INTERBEDDED LAYERS OF GRAVEL, WELL-GRADED, DARK REDDISH BROWN, (MH)	1530 HNU=0 PPM RAD=50 CPM
82	82-84			4-3-3-5 (6)	SAME AS ABOVE, (MH)	1558 HNU=0 PPM RAD=
84	84-86		1.8'	3-4-5-5 (9)	SAME AS ABOVE, (MH)	0834 HNU=0 PPM RAD=44 CPM RESUME DRILLING/SAMPLING 3/25/90, 0800
86	86-88	4176	2.0'	4-4-3-5 (7)	ELASTIC SILT, SAME AS ABOVE, WITH THIN INTERBEDDED SAND WITH SILT, GRAYISH ORANGE (10 YR 7/4), MEDIUM, POORLY GRADED, WET, SUBANGULAR-ANGULAR GRAINS, <10% DARK MINERALS, MOSTLY QUARTZ	0850 HNU=0 PPM RAD=58 CPM
88	88-90		2.0'	3-3-2-3 (5)	ELASTIC SILT, LIGHT GRAY (N7) STREAKED WITH MEDIUM GRAY (N5), MOIST, FIRM, PLASTIC, WITH INTERBEDDED SAND, GRAYISH ORANGE (10 YR 7/4) AS ABOVE, (MH)	0912 HNU=0 PPM RAD=38 CPM SAMPLE COMPOSITED 0918
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 4 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

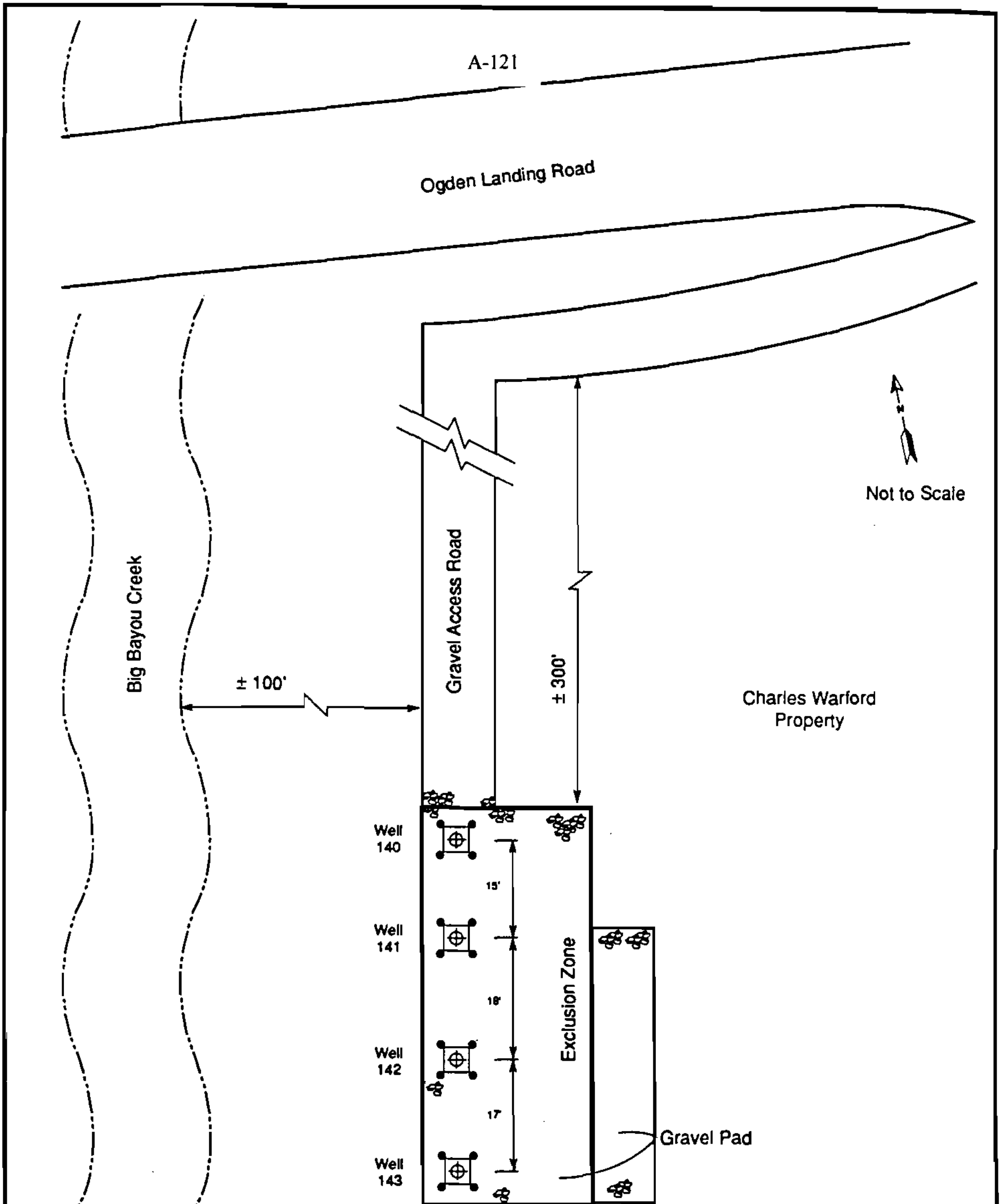
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90	90-92	4177	2.0'	4-4-8-10 (12)	SAME AS ABOVE, CHANGING TO FAT CLAY WITH SILT, MEDIUM GRAY (N5), MOIST, STIFF, INTERBEDDED COARSE SAND AND GRAVEL, GRAYISH ORANGE, (CH-MH)	1020 HNU=0 PPM RAD=36 CPM
92	92-94		1.9'	4-4-5-4 (9)	FAT CLAY WITH SILT, SAME AS ABOVE, (CH-MH), CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, STIFF, (CH)	1035 HNU=0 PPM RAD=34 CPM
94	94-96			4-4-5-6 (9)	SAME AS ABOVE, (CH)	1103 HNU=0 PPM RAD= STOP DRILLING 1145, SAMPLE COMPOSITED 1110
96	96-97.6					CASING SET @ 97' RESUMED SAMPLING 4/5/90, 1010 HNU=0 PPM RAD=136 CPM SAMPLE 4178=SHELBY TUBE SAMPLE
98	97.6-99.6	4178	2.0'	N/A	WELL GRADED SAND, MEDIUM-COARSE, CHERTY, (SW)	
100	99.6-101					
102	101-103	4179		5-7-10-11 (17)	ELASTIC SILT, MEDIUM DARK GRAY (N4), DAMP, MICACEOUS, VERY STIFF, (MH)	1050 HNU=0 PPM RAD=40 CPM 300# HAMMER
104	103-106					
106	106-108	4180		8-20-17-28 (37)	WELL GRADED SAND, LIGHT GRAY (N7), MOIST, DENSE, FINE-MEDIUM, SUBANGULAR, <5% DARK MINERALS, <1% MICACEOUS; (SW); CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), DAMP, HARD, (CH)	1405 HNU=0 PPM RAD=32 CPM
108	108-111					
110						
112	111-113	4181	1.75'	8-18-12-29 (30)	WELL GRADED SAND, LIGHT GRAY (N7) TO MEDIUM GRAY (N8), MOIST, MEDIUM DENSE, VERY FINE-MEDIUM, <5%, DARK RED, 5-10% MICA, SUBANGULAR, (SW)	1450 HNU=0 PPM RAD=48 CPM
114	113-116					
116	116-118	4182	2.0'	3-7-8-16 (15)	SILTY SAND, LIGHT TO MEDIUM GRAY (N7-N4), MOIST TO DAMP, MEDIUM DENSE, FINE TO MEDIUM, MANY THIN LAYERS, 15-40% SILT, 5-10% MICA, (SM)	1530 HNU=0 PPM RAD=28 CPM
118						
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 5 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION ______ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE ______ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
122	121-123	4183	2.0'	17-8-10-17 (18)	SILTY SAND, SAME AS ABOVE, 10-25% SILT (SM); CHANGING TO WELL GRADED SAND WITH SILT, , LIGHT GRAY (N7), MOIST, MEDIUM DENSE, VERY FINE TO MEDIUM, MICACEOUS, 5% SILT, (SW-SM)	HNU=0 PPM RAD=40 CPM STOPPED DRILLING 1620
124						
126	126-128	4185	1.5'	8-21-18-20 (39)	POORLY GRADED SAND, MEDIUM LIGHT GRAY (N6), MOIST-WET, DENSE, FINE, 3% DARK MINERALS, 3% MICA, (SP)	RESUMED SAMPLING 4/6/90, 0830, 300# HAMMER HNU=0 PPM RAD=39 CPM 0900
128						
130						
132	131-133	4186	1.75'	8-17-35-96 (52)	SAME AS ABOVE, FINE-MEDIUM, (SP); CHANGING TO FAT CLAY, VERY HARD, MICACEOUS, BROWNISH BLACK @ 133.5', (CH)	1020 HNU=0 PPM RAD=
134						
136	136-138	4187	2.0'	10-9-15-16 (24)	POORLY GRADED SAND, SAME AS ABOVE, MEDIUM DENSE, CONTAINS TWO 4" SEAMS OF FAT CLAY AS ABOVE, (SP)	1100 HNU=0 PPM RAD=40 CPM
138						
140						
142	141-143	4188		4-10-21-23 (31)	FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, VERY STIFF, MICACEOUS, (CH); CHANGING TO POORLY GRADED SAND, SAME AS ABOVE, (SP)	1530 HNU=0 PPM RAD=48 CPM STOPPED DRILLING 1535 TD OF BORING 143'



Legend

Well with Concrete Pad

• Guardpost

Figure 5-2
Well Cluster 4
Well Layout Sketch

CH2M HILL

[Page left blank]

Summary of McNairy Background Wells

MW 239

Location - Northwest Plume Interim Remedial Action - North Well Field
N (7330), E (-5204)
Date Installed - Sept. 29, 1994
Screened Depth - Middle McNairy
Top - 147 ft bgs
Bottom - 157 ft bgs
Dates Sampled (Data available) - Q1 95; Q2 95 (3); Q3 95 (3); Q4 95 (3); Q1 96 (3); Q2 96 (3); Q3 96 (3); Q4 96 (3); Q1 97 (3); Q2 97 (3); Q 3 97 (3); Q1 94
Construction Information Reference -
Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; μg/l)				
Trichloroethene	2	NA	12/11/96	6395-96
Trichloroethene	7	NA	6/12/97	5409-97
Trichloroethene	7	NA	8/14/97	5575-97
Radionuclides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	18	19	3/29/95	6043-95
^{99}Tc	20	19	4/13/95	6143-95
^{99}Tc	9	20	5/3/95	6366-95
^{99}Tc	4	11	7/24/95	7106-95
^{99}Tc	1	11	8/9/95	7230-95
^{99}Tc	10	10	9/26/95	7361-95
^{99}Tc	3	10	10/18/95	7920-95
^{99}Tc	7	10	11/8/95	8036-95
^{99}Tc	4	10	12/19/95	8165-95
^{99}Tc	4	10	2/15/96	5384-96
^{99}Tc	14	11	3/20/96	5647-96
^{99}Tc	10	10	4/18/96	5805-96
^{99}Tc	2	11	5/21/96	5862-96
^{99}Tc	2	10	6/13/96	5916-96
^{99}Tc	2	10	7/25/96	6007-96
^{99}Tc	13	11	8/6/96	6042-96
^{99}Tc	13	11	9/10/96	6164-96
^{99}Tc	8	11	12/11/96	6395-96
^{99}Tc	4	11	1/23/97	5040-97
^{99}Tc	3	11	2/17/97	5115-97
^{99}Tc	1	11	3/18/97	5172-97
^{99}Te	6	10	4/15/97	5265-97
^{99}Te	4	12	5/20/97	5331-97
^{99}Tc	11	12	6/12/97	5409-97
^{99}Tc	7	11	7/10/97	5516-97
^{99}Te	10	11	9/15/97	5660-97
^{99}Tc	5	12	10/16/97	5752-97
Radionuclides (^{99}Te only; pCi/l; filtered samples; ordered by date of collection)				
NONE	NA	NA	NA	NA

Notes: NA = Entry not applicable or not available.

MW 239 (continued)

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	31	62.7	37 - 87	mg/L
Depth to Water	32	43.5	38.5 - 47.75	feet
Dissolved Oxygen	31	1.00	0.23 - 5.8	mg/L
Dissolved Solids	4	151.5	125 - 187	mg/L
pH	70	5.9	5.7 - 6.2	SU
Specific Conductanee	70	235.7	180 - 269	umhos/cm
Temperature	72	60.9	56.5 - 72	F
Total Organic Carbon	10	< 1	< 1 - 1	mg/L
Turbidity	31	19.6	2.4 - 140	NTU

Notes: NA = Entry not applicable or not available.

Summary of McNairy Background Wells

MW 247
Location - Northwest Plume Interim Remedial Action - South Well Field
N (1358), E (-7433)
Date Installed - Sept. 26, 1994
Screened Depth - Middle McNairy
Top - 135 ft bgs
Bottom - 145 ft bgs
Dates Sampled (Data available) - Q1 95; Q2 95 (2); Q3 95 (3); Q4 95 (3); Q1 96 (3); Q2 96 (3); Q3 96 (3); Q4 96 (3); Q1 97 (3); Q2 97 (3); Q 3 97 (3); Q1 94 (2)
Construction Information Reference -
Potential Contaminant Information -

Compound	Detected Concentration	Detection Error (Rad only)	Date of Collection	Sample ID
Organic Compounds (all; µg/l)				
Trichloroethene	2	NA	9/20/95	7393-95
Trichloroethene	1	NA	3/20/97	5180-97
Trichloroethene	2	NA	5/20/97	5339-97
Trichloroethene	9,600	NA	7/24/97	5524-97
Radionuelides (^{99}Tc only; pCi/l; unfiltered samples; ordered by date of collection)				
^{99}Tc	10	34	3/27/95	6075-95
^{99}Tc	14	28	4/19/95	6175-95
^{99}Tc	7	11	6/20/95	6508-95
^{99}Tc	11	10	7/19/95	7138-95
^{99}Te	12	10	8/22/95	7262-95
^{99}Tc	13	10	9/20/95	7393-95
^{99}Tc	2	10	10/23/95	7952-95
^{99}Tc	15	10	11/28/95	8068-95
^{99}Tc	2	11	3/25/96	5679-96
^{99}Tc	7	11	5/28/96	5870-96
^{99}Tc	8	9	6/18/96	5924-96
^{99}Tc	6	11	7/18/96	6015-96
^{99}Tc	8	10	8/13/96	6050-96
^{99}Tc	4	11	9/17/96	6172-96
^{99}Tc	3	10	10/2/96	6260-96
^{99}Tc	2	11	11/12/96	6316-96
^{99}Tc	5	12	12/10/96	6403-96
^{99}Tc	1	15	1/24/97	5048-97
^{99}Tc	13	11	2/17/97	5123-97
^{99}Tc	5	12	4/10/97	5273-97
^{99}Tc	1,953	43	7/24/97	5524-97
^{99}Tc	4	12	8/11/97	5583-97
^{99}Tc	11	12	9/17/97	5668-97
^{99}Tc	11	12	10/23/97	5760-97
^{99}Tc	-12	0	11/25/97	5857-97
Radionuelides (^{99}Tc only; pCi/l; filtered samples; ordered by date of collection)				
NONE	NA	NA	NA	NA

Notes: NA = Entry not applieable or not available.

MW 247 (continued)

Physical Data Summary -

Parameter	Number of Observations	Arithmetic Average of Results	Range of Results	Units
Alkalinity	31	127.4	71 - 164	mg/L
Depth to Water	32	38.60	27.31 - 43.5	feet
Dissolved Oxygen	32	1.74	0.23 - 11.58	mg/L
Dissolved Solids	4	150	103 - 194	mg/L
pH	68	6.5	5.78 - 7.42	SU
Specific Conductance	68	271.4	225 - 393	umhos/cm
Temperature	32	61.0	57 - 69	F
Total Organic Carbon	10	< 1	< 1 - 1	mg/L
Turbidity	31	59.2	3.2 - 131	NTU

Notes: NA = Entry not applicable or not available.

APPENDIX B

DATA SUMMARIES FOR SELECTED BACKGROUND WELLS

THIS PAGE INTENTIONALLY LEFT BLANK

Data Summary

This appendix presents, by analyte within aquifer classification, the original data and modified data used derive the background concentrations for the Regional Gravel Aquifer and McNairy Formation. For each analyte, the original and modified data, a graphic plot of the modified data, and reasons for data modification are presented by well. Table B-1 is a guide that can be used to find the results for individual analytes. For additional explanations concerning the information presented for each analyte, please see page B-5.

Table B-1. Table of Contents for Appendix B

THIS PAGE INTENTIONALLY LEFT BLANK

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Aluminum	0 1	<	NO	5944-93	MW103	mg/L
Aluminum	0 112		YES	5187-94	MW103	mg/L
Aluminum	0.115		YES	4272-94	MW103	mg/L
Aluminum	0.125		YES	7299-93	MW103	mg/L
Aluminum	0.206		YES	6026-94	MW103	mg/L
Aluminum	0.243		YES	5178-93	MW103	mg/L
Aluminum	0.625	<	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	0.625	N*<	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	0.75	<	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	0 289		YES	4697-94	MW106	mg/L
Aluminum	0.62	<	NO	7272-94	MW106	mg/L
Aluminum	11		YES	5322-93	MW106	mg/L
Aluminum	0.157		YES	6054-94	MW141	mg/L
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	0.169		YES	5203-94	MW142	mg/L
Aluminum	0.267		YES	6096-93	MW142	mg/L
Aluminum	0 267		YES	7089-93	MW142	mg/L
Aluminum	0.501		YES	6084-93	MW142	mg/L
Aluminum	0 62	<	NO	6872-94	MW142	mg/L
Aluminum	0 625	N*<	NO	5317-96	MW142	mg/L
Aluminum	0.75	<	NO	5147-97	MW142	mg/L
Aluminum	0 625	N*<	NO	5321-96	MW150	mg/L
Aluminum	0 75	<	NO	5146-97	MW150	mg/L
Aluminum	1 01		YES	4789-94	MW150	mg/L
Aluminum	2 22		YES	5650-93	MW150	mg/L
Aluminum	0 172		YES	7311-93	MW199	mg/L
Aluminum	0 721		YES	6074-94	MW199	mg/L
Aluminum	1.2		YES	6886-94	MW199	mg/L
Aluminum	1.3		YES	5280-94	MW199	mg/L
Aluminum	2.08		YES	4312-94	MW199	mg/L
Aluminum	2 42		YES	5558-97	MW199	mg/L
Aluminum	2.6		YES	5984-93	MW199	mg/L
Aluminum	4.77		YES	5170-93	MW199	mg/L

This area presents the corrected data set sorted by well.

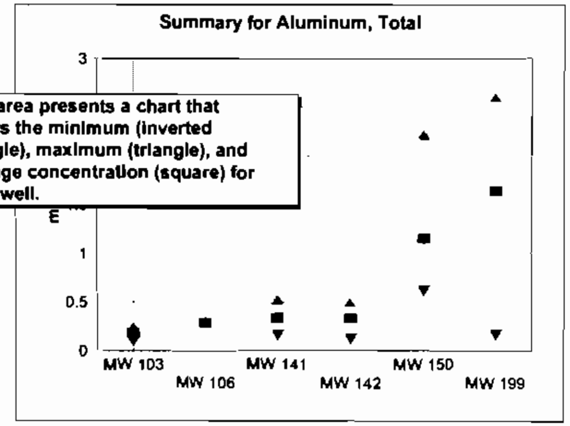
This area presents the summary statistics both within and over wells. Statistics shown are the minimum value in the corrected data set for each well and across all wells, the maximum value in the corrected data set for each well and across all wells, the average concentration for the corrected data set for each well and across all wells, and the number of observations for each well and across all wells.

CORRECTED DATA SET

MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Aluminum							
0.1	0 289	0.157	0.123	0.625	0 172		
0.112	0.289	0.188	0.166	0 75	0 721		
0.115	0.289	0.204	0.169	1.01	1 2		
0.125		0.254	0.267	2.22	1 3		
0.206		0.486	0.267		2 08		
0.243		0.524	0.501		2 42		
0.243		0.524	0 501		2 6		
0.243			0.501		2 6		
0.243			0 501				

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Min	0.100	0.289	0.157	0.123	0.625	0.172	0 100	
Max	0.243	0 289	0.524	0.501	2.220	2.600	2 600	
Average	0.181	0.289	0.334	0.333	1.151	1.637	0 638	0.654
Number	9	3	7	9	4	8	40	

This area presents a chart that shows the minimum (inverted triangle), maximum (triangle), and average concentration (square) for each well.



This area presents the original data sorted by concentration within well.

The units for all chemical concentrations are mg/liter, and the units for all radionuclide concentrations are pCi/liter.

This area describes the actions that were taken to correct the data set for each

MW 103 - Two nondetects greater than maximum detected value set to maximum detected value

MW 106 - Detection at 11 mg/L declared an outlier and changed to maximum detected value nondetect greater than new maximum detected value set to maximum detected value

MW 141 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value

MW 142 - Three nondetects greater than maximum detected value set to maximum detected value

MW 150 - Data were not modified

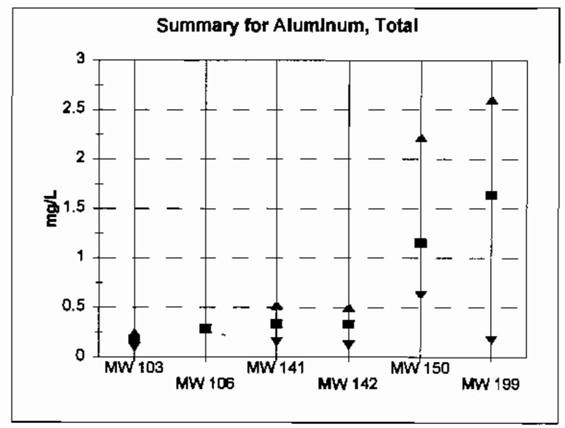
MW 199 - Detection at 4 77 mg/L declared an outlier and changed to new maximum detected value at 2 6 mg/L

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Aluminum	0.1	<	NO	5944-93	MW103	mg/L
Aluminum	0.112		YES	5187-94	MW103	mg/L
Aluminum	0.115		YES	4272-94	MW103	mg/L
Aluminum	0.125		YES	7299-93	MW103	mg/L
Aluminum	0.206		YES	6026-94	MW103	mg/L
Aluminum	0.243		YES	5178-93	MW103	mg/L
Aluminum	0.625	<	NO	6774-94	MW103	mg/L
Aluminum	0.625	N*<	NO	5285-96	MW103	mg/L
Aluminum	0.75	<	NO	5142-97	MW103	mg/L
Aluminum	0.289		YES	4697-94	MW106	mg/L
Aluminum	0.62	<	NO	7272-94	MW106	mg/L
Aluminum	11		YES	5322-93	MW106	mg/L
Aluminum	0.157		YES	6054-94	MW141	mg/L
Aluminum	0.188		YES	5199-94	MW141	mg/L
Aluminum	0.204		YES	4229-94	MW141	mg/L
Aluminum	0.254		YES	7085-93	MW141	mg/L
Aluminum	0.486		YES	6092-93	MW141	mg/L
Aluminum	0.524		YES	6080-93	MW141	mg/L
Aluminum	0.62	<	NO	6866-94	MW141	mg/L
Aluminum	0.123		YES	4233-94	MW142	mg/L
Aluminum	0.166		YES	6056-94	MW142	mg/L
Aluminum	0.169		YES	5203-94	MW142	mg/L
Aluminum	0.267		YES	6096-93	MW142	mg/L
Aluminum	0.267		YES	7069-93	MW142	mg/L
Aluminum	0.501		YES	6084-93	MW142	mg/L
Aluminum	0.62	<	NO	6872-94	MW142	mg/L
Aluminum	0.625	N*<	NO	5317-96	MW142	mg/L
Aluminum	0.75	<	NO	5147-97	MW142	mg/L
Aluminum	0.625	N*<	NO	5321-96	MW150	mg/L
Aluminum	0.75	<	NO	5148-97	MW150	mg/L
Aluminum	1.01		YES	4769-94	MW150	mg/L
Aluminum	2.22		YES	5650-93	MW150	mg/L
Aluminum	0.172		YES	7311-93	MW199	mg/L
Aluminum	0.721		YES	6074-94	MW199	mg/L
Aluminum	1.2		YES	6868-94	MW199	mg/L
Aluminum	1.3		YES	5260-94	MW199	mg/L
Aluminum	2.08		YES	4312-94	MW199	mg/L
Aluminum	2.42		YES	5558-97	MW199	mg/L
Aluminum	2.6		YES	5984-93	MW199	mg/L
Aluminum	4.77		YES	5170-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Aluminum							
	0.1	0.289	0.157	0.123	0.625	0.172		
	0.112	0.289	0.188	0.166	0.75	0.721		
	0.115	0.289	0.204	0.169	1.01	1.2		
	0.125		0.254	0.267	2.22	1.3		
	0.206		0.486	0.267		2.08		
	0.243		0.524	0.501		2.42		
	0.243		0.524	0.501		2.6		
	0.243			0.501		2.6		
	0.243			0.501				
Min	0.100	0.289	0.157	0.123	0.625	0.172	0.100	
Max	0.243	0.289	0.524	0.501	2.220	2.600	2.600	
Average	0.161	0.289	0.334	0.333	1.151	1.637	0.636	0.654
Number	9	3	7	9	4	8	40	



MW 103 - Two nondetects greater than maximum detected value set to maximum detected value.

MW 106 - Detection at 11 mg/L declared an outlier and changed to maximum detected value; nondetect greater than new maximum detected value set to maximum detected value.

MW 141 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value.

MW 142 - Three nondetects greater than maximum detected value set to maximum detected value.

MW 150 - Data were not modifed.

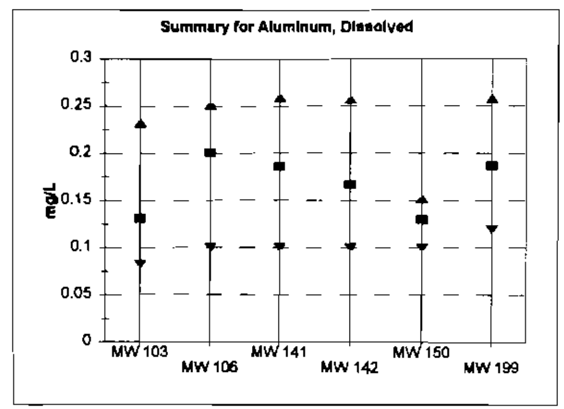
MW 199 - Detection at 4.77 mg/L declared an outlier and changed to new maximum detected value at 2.6 mg/L.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Aluminum, Dissolved	0.082		YES	6026-94	MW103	mg/L
Aluminum, Dissolved	0.1	<	NO	5944-93	MW103	mg/L
Aluminum, Dissolved	0.1	<	NO	7299-93	MW103	mg/L
Aluminum, Dissolved	0.1	<	NO	5187-94	MW103	mg/L
Aluminum, Dissolved	0.101		YES	4272-94	MW103	mg/L
Aluminum, Dissolved	0.232		YES	5178-93	MW103	mg/L
Aluminum, Dissolved	0.625	<	NO	6774-94	MW103	mg/L
Aluminum, Dissolved		Q	NO	5285-96	MW103	
Aluminum, Dissolved	0.1	<	NO	4697-94	MW106	mg/L
Aluminum, Dissolved	0.251		YES	5322-93	MW106	mg/L
Aluminum, Dissolved	0.62	<	NO	7272-94	MW106	mg/L
Aluminum, Dissolved	0.1	<	NO	4229-94	MW141	mg/L
Aluminum, Dissolved	0.1	<	NO	5199-94	MW141	mg/L
Aluminum, Dissolved	0.153		YES	8054-94	MW141	mg/L
Aluminum, Dissolved	0.179		YES	7065-93	MW141	mg/L
Aluminum, Dissolved	0.25		YES	8080-93	MW141	mg/L
Aluminum, Dissolved	0.259		YES	8092-93	MW141	mg/L
Aluminum, Dissolved	0.62	<	NO	8868-94	MW141	mg/L
Aluminum, Dissolved	0.1	<	NO	4233-94	MW142	mg/L
Aluminum, Dissolved	0.1	<	NO	5203-94	MW142	mg/L
Aluminum, Dissolved	0.162		YES	6058-94	MW142	mg/L
Aluminum, Dissolved	0.171		YES	6084-93	MW142	mg/L
Aluminum, Dissolved	0.188		YES	7089-93	MW142	mg/L
Aluminum, Dissolved	0.257		YES	6096-93	MW142	mg/L
Aluminum, Dissolved	0.62	<	NO	8872-94	MW142	mg/L
Aluminum, Dissolved		Q	NO	5317-98	MW142	
Aluminum, Dissolved	0.137		YES	4789-94	MW150	mg/L
Aluminum, Dissolved	0.152		YES	5650-93	MW150	mg/L
Aluminum, Dissolved		Q	NO	5321-98	MW150	
Aluminum, Dissolved	0.119		YES	6074-94	MW199	mg/L
Aluminum, Dissolved	0.124		YES	4312-94	MW199	mg/L
Aluminum, Dissolved	0.137		YES	5170-93	MW199	mg/L
Aluminum, Dissolved	0.153		YES	5984-93	MW199	mg/L
Aluminum, Dissolved	0.258		YES	5260-94	MW199	mg/L
Aluminum, Dissolved	0.62	<	NO	6888-94	MW199	mg/L
Aluminum, Dissolved	1.68		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Aluminum, Dissolved							
	0.082	0.1	0.1	0.1	0.137	0.119		
	0.1	0.251	0.1	0.1	0.152	0.124		
	0.1	0.251	0.153	0.162	0.1	0.137		
	0.1		0.179	0.171		0.153		
	0.101		0.25	0.188		0.258		
	0.232		0.259	0.257		0.258		
	0.232		0.259	0.257		0.258		
	0.1			0.1				
Min	0.082	0.100	0.100	0.100	0.100	0.119	0.082	
Max	0.232	0.251	0.259	0.257	0.152	0.258	0.259	
Average	0.131	0.201	0.186	0.167	0.130	0.187	0.168	0.167
Number	8	3	7	8	3	7	36	



Several results were qualified "Q." This is defined as "No result available or not required because total analyses is less than PQL." For these instances, it is assumed that the result is a nondetect at the minimum detection limit across all samples.

MW 103 - One nondetect greater than maximum detected value set to maximum detected value; one "Q" qualified result value changed to minimum detection limit for samples from this well (0.1 mg/L).

MW 106 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value.

MW 141 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value.

MW 142 - One nondetect with a value greater than the maximum detected value set to maximum detected value; one "Q" qualified result given value of minimum detection limit for samples from this well (0.1 mg/L).

MW 150 - One "Q" qualified result given value of minimum detection limit for aluminum, dissolved in samples from other wells (0.1 mg/L) because there were no detection limits less than the maximum detected concentration for samples from this well.

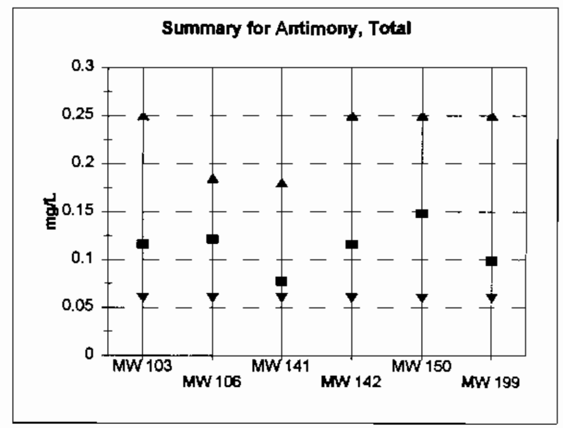
MW 199 - One nondetect greater than the maximum detected value reduced to maximum detected value; maximum detected value within this well was greater than other values; this value was reduced to the next greatest detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Antimony	0.06	<	NO	5178-93	MW103	mg/L
Antimony	0.06	<	NO	5944-93	MW103	mg/L
Antimony	0.06	<	NO	7299-93	MW103	mg/L
Antimony	0.06	<	NO	4272-94	MW103	mg/L
Antimony	0.06	<	NO	5187-94	MW103	mg/L
Antimony	0.06	<	NO	6028-94	MW103	mg/L
Antimony	0.18	<	NO	6774-94	MW103	mg/L
Antimony	0.185	<	NO	5440-95	MW103	mg/L
Antimony	0.185	J<	NO	5285-96	MW103	mg/L
Antimony	0.25	<	NO	5142-97	MW103	mg/L
Antimony	0.06	<	NO	5322-93	MW106	mg/L
Antimony	0.06	<	NO	4697-94	MW106	mg/L
Antimony	0.18	<	NO	7272-94	MW108	mg/L
Antimony	0.185	<	NO	5444-95	MW108	mg/L
Antimony	0.06	<	NO	8080-93	MW141	mg/L
Antimony	0.06	<	NO	6092-93	MW141	mg/L
Antimony	0.06	<	NO	7085-93	MW141	mg/L
Antimony	0.06	<	NO	4229-94	MW141	mg/L
Antimony	0.06	<	NO	5199-94	MW141	mg/L
Antimony	0.06	<	NO	6054-94	MW141	mg/L
Antimony	0.18	<	NO	8868-94	MW141	mg/L
Antimony	0.08	<	NO	6084-93	MW142	mg/L
Antimony	0.06	<	NO	6096-93	MW142	mg/L
Antimony	0.08	<	NO	7089-93	MW142	mg/L
Antimony	0.08	<	NO	4233-94	MW142	mg/L
Antimony	0.08	<	NO	5203-94	MW142	mg/L
Antimony	0.06	<	NO	8058-94	MW142	mg/L
Antimony	0.18	<	NO	6872-94	MW142	mg/L
Antimony	0.185	<	NO	5464-95	MW142	mg/L
Antimony	0.185	J<	NO	5317-96	MW142	mg/L
Antimony	0.25	<	NO	5147-97	MW142	mg/L
Antimony	0.06	<	NO	5650-93	MW150	mg/L
Antimony	0.06	<	NO	4789-94	MW150	mg/L
Antimony	0.185	<	NO	5468-95	MW150	mg/L
Antimony	0.185	J<	NO	5321-96	MW150	mg/L
Antimony	0.25	<	NO	5148-97	MW150	mg/L
Antimony	0.06	<	NO	5170-93	MW199	mg/L
Antimony	0.08	<	NO	5984-93	MW199	mg/L
Antimony	0.06	<	NO	7311-93	MW199	mg/L
Antimony	0.06	<	NO	4312-94	MW199	mg/L
Antimony	0.08	<	NO	5280-94	MW199	mg/L
Antimony	0.06	<	NO	6074-94	MW199	mg/L
Antimony	0.18	<	NO	6888-94	MW199	mg/L
Antimony	0.25	<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Antimony							
	0.08	0.06	0.08	0.08	0.06	0.06		
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.18	0.08	0.08	0.185	0.08		
	0.08	0.185	0.08	0.08	0.185	0.06		
	0.08		0.08	0.06	0.25	0.06		
	0.08		0.08	0.06		0.06		
	0.18		0.18	0.18		0.18		
	0.185			0.185		0.25		
	0.185			0.185				
	0.25			0.25				
Min	0.080	0.060	0.060	0.060	0.060	0.080	0.060	
Max	0.250	0.185	0.180	0.250	0.250	0.250	0.250	
Average	0.116	0.121	0.077	0.118	0.148	0.099	0.111	0.113
Number	10	4	7	10	5	8	44	



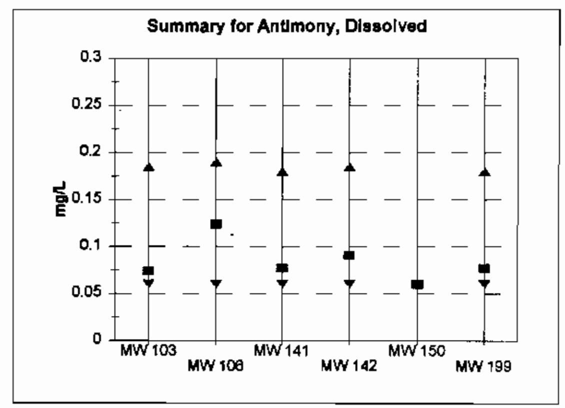
All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Antimony, Dissolved	0.06	<	NO	5178-93	MW103	mg/L
Antimony, Dissolved	0.06	<	NO	5944-93	MW103	mg/L
Antimony, Dissolved	0.06	<	NO	7299-93	MW103	mg/L
Antimony, Dissolved	0.06	<	NO	4272-94	MW103	mg/L
Antimony, Dissolved	0.06	<	NO	5187-94	MW103	mg/L
Antimony, Dissolved	0.06	<	NO	6026-94	MW103	mg/L
Antimony, Dissolved	0.185	<	NO	6774-94	MW103	mg/L
Antimony, Dissolved		Q	NO	5440-95	MW103	
Antimony, Dissolved		Q	NO	5285-96	MW103	
Antimony, Dissolved	0.06	<	NO	5322-93	MW106	mg/L
Antimony, Dissolved	0.06	<	NO	4697-94	MW106	mg/L
Antimony, Dissolved	0.165	<	NO	5444-95	MW106	mg/L
Antimony, Dissolved	0.19	<	NO	7272-94	MW106	mg/L
Antimony, Dissolved	0.06	<	NO	6080-93	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	6092-93	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	7085-93	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	4229-94	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	5199-94	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	6054-94	MW141	mg/L
Antimony, Dissolved	0.18	<	NO	6868-94	MW141	mg/L
Antimony, Dissolved	0.06	<	NO	6084-93	MW142	mg/L
Antimony, Dissolved	0.06	<	NO	6096-93	MW142	mg/L
Antimony, Dissolved	0.06	<	NO	7069-93	MW142	mg/L
Antimony, Dissolved	0.06	<	NO	4233-94	MW142	mg/L
Antimony, Dissolved	0.06	<	NO	5203-94	MW142	mg/L
Antimony, Dissolved	0.06	<	NO	6056-94	MW142	mg/L
Antimony, Dissolved	0.18	<	NO	6872-94	MW142	mg/L
Antimony, Dissolved	0.185	<	NO	5484-95	MW142	mg/L
Antimony, Dissolved		Q	NO	5317-96	MW142	
Antimony, Dissolved	0.06	<	NO	5650-93	MW150	mg/L
Antimony, Dissolved	0.06	<	NO	4769-94	MW150	mg/L
Antimony, Dissolved		Q	NO	5466-95	MW150	
Antimony, Dissolved		Q	NO	5321-96	MW150	
Antimony, Dissolved	0.06	<	NO	5170-93	MW199	mg/L
Antimony, Dissolved	0.06	<	NO	5984-93	MW199	mg/L
Antimony, Dissolved	0.06	<	NO	7311-93	MW199	mg/L
Antimony, Dissolved	0.06	<	NO	4312-94	MW199	mg/L
Antimony, Dissolved	0.06	<	NO	5260-94	MW199	mg/L
Antimony, Dissolved	0.06	<	NO	6074-94	MW199	mg/L
Antimony, Dissolved	0.18	<	NO	6688-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Antimony, Dissolved							
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.165	0.06	0.06		0.06		
	0.06	0.19	0.06	0.06		0.06		
	0.06		0.06	0.06		0.06		
	0.06		0.06	0.06		0.06		
	0.165		0.18	0.18		0.16		
	0.06			0.185				
	0.06							
Min	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Max	0.185	0.190	0.180	0.185	0.060	0.180	0.190	
Average	0.074	0.124	0.077	0.091	0.060	0.077	0.083	0.084
Number	9	4	7	8	2	7	37	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

MW 103 - Two "Q" qualified result values changed to minimum detection limit for samples from this well (0.06 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.06 mg/L).

MW 150 - Two "Q" qualified results given value of minimum detection limit for samplesfrom this well (0.06 mg/l).

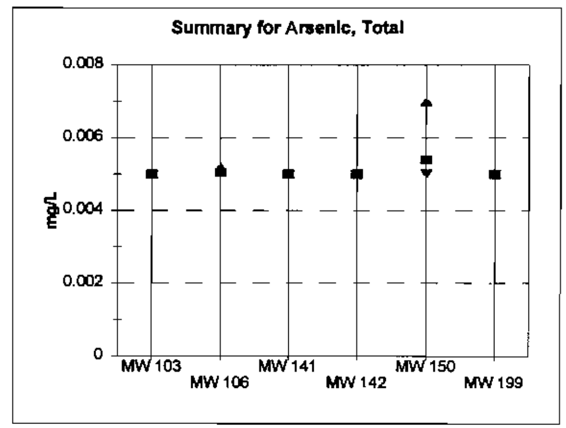
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Arsenic	0.005	<	NO	5178-93	MW103	mg/L
Arsenic	0.005	<	NO	5944-93	MW103	mg/L
Arsenic	0.005	<	NO	7299-93	MW103	mg/L
Arsenic	0.005	<	NO	4272-94	MW103	mg/L
Arsenic	0.005	<	NO	5187-94	MW103	mg/L
Arsenic	0.005	<	NO	6026-94	MW103	mg/L
Arsenic	0.005	<	NO	6774-94	MW103	mg/L
Arsenic	0.005	<	NO	5440-95	MW103	mg/L
Arsenic	0.005	<	NO	5285-96	MW103	mg/L
Arsenic	0.005	<	NO	5142-97	MW103	mg/L
Arsenic	0.005	<	NO	4697-94	MW106	mg/L
Arsenic	0.005	<	NO	7272-94	MW106	mg/L
Arsenic	0.005	<	NO	5444-95	MW106	mg/L
Arsenic	0.0052		YES	5322-93	MW106	mg/L
Arsenic	0.005	<	NO	6060-93	MW141	mg/L
Arsenic	0.005	<	NO	6092-93	MW141	mg/L
Arsenic	0.005	<	NO	7085-93	MW141	mg/L
Arsenic	0.005	<	NO	4229-94	MW141	mg/L
Arsenic	0.005	<	NO	5199-94	MW141	mg/L
Arsenic	0.005	<	NO	6054-94	MW141	mg/L
Arsenic	0.005	<	NO	6666-94	MW141	mg/L
Arsenic	0.005	<	NO	6064-93	MW142	mg/L
Arsenic	0.005	<	NO	6096-93	MW142	mg/L
Arsenic	0.005	<	NO	7089-93	MW142	mg/L
Arsenic	0.005	<	NO	4233-94	MW142	mg/L
Arsenic	0.005	<	NO	5203-94	MW142	mg/L
Arsenic	0.005	<	NO	6056-94	MW142	mg/L
Arsenic	0.005	<	NO	6672-94	MW142	mg/L
Arsenic	0.005	<	NO	5464-95	MW142	mg/L
Arsenic	0.005	<	NO	5317-96	MW142	mg/L
Arsenic	0.005	<	NO	5147-97	MW142	mg/L
Arsenic	0.005	<	NO	5650-93	MW150	mg/L
Arsenic	0.005	<	NO	4769-94	MW150	mg/L
Arsenic	0.005	<	NO	5466-95	MW150	mg/L
Arsenic	0.005	<	NO	5321-96	MW150	mg/L
Arsenic	0.007		YES	5146-97	MW150	mg/L
Arsenic	0.005	<	NO	5170-93	MW199	mg/L
Arsenic	0.005	<	NO	5964-93	MW199	mg/L
Arsenic	0.005	<	NO	7311-93	MW199	mg/L
Arsenic	0.005	<	NO	4312-94	MW199	mg/L
Arsenic	0.005	<	NO	5260-94	MW199	mg/L
Arsenic	0.005	<	NO	6074-94	MW199	mg/L
Arsenic	0.005	<	NO	6666-94	MW199	mg/L
Arsenic	0.005	<	NO	5556-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Arsenic							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.0052	0.005	0.005	0.005	0.005		
	0.005		0.005	0.005	0.007	0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.005			0.005		0.005		
	0.005			0.005				
	0.005			0.005				
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.005	0.005	0.005	0.007	0.005	0.007	
Average	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Number	10	4	7	10	5	6	44	



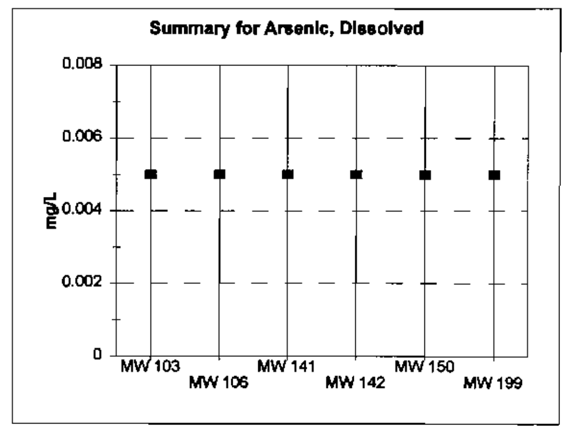
Data for Arsenic, Total was not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Arsenic, Dissolved		Q	NO	5178-93	MW103	
Arsenic, Dissolved		Q	NO	5944-93	MW103	
Arsenic, Dissolved		Q	NO	7299-93	MW103	
Arsenic, Dissolved		Q	NO	4272-94	MW103	
Arsenic, Dissolved		Q	NO	5187-94	MW103	
Arsenic, Dissolved		Q	NO	6026-94	MW103	
Arsenic, Dissolved		Q	NO	6774-94	MW103	
Arsenic, Dissolved		Q	NO	5440-95	MW103	
Arsenic, Dissolved		Q	NO	5285-96	MW103	
Arsenic, Dissolved		Q	NO	5142-97	MW103	
Arsenic, Dissolved	0.005	<	NO	5322-93	MW106	mg/L
Arsenic, Dissolved		Q	NO	4697-94	MW106	
Arsenic, Dissolved		Q	NO	7272-94	MW106	
Arsenic, Dissolved		Q	NO	5444-95	MW106	
Arsenic, Dissolved		Q	NO	6080-93	MW141	
Arsenic, Dissolved		Q	NO	6092-93	MW141	
Arsenic, Dissolved		Q	NO	7085-93	MW141	
Arsenic, Dissolved		Q	NO	4229-94	MW141	
Arsenic, Dissolved		Q	NO	5199-94	MW141	
Arsenic, Dissolved		Q	NO	6054-94	MW141	
Arsenic, Dissolved		Q	NO	6666-94	MW141	
Arsenic, Dissolved		Q	NO	6084-93	MW142	
Arsenic, Dissolved		Q	NO	6096-93	MW142	
Arsenic, Dissolved		Q	NO	7089-93	MW142	
Arsenic, Dissolved		Q	NO	4233-94	MW142	
Arsenic, Dissolved		Q	NO	5203-94	MW142	
Arsenic, Dissolved		Q	NO	6058-94	MW142	
Arsenic, Dissolved		Q	NO	6872-94	MW142	
Arsenic, Dissolved		Q	NO	5464-95	MW142	
Arsenic, Dissolved		Q	NO	5317-96	MW142	
Arsenic, Dissolved		Q	NO	5147-97	MW142	
Arsenic, Dissolved	0.005	<	NO	5148-97	MW150	mg/L
Arsenic, Dissolved		Q	NO	5650-93	MW150	
Arsenic, Dissolved		Q	NO	4769-94	MW150	
Arsenic, Dissolved		Q	NO	5468-95	MW150	
Arsenic, Dissolved		Q	NO	5321-96	MW150	
Arsenic, Dissolved		Q	NO	5170-93	MW199	
Arsenic, Dissolved		Q	NO	5964-93	MW199	
Arsenic, Dissolved		Q	NO	7311-93	MW199	
Arsenic, Dissolved		Q	NO	4312-94	MW199	
Arsenic, Dissolved		Q	NO	5260-94	MW199	
Arsenic, Dissolved		Q	NO	6074-94	MW199	
Arsenic, Dissolved		Q	NO	6868-94	MW199	
Arsenic, Dissolved		Q	NO	5558-97	MW199	

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Arsenic, Dissolved							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005		0.005	0.005	0.005	0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.005			0.005		0.005		
	0.005			0.005				
	0.005			0.005				
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Average	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Number	10	4	7	10	5	8	44	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

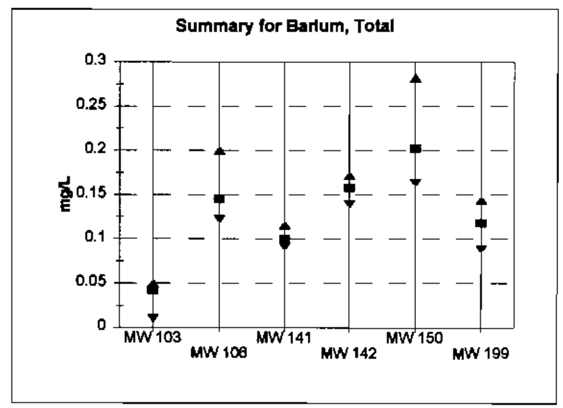
All "Q" qualified resultsin these data set to the minimum detection limit over all wells (0.005 mg/l).

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Barium	0.01		YES	5944-93	MW103	mg/L
Barium	0.038		YES	7299-93	MW103	mg/L
Barium	0.039		YES	6026-94	MW103	mg/L
Barium	0.04		YES	4272-94	MW103	mg/L
Barium	0.046		YES	5187-94	MW103	mg/L
Barium	0.048		YES	5178-93	MW103	mg/L
Barium	0.05		YES	5440-95	MW103	mg/L
Barium	0.05	<	NO	5142-97	MW103	mg/L
Barium	0.07	<	NO	6774-94	MW103	mg/L
Barium	0.07	<	NO	5285-96	MW103	mg/L
Barium	0.122		YES	5444-95	MW106	mg/L
Barium	0.127		YES	4697-94	MW106	mg/L
Barium	0.13		YES	7272-94	MW106	mg/L
Barium	0.2		YES	5322-93	MW106	mg/L
Barium	0.091		YES	6054-94	MW141	mg/L
Barium	0.094		YES	6080-93	MW141	mg/L
Barium	0.094		YES	7085-93	MW141	mg/L
Barium	0.096		YES	6868-94	MW141	mg/L
Barium	0.099		YES	4229-94	MW141	mg/L
Barium	0.11		YES	5199-94	MW141	mg/L
Barium	0.116		YES	6092-93	MW141	mg/L
Barium	0.139		YES	5203-94	MW142	mg/L
Barium	0.145		YES	5464-95	MW142	mg/L
Barium	0.149		YES	7089-93	MW142	mg/L
Barium	0.156		YES	6064-93	MW142	mg/L
Barium	0.16		YES	4233-94	MW142	mg/L
Barium	0.16		YES	6872-94	MW142	mg/L
Barium	0.165		YES	5317-96	MW142	mg/L
Barium	0.167		YES	5147-97	MW142	mg/L
Barium	0.168		YES	6096-93	MW142	mg/L
Barium	0.172		YES	6058-94	MW142	mg/L
Barium	0.163		YES	4789-94	MW150	mg/L
Barium	0.176		YES	5321-96	MW150	mg/L
Barium	0.19		YES	5468-95	MW150	mg/L
Barium	0.199		YES	5650-93	MW150	mg/L
Barium	0.282		YES	5148-97	MW150	mg/L
Barium	0.088		YES	5170-93	MW199	mg/L
Barium	0.094		YES	5260-94	MW199	mg/L
Barium	0.116		YES	6074-94	MW199	mg/L
Barium	0.117		YES	7311-93	MW199	mg/L
Barium	0.12		YES	6866-94	MW199	mg/L
Barium	0.132		YES	4312-94	MW199	mg/L
Barium	0.132		YES	5556-97	MW199	mg/L
Barium	0.144		YES	5964-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Barium							
	0.01	0.122	0.091	0.139	0.163	0.088		
	0.038	0.127	0.094	0.145	0.176	0.094		
	0.039	0.13	0.094	0.149	0.19	0.116		
	0.04	0.2	0.096	0.156	0.199	0.117		
	0.046		0.099	0.16	0.282	0.12		
	0.048		0.11	0.16		0.132		
	0.05		0.116	0.165		0.132		
	0.05			0.167		0.144		
	0.05			0.168				
	0.05			0.172				
Min	0.010	0.122	0.091	0.139	0.163	0.088	0.010	
Max	0.050	0.200	0.116	0.172	0.282	0.144	0.282	
Average	0.042	0.145	0.100	0.158	0.202	0.118	0.119	0.127
Number	10	4	7	10	5	8	44	



MW 103 - Two nondetects with results greater than the maximum detected value were changed to the maximum detected value (0.05 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

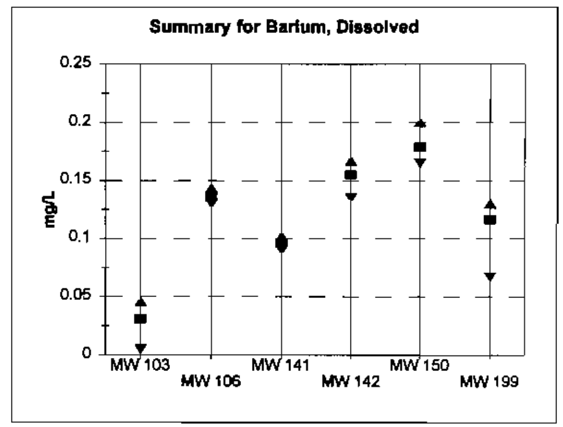
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Barium, Dissolved	0.005	<	NO	5944-93	MW103	mg/L
Barium, Dissolved	0.031		YES	6026-94	MW103	mg/L
Barium, Dissolved	0.039		YES	7299-93	MW103	mg/L
Barium, Dissolved	0.041		YES	4272-94	MW103	mg/L
Barium, Dissolved	0.045		YES	5176-93	MW103	mg/L
Barium, Dissolved	0.046		YES	5187-94	MW103	mg/L
Barium, Dissolved	0.07	<	NO	6774-94	MW103	mg/L
Barium, Dissolved	0.07	<	NO	5440-95	MW103	mg/L
Barium, Dissolved		Q	NO	5265-96	MW103	
Barium, Dissolved		Q	NO	5142-97	MW103	
Barium, Dissolved	0.13		YES	7272-94	MW106	mg/L
Barium, Dissolved	0.134		YES	4697-94	MW106	mg/L
Barium, Dissolved	0.136		YES	5444-95	MW106	mg/L
Barium, Dissolved	0.143		YES	5322-93	MW106	mg/L
Barium, Dissolved	0.09		YES	5199-94	MW141	mg/L
Barium, Dissolved	0.092		YES	7085-93	MW141	mg/L
Barium, Dissolved	0.095		YES	6080-93	MW141	mg/L
Barium, Dissolved	0.096		YES	4229-94	MW141	mg/L
Barium, Dissolved	0.097		YES	6666-94	MW141	mg/L
Barium, Dissolved	0.101		YES	6054-94	MW141	mg/L
Barium, Dissolved	0.102		YES	6092-93	MW141	mg/L
Barium, Dissolved	0.135		YES	5147-97	MW142	mg/L
Barium, Dissolved	0.146		YES	5203-94	MW142	mg/L
Barium, Dissolved	0.147		YES	5317-96	MW142	mg/L
Barium, Dissolved	0.15		YES	7069-93	MW142	mg/L
Barium, Dissolved	0.152		YES	6084-93	MW142	mg/L
Barium, Dissolved	0.18		YES	6672-94	MW142	mg/L
Barium, Dissolved	0.162		YES	4233-94	MW142	mg/L
Barium, Dissolved	0.164		YES	6096-93	MW142	mg/L
Barium, Dissolved	0.168		YES	6056-94	MW142	mg/L
Barium, Dissolvad	0.167		YES	5484-95	MW142	mg/L
Barium, Dissolved	0.165		YES	5321-96	MW150	mg/L
Barium, Dissolved	0.167		YES	5146-97	MW150	mg/L
Barium, Dissolved	0.177		YES	5650-93	MW150	mg/L
Barium, Dissolved	0.185		YES	4789-94	MW150	mg/L
Barium, Dissolved	0.2		YES	5466-95	MW150	mg/L
Barium, Dissolved	0.067		YES	5170-93	MW199	mg/L
Barium, Dissolved	0.116		YES	5558-97	MW199	mg/L
Barium, Dissolved	0.119		YES	5260-94	MW199	mg/L
Barium, Dissolved	0.12		YES	6666-94	MW199	mg/L
Barium, Dissolved	0.121		YES	6074-94	MW199	mg/L
Barium, Dissolved	0.125		YES	7311-93	MW199	mg/L
Barium, Dissolved	0.13		YES	5984-93	MW199	mg/L
Barium, Dissolved	0.13		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Barium, Dissolved							
	0.005	0.13	0.09	0.135	0.165	0.067		
	0.031	0.134	0.092	0.146	0.167	0.118		
	0.039	0.136	0.095	0.147	0.177	0.119		
	0.041	0.143	0.096	0.15	0.165	0.12		
	0.045		0.097	0.152	0.2	0.121		
	0.046		0.101	0.16		0.125		
	0.046		0.102	0.162		0.13		
	0.046			0.164		0.13		
	0.005			0.166				
	0.005			0.167				
Min	0.005	0.130	0.090	0.135	0.165	0.067	0.005	
Max	0.046	0.143	0.102	0.167	0.200	0.130	0.200	
Average	0.031	0.136	0.096	0.155	0.179	0.116	0.111	0.119
Number	10	4	7	10	5	8	44	



MW 103 - Two nondetects with results greater than the maximum detected value were changed to the maximum detected value (0.046 mg/L); two "Q" qualified data points were assigned the minimum nondetected result.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

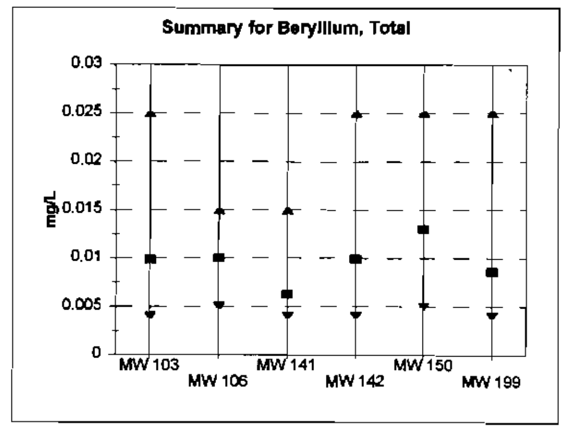
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Beryllium	0.004	<	NO	6026-94	MW103	mg/L
Beryllium	0.005	<	NO	5178-93	MW103	mg/L
Beryllium	0.005	<	NO	5944-93	MW103	mg/L
Beryllium	0.005	<	NO	7299-93	MW103	mg/L
Beryllium	0.005	<	NO	4272-94	MW103	mg/L
Beryllium	0.005	<	NO	5187-94	MW103	mg/L
Beryllium	0.015	<	NO	6774-94	MW103	mg/L
Beryllium	0.015	<	NO	5440-95	MW103	mg/L
Beryllium	0.015	<	NO	5285-96	MW103	mg/L
Beryllium	0.025	<	NO	5142-97	MW103	mg/L
Beryllium	0.005	<	NO	5322-93	MW106	mg/L
Beryllium	0.005	<	NO	4697-94	MW106	mg/L
Beryllium	0.015	<	NO	7272-94	MW106	mg/L
Beryllium	0.015	<	NO	5444-95	MW106	mg/L
Beryllium	0.004	<	NO	6054-94	MW141	mg/L
Beryllium	0.005	<	NO	6080-93	MW141	mg/L
Beryllium	0.005	<	NO	8092-93	MW141	mg/L
Beryllium	0.005	<	NO	7085-93	MW141	mg/L
Beryllium	0.005	<	NO	4229-94	MW141	mg/L
Beryllium	0.005	<	NO	5199-94	MW141	mg/L
Beryllium	0.015	<	NO	6666-94	MW141	mg/L
Beryllium	0.004	<	NO	6058-94	MW142	mg/L
Beryllium	0.005	<	NO	6084-93	MW142	mg/L
Beryllium	0.005	<	NO	6096-93	MW142	mg/L
Beryllium	0.005	<	NO	7089-93	MW142	mg/L
Beryllium	0.005	<	NO	4233-94	MW142	mg/L
Beryllium	0.005	<	NO	5203-94	MW142	mg/L
Beryllium	0.015	<	NO	6672-94	MW142	mg/L
Beryllium	0.015	<	NO	5484-95	MW142	mg/L
Beryllium	0.015	<	NO	5317-96	MW142	mg/L
Beryllium	0.025	<	NO	5147-97	MW142	mg/L
Beryllium	0.005	<	NO	5650-93	MW150	mg/L
Beryllium	0.005	<	NO	4789-94	MW150	mg/L
Beryllium	0.015	<	NO	5468-95	MW150	mg/L
Beryllium	0.015	<	NO	5321-96	MW150	mg/L
Beryllium	0.025	<	NO	5148-97	MW150	mg/L
Beryllium	0.004	<	NO	8074-94	MW199	mg/L
Beryllium	0.005	<	NO	5170-93	MW199	mg/L
Beryllium	0.005	<	NO	5984-93	MW199	mg/L
Beryllium	0.005	<	NO	7311-93	MW199	mg/L
Beryllium	0.005	<	NO	4312-94	MW199	mg/L
Beryllium	0.005	<	NO	5260-94	MW199	mg/L
Beryllium	0.015	<	NO	6666-94	MW199	mg/L
Beryllium	0.025	<	NO	5556-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Beryllium							
	0.004	0.005	0.004	0.004	0.005	0.004		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.015	0.005	0.005	0.015	0.005		
	0.005	0.015	0.005	0.005	0.015	0.005		
	0.005		0.005	0.005	0.025	0.005		
	0.005		0.005	0.005		0.005		
	0.015		0.015	0.015		0.015		
	0.015			0.015		0.025		
	0.015			0.015				
	0.025			0.025				
Min	0.004	0.005	0.004	0.004	0.005	0.004	0.004	
Max	0.025	0.015	0.015	0.025	0.025	0.025	0.025	
Average	0.010	0.010	0.006	0.010	0.013	0.009	0.009	0.010
Number	10	4	7	10	5	8	44	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

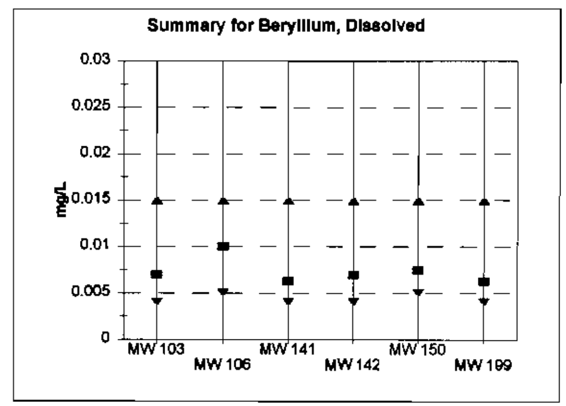
Data for Beryllium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Beryllium, Dissolved	0.004	<	NO	6026-94	MW103	mg/L
Beryllium, Dissolved	0.005	<	NO	5178-93	MW103	mg/L
Beryllium, Dissolved	0.005	<	NO	5944-93	MW103	mg/L
Beryllium, Dissolved	0.005	<	NO	7299-93	MW103	mg/L
Beryllium, Dissolved	0.005	<	NO	4272-94	MW103	mg/L
Beryllium, Dissolved	0.005	<	NO	5187-94	MW103	mg/L
Beryllium, Dissolved	0.015	<	NO	6774-94	MW103	mg/L
Beryllium, Dissolved	0.015	<	NO	5440-95	MW103	mg/L
Beryllium, Dissolved		Q	NO	5285-96	MW103	
Beryllium, Dissolved	0.005	<	NO	5322-93	MW106	mg/L
Beryllium, Dissolved	0.005	<	NO	4697-94	MW106	mg/L
Beryllium, Dissolved	0.015	<	NO	7272-94	MW106	mg/L
Beryllium, Dissolved	0.015	<	NO	5444-95	MW106	mg/L
Beryllium, Dissolved	0.004	<	NO	6054-94	MW141	mg/L
Beryllium, Dissolved	0.005	<	NO	6080-93	MW141	mg/L
Beryllium, Dissolved	0.005	<	NO	6092-93	MW141	mg/L
Beryllium, Dissolved	0.005	<	NO	7085-93	MW141	mg/L
Beryllium, Dissolved	0.005	<	NO	4229-94	MW141	mg/L
Beryllium, Dissolved	0.005	<	NO	5199-94	MW141	mg/L
Beryllium, Dissolved	0.015	<	NO	6868-94	MW141	mg/L
Beryllium, Dissolved	0.004	<	NO	6058-94	MW142	mg/L
Beryllium, Dissolved	0.005	<	NO	6084-93	MW142	mg/L
Beryllium, Dissolved	0.005	<	NO	6096-93	MW142	mg/L
Beryllium, Dissolved	0.005	<	NO	7089-93	MW142	mg/L
Beryllium, Dissolved	0.005	<	NO	4233-94	MW142	mg/L
Beryllium, Dissolved	0.005	<	NO	5203-94	MW142	mg/L
Beryllium, Dissolved	0.015	<	NO	6672-94	MW142	mg/L
Beryllium, Dissolved	0.015	<	NO	5484-95	MW142	mg/L
Beryllium, Dissolved		Q	NO	5317-98	MW142	
Beryllium, Dissolved	0.005	<	NO	5650-93	MW150	mg/L
Beryllium, Dissolved	0.005	<	NO	4789-94	MW150	mg/L
Beryllium, Dissolved	0.015	<	NO	5466-95	MW150	mg/L
Beryllium, Dissolved		Q	NO	5321-96	MW150	
Beryllium, Dissolved	0.004	<	NO	6074-94	MW199	mg/L
Beryllium, Dissolved	0.005	<	NO	5170-93	MW199	mg/L
Beryllium, Dissolved	0.005	<	NO	5984-93	MW199	mg/L
Beryllium, Dissolved	0.005	<	NO	7311-93	MW199	mg/L
Beryllium, Dissolved	0.005	<	NO	4312-94	MW199	mg/L
Beryllium, Dissolved	0.005	<	NO	5260-94	MW199	mg/L
Beryllium, Dissolved	0.015	<	NO	6888-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Beryllium, Dissolved							
	0.004	0.005	0.004	0.004	0.005	0.004		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.015	0.005	0.005	0.015	0.005		
	0.005	0.015	0.005	0.005	0.005	0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.015		0.015	0.015		0.015		
	0.015			0.015				
	0.004			0.004				
Min	0.004	0.005	0.004	0.004	0.005	0.004	0.004	
Max	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
Average	0.007	0.010	0.006	0.007	0.008	0.006	0.007	0.007
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.004 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.004 mg/L).

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L).

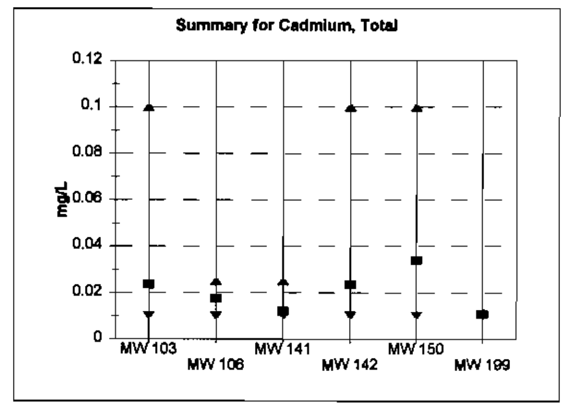
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Cadmium	0.01	<	NO	5178-93	MW103	mg/L
Cadmium	0.01	<	NO	5944-93	MW103	mg/L
Cadmium	0.01	<	NO	7299-93	MW103	mg/L
Cadmium	0.01	<	NO	4272-94	MW103	mg/L
Cadmium	0.01	<	NO	5187-94	MW103	mg/L
Cadmium	0.01	<	NO	6026-94	MW103	mg/L
Cadmium	0.025	<	NO	6774-94	MW103	mg/L
Cadmium	0.025	<	NO	5440-95	MW103	mg/L
Cadmium	0.025	<	NO	5285-96	MW103	mg/L
Cadmium	0.1	<	NO	5142-97	MW103	mg/L
Cadmium	0.01	<	NO	5322-93	MW106	mg/L
Cadmium	0.01	<	NO	4697-94	MW106	mg/L
Cadmium	0.025	<	NO	7272-94	MW106	mg/L
Cadmium	0.025	<	NO	5444-95	MW106	mg/L
Cadmium	0.01	<	NO	6080-93	MW141	mg/L
Cadmium	0.01	<	NO	6092-93	MW141	mg/L
Cadmium	0.01	<	NO	7085-93	MW141	mg/L
Cadmium	0.01	<	NO	4229-94	MW141	mg/L
Cadmium	0.01	<	NO	5199-94	MW141	mg/L
Cadmium	0.01	<	NO	6054-94	MW141	mg/L
Cadmium	0.025	<	NO	6668-94	MW141	mg/L
Cadmium	0.01	<	NO	6084-93	MW142	mg/L
Cadmium	0.01	<	NO	6098-93	MW142	mg/L
Cadmium	0.01	<	NO	7089-93	MW142	mg/L
Cadmium	0.01	<	NO	4233-94	MW142	mg/L
Cadmium	0.01	<	NO	5203-94	MW142	mg/L
Cadmium	0.01	<	NO	6058-94	MW142	mg/L
Cadmium	0.025	<	NO	6672-94	MW142	mg/L
Cadmium	0.025	<	NO	5484-95	MW142	mg/L
Cadmium	0.025	<	NO	5317-96	MW142	mg/L
Cadmium	0.1	<	NO	5147-97	MW142	mg/L
Cadmium	0.01	<	NO	5650-93	MW150	mg/L
Cadmium	0.01	<	NO	4789-94	MW150	mg/L
Cadmium	0.025	<	NO	5468-95	MW150	mg/L
Cadmium	0.025	<	NO	5321-96	MW150	mg/L
Cadmium	0.1	<	NO	5148-97	MW150	mg/L
Cadmium	0.01	<	NO	5170-93	MW199	mg/L
Cadmium	0.01	<	NO	5984-93	MW199	mg/L
Cadmium	0.01	<	NO	7311-93	MW199	mg/L
Cadmium	0.01	<	NO	4312-94	MW199	mg/L
Cadmium	0.01	<	NO	6074-94	MW199	mg/L
Cadmium	0.012		YES	5260-94	MW199	mg/L
Cadmium	0.025	<	NO	6888-94	MW199	mg/L
Cadmium	0.1	<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Cadmium							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.025	0.01	0.01	0.025	0.01		
	0.01	0.025	0.01	0.01	0.025	0.01		
	0.01		0.01	0.01	0.1	0.01		
	0.01		0.01	0.01		0.012		
	0.025		0.025	0.025		0.012		
	0.025			0.025		0.012		
	0.025			0.025				
	0.1			0.1				
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.100	0.025	0.025	0.100	0.100	0.012	0.100	
Average	0.024	0.016	0.012	0.024	0.034	0.011	0.020	0.020
Number	10	4	7	10	5	8	44	



MW 103 - Data were not modified.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modified.

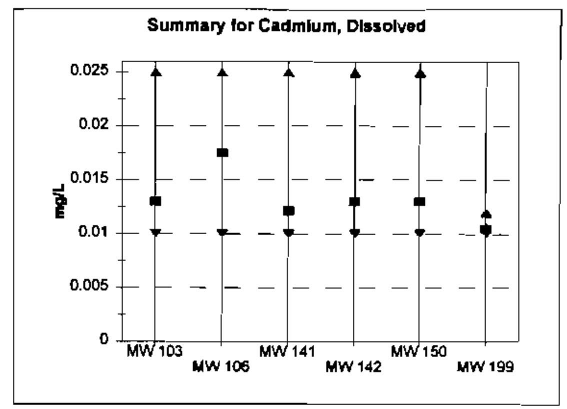
MW 199 - Two nondetected results greater than than the maximum detected value were reduced to the maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Cadmium, Dissolved	0.01	<	NO	5178-93	MW103	mg/L
Cadmium, Dissolved	0.01	<	NO	5944-93	MW103	mg/L
Cadmium, Dissolved	0.01	<	NO	7299-93	MW103	mg/L
Cadmium, Dissolved	0.01	<	NO	4272-94	MW103	mg/L
Cadmium, Dissolved	0.01	<	NO	5187-94	MW103	mg/L
Cadmium, Dissolved	0.01	<	NO	6026-94	MW103	mg/L
Cadmium, Dissolved	0.025	<	NO	8774-94	MW103	mg/L
Cadmium, Dissolved	0.025	<	NO	5440-95	MW103	mg/L
Cadmium, Dissolved		Q	NO	5265-96	MW103	
Cadmium, Dissolved		Q	NO	5142-97	MW103	
Cadmium, Dissolved	0.01	<	NO	5322-93	MW106	mg/L
Cadmium, Dissolved	0.01	<	NO	4697-94	MW106	mg/L
Cadmium, Dissolved	0.025	<	NO	7272-94	MW106	mg/L
Cadmium, Dissolved	0.025	<	NO	5444-95	MW106	mg/L
Cadmium, Dissolved	0.01	<	NO	6060-93	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	8092-93	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	7065-93	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	4229-94	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	5199-94	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	6054-94	MW141	mg/L
Cadmium, Dissolved	0.025	<	NO	8868-94	MW141	mg/L
Cadmium, Dissolved	0.01	<	NO	6084-93	MW142	mg/L
Cadmium, Dissolved	0.01	<	NO	8096-93	MW142	mg/L
Cadmium, Dissolved	0.01	<	NO	7089-93	MW142	mg/L
Cadmium, Dissolved	0.01	<	NO	4233-94	MW142	mg/L
Cadmium, Dissolved	0.01	<	NO	5203-94	MW142	mg/L
Cadmium, Dissolved	0.01	<	NO	6056-94	MW142	mg/L
Cadmium, Dissolved	0.025	<	NO	8672-94	MW142	mg/L
Cadmium, Dissolved	0.025	<	NO	5464-95	MW142	mg/L
Cadmium, Dissolved		O	NO	5317-98	MW142	
Cadmium, Dissolved		O	NO	5147-97	MW142	
Cadmium, Dissolved	0.01	<	NO	5650-93	MW150	mg/L
Cadmium, Dissolved	0.01	<	NO	4789-94	MW150	mg/L
Cadmium, Dissolved	0.025	<	NO	5468-95	MW150	mg/L
Cadmium, Dissolved		O	NO	5321-96	MW150	
Cadmium, Dissolved		O	NO	5146-97	MW150	
Cadmium, Dissolved	0.01	<	NO	5170-93	MW199	mg/L
Cadmium, Dissolved	0.01	<	NO	5964-93	MW199	mg/L
Cadmium, Dissolved	0.01	<	NO	7311-93	MW199	mg/L
Cadmium, Dissolved	0.01	<	NO	4312-94	MW199	mg/L
Cadmium, Dissolved	0.01	<	NO	6074-94	MW199	mg/L
Cadmium, Dissolved	0.012		YES	5260-94	MW199	mg/L
Cadmium, Dissolved	0.025	<	NO	8886-94	MW199	mg/L
Cadmium, Dissolved		Q	NO	5556-97	MW199	

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Cadmium, Dissolved							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.025	0.01	0.01	0.025	0.01		
	0.01	0.025	0.01	0.01	0.01	0.01		
	0.01		0.01	0.01	0.01	0.01		
	0.01		0.01	0.01		0.012		
	0.025		0.025	0.025		0.012		
	0.025			0.025		0.01		
	0.01			0.01				
	0.01			0.01				
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.025	0.025	0.025	0.025	0.025	0.012	0.025	
Average	0.013	0.016	0.012	0.013	0.013	0.011	0.013	0.013
Number	10	4	7	10	5	8	44	



MW 103 - Two "Q" qualified results assigned value of minimum nondetected result (0.01 mg/L)

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Two "Q" qualified results assigned value of minimum nondetected result (0.01 mg/L).

MW 150 - Two "Q" qualified results given value of minimum detection limit for samples from this well (0.01 mg/l).

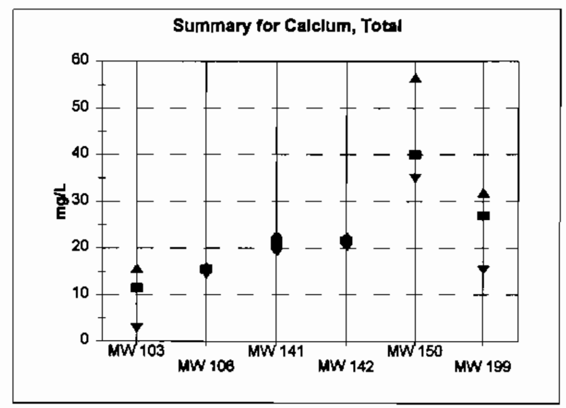
MW 199 - One "Q" qualified result assigned value of minimum nondetected result (0.01 mg/L).

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Calcium	2.88		YES	5944-93	MW103	mg/L
Calcium	10.8		YES	6026-94	MW103	mg/L
Calcium	11.2		YES	6774-94	MW103	mg/L
Calcium	11.3		YES	7299-93	MW103	mg/L
Calcium	11.7		YES	5187-94	MW103	mg/L
Calcium	12.4		YES	5440-95	MW103	mg/L
Calcium	12.5		YES	4272-94	MW103	mg/L
Calcium	12.75		YES	5178-93	MW103	mg/L
Calcium	13	N	YES	5285-96	MW103	mg/L
Calcium	15.6	N	YES	5142-97	MW103	mg/L
Calcium	14.4		YES	4897-94	MW106	mg/L
Calcium	15.6		YES	5322-93	MW106	mg/L
Calcium	16		YES	7272-94	MW106	mg/L
Calcium	16		YES	5444-95	MW106	mg/L
Calcium	19.03		YES	6054-94	MW141	mg/L
Calcium	20.3		YES	5199-94	MW141	mg/L
Calcium	20.35		YES	6080-93	MW141	mg/L
Calcium	20.5		YES	7065-93	MW141	mg/L
Calcium	21.5		YES	4229-94	MW141	mg/L
Calcium	22		YES	6866-94	MW141	mg/L
Calcium	23		YES	6092-93	MW141	mg/L
Calcium	20.1		YES	7089-93	MW142	mg/L
Calcium	20.6		YES	5203-94	MW142	mg/L
Calcium	20.9		YES	5464-95	MW142	mg/L
Calcium	21.39		YES	6084-93	MW142	mg/L
Calcium	21.7	N	YES	5147-97	MW142	mg/L
Calcium	22		YES	4233-94	MW142	mg/L
Calcium	22		YES	6872-94	MW142	mg/L
Calcium	22.4		YES	6096-93	MW142	mg/L
Calcium	22.4	N	YES	5317-96	MW142	mg/L
Calcium	22.62		YES	6058-94	MW142	mg/L
Calcium	35		YES	5468-95	MW150	mg/L
Calcium	35.2		YES	4789-94	MW150	mg/L
Calcium	36.6		YES	5650-93	MW150	mg/L
Calcium	36.6	N	YES	5321-96	MW150	mg/L
Calcium	56.5	N	YES	5148-97	MW150	mg/L
Calcium	15.31		YES	5170-93	MW199	mg/L
Calcium	25.8		YES	5260-94	MW199	mg/L
Calcium	26.8		YES	6074-94	MW199	mg/L
Calcium	27	N	YES	5558-97	MW199	mg/L
Calcium	27.8		YES	7311-93	MW199	mg/L
Calcium	30		YES	6868-94	MW199	mg/L
Calcium	30.7		YES	4312-94	MW199	mg/L
Calcium	31.9		YES	5964-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Calcium							
	2.88	14.4	19.03	20.1	35	15.31		
	10.8	15.6	20.3	20.6	35.2	25.8		
	11.2	16	20.35	20.9	36.6	26.8		
	11.3	16	20.5	21.39	36.8	27		
	11.7		21.5	21.7	56.5	27.8		
	12.4		22	22		30		
	12.5		23	22		30.7		
	12.75			22.4		31.9		
	13			22.4				
	15.6			22.62				
Min	2.880	14.400	19.030	20.100	35.000	15.310	2.880	
Max	15.600	18.000	23.000	22.620	56.500	31.900	56.500	
Average	11.413	15.500	20.954	21.611	40.020	26.914	21.689	22.735
Number	10	4	7	10	5	8	44	



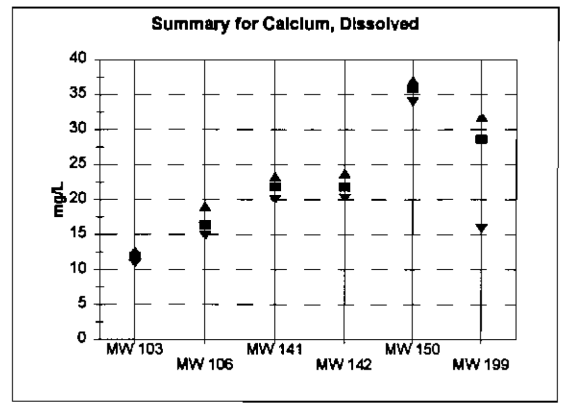
Data for Calcium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Calcium, Dissolved	0.026		YES	5944-93	MW103	mg/L
Calcium, Dissolved	10.9		YES	7299-93	MW103	mg/L
Calcium, Dissolved	11.7		YES	6774-94	MW103	mg/L
Calcium, Dissolved	11.8	N	YES	5265-96	MW103	mg/L
Calcium, Dissolved	11.9		YES	5187-94	MW103	mg/L
Calcium, Dissolved	11.91		YES	5176-93	MW103	mg/L
Calcium, Dissolved	12		YES	4272-94	MW103	mg/L
Calcium, Dissolved	12.2		YES	6028-94	MW103	mg/L
Calcium, Dissolved	12.6		YES	5440-95	MW103	mg/L
Calcium, Dissolved	14.8		YES	4697-94	MW106	mg/L
Calcium, Dissolved	15.1		YES	5322-93	MW106	mg/L
Calcium, Dissolved	16.5		YES	5444-95	MW106	mg/L
Calcium, Dissolved	19		YES	7272-94	MW106	mg/L
Calcium, Dissolved	20		YES	7085-93	MW141	mg/L
Calcium, Dissolved	20.7		YES	6080-93	MW141	mg/L
Calcium, Dissolved	21.4		YES	5199-94	MW141	mg/L
Calcium, Dissolved	22.1		YES	6092-93	MW141	mg/L
Calcium, Dissolved	22.3		YES	4229-94	MW141	mg/L
Calcium, Dissolved	23		YES	8686-94	MW141	mg/L
Calcium, Dissolved	23.27		YES	6054-94	MW141	mg/L
Calcium, Dissolved	20.2	N	YES	5317-96	MW142	mg/L
Calcium, Dissolved	20.4		YES	7089-93	MW142	mg/L
Calcium, Dissolved	20.93		YES	6084-93	MW142	mg/L
Calcium, Dissolved	21.3		YES	5464-95	MW142	mg/L
Calcium, Dissolved	21.5		YES	5203-94	MW142	mg/L
Calcium, Dissolved	22		YES	6098-93	MW142	mg/L
Calcium, Dissolved	22.9		YES	4233-94	MW142	mg/L
Calcium, Dissolved	23		YES	8672-94	MW142	mg/L
Calcium, Dissolved	23.72		YES	6056-94	MW142	mg/L
Calcium, Dissolved	34	N	YES	5321-96	MW150	mg/L
Calcium, Dissolved	36		YES	4789-94	MW150	mg/L
Calcium, Dissolved	36.3		YES	5650-93	MW150	mg/L
Calcium, Dissolved	37		YES	5466-95	MW150	mg/L
Calcium, Dissolved	15.86		YES	5170-93	MW199	mg/L
Calcium, Dissolved	28.4		YES	7311-93	MW199	mg/L
Calcium, Dissolved	30.2		YES	6074-94	MW199	mg/L
Calcium, Dissolved	31		YES	8868-94	MW199	mg/L
Calcium, Dissolved	31.4		YES	5984-93	MW199	mg/L
Calcium, Dissolved	31.6		YES	5260-94	MW199	mg/L
Calcium, Dissolved	31.8		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Calcium, Dissolved							
	10.9	14.8	20	20.2	34	15.86		
	10.9	15.1	20.7	20.4	36	28.4		
	11.7	16.5	21.4	20.93	36.3	30.2		
	11.8	19	22.1	21.3	37	31		
	11.9		22.3	21.5		31.4		
	11.91		23	22		31.6		
	12		23.27	22.9		31.8		
	12.2			23				
	12.6			23.72				
Min	10.900	14.800	20.000	20.200	34.000	15.860	10.900	
Max	12.600	19.000	23.270	23.720	37.000	31.800	37.000	
Average	11.768	16.350	21.824	21.772	35.825	28.609	21.590	22.691
Number	9	4	7	9	4	7	40	



MW 103 - Very small value (0.026 mg/L) was changed to next lowest detected value (10.9 mg/L) as an outlier.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data not modified.

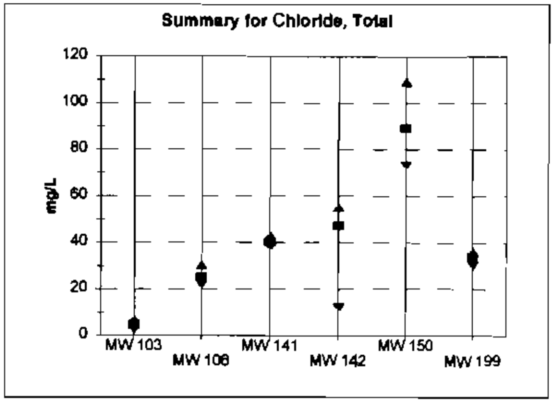
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Chloride	2.9		YES	5142-97	MW103	mg/L
Chloride	3.1		YES	5285-96	MW103	mg/L
Chloride	3.4		YES	6026-94	MW103	mg/L
Chloride	3.5		YES	5440-95	MW103	mg/L
Chloride	3.9		YES	8774-94	MW103	mg/L
Chloride	5		YES	5178-93	MW103	mg/L
Chloride	6		YES	4272-94	MW103	mg/L
Chloride	6		YES	5187-94	MW103	mg/L
Chloride	7		YES	5944-93	MW103	mg/L
Chloride	7		YES	7299-93	MW103	mg/L
Chloride	22		YES	5322-93	MW106	mg/L
Chloride	23		YES	4897-94	MW106	mg/L
Chloride	30.5		YES	5444-95	MW106	mg/L
Chloride	38		YES	6080-93	MW141	mg/L
Chloride	39		YES	7085-93	MW141	mg/L
Chloride	39		YES	4229-94	MW141	mg/L
Chloride	40		YES	6092-93	MW141	mg/L
Chloride	40		YES	5199-94	MW141	mg/L
Chloride	42.4		YES	6868-94	MW141	mg/L
Chloride	42.9		YES	6054-94	MW141	mg/L
Chloride	12		YES	6058-94	MW142	mg/L
Chloride	48		YES	4233-94	MW142	mg/L
Chloride	48.4		YES	5147-97	MW142	mg/L
Chloride	49		YES	7089-93	MW142	mg/L
Chloride	49		YES	5203-94	MW142	mg/L
Chloride	52		YES	8084-93	MW142	mg/L
Chloride	52.4		YES	6872-94	MW142	mg/L
Chloride	52.9		YES	5317-96	MW142	mg/L
Chloride	53.2		YES	5464-95	MW142	mg/L
Chloride	55		YES	6098-93	MW142	mg/L
Chloride	73		YES	5850-93	MW150	mg/L
Chloride	83		YES	4769-94	MW150	mg/L
Chloride	83.8	B	YES	5321-96	MW150	mg/L
Chloride	97.1		YES	5468-95	MW150	mg/L
Chloride	109.1		YES	5148-97	MW150	mg/L
Chloride	30		YES	5170-93	MW199	mg/L
Chloride	33		YES	7311-93	MW199	mg/L
Chloride	33		YES	5280-94	MW199	mg/L
Chloride	33.8		YES	6886-94	MW199	mg/L
Chloride	34.5		YES	6074-94	MW199	mg/L
Chloride	35		YES	4312-94	MW199	mg/L
Chloride	35.9		YES	5558-97	MW199	mg/L
Chloride	36		YES	5984-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Chloride							
	2.9	22	38	12	73	30		
	3.1	23	39	48	83	33		
	3.4	30.5	39	48.4	83.8	33		
	3.5		40	49	97.1	33.8		
	3.9		40	49	109.1	34.5		
	5		42.4	52		35		
	6		42.9	52.4		35.9		
	6			52.9		36		
	7			53.2				
	7			55				
Min	2.900	22.000	38.000	12.000	73.000	30.000	2.900	
Max	7.000	30.500	42.900	55.000	109.100	36.000	109.100	
Average	4.780	25.167	40.186	47.190	89.200	33.900	37.063	40.070
Number	10	3	7	10	5	8	43	



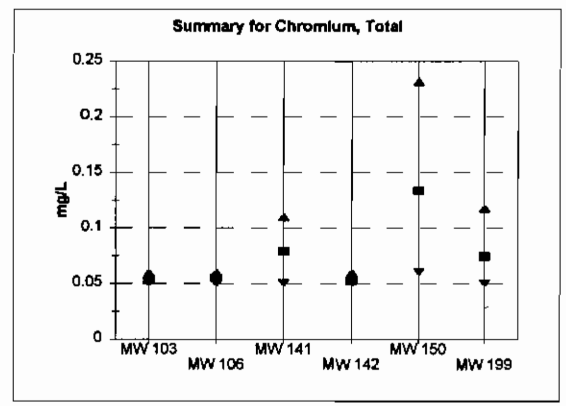
Data for Chloride, Total was not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Chromium	0.05	<	NO	5178-93	MW103	mg/L
Chromium	0.05	<	NO	5944-93	MW103	mg/L
Chromium	0.05	<	NO	7299-93	MW103	mg/L
Chromium	0.05	<	NO	4272-94	MW103	mg/L
Chromium	0.05	<	NO	5187-94	MW103	mg/L
Chromium	0.05	<	NO	6026-94	MW103	mg/L
Chromium	0.06	<	NO	6774-94	MW103	mg/L
Chromium	0.06	<	NO	5440-95	MW103	mg/L
Chromium	0.05	<	NO	5322-93	MW106	mg/L
Chromium	0.05	<	NO	4697-94	MW106	mg/L
Chromium	0.06	<	NO	7272-94	MW106	mg/L
Chromium	0.06	<	NO	5444-95	MW106	mg/L
Chromium	0.05	<	NO	4229-94	MW141	mg/L
Chromium	0.053		YES	7065-93	MW141	mg/L
Chromium	0.067		YES	6060-93	MW141	mg/L
Chromium	0.074		YES	6054-94	MW141	mg/L
Chromium	0.089		YES	5199-94	MW141	mg/L
Chromium	0.11		YES	6668-94	MW141	mg/L
Chromium	0.926		YES	6092-93	MW141	mg/L
Chromium	0.05	<	NO	6084-93	MW142	mg/L
Chromium	0.05	<	NO	6096-93	MW142	mg/L
Chromium	0.05	<	NO	7089-93	MW142	mg/L
Chromium	0.05	<	NO	4233-94	MW142	mg/L
Chromium	0.05	<	NO	5203-94	MW142	mg/L
Chromium	0.05	<	NO	6058-94	MW142	mg/L
Chromium	0.06	<	NO	6872-94	MW142	mg/L
Chromium	0.06	<	NO	5464-95	MW142	mg/L
Chromium	0.06	<	NO	5468-95	MW150	mg/L
Chromium	0.109		YES	5850-93	MW150	mg/L
Chromium	0.232		YES	4769-94	MW150	mg/L
Chromium	0.05	<	NO	5984-93	MW199	mg/L
Chromium	0.05	<	NO	5260-94	MW199	mg/L
Chromium	0.05	<	NO	6074-94	MW199	mg/L
Chromium	0.06	<	NO	6888-94	MW199	mg/L
Chromium	0.093		YES	4312-94	MW199	mg/L
Chromium	0.1		YES	7311-93	MW199	mg/L
Chromium	0.118		YES	5170-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Chromium							
	0.05	0.05	0.05	0.05	0.06	0.05		
	0.05	0.05	0.053	0.05	0.109	0.05		
	0.05	0.06	0.067	0.05	0.232	0.05		
	0.05	0.06	0.074	0.05		0.06		
	0.05		0.089	0.05		0.093		
	0.05		0.11	0.05		0.1		
	0.06		0.11	0.06		0.118		
	0.06			0.06				
Min	0.050	0.050	0.050	0.050	0.060	0.050	0.050	
Max	0.060	0.060	0.110	0.060	0.232	0.118	0.232	
Average	0.053	0.055	0.079	0.053	0.134	0.074	0.069	0.075
Number	8	4	7	8	3	7	37	



MW 103 - Data not modified.

MW 106 - Data not modified.

MW 141 - Value of 0.926 mg/L was much greater than other values for this well and determined to be related to the turbidity of the sample. Therefore, this value for this sample reduced to next highest value.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

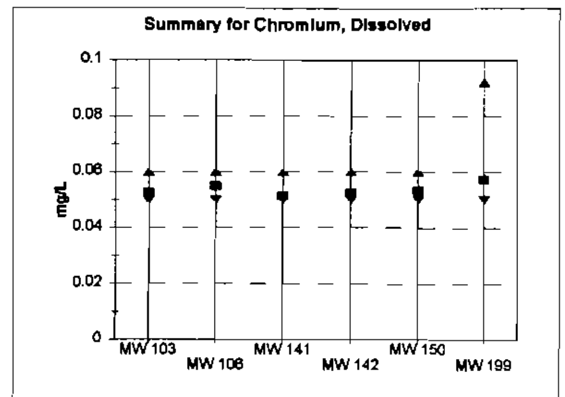
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Chromium, Dissolved	0.05	<	NO	5176-93	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	5944-93	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	5187-94	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	6026-94	MW103	mg/L
Chromium, Dissolved	0.06	<	NO	6774-94	MW103	mg/L
Chromium, Dissolved	0.06	<	NO	5440-95	MW103	mg/L
Chromium, Dissolved	0.05	<	NO	5322-93	MW106	mg/L
Chromium, Dissolved	0.05	<	NO	4697-94	MW106	mg/L
Chromium, Dissolved	0.06	<	NO	7272-94	MW106	mg/L
Chromium, Dissolved	0.06	<	NO	5444-95	MW106	mg/L
Chromium, Dissolved	0.05	<	NO	6080-93	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	6092-93	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	7085-93	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	4229-94	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	5199-94	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	6054-94	MW141	mg/L
Chromium, Dissolved	0.08	<	NO	6868-94	MW141	mg/L
Chromium, Dissolved	0.05	<	NO	6084-93	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	6096-93	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	7089-93	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	5203-94	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	6056-94	MW142	mg/L
Chromium, Dissolved	0.06	<	NO	6872-94	MW142	mg/L
Chromium, Dissolved	0.06	<	NO	5464-95	MW142	mg/L
Chromium, Dissolved	0.05	<	NO	5850-93	MW150	mg/L
Chromium, Dissolved	0.05	<	NO	4789-94	MW150	mg/L
Chromium, Dissolved	0.06	<	NO	5466-95	MW150	mg/L
Chromium, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Chromium, Dissolved	0.05	<	NO	5984-93	MW199	mg/L
Chromium, Dissolved	0.05	<	NO	4312-94	MW199	mg/L
Chromium, Dissolved	0.05	<	NO	5260-94	MW199	mg/L
Chromium, Dissolved	0.05	<	NO	6074-94	MW199	mg/L
Chromium, Dissolved	0.06	<	NO	6868-94	MW199	mg/L
Chromium, Dissolved	0.092		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Chromium, Dissolved							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.06	0.05	0.05	0.06	0.05		
	0.05	0.06	0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.06		
	0.06		0.06	0.06		0.092		
	0.06			0.06				
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.060	0.060	0.060	0.060	0.060	0.092	0.092	
Average	0.053	0.055	0.051	0.053	0.053	0.057	0.054	0.054
Number	8	4	7	8	3	7	37	



Data for Chromium, Dissolved were not modified.

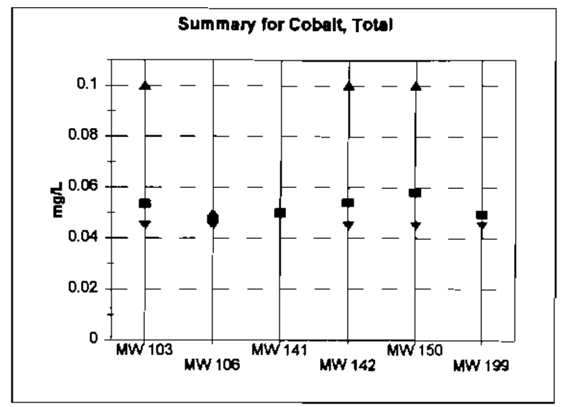
For all but MW 199, the plots are of nondetected values only.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Cobalt	0.045	<	NO	6774-94	MW103	mg/L
Cobalt	0.045	<	NO	5440-95	MW103	mg/L
Cobalt	0.045	<	NO	5285-96	MW103	mg/L
Cobalt	0.05	<	NO	5178-93	MW103	mg/L
Cobalt	0.05	<	NO	5944-93	MW103	mg/L
Cobalt	0.05	<	NO	7299-93	MW103	mg/L
Cobalt	0.05	<	NO	4272-94	MW103	mg/L
Cobalt	0.05	<	NO	5187-94	MW103	mg/L
Cobalt	0.05	<	NO	6026-94	MW103	mg/L
Cobalt	0.1	<	NO	5142-97	MW103	mg/L
Cobalt	0.045	<	NO	7272-94	MW106	mg/L
Cobalt	0.045	<	NO	5444-95	MW106	mg/L
Cobalt	0.05	<	NO	5322-93	MW106	mg/L
Cobalt	0.05	<	NO	4697-94	MW106	mg/L
Cobalt	0.05	<	NO	6080-93	MW141	mg/L
Cobalt	0.05	<	NO	6092-93	MW141	mg/L
Cobalt	0.05	<	NO	7085-93	MW141	mg/L
Cobalt	0.05	<	NO	4229-94	MW141	mg/L
Cobalt	0.05	<	NO	5199-94	MW141	mg/L
Cobalt	0.05	<	NO	6054-94	MW141	mg/L
Cobalt	0.05	<	NO	6868-94	MW141	mg/L
Cobalt	0.045	<	NO	5464-95	MW142	mg/L
Cobalt	0.045	<	NO	5317-96	MW142	mg/L
Cobalt	0.05	<	NO	6084-93	MW142	mg/L
Cobalt	0.05	<	NO	6098-93	MW142	mg/L
Cobalt	0.05	<	NO	7089-93	MW142	mg/L
Cobalt	0.05	<	NO	4233-94	MW142	mg/L
Cobalt	0.05	<	NO	5203-94	MW142	mg/L
Cobalt	0.05	<	NO	6058-94	MW142	mg/L
Cobalt	0.05	<	NO	6872-94	MW142	mg/L
Cobalt	0.1	<	NO	5147-97	MW142	mg/L
Cobalt	0.045	<	NO	5488-95	MW150	mg/L
Cobalt	0.045	<	NO	5321-96	MW150	mg/L
Cobalt	0.05	<	NO	5650-93	MW150	mg/L
Cobalt	0.05	<	NO	4789-94	MW150	mg/L
Cobalt	0.1	<	NO	5148-97	MW150	mg/L
Cobalt	0.045	<	NO	8888-94	MW199	mg/L
Cobalt	0.05	<	NO	5170-93	MW199	mg/L
Cobalt	0.05	<	NO	5984-93	MW199	mg/L
Cobalt	0.05	<	NO	7311-93	MW199	mg/L
Cobalt	0.05	<	NO	4312-94	MW199	mg/L
Cobalt	0.05	<	NO	5260-94	MW199	mg/L
Cobalt	0.05	<	NO	8074-94	MW199	mg/L
Cobalt	0.05	<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Cobalt							
	0.045	0.045	0.05	0.045	0.045	0.045		
	0.045	0.045	0.05	0.045	0.045	0.05		
	0.045	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05		0.05	0.05	0.1	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05			0.05		0.05		
	0.05			0.05				
	0.1			0.1				
Min	0.045	0.045	0.050	0.045	0.045	0.045	0.045	
Max	0.100	0.050	0.050	0.100	0.100	0.050	0.100	
Average	0.053	0.046	0.050	0.054	0.058	0.049	0.052	0.052
Number	10	4	7	10	5	8	44	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

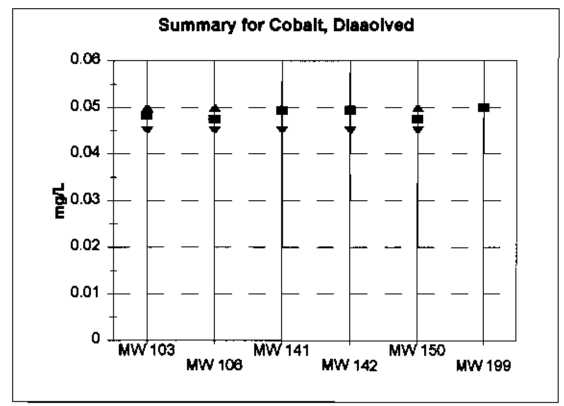
Data for Cobalt, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Cobalt, Dissolved	0.045	<	NO	8774-94	MW103	mg/L
Cobalt, Dissolved	0.045	<	NO	5440-95	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	5176-93	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	5944-93	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	5187-94	MW103	mg/L
Cobalt, Dissolved	0.05	<	NO	8026-94	MW103	mg/L
Cobalt, Dissolved		Q	NO	5285-96	MW103	
Cobalt, Dissolved	0.045	<	NO	7272-94	MW106	mg/L
Cobalt, Dissolved	0.045	<	NO	5444-95	MW106	mg/L
Cobalt, Dissolved	0.05	<	NO	5322-93	MW106	mg/L
Cobalt, Dissolved	0.05	<	NO	4697-94	MW106	mg/L
Cobalt, Dissolved	0.045	<	NO	6866-94	MW141	mg/L
Cobalt, Dissolved	0.05	<	NO	6080-93	MW141	mg/L
Cobalt, Dissolved	0.05	<	NO	8092-93	MW141	mg/L
Cobelt, Dissolved	0.05	<	NO	7085-93	MW141	mg/L
Cobalt, Dissolved	0.05	<	NO	4229-94	MW141	mg/L
Cobalt, Dissolved	0.05	<	NO	5199-94	MW141	mg/L
Cobalt, Dissolved	0.05	<	NO	6054-94	MW141	mg/L
Cobalt, Dissolved	0.045	<	NO	8672-94	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	6084-93	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	6098-93	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	7069-93	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	5203-94	MW142	mg/L
Cobalt, Dissolved	0.05	<	NO	6058-94	MW142	mg/L
Cobalt, Dissolved	0.45	<	NO	5464-95	MW142	mg/L
Cobelt, Dissolved		Q	NO	5317-96	MW142	
Cobelt, Dissolved	0.045	<	NO	5488-95	MW150	mg/L
Cobalt, Dissolved	0.05	<	NO	5650-93	MW150	mg/L
Cobalt, Dissolved	0.05	<	NO	4789-94	MW150	mg/L
Cobalt, Dissolved		Q	NO	5321-96	MW150	
Cobalt, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	5964-93	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	7311-93	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	4312-94	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	5260-94	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	6074-94	MW199	mg/L
Cobalt, Dissolved	0.05	<	NO	8666-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Cobalt, Dissolved							
	0.045	0.045	0.045	0.045	0.045	0.05		
	0.045	0.045	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.045	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05			0.05				
	0.045			0.05				
Min	0.045	0.045	0.045	0.045	0.045	0.050	0.045	
Max	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Average	0.048	0.048	0.049	0.049	0.048	0.050	0.049	0.049
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.045 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.045 mg/L); one nondetect result is much greater than others; value was reduced to next highest detection limit.

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.045 mg/L).

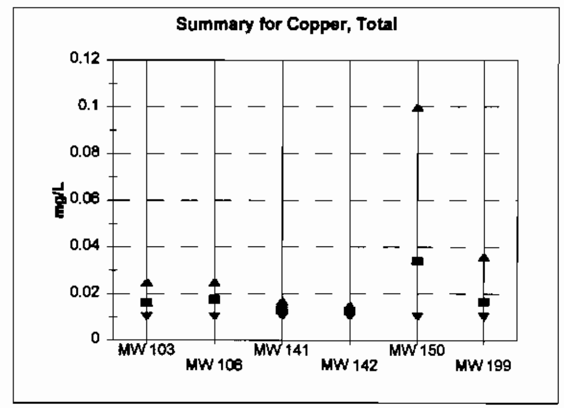
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Copper	0.01	<	NO	5178-93	MW103	mg/L
Copper	0.01	<	NO	5944-93	MW103	mg/L
Copper	0.01	<	NO	7299-93	MW103	mg/L
Copper	0.01	<	NO	4272-94	MW103	mg/L
Copper	0.01	<	NO	5187-94	MW103	mg/L
Copper	0.01	<	NO	6026-94	MW103	mg/L
Copper	0.025		YES	6774-94	MW103	mg/L
Copper	0.025	<	NO	5440-95	MW103	mg/L
Copper	0.025	<	NO	5285-96	MW103	mg/L
Copper	0.1	<	NO	5142-97	MW103	mg/L
Copper	0.01	<	NO	5322-93	MW106	mg/L
Copper	0.01	<	NO	4697-94	MW106	mg/L
Copper	0.025	<	NO	7272-94	MW106	mg/L
Copper	0.025	<	NO	5444-95	MW106	mg/L
Copper	0.01	<	NO	6080-93	MW141	mg/L
Copper	0.01	<	NO	4229-94	MW141	mg/L
Copper	0.01	<	NO	6054-94	MW141	mg/L
Copper	0.012		YES	7065-93	MW141	mg/L
Copper	0.014		YES	5199-94	MW141	mg/L
Copper	0.017		YES	6092-93	MW141	mg/L
Copper	0.025	<	NO	6868-94	MW141	mg/L
Copper	0.01	<	NO	6084-93	MW142	mg/L
Copper	0.01	<	NO	7069-93	MW142	mg/L
Copper	0.01	<	NO	4233-94	MW142	mg/L
Copper	0.01	<	NO	5203-94	MW142	mg/L
Copper	0.01	<	NO	6056-94	MW142	mg/L
Copper	0.015		YES	6096-93	MW142	mg/L
Copper	0.025	<	NO	6872-94	MW142	mg/L
Copper	0.025	<	NO	5484-95	MW142	mg/L
Copper	0.025	<	NO	5317-96	MW142	mg/L
Copper	0.1	<	NO	5147-97	MW142	mg/L
Copper	0.01	<	NO	5650-93	MW150	mg/L
Copper	0.01	<	NO	4789-94	MW150	mg/L
Copper	0.025	<	NO	5468-95	MW150	mg/L
Copper	0.025	<	NO	5321-96	MW150	mg/L
Copper	0.1	<	NO	5146-97	MW150	mg/L
Copper	0.01	<	NO	5170-93	MW199	mg/L
Copper	0.01	<	NO	5984-93	MW199	mg/L
Copper	0.01	<	NO	7311-93	MW199	mg/L
Copper	0.01	<	NO	4312-94	MW199	mg/L
Copper	0.01	<	NO	5260-94	MW199	mg/L
Copper	0.01		YES	6074-94	MW199	mg/L
Copper	0.036		YES	8686-94	MW199	mg/L
Copper	0.1	<	NO	5556-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Copper							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.025	0.01	0.01	0.025	0.01		
	0.01	0.025	0.012	0.01	0.025	0.01		
	0.01		0.014	0.01	0.1	0.01		
	0.01		0.017	0.015		0.01		
	0.025		0.017	0.015		0.036		
	0.025			0.015		0.036		
	0.025			0.015				
	0.025			0.015				
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.025	0.025	0.017	0.015	0.100	0.036	0.100	
Average	0.016	0.016	0.013	0.013	0.034	0.017	0.017	0.018
Number	10	4	7	10	5	8	44	



MW 103 - One nondetect greater than maximum detected value set to maximum detected value.

MW 106 - Data not modified.

MW 141 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value.

MW 142 - Four nondetects greater than maximum detected value set to maximum detected value.

MW 150 - Data were not modified.

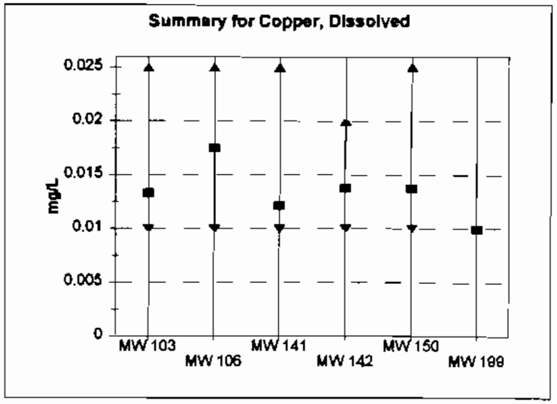
MW 199 - One nondetect greater than the maximum detected value reduced to maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Copper, Dissolved	0.01	<	NO	5178-93	MW103	mg/L
Copper, Dissolved	0.01	<	NO	5944-93	MW103	mg/L
Copper, Dissolved	0.01	<	NO	7299-93	MW103	mg/L
Copper, Dissolved	0.01	<	NO	4272-94	MW103	mg/L
Copper, Dissolved	0.01	<	NO	5167-94	MW103	mg/L
Copper, Dissolved	0.01	<	NO	6026-94	MW103	mg/L
Copper, Dissolved	0.025	<	NO	6774-94	MW103	mg/L
Copper, Dissolved	0.025	<	NO	5440-95	MW103	mg/L
Copper, Dissolved		Q	NO	5285-96	MW103	
Copper, Dissolved	0.01	<	NO	5322-93	MW106	mg/L
Copper, Dissolved	0.01	<	NO	4697-94	MW106	mg/L
Copper, Dissolved	0.025	<	NO	7272-94	MW106	mg/L
Copper, Dissolved	0.025	<	NO	5444-95	MW106	mg/L
Copper, Dissolved	0.01	<	NO	6080-93	MW141	mg/L
Copper, Dissolved	0.01	<	NO	6092-93	MW141	mg/L
Copper, Dissolved	0.01	<	NO	7065-93	MW141	mg/L
Copper, Dissolved	0.01	<	NO	4229-94	MW141	mg/L
Copper, Dissolved	0.01	<	NO	5199-94	MW141	mg/L
Copper, Dissolved	0.01	<	NO	6054-94	MW141	mg/L
Copper, Dissolved	0.025	<	NO	6668-94	MW141	mg/L
Copper, Dissolved	0.01	<	NO	6064-93	MW142	mg/L
Copper, Dissolved	0.01	<	NO	4233-94	MW142	mg/L
Copper, Dissolved	0.01	<	NO	5203-94	MW142	mg/L
Copper, Dissolved	0.01	<	NO	6058-94	MW142	mg/L
Copper, Dissolved	0.014		YES	6096-93	MW142	mg/L
Copper, Dissolved	0.02		YES	7089-93	MW142	mg/L
Copper, Dissolved	0.025	<	NO	6872-94	MW142	mg/L
Copper, Dissolved	0.025	<	NO	5464-95	MW142	mg/L
Copper, Dissolved		Q	NO	5317-96	MW142	
Copper, Dissolved	0.01	<	NO	5650-93	MW150	mg/L
Copper, Dissolved	0.01	<	NO	4789-94	MW150	mg/L
Copper, Dissolved	0.025	<	NO	5468-95	MW150	mg/L
Copper, Dissolved		Q	NO	5321-96	MW150	
Copper, Dissolved	0.01	<	NO	5170-93	MW199	mg/L
Copper, Dissolved	0.01	<	NO	5984-93	MW199	mg/L
Copper, Dissolved	0.01		YES	7311-93	MW199	mg/L
Copper, Dissolved	0.01	<	NO	4312-94	MW199	mg/L
Copper, Dissolved	0.01	<	NO	5260-94	MW199	mg/L
Copper, Dissolved	0.01	<	NO	6074-94	MW199	mg/L
Copper, Dissolved	0.025	<	NO	6666-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Copper, Dissolved							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.025	0.01	0.01	0.025	0.01		
	0.01	0.025	0.01	0.01	0.01	0.01		
	0.01		0.01	0.014		0.01		
	0.01		0.01	0.02		0.01		
	0.025		0.025	0.02		0.01		
	0.025			0.02				
	0.01			0.01				
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.025	0.025	0.025	0.020	0.025	0.010	0.025	
Average	0.013	0.016	0.012	0.014	0.014	0.010	0.013	0.013
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.01 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.01 mg/L); two nondetected result with concentration greater than maximum detected concentration reduced to maximum detected concentration.

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.01 mg/L).

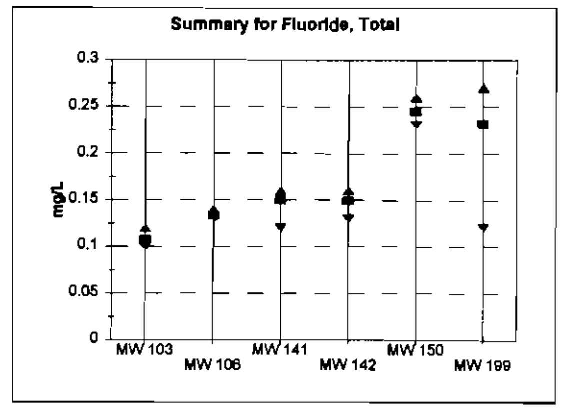
MW 199 - One nondetect greater than the maximum detected value reduced to maximum detected value; maximum detected value within this well was greater than other values; this value was reduced to the next greatest detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Fluoride	0.1		YES	7299-93	MW103	mg/L
Fluoride	0.1	<	NO	4272-94	MW103	mg/L
Fluoride	0.1		YES	6026-94	MW103	mg/L
Fluoride	0.1		YES	5285-96	MW103	mg/L
Fluoride	0.11		YES	6774-94	MW103	mg/L
Fluoride	0.11		YES	5440-95	MW103	mg/L
Fluoride	0.12		YES	5944-93	MW103	mg/L
Fluoride	0.12		YES	5187-94	MW103	mg/L
Fluoride	0.13		YES	4697-94	MW106	mg/L
Fluoride	0.13		YES	5444-95	MW106	mg/L
Fluoride	0.14		YES	5322-93	MW106	mg/L
Fluoride	0.12		YES	6092-93	MW141	mg/L
Fluoride	0.15		YES	4229-94	MW141	mg/L
Fluoride	0.15		YES	6868-94	MW141	mg/L
Fluoride	0.16		YES	7085-93	MW141	mg/L
Fluoride	0.16		YES	5199-94	MW141	mg/L
Fluoride	0.16		YES	6054-94	MW141	mg/L
Fluoride	0.13		YES	6096-93	MW142	mg/L
Fluoride	0.14		YES	5317-96	MW142	mg/L
Fluoride	0.15		YES	7069-93	MW142	mg/L
Fluoride	0.15		YES	4233-94	MW142	mg/L
Fluoride	0.15		YES	6058-94	MW142	mg/L
Fluoride	0.15		YES	6672-94	MW142	mg/L
Fluoride	0.16		YES	5203-94	MW142	mg/L
Fluoride	0.16		YES	5464-95	MW142	mg/L
Fluoride	0.23		YES	5321-98	MW150	mg/L
Fluoride	0.24		YES	4789-94	MW150	mg/L
Fluoride	0.25		YES	5650-93	MW150	mg/L
Fluoride	0.26		YES	5468-95	MW150	mg/L
Fluoride	0.12		YES	4312-94	MW199	mg/L
Fluoride	0.24		YES	6074-94	MW199	mg/L
Fluoride	0.25		YES	5280-94	MW199	mg/L
Fluoride	0.25		YES	6688-94	MW199	mg/L
Fluoride	0.26		YES	5964-93	MW199	mg/L
Fluoride	0.27		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Fluoride							
	0.1	0.13	0.12	0.13	0.23	0.12		
	0.1	0.13	0.15	0.14	0.24	0.24		
	0.1	0.14	0.15	0.15	0.25	0.25		
	0.1		0.16	0.15	0.26	0.25		
	0.11		0.16	0.15		0.26		
	0.11		0.16	0.15		0.27		
	0.12			0.16				
	0.12			0.16				
Min	0.100	0.130	0.120	0.130	0.230	0.120	0.100	
Max	0.120	0.140	0.160	0.160	0.260	0.270	0.270	
Average	0.106	0.133	0.150	0.149	0.245	0.232	0.163	0.169
Number	6	3	6	8	4	6	35	



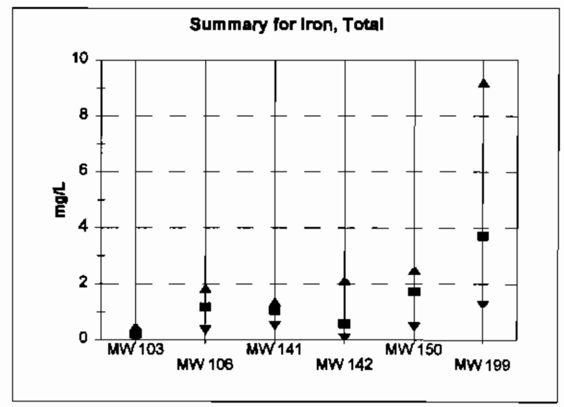
Data for Fluoride, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Iron	0.01	<	NO	5944-93	MW103	mg/L
Iron	0.043		YES	7299-93	MW103	mg/L
Iron	0.053		YES	5187-94	MW103	mg/L
Iron	0.064		YES	4272-94	MW103	mg/L
Iron	0.069		YES	6026-94	MW103	mg/L
Iron	0.3	N<	NO	5142-97	MW103	mg/L
Iron	0.355	<	NO	6774-94	MW103	mg/L
Iron	0.355	N<	NO	5265-96	MW103	mg/L
Iron	0.436		YES	5440-95	MW103	mg/L
Iron	0.464		YES	5176-93	MW103	mg/L
Iron	0.354		YES	4897-94	MW106	mg/L
Iron	0.82		YES	7272-94	MW106	mg/L
Iron	1.84		YES	5444-95	MW106	mg/L
Iron	18.6		YES	5322-93	MW106	mg/L
Iron	0.515		YES	6054-94	MW141	mg/L
Iron	0.681		YES	4229-94	MW141	mg/L
Iron	1.02		YES	7085-93	MW141	mg/L
Iron	1.16		YES	5199-94	MW141	mg/L
Iron	1.3		YES	6668-94	MW141	mg/L
Iron	1.35		YES	6060-93	MW141	mg/L
Iron	11.3		YES	6092-93	MW141	mg/L
Iron	0.067		YES	6056-94	MW142	mg/L
Iron	0.172		YES	4233-94	MW142	mg/L
Iron	0.26		YES	5203-94	MW142	mg/L
Iron	0.354		YES	6096-93	MW142	mg/L
Iron	0.355	<	NO	5464-95	MW142	mg/L
Iron	0.355	N<	NO	5317-96	MW142	mg/L
Iron	0.36	<	NO	6672-94	MW142	mg/L
Iron	0.861		YES	7069-93	MW142	mg/L
Iron	1.01	N	YES	5147-97	MW142	mg/L
Iron	2.13		YES	6084-93	MW142	mg/L
Iron	0.46		YES	5468-95	MW150	mg/L
Iron	0.872	N	YES	5321-96	MW150	mg/L
Iron	2.31		YES	4769-94	MW150	mg/L
Iron	2.49		YES	5650-93	MW150	mg/L
Iron	46.6	N	YES	5146-97	MW150	mg/L
Iron	1.24		YES	6074-94	MW199	mg/L
Iron	1.52		YES	7311-93	MW199	mg/L
Iron	1.6		YES	6686-94	MW199	mg/L
Iron	1.75		YES	5260-94	MW199	mg/L
Iron	3.59		YES	4312-94	MW199	mg/L
Iron	3.94		YES	5984-93	MW199	mg/L
Iron	6.91		YES	5170-93	MW199	mg/L
Iron	9.2		YES	5556-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 108	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Iron							
	0.01	0.354	0.515	0.087	0.48	1.24		
	0.043	0.82	0.881	0.172	0.872	1.52		
	0.053	1.84	1.02	0.26	2.31	1.6		
	0.064	1.84	1.16	0.354	2.49	1.75		
	0.069		1.3	0.355	2.49	3.59		
	0.3		1.35	0.355		3.94		
	0.355		1.35	0.36		6.91		
	0.355			0.661		9.2		
	0.436			1.01				
	0.464			2.13				
Min	0.010	0.354	0.515	0.067	0.480	1.240	0.010	
Max	0.464	1.840	1.350	2.130	2.490	9.200	9.200	
Average	0.215	1.184	1.054	0.574	1.726	3.719	1.325	1.409
Number	10	4	7	10	5	8	44	



MW 103 - Data were not modified.

MW 106 - Maxiumum value is much greater than other results and is related to turbidity of sample. Result was reduced to next greatest maximum value.

MW 141 - Maximum value is much greater than other results and is related to turbidity of sample. Result reduced to next greatest value.

MW 142 - Data not modified.

MW 150 - Maximum value is much greater than that in other samples. This was related to turbidity of sample and result reduced to next greatest value

MW 199 - Data not modified.

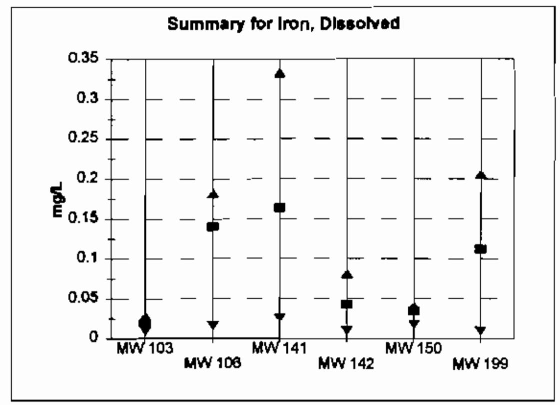
Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Iron, Dissolved	0.01	<	NO	5944-93	MW103	mg/L
Iron, Dissolved	0.01	<	NO	7299-93	MW103	mg/L
Iron, Dissolved	0.01	<	NO	4272-94	MW103	mg/L
Iron, Dissolved	0.022		YES	6026-94	MW103	mg/L
Iron, Dissolved	0.025		YES	5167-94	MW103	mg/L
Iron, Dissolved	0.028		YES	5178-93	MW103	mg/L
Iron, Dissolved	0.355	<	NO	6774-94	MW103	mg/L
Iron, Dissolved	0.355	<	NO	5440-95	MW103	mg/L
Iron, Dissolved		Q	NO	5265-96	MW103	
Iron, Dissolved	0.016		YES	4697-94	MW106	mg/L
Iron, Dissolved	0.162		YES	5322-93	MW106	mg/L
Iron, Dissolved	0.355	<	NO	5444-95	MW108	mg/L
Iron, Dissolved	0.36	<	NO	7272-94	MW106	mg/L
Iron, Dissolved	0.025		YES	4229-94	MW141	mg/L
Iron, Dissolved	0.04		YES	5199-94	MW141	mg/L
Iron, Dissolved	0.11		YES	6060-93	MW141	mg/L
Iron, Dissolved	0.152		YES	6092-93	MW141	mg/L
Iron, Dissolved	0.152		YES	7065-93	MW141	mg/L
Iron, Dissolved	0.333		YES	6054-94	MW141	mg/L
Iron, Dissolved	0.36	<	NO	6868-94	MW141	mg/L
Iron, Dissolved	0.01	<	NO	4233-94	MW142	mg/L
Iron, Dissolved	0.01	<	NO	5203-94	MW142	mg/L
Iron, Dissolved	0.01	<	NO	6058-94	MW142	mg/L
Iron, Dissolved	0.02		YES	6084-93	MW142	mg/L
Iron, Dissolved	0.06		YES	7089-93	MW142	mg/L
Iron, Dissolved	0.081		YES	6098-93	MW142	mg/L
Iron, Dissolved	0.355	<	NO	5464-95	MW142	mg/L
Iron, Dissolved	0.36	<	NO	6672-94	MW142	mg/L
Iron, Dissolved		Q	NO	5317-96	MW142	
Iron, Dissolved	0.018		YES	5650-93	MW150	mg/L
Iron, Dissolved	0.04		YES	4789-94	MW150	mg/L
Iron, Dissolved	0.355	<	NO	5468-95	MW150	mg/L
Iron, Dissolved	0.355	N<	NO	5321-96	MW150	mg/L
Iron, Dissolved	0.01	<	NO	5170-93	MW199	mg/L
Iron, Dissolved	0.02		YES	6074-94	MW199	mg/L
Iron, Dissolved	0.031		YES	4312-94	MW199	mg/L
Iron, Dissolved	0.103		YES	5984-93	MW199	mg/L
Iron, Dissolved	0.208		YES	5260-94	MW199	mg/L
Iron, Dissolved	0.36	<	NO	6888-94	MW199	mg/L
Iron, Dissolved	2.65		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

Iron, Dissolved

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	0.01	0.016	0.025	0.01	0.016	0.01		
	0.01	0.182	0.04	0.01	0.04	0.02		
	0.01	0.182	0.11	0.01	0.04	0.031		
	0.022	0.182	0.152	0.02	0.04	0.103		
	0.025		0.152	0.06		0.206		
	0.028		0.333	0.061		0.206		
	0.028		0.333	0.061		0.206		
	0.028			0.061				
	0.01			0.01				
Min	0.010	0.016	0.025	0.010	0.018	0.010	0.010	
Max	0.028	0.182	0.333	0.061	0.040	0.206	0.333	
Average	0.019	0.141	0.164	0.043	0.035	0.112	0.060	0.085
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.01 mg/L); two nondetects with values greater than maximum detected value were reduced to the maximum detected value.

MW 106 - Two nondetect results with values greater than the maximum detected value were reduced to the maximum detected value.

MW 141 - One nondetect with a value greater than the maximum detected value reduced to the maximum detected value.

Mw 142 - Two nondetect results with values greater than the maximum detected value were reduced to the maximum detected value; one "O" qualified result was given the minimum detection limit for samples from this well (0.01 mg/L).

MW 150 - Two nondetect results with values greater than the maximum detected value were reduced to the maximum detected value.

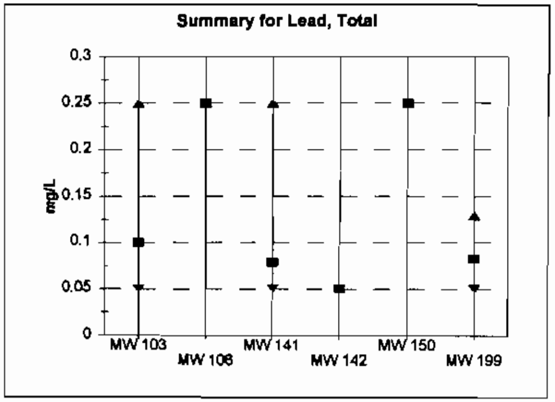
MW 199 - The maximum detected value within this well was much greater than other values; this value was reduced to the next greatest detected value

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Lead	0.05	<	NO	5176-93	MW103	mg/L
Lead	0.05	<	NO	5944-93	MW103	mg/L
Lead	0.05	<	NO	7299-93	MW103	mg/L
Lead	0.05	<	NO	4272-94	MW103	mg/L
Lead	0.05	<	NO	5187-94	MW103	mg/L
Lead	0.05	<	NO	6026-94	MW103	mg/L
Lead	0.25	<	NO	6774-94	MW103	mg/L
Lead	0.25	<	NO	5440-95	MW103	mg/L
Lead	0.25	<	NO	5444-95	MW106	mg/L
Lead	0.05	<	NO	6060-93	MW141	mg/L
Lead	0.05	<	NO	6092-93	MW141	mg/L
Lead	0.05	<	NO	7085-93	MW141	mg/L
Lead	0.05	<	NO	4229-94	MW141	mg/L
Lead	0.05	<	NO	5199-94	MW141	mg/L
Lead	0.05	<	NO	6054-94	MW141	mg/L
Lead	0.25	<	NO	6866-94	MW141	mg/L
Lead	0.05	<	NO	6064-93	MW142	mg/L
Lead	0.05	<	NO	6096-93	MW142	mg/L
Lead	0.05	<	NO	7089-93	MW142	mg/L
Lead	0.05	<	NO	4233-94	MW142	mg/L
Lead	0.05	<	NO	6056-94	MW142	mg/L
Lead	0.051		YES	5203-94	MW142	mg/L
Lead	0.25	<	NO	6872-94	MW142	mg/L
Lead	0.25	<	NO	5464-95	MW142	mg/L
Lead	0.25	<	NO	5466-95	MW150	mg/L
Lead	0.05	<	NO	5170-93	MW199	mg/L
Lead	0.05	<	NO	7311-93	MW199	mg/L
Lead	0.05	<	NO	6074-94	MW199	mg/L
Lead	0.066		YES	5260-94	MW199	mg/L
Lead	0.1		YES	4312-94	MW199	mg/L
Lead	0.129		YES	5984-93	MW199	mg/L
Lead	0.25	<	NO	6688-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Lead							
	0.05	0.25	0.05	0.05	0.25	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.066		
	0.05		0.05	0.05		0.1		
	0.05		0.05	0.051		0.129		
	0.25		0.25	0.051		0.129		
	0.25			0.051				
Min	0.050	0.250	0.050	0.050	0.250	0.050	0.050	
Max	0.250	0.250	0.250	0.051	0.250	0.129	0.250	
Average	0.100	0.250	0.079	0.050	0.250	0.062	0.068	0.135
Number	8	1	7	8	1	7	32	



MW 103 - Data were not modified.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

MW 150 - Dete were not modifed.

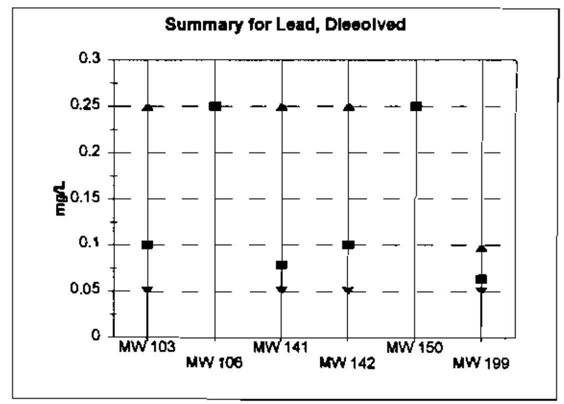
MW 199 - One nondetected result with a value greater than the maximum detected concentration was reduced to the maximum detected concentration.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Lead, Dissolved	0.05	<	NO	5178-93	MW103	mg/L
Lead, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Lead, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Lead, Dissolved	0.05	<	NO	5187-94	MW103	mg/L
Lead, Dissolved	0.05	<	NO	6026-94	MW103	mg/L
Lead, Dissolved	0.25	<	NO	6774-94	MW103	mg/L
Lead, Dissolved	0.25	<	NO	5440-95	MW103	mg/L
Lead, Dissolved		Q	NO	5944-93	MW103	
Lead, Dissolved	0.25	<	NO	5444-95	MW106	mg/L
Lead, Dissolved	0.05	<	NO	6080-93	MW141	mg/L
Lead, Dissolved	0.05	<	NO	6092-93	MW141	mg/L
Lead, Dissolved	0.05	<	NO	7085-93	MW141	mg/L
Lead, Dissolved	0.05	<	NO	4229-94	MW141	mg/L
Lead, Dissolved	0.05	<	NO	5199-94	MW141	mg/L
Lead, Dissolved	0.25	<	NO	6868-94	MW141	mg/L
Lead, Dissolved		Q	NO	6054-94	MW141	
Lead, Dissolved	0.05	<	NO	6084-93	MW142	mg/L
Lead, Dissolved	0.05	<	NO	6096-93	MW142	mg/L
Lead, Dissolved	0.05	<	NO	7089-93	MW142	mg/L
Lead, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Lead, Dissolved	0.05	<	NO	5203-94	MW142	mg/L
Lead, Dissolved	0.25	<	NO	6872-94	MW142	mg/L
Lead, Dissolved	0.25	<	NO	5464-95	MW142	mg/L
Lead, Dissolved		Q	NO	6058-94	MW142	
Lead, Dissolved	0.25	<	NO	5468-95	MW150	mg/L
Lead, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Lead, Dissolved	0.05	<	NO	5964-93	MW199	mg/L
Lead, Dissolved	0.05	<	NO	4312-94	MW199	mg/L
Lead, Dissolved	0.05	<	NO	5260-94	MW199	mg/L
Lead, Dissolved	0.05	<	NO	6074-94	MW199	mg/L
Lead, Dissolved	0.098		YES	7311-93	MW199	mg/L
Lead, Dissolved	0.25	<	NO	8868-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Lead, Dissolved							
	0.05	0.25	0.05	0.05	0.25	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.25		0.25	0.25		0.098		
	0.25		0.05	0.25		0.098		
	0.05			0.05				
Min	0.050	0.250	0.050	0.050	0.250	0.050	0.050	
Max	0.250	0.250	0.250	0.250	0.250	0.098	0.250	
Average	0.100	0.250	0.079	0.100	0.250	0.084	0.097	0.140
Number	8	1	7	8	1	7	32	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 106 - Data not modified.

MW 141 - One "Q" qualified result given value of minimum detection limit for samples from this well.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 150 - Data were not modified.

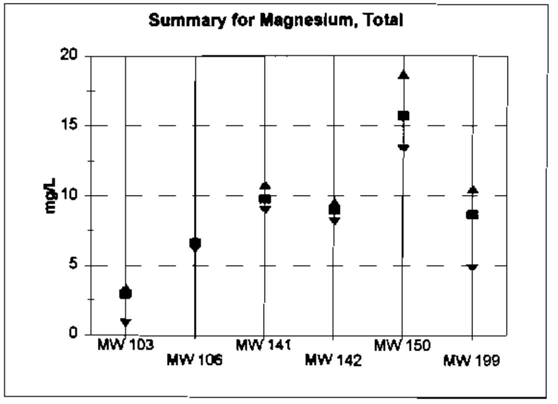
MW 199 - One nondetect greater than the maximum detected value reduced to maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Magnesium	0.879		YES	5944-93	MW103	mg/L
Magnesium	2.96		YES	7299-93	MW103	mg/L
Magnesium	3.1		YES	6026-94	MW103	mg/L
Magnesium	3.12		YES	6774-94	MW103	mg/L
Magnesium	3.14		YES	4272-94	MW103	mg/L
Magnesium	3.15		YES	5178-93	MW103	mg/L
Magnesium	3.28		YES	5187-94	MW103	mg/L
Magnesium	3.32	N	YES	5142-97	MW103	mg/L
Magnesium	3.37	N	YES	5285-96	MW103	mg/L
Magnesium	3.4		YES	5440-95	MW103	mg/L
Magnesium	6.2		YES	4697-94	MW106	mg/L
Magnesium	6.65		YES	5444-95	MW106	mg/L
Magnesium	6.73		YES	5322-93	MW106	mg/L
Magnesium	6.9		YES	7272-94	MW106	mg/L
Magnesium	8.95		YES	6054-94	MW141	mg/L
Magnesium	9.25		YES	5199-94	MW141	mg/L
Magnesium	9.51		YES	6080-93	MW141	mg/L
Magnesium	9.84		YES	7085-93	MW141	mg/L
Magnesium	9.9		YES	8868-94	MW141	mg/L
Magnesium	10.1		YES	4229-94	MW141	mg/L
Magnesium	10.8		YES	6092-93	MW141	mg/L
Magnesium	8.13		YES	5203-94	MW142	mg/L
Magnesium	8.34		YES	5464-95	MW142	mg/L
Magnesium	8.63		YES	7089-93	MW142	mg/L
Magnesium	8.86	N	YES	5147-97	MW142	mg/L
Magnesium	8.89		YES	6084-93	MW142	mg/L
Magnesium	9.1		YES	6872-94	MW142	mg/L
Magnesium	9.25		YES	4233-94	MW142	mg/L
Magnesium	9.36	N	YES	5317-96	MW142	mg/L
Magnesium	9.45		YES	6096-93	MW142	mg/L
Magnesium	9.51		YES	6056-94	MW142	mg/L
Magnesium	13.3		YES	4789-94	MW150	mg/L
Magnesium	15.2		YES	5650-93	MW150	mg/L
Magnesium	15.3	N	YES	5321-96	MW150	mg/L
Magnesium	16		YES	5468-95	MW150	mg/L
Magnesium	18.7	N	YES	5148-97	MW150	mg/L
Magnesium	4.81		YES	5170-93	MW199	mg/L
Magnesium	7.99		YES	5260-94	MW199	mg/L
Magnesium	8.52		YES	5558-97	MW199	mg/L
Magnesium	8.9		YES	7311-93	MW199	mg/L
Magnesium	9.26		YES	4312-94	MW199	mg/L
Magnesium	9.59		YES	6074-94	MW199	mg/L
Magnesium	9.7		YES	6886-94	MW199	mg/L
Magnesium	10.5		YES	5984-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Magnesium							
	0.879	6.2	8.95	8.13	13.3	4.81		
	2.96	6.65	9.25	8.34	15.2	7.99		
	3.1	6.73	9.51	8.63	15.3	8.52		
	3.12	6.9	9.84	8.88	16	8.9		
	3.14		9.9	8.89	18.7	9.26		
	3.15		10.1	9.1		9.59		
	3.28		10.8	9.25		9.7		
	3.32			9.38		10.5		
	3.37			9.45				
	3.4			9.51				
Min	0.879	6.200	8.950	8.130	13.300	4.810	0.879	
Max	3.400	6.900	10.800	9.510	18.700	10.500	18.700	
Average	2.972	6.620	9.784	8.954	15.700	8.659	8.224	8.778
Number	10	4	7	10	5	8	44	



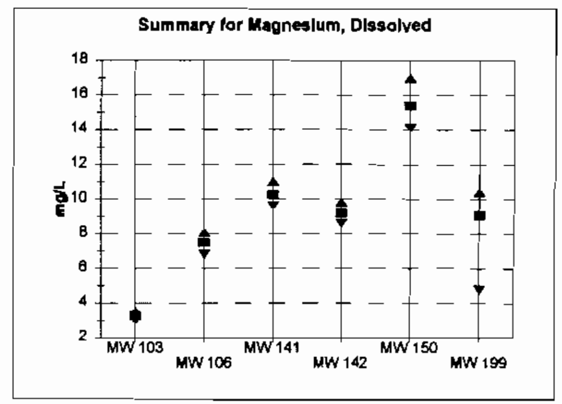
Data for Magnesium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Magnesium, Dissolved	0.008		YES	5944-93	MW103	mg/L
Magnesium, Dissolved	3.01		YES	7299-93	MW103	mg/L
Magnesium, Dissolved	3.07	N	YES	5285-96	MW103	mg/L
Magnesium, Dissolved	3.22		YES	5178-93	MW103	mg/L
Magnesium, Dissolved	3.33		YES	4272-94	MW103	mg/L
Magnesium, Dissolved	3.34		YES	8774-94	MW103	mg/L
Magnesium, Dissolved	3.48		YES	6026-94	MW103	mg/L
Magnesium, Dissolved	3.48		YES	5440-95	MW103	mg/L
Magnesium, Dissolved	3.51		YES	5187-94	MW103	mg/L
Magnesium, Dissolved	6.62		YES	4697-94	MW106	mg/L
Magnesium, Dissolved	7.58		YES	5444-95	MW106	mg/L
Magnesium, Dissolved	8.08		YES	7272-94	MW106	mg/L
Magnesium, Dissolved	9.6		YES	7085-93	MW141	mg/L
Magnesium, Dissolved	9.67		YES	6080-93	MW141	mg/L
Magnesium, Dissolved	9.8		YES	5199-94	MW141	mg/L
Magnesium, Dissolved	10.4		YES	6092-93	MW141	mg/L
Magnesium, Dissolved	10.6		YES	4229-94	MW141	mg/L
Magnesium, Dissolved	10.73		YES	6054-94	MW141	mg/L
Magnesium, Dissolved	11		YES	6868-94	MW141	mg/L
Magnesium, Dissolved	8.6	N	YES	5317-96	MW142	mg/L
Magnesium, Dissolved	8.69		YES	5203-94	MW142	mg/L
Magnesium, Dissolved	8.7		YES	6084-93	MW142	mg/L
Magnesium, Dissolved	8.72		YES	7069-93	MW142	mg/L
Magnesium, Dissolved	9.29		YES	8098-93	MW142	mg/L
Magnesium, Dissolved	9.59		YES	5464-95	MW142	mg/L
Magnesium, Dissolved	9.63		YES	4233-94	MW142	mg/L
Magnesium, Dissolved	9.66		YES	8058-94	MW142	mg/L
Magnesium, Dissolved	9.8		YES	6872-94	MW142	mg/L
Magnesium, Dissolved	14.1	N	YES	5321-96	MW150	mg/L
Magnesium, Dissolved	15		YES	5650-93	MW150	mg/L
Magnesium, Dissolved	15.5		YES	4789-94	MW150	mg/L
Magnesium, Dissolved	17		YES	5466-95	MW150	mg/L
Magnesium, Dissolved	4.78		YES	5170-93	MW199	mg/L
Magnesium, Dissolved	9.15		YES	7311-93	MW199	mg/L
Magnesium, Dissolved	9.31		YES	5260-94	MW199	mg/L
Magnesium, Dissolved	9.74		YES	4312-94	MW199	mg/L
Magnesium, Dissolved	10		YES	6888-94	MW199	mg/L
Magnesium, Dissolved	10.2		YES	5984-93	MW199	mg/L
Magnesium, Dissolved	10.4		YES	6074-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Magnesium, Dissolved							
	3.01	6.62	9.6	8.6	14.1	4.78		
	3.01	7.58	9.67	8.89	15	9.15		
	3.07	8.08	9.8	8.7	15.5	9.31		
	3.22		10.4	8.72	17	9.74		
	3.33		10.6	9.29		10		
	3.34		10.73	9.59		10.2		
	3.46		11	9.63		10.4		
	3.48			9.66				
	3.51			9.8				
Min	3.010	6.620	9.600	8.600	14.100	4.780	3.010	
Max	3.510	8.080	11.000	9.800	17.000	10.400	17.000	
Average	3.270	7.493	10.257	9.187	15.400	9.083	8.502	9.115
Number	9	3	7	9	4	7	39	



MW 103 - One very small detected result was (0.008 mg/L) was determined to be an outlier and increased to the next smallest result.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

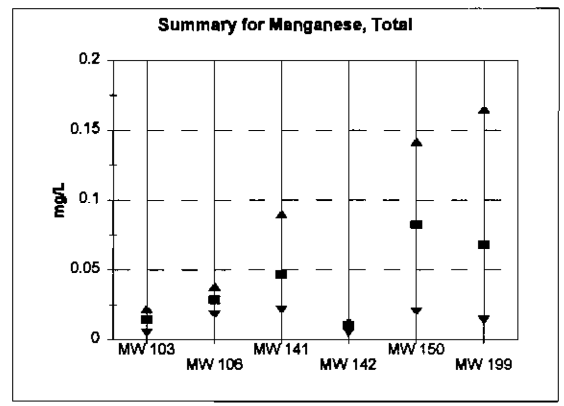
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Manganese	0.005	<	NO	5944-93	MW103	mg/L
Manganese	0.008		YES	4272-94	MW103	mg/L
Manganese	0.008		YES	5187-94	MW103	mg/L
Manganese	0.008		YES	6026-94	MW103	mg/L
Manganese	0.013		YES	7299-93	MW103	mg/L
Manganese	0.02	<	NO	6774-94	MW103	mg/L
Manganese	0.02	<	NO	5440-95	MW103	mg/L
Manganese	0.02	<	NO	5265-96	MW103	mg/L
Manganese	0.022		YES	5178-93	MW103	mg/L
Manganese	0.05	<	NO	5142-97	MW103	mg/L
Manganese	0.018		YES	4697-94	MW106	mg/L
Manganese	0.02	<	NO	7272-94	MW106	mg/L
Manganese	0.036		YES	5444-95	MW106	mg/L
Manganese	0.409		YES	5322-93	MW106	mg/L
Manganese	0.021		YES	6054-94	MW141	mg/L
Manganese	0.024		YES	6868-94	MW141	mg/L
Manganese	0.032		YES	6080-93	MW141	mg/L
Manganese	0.041		YES	5199-94	MW141	mg/L
Manganese	0.054		YES	4229-94	MW141	mg/L
Manganese	0.065		YES	7085-93	MW141	mg/L
Manganese	0.09		YES	6092-93	MW141	mg/L
Manganese	0.005		YES	4233-94	MW142	mg/L
Manganese	0.005	<	NO	5203-94	MW142	mg/L
Manganese	0.005	<	NO	6058-94	MW142	mg/L
Manganese	0.008		YES	7089-93	MW142	mg/L
Manganese	0.01		YES	6084-93	MW142	mg/L
Manganese	0.013		YES	6098-93	MW142	mg/L
Manganese	0.02	<	NO	6872-94	MW142	mg/L
Manganese	0.02	<	NO	5484-95	MW142	mg/L
Manganese	0.02	<	NO	5317-96	MW142	mg/L
Manganese	0.05	<	NO	5147-97	MW142	mg/L
Manganese	0.02		YES	5468-95	MW150	mg/L
Manganese	0.02	<	NO	5321-96	MW150	mg/L
Manganese	0.111		YES	4769-94	MW150	mg/L
Manganese	0.119		YES	5146-97	MW150	mg/L
Manganese	0.142		YES	5650-93	MW150	mg/L
Manganese	0.014		YES	6074-94	MW199	mg/L
Manganese	0.02	<	NO	8888-94	MW199	mg/L
Manganese	0.042		YES	4312-94	MW199	mg/L
Manganese	0.048		YES	7311-93	MW199	mg/L
Manganese	0.077		YES	5984-93	MW199	mg/L
Manganese	0.086		YES	5170-93	MW199	mg/L
Manganese	0.092		YES	5260-94	MW199	mg/L
Manganese	0.165		YES	5556-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Manganese							
	0.005	0.018	0.021	0.005	0.02	0.014		
	0.008	0.02	0.024	0.005	0.02	0.02		
	0.008	0.036	0.032	0.005	0.111	0.042		
	0.008	0.036	0.041	0.008	0.119	0.048		
	0.013		0.054	0.01	0.142	0.077		
	0.02		0.065	0.013		0.086		
	0.02		0.09	0.013		0.092		
	0.02			0.013		0.165		
	0.022			0.013				
	0.022			0.013				
Min	0.005	0.018	0.021	0.005	0.020	0.014	0.005	
Max	0.022	0.038	0.090	0.013	0.142	0.165	0.165	
Average	0.015	0.029	0.047	0.010	0.082	0.068	0.037	0.042
Number	10	4	7	10	5	8	44	



MW 103 - One nondetect greater than maximum detected value set to maximum detected value.

MW 106 - Maximum detected value greatly exceeded the next greatest detection and was declared an outlier. The value was reduced to the next greatesr detected value. This decision is supported by the very high turbidity of the sample with the anamolous reesult.

MW 141 - Data not modified.

MW 142 - Four nondetected results greater than the maximum detected value set to maximum detected value.

MW 150 - Data were not modifed.

MW 199 - Date not modified.

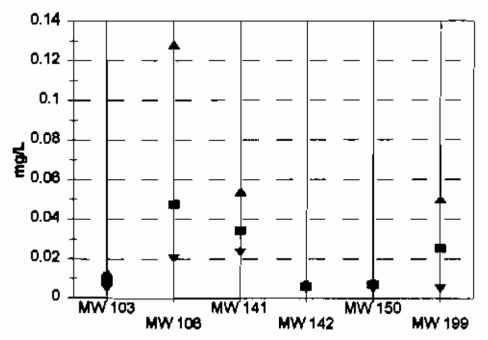
Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Manganese, Dissolved	0.005	<	NO	5944-93	MW103	mg/L
Manganese, Dissolved	0.005		YES	5187-94	MW103	mg/L
Manganese, Dissolved	0.005	<	NO	6026-94	MW103	mg/L
Manganese, Dissolved	0.007		YES	4272-94	MW103	mg/L
Manganese, Dissolved	0.011		YES	7299-93	MW103	mg/L
Manganese, Dissolved	0.013		YES	5178-93	MW103	mg/L
Manganese, Dissolved	0.02	<	NO	6774-94	MW103	mg/L
Manganese, Dissolved	0.02	<	NO	5440-95	MW103	mg/L
Manganese, Dissolved		Q	NO	5285-96	MW103	
Manganese, Dissolved	0.02	<	NO	7272-94	MW106	mg/L
Manganese, Dissolved	0.02	<	NO	5444-95	MW106	mg/L
Manganese, Dissolved	0.022		YES	4897-94	MW106	mg/L
Manganese, Dissolved	0.128		YES	5322-93	MW106	mg/L
Manganese, Dissolved	0.023		YES	8080-93	MW141	mg/L
Manganese, Dissolved	0.024		YES	5199-94	MW141	mg/L
Manganese, Dissolved	0.024		YES	6054-94	MW141	mg/L
Manganese, Dissolved	0.026		YES	6668-94	MW141	mg/L
Manganese, Dissolved	0.038		YES	6092-93	MW141	mg/L
Manganese, Dissolved	0.049		YES	4229-94	MW141	mg/L
Manganese, Dissolved	0.054		YES	7085-93	MW141	mg/L
Manganese, Dissolved	0.005	<	NO	6096-93	MW142	mg/L
Manganese, Dissolved	0.005	<	NO	7089-93	MW142	mg/L
Manganese, Dissolved	0.005	<	NO	4233-94	MW142	mg/L
Manganese, Dissolved	0.005	<	NO	5203-94	MW142	mg/L
Manganese, Dissolved	0.005		YES	6058-94	MW142	mg/L
Manganese, Dissolved	0.008		YES	6084-93	MW142	mg/L
Manganese, Dissolved	0.02	<	NO	6872-94	MW142	mg/L
Manganese, Dissolved	0.02	<	NO	5464-95	MW142	mg/L
Manganese, Dissolved		Q	NO	5317-96	MW142	
Manganese, Dissolved	0.005		YES	5650-93	MW150	mg/L
Manganese, Dissolved	0.009		YES	4789-94	MW150	mg/L
Manganese, Dissolved	0.02	<	NO	5488-95	MW150	mg/L
Manganese, Dissolved		Q	NO	5321-96	MW150	
Manganese, Dissolved	0.005	<	NO	5280-94	MW199	mg/L
Manganese, Dissolved	0.005	<	NO	8074-94	MW199	mg/L
Manganese, Dissolved	0.008		YES	4312-94	MW199	mg/L
Manganese, Dissolved	0.02	<	NO	6886-94	MW199	mg/L
Manganese, Dissolved	0.043		YES	5170-93	MW199	mg/L
Manganese, Dissolved	0.045		YES	5984-93	MW199	mg/L
Manganese, Dissolved	0.05		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Manganese, Dissolved							
	0.005	0.02	0.023	0.005	0.005	0.005		
	0.005	0.02	0.024	0.005	0.009	0.005		
	0.005	0.022	0.024	0.005	0.009	0.008		
	0.007	0.128	0.026	0.005	0.005	0.02		
	0.011		0.038	0.005		0.043		
	0.013		0.049	0.008		0.045		
	0.013		0.054	0.008		0.05		
	0.013			0.008				
	0.005			0.005				
Min	0.005	0.020	0.023	0.005	0.005	0.005	0.005	
Max	0.013	0.128	0.054	0.008	0.009	0.050	0.128	
Average	0.009	0.048	0.034	0.006	0.007	0.025	0.019	0.021
Number	9	4	7	9	4	7	40	

Summary for Manganese, Dissolved



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L); two nondetect results reduced to maximum detected value.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L); two nondetect values reduced to maximum detected value for this well.

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L); one nondetect result reduced to maximum detected value for this well.

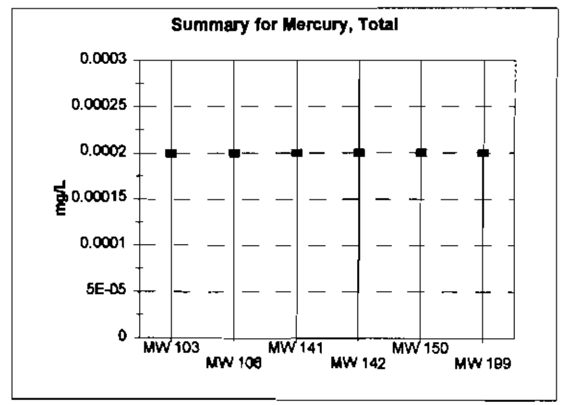
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Mercury	0.0002	<	NO	5176-93	MW103	mg/L
Mercury	0.0002	<	NO	5944-93	MW103	mg/L
Mercury	0.0002	<	NO	7299-93	MW103	mg/L
Mercury	0.0002	<	NO	4272-94	MW103	mg/L
Mercury	0.0002	<	NO	5167-94	MW103	mg/L
Mercury	0.0002	<	NO	6026-94	MW103	mg/L
Mercury	0.0002	<	NO	6774-94	MW103	mg/L
Mercury	0.0002	<	NO	5440-95	MW103	mg/L
Mercury	0.0002	<	NO	5444-95	MW106	mg/L
Mercury	0.0002	<	NO	6060-93	MW141	mg/L
Mercury	0.0002	<	NO	6092-93	MW141	mg/L
Mercury	0.0002	<	NO	7085-93	MW141	mg/L
Mercury	0.0002	<	NO	4229-94	MW141	mg/L
Mercury	0.0002	<	NO	6054-94	MW141	mg/L
Mercury	0.0002	<	NO	6688-94	MW141	mg/L
Mercury		Q	NO	5199-94	MW141	
Mercury	0.0002	<	NO	6084-93	MW142	mg/L
Mercury	0.0002	<	NO	6098-93	MW142	mg/L
Mercury	0.0002	<	NO	7089-93	MW142	mg/L
Mercury	0.0002	<	NO	4233-94	MW142	mg/L
Mercury	0.0002	<	NO	5203-94	MW142	mg/L
Mercury	0.0002	<	NO	6058-94	MW142	mg/L
Mercury	0.0002	<	NO	6672-94	MW142	mg/L
Mercury	0.0002	<	NO	5464-95	MW142	mg/L
Mercury	0.0002	<	NO	5468-95	MW150	mg/L
Mercury	0.0002	<	NO	5170-93	MW199	mg/L
Mercury	0.0002	<	NO	5984-93	MW199	mg/L
Mercury	0.0002	<	NO	7311-93	MW199	mg/L
Mercury	0.0002	<	NO	4312-94	MW199	mg/L
Mercury	0.0002	<	NO	5260-94	MW199	mg/L
Mercury	0.0002	<	NO	6074-94	MW199	mg/L
Mercury	0.0002	<	NO	6886-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Mercury							
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002		0.0002	0.0002		0.0002		
	0.0002			0.0002				
Min	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
Max	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
Average	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Number	8	1	7	8	1	7	32	



All results for this well were below their respective detection limits, therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

MW 103 - Data not modified.

MW 106 - Data not modified.

MW 141 - One "Q" qualified result assigned minimum detection limit for samples taken from this well.

MW 142 - Data not modified.

MW 150 - Data not modified.

MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Mercury, Dissolved		Q	NO	5176-93	MW103	
Mercury, Dissolved		Q	NO	5944-93	MW103	
Mercury, Dissolved		Q	NO	7299-93	MW103	
Mercury, Dissolved		Q	NO	4272-94	MW103	
Mercury, Dissolved		Q	NO	5167-94	MW103	
Mercury, Dissolved		Q	NO	6026-94	MW103	
Mercury, Dissolved		Q	NO	6774-94	MW103	
Mercury, Dissolved		Q	NO	5440-95	MW103	
Mercury, Dissolved		Q	NO	5444-95	MW106	
Mercury, Dissolved		Q	NO	6060-93	MW141	
Mercury, Dissolved		Q	NO	6092-93	MW141	
Mercury, Dissolved		Q	NO	7065-93	MW141	
Mercury, Dissolved		Q	NO	4229-94	MW141	
Mercury, Dissolved		Q	NO	5199-94	MW141	
Mercury, Dissolved		Q	NO	6054-94	MW141	
Mercury, Dissolved		Q	NO	6666-94	MW141	
Mercury, Dissolved		Q	NO	6084-93	MW142	
Mercury, Dissolved		Q	NO	6096-93	MW142	
Mercury, Dissolved		Q	NO	7069-93	MW142	
Mercury, Dissolved		Q	NO	4233-94	MW142	
Mercury, Dissolved		Q	NO	5203-94	MW142	
Mercury, Dissolved		Q	NO	6056-94	MW142	
Mercury, Dissolved		Q	NO	6672-94	MW142	
Mercury, Dissolved		Q	NO	5484-95	MW142	
Mercury, Dissolved		Q	NO	5466-95	MW150	
Mercury, Dissolved		Q	NO	5170-93	MW199	
Mercury, Dissolved		Q	NO	5984-93	MW199	
Mercury, Dissolved		Q	NO	7311-93	MW199	
Mercury, Dissolved		Q	NO	4312-94	MW199	
Mercury, Dissolved		Q	NO	5260-94	MW199	
Mercury, Dissolved		Q	NO	6074-94	MW199	
Mercury, Dissolved		Q	NO	6686-94	MW199	

CORRECTED DATA SET

Mercury, Dissolved

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Number	0	0	0	0	0	0	0	

Mercury, Dissolved

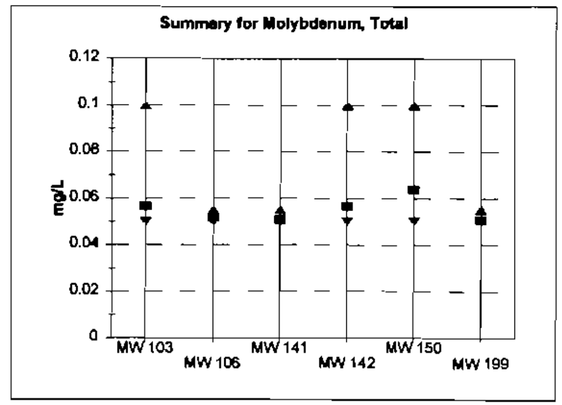
- Analysis for Mercury, Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of mercury in a filtered sample exceeds the background concentration.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Molybdenum	0.05	<	NO	5178-93	MW103	mg/L
Molybdenum	0.05	<	NO	5944-93	MW103	mg/L
Molybdenum	0.05	<	NO	7299-93	MW103	mg/L
Molybdenum	0.05	<	NO	4272-94	MW103	mg/L
Molybdenum	0.05	<	NO	5187-94	MW103	mg/L
Molybdenum	0.05	<	NO	8026-94	MW103	mg/L
Molybdenum	0.055	<	NO	6774-94	MW103	mg/L
Molybdenum	0.055	<	NO	5285-96	MW103	mg/L
Molybdenum	0.1	<	NO	5142-97	MW103	mg/L
Molybdenum	0.05	<	NO	5322-93	MW106	mg/L
Molybdenum	0.05	<	NO	4697-94	MW106	mg/L
Molybdenum	0.055	<	NO	7272-94	MW106	mg/L
Molybdenum	0.05	<	NO	6080-93	MW141	mg/L
Molybdenum	0.05	<	NO	6092-93	MW141	mg/L
Molybdenum	0.05	<	NO	7085-93	MW141	mg/L
Molybdenum	0.05	<	NO	4229-94	MW141	mg/L
Molybdenum	0.05	<	NO	5199-94	MW141	mg/L
Molybdenum	0.05	<	NO	6054-94	MW141	mg/L
Molybdenum	0.055	<	NO	8888-94	MW141	mg/L
Molybdenum	0.05	<	NO	6084-93	MW142	mg/L
Molybdenum	0.05	<	NO	6096-93	MW142	mg/L
Molybdenum	0.05	<	NO	7089-93	MW142	mg/L
Molybdenum	0.05	<	NO	4233-94	MW142	mg/L
Molybdenum	0.05	<	NO	5203-94	MW142	mg/L
Molybdenum	0.05	<	NO	6058-94	MW142	mg/L
Molybdenum	0.055	<	NO	6872-94	MW142	mg/L
Molybdenum	0.055	<	NO	5317-96	MW142	mg/L
Molybdenum	0.1	<	NO	5147-97	MW142	mg/L
Molybdenum	0.05	<	NO	5650-93	MW150	mg/L
Molybdenum	0.05	<	NO	4769-94	MW150	mg/L
Molybdenum	0.055	<	NO	5321-96	MW150	mg/L
Molybdenum	0.1	<	NO	5148-97	MW150	mg/L
Molybdenum	0.05	<	NO	5170-93	MW199	mg/L
Molybdenum	0.05	<	NO	5984-93	MW199	mg/L
Molybdenum	0.05	<	NO	7311-93	MW199	mg/L
Molybdenum	0.05	<	NO	4312-94	MW199	mg/L
Molybdenum	0.05	<	NO	5260-94	MW199	mg/L
Molybdenum	0.05	<	NO	6074-94	MW199	mg/L
Molybdenum	0.05	<	NO	5558-97	MW199	mg/L
Molybdenum	0.055	<	NO	6888-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Molybdenum							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.055	0.05	0.05	0.055	0.05		
	0.05		0.05	0.05	0.1	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.055		0.055	0.055		0.05		
	0.055			0.055		0.055		
	0.1			0.1				
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.100	0.055	0.055	0.100	0.100	0.055	0.100	
Average	0.057	0.052	0.051	0.057	0.064	0.051	0.055	0.055
Number	9	3	7	9	4	8	40	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

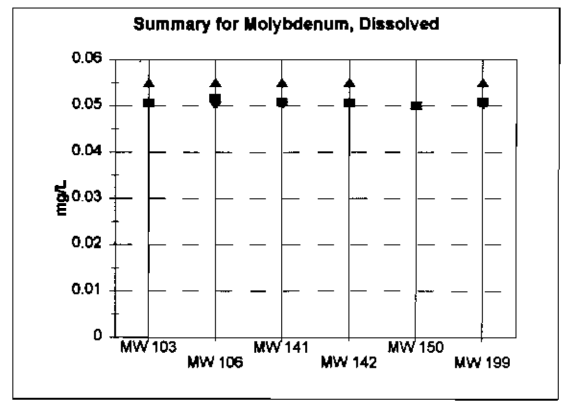
Data for Molybdenum, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Molybdenum, Dissolved	0.05	<	NO	5178-93	MW103	mg/L
Molybdenum, Dissolved	0.05	<	NO	5944-93	MW103	mg/L
Molybdenum, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Molybdenum, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Molybdenum, Dissolved	0.05	<	NO	5187-94	MW103	mg/L
Molybdenum, Dissolved	0.05	<	NO	6026-94	MW103	mg/L
Molybdenum, Dissolved	0.055	<	NO	6774-94	MW103	mg/L
Molybdenum, Dissolved		Q	NO	5285-96	MW103	
Molybdenum, Dissolved	0.05	<	NO	5322-93	MW106	mg/L
Molybdenum, Dissolved	0.05	<	NO	4697-94	MW106	mg/L
Molybdenum, Dissolved	0.055	<	NO	7272-94	MW106	mg/L
Molybdenum, Dissolved	0.05	<	NO	6080-93	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	6092-93	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	7085-93	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	4229-94	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	5199-94	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	6054-94	MW141	mg/L
Molybdenum, Dissolved	0.055	<	NO	6668-94	MW141	mg/L
Molybdenum, Dissolved	0.05	<	NO	6084-93	MW142	mg/L
Molybdenum, Dissolved	0.05	<	NO	6096-93	MW142	mg/L
Molybdenum, Dissolved	0.05	<	NO	7089-93	MW142	mg/L
Molybdenum, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Molybdenum, Dissolved	0.05	<	NO	5203-94	MW142	mg/L
Molybdenum, Dissolved	0.05	<	NO	6058-94	MW142	mg/L
Molybdenum, Dissolved	0.055	<	NO	6872-94	MW142	mg/L
Molybdenum, Dissolved		Q	NO	5317-96	MW142	
Molybdenum, Dissolved	0.05	<	NO	5650-93	MW150	mg/L
Molybdenum, Dissolved	0.05	<	NO	4789-94	MW150	mg/L
Molybdenum, Dissolved		Q	NO	5321-96	MW150	
Molybdenum, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Molybdenum, Dissolved	0.05	<	NO	5984-93	MW199	mg/L
Molybdenum, Dissolved	0.05	<	NO	7311-93	MW199	mg/L
Molybdenum, Dissolved	0.05	<	NO	4312-94	MW199	mg/L
Molybdenum, Dissolved	0.05	<	NO	5260-94	MW199	mg/L
Molybdenum, Dissolved	0.05	<	NO	6074-94	MW199	mg/L
Molybdenum, Dissolved	0.055	<	NO	8888-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Molybdenum, Dissolved							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.055	0.05	0.05	0.05	0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.05		0.05	0.05		0.05		
	0.055		0.055	0.055		0.055		
	0.05			0.05				
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.055	0.055	0.055	0.055	0.050	0.055	0.055	
Average	0.051	0.052	0.051	0.051	0.050	0.051	0.051	0.051
Number	6	3	7	8	3	7	36	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

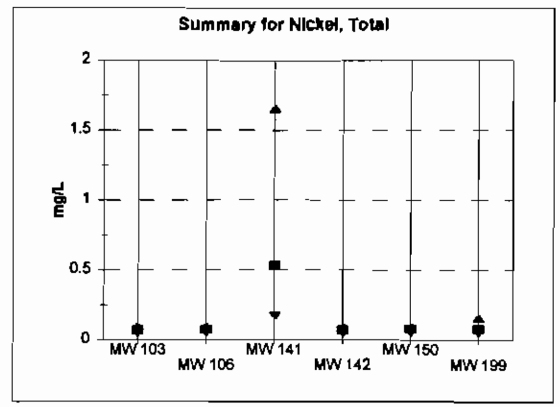
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Nickel	0.05	<	NO	5178-93	MW103	mg/L
Nickel	0.05	<	NO	5944-93	MW103	mg/L
Nickel	0.05	<	NO	7299-93	MW103	mg/L
Nickel	0.05	<	NO	4272-94	MW103	mg/L
Nickel	0.05	<	NO	5187-94	MW103	mg/L
Nickel	0.05	<	NO	6026-94	MW103	mg/L
Nickel	0.1	<	NO	6774-94	MW103	mg/L
Nickel	0.1	<	NO	5440-95	MW103	mg/L
Nickel	0.1	<	NO	5285-96	MW103	mg/L
Nickel	0.1	<	NO	5142-97	MW103	mg/L
Nickel	0.05	<	NO	5322-93	MW106	mg/L
Nickel	0.05	<	NO	4697-94	MW106	mg/L
Nickel	0.1	<	NO	7272-94	MW106	mg/L
Nickel	0.1	<	NO	5444-95	MW106	mg/L
Nickel	0.17		YES	8054-94	MW141	mg/L
Nickel	0.23		YES	6868-94	MW141	mg/L
Nickel	0.349		YES	5199-94	MW141	mg/L
Nickel	0.396		YES	7085-93	MW141	mg/L
Nickel	0.401		YES	4229-94	MW141	mg/L
Nickel	0.502		YES	6092-93	MW141	mg/L
Nickel	1.66		YES	6080-93	MW141	mg/L
Nickel	0.05	<	NO	6084-93	MW142	mg/L
Nickel	0.05	<	NO	6096-93	MW142	mg/L
Nickel	0.05	<	NO	7089-93	MW142	mg/L
Nickel	0.05	<	NO	4233-94	MW142	mg/L
Nickel	0.05	<	NO	6056-94	MW142	mg/L
Nickel	0.051		YES	5203-94	MW142	mg/L
Nickel	0.1	<	NO	6872-94	MW142	mg/L
Nickel	0.1	<	NO	5464-95	MW142	mg/L
Nickel	0.1	<	NO	5317-96	MW142	mg/L
Nickel	0.1	<	NO	5147-97	MW142	mg/L
Nickel	0.05	<	NO	5650-93	MW150	mg/L
Nickel	0.05	<	NO	4789-94	MW150	mg/L
Nickel	0.1	<	NO	5466-95	MW150	mg/L
Nickel	0.1	<	NO	5321-96	MW150	mg/L
Nickel	0.1	<	NO	5148-97	MW150	mg/L
Nickel	0.05	<	NO	5170-93	MW199	mg/L
Nickel	0.05	<	NO	5984-93	MW199	mg/L
Nickel	0.05	<	NO	7311-93	MW199	mg/L
Nickel	0.05	<	NO	4312-94	MW199	mg/L
Nickel	0.05	<	NO	6074-94	MW199	mg/L
Nickel	0.1	<	NO	6686-94	MW199	mg/L
Nickel	0.126		YES	5280-94	MW199	mg/L
Nickel	0.162		YES	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Nickel							
	0.05	0.05	0.17	0.05	0.05	0.05		
	0.05	0.05	0.23	0.05	0.05	0.05		
	0.05	0.1	0.349	0.05	0.1	0.05		
	0.05	0.1	0.396	0.05	0.1	0.05		
	0.05		0.401	0.05	0.1	0.05		
	0.05		0.502	0.051		0.1		
	0.1		1.66	0.1		0.126		
	0.1			0.1		0.162		
	0.1			0.1				
	0.1			0.1				
Min	0.050	0.050	0.170	0.050	0.050	0.050	0.050	
Max	0.100	0.100	1.660	0.100	0.100	0.162	1.660	
Average	0.070	0.075	0.530	0.070	0.080	0.080	0.147	0.151
Number	10	4	7	10	5	8	44	



MW 103 - Data not modified.

MW 106 - Data not modified.

MW 141 - Detected results in this well were determined to be directly related to the turbidity of the samples, however, turbidity was not excessive for any sample; therefore, data were not modified.

MW 142 - Four samples with nondetect values greater than the maximum detected value were reduced to the maximum detected value

MW 150 - Data were not modifed.

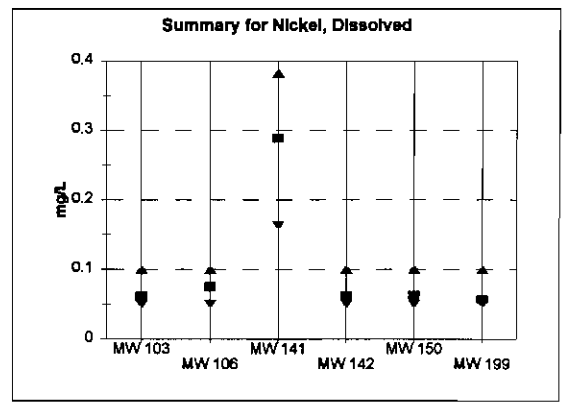
MW 199 - Date not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Nickel, Dissolved	0.05	<	NO	5176-93	MW103	mg/L
Nickel, Dissolved	0.05	<	NO	5944-93	MW103	mg/L
Nickel, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Nickel, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Nickel, Dissolved	0.05	<	NO	5167-94	MW103	mg/L
Nickel, Dissolved	0.05	<	NO	6026-94	MW103	mg/L
Nickel, Dissolved	0.1	<	NO	6774-94	MW103	mg/L
Nickel, Dissolved	0.1	<	NO	5440-95	MW103	mg/L
Nickel, Dissolved		Q	NO	5265-96	MW103	
Nickel, Dissolved	0.05	<	NO	5322-93	MW106	mg/L
Nickel, Dissolved	0.05	<	NO	4697-94	MW106	mg/L
Nickel, Dissolved	0.1	<	NO	7272-94	MW106	mg/L
Nickel, Dissolved	0.1	<	NO	5444-95	MW106	mg/L
Nickel, Dissolved	0.163		YES	6080-93	MW141	mg/L
Nickel, Dissolved	0.205		YES	6054-94	MW141	mg/L
Nickel, Dissolved	0.25		YES	6668-94	MW141	mg/L
Nickel, Dissolved	0.266		YES	6092-93	MW141	mg/L
Nickel, Dissolved	0.365		YES	7065-93	MW141	mg/L
Nickel, Dissolved	0.366		YES	4229-94	MW141	mg/L
Nickel, Dissolved	0.362		YES	5199-94	MW141	mg/L
Nickel, Dissolved	0.05	<	NO	6084-93	MW142	mg/L
Nickel, Dissolved	0.05	<	NO	6098-93	MW142	mg/L
Nickel, Dissolved	0.05	<	NO	7069-93	MW142	mg/L
Nickel, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Nickel, Dissolved	0.05	<	NO	5203-94	MW142	mg/L
Nickel, Dissolved	0.05	<	NO	6058-94	MW142	mg/L
Nickel, Dissolved	0.1	<	NO	6672-94	MW142	mg/L
Nickel, Dissolved	0.1	<	NO	5464-95	MW142	mg/L
Nickel, Dissolved		Q	NO	5317-96	MW142	
Nickel, Dissolved	0.05	<	NO	5650-93	MW150	mg/L
Nickel, Dissolved	0.05	<	NO	4769-94	MW150	mg/L
Nickel, Dissolved	0.1	<	NO	5468-95	MW150	mg/L
Nickel, Dissolved		Q	NO	5321-96	MW150	
Nickel, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Nickel, Dissolved	0.05	<	NO	5984-93	MW199	mg/L
Nickel, Dissolved	0.05	<	NO	4312-94	MW199	mg/L
Nickel, Dissolved	0.05	<	NO	5260-94	MW199	mg/L
Nickel, Dissolved	0.05	<	NO	6074-94	MW199	mg/L
Nickel, Dissolved	0.1	<	NO	6668-94	MW199	mg/L
Nickel, Dissolved		Q	NO	7311-93	MW199	

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Nickel, Dissolved							
	0.05	0.05	0.163	0.05	0.05	0.05		
	0.05	0.05	0.205	0.05	0.05	0.05		
	0.05	0.1	0.25	0.05	0.1	0.05		
	0.05	0.1	0.266	0.05	0.05	0.05		
	0.05		0.365	0.05		0.05		
	0.05		0.366	0.05		0.1		
	0.1		0.362	0.1		0.05		
	0.1			0.1				
	0.05			0.05				
Min	0.050	0.050	0.163	0.050	0.050	0.050	0.050	
Max	0.100	0.100	0.362	0.100	0.100	0.100	0.362	
Average	0.061	0.075	0.268	0.061	0.063	0.057	0.102	0.101
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

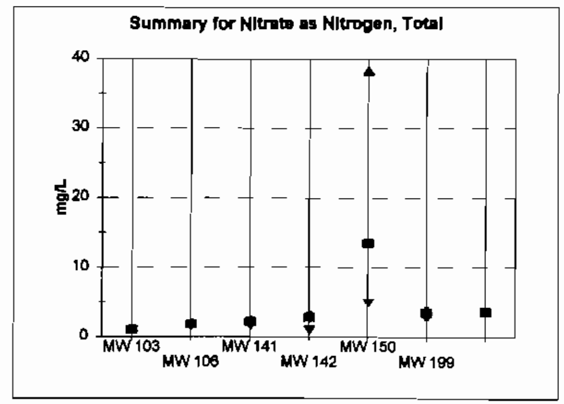
MW 199 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.05 mg/L).

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Nitrate as Nitrogen	1	<	NO	5176-93	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	5944-93	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	7299-93	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	4272-94	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	6026-94	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	6774-94	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	5440-95	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	5265-96	MW103	mg/L
Nitrate as Nitrogen	1	<	NO	5142-97	MW103	mg/L
Nitrate as Nitrogen	1.4		YES	5167-94	MW103	mg/L
Nitrate as Nitrogen	1.6		YES	5444-95	MW106	mg/L
Nitrate as Nitrogen	1.8		YES	5322-93	MW106	mg/L
Nitrate as Nitrogen	2.2		YES	4697-94	MW106	mg/L
Nitrate as Nitrogen	1.7		YES	6092-93	MW141	mg/L
Nitrate as Nitrogen	2		YES	6060-93	MW141	mg/L
Nitrate as Nitrogen	2		YES	6054-94	MW141	mg/L
Nitrate as Nitrogen	2.1		YES	6868-94	MW141	mg/L
Nitrate as Nitrogen	2.3		YES	7065-93	MW141	mg/L
Nitrate as Nitrogen	2.6		YES	4229-94	MW141	mg/L
Nitrate as Nitrogen	2.7		YES	5199-94	MW141	mg/L
Nitrate as Nitrogen	1	<	NO	6058-94	MW142	mg/L
Nitrate as Nitrogen	2.6		YES	6096-93	MW142	mg/L
Nitrate as Nitrogen	2.9		YES	6084-93	MW142	mg/L
Nitrate as Nitrogen	2.9		YES	5464-95	MW142	mg/L
Nitrate as Nitrogen	3		YES	7089-93	MW142	mg/L
Nitrate as Nitrogen	3		YES	4233-94	MW142	mg/L
Nitrate as Nitrogen	3		YES	6872-94	MW142	mg/L
Nitrate as Nitrogen	3		YES	5317-96	MW142	mg/L
Nitrate as Nitrogen	3		YES	5147-97	MW142	mg/L
Nitrate as Nitrogen	3.5		YES	5203-94	MW142	mg/L
Nitrate as Nitrogen	4.9		YES	5146-97	MW150	mg/L
Nitrate as Nitrogen	6.3		YES	5488-95	MW150	mg/L
Nitrate as Nitrogen	7.7		YES	5650-93	MW150	mg/L
Nitrate as Nitrogen	10.2		YES	4789-94	MW150	mg/L
Nitrate as Nitrogen	38.3		YES	5321-96	MW150	mg/L
Nitrate as Nitrogen	2.7		YES	5170-93	MW199	mg/L
Nitrate as Nitrogen	3.3		YES	5984-93	MW199	mg/L
Nitrate as Nitrogen	3.4		YES	6074-94	MW199	mg/L
Nitrate as Nitrogen	3.4		YES	6888-94	MW199	mg/L
Nitrate as Nitrogen	3.4		YES	5556-97	MW199	mg/L
Nitrate as Nitrogen	3.7		YES	7311-93	MW199	mg/L
Nitrate as Nitrogen	3.8		YES	4312-94	MW199	mg/L
Nitrate as Nitrogen	4.1		YES	5260-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Nitrate as Nitrogen							
	1	1.6	1.7	1	4.9	2.7		
	1	1.8	2	2.6	6.3	3.3		
	1	2.2	2	2.9	7.7	3.4		
	1		2.1	2.9	10.2	3.4		
	1		2.3	3	38.3	3.4		
	1		2.6	3		3.7		
	1		2.7	3		3.8		
	1			3		4.1		
	1			3				
	1.4			3.5				
Min	1.000	1.600	1.700	1.000	4.900	2.700	1.000	
Max	1.400	2.200	2.700	3.500	38.300	4.100	38.300	
Average	1.040	1.867	2.200	2.790	13.480	3.475	3.593	4.142
Number	10	3	7	10	5	8	43	



MW 103 - Data were not modified.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Although values were high in this well, the results could not be related to turbidity of samples; therefore, data were not modified.

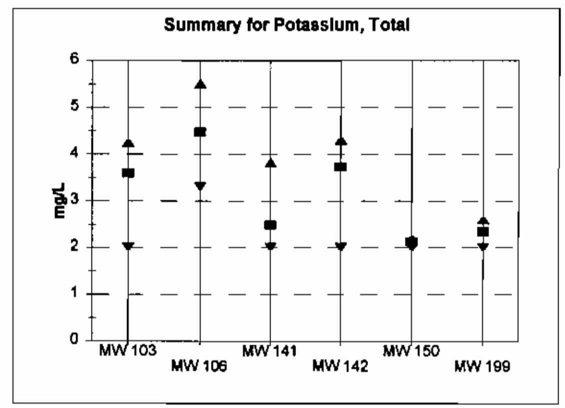
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Potassium	2	<	NO	5944-93	MW103	mg/L
Potassium	3.26		YES	7299-93	MW103	mg/L
Potassium	3.26		YES	6774-94	MW103	mg/L
Potassium	3.46		YES	4272-94	MW103	mg/L
Potassium	3.58		YES	5187-94	MW103	mg/L
Potassium	3.66		YES	6026-94	MW103	mg/L
Potassium	3.91		YES	5178-93	MW103	mg/L
Potassium	4.25		YES	5440-95	MW103	mg/L
Potassium	5	<	NO	5142-97	MW103	mg/L
Potassium	10.5	<	NO	5285-96	MW103	mg/L
Potassium	3.3		YES	5444-95	MW106	mg/L
Potassium	4.04		YES	4897-94	MW106	mg/L
Potassium	5.03		YES	7272-94	MW106	mg/L
Potassium	5.51		YES	5322-93	MW106	mg/L
Potassium	2	<	NO	4229-94	MW141	mg/L
Potassium	2	<	NO	6054-94	MW141	mg/L
Potassium	2.02		YES	5199-94	MW141	mg/L
Potassium	2.11		YES	7065-93	MW141	mg/L
Potassium	2.3		YES	6886-94	MW141	mg/L
Potassium	3.14		YES	8080-93	MW141	mg/L
Potassium	3.82		YES	6092-93	MW141	mg/L
Potassium	2	<	NO	8084-93	MW142	mg/L
Potassium	2	<	NO	7069-93	MW142	mg/L
Potassium	2	<	NO	4233-94	MW142	mg/L
Potassium	2	<	NO	5203-94	MW142	mg/L
Potassium	2	<	NO	8058-94	MW142	mg/L
Potassium	2	<	NO	8872-94	MW142	mg/L
Potassium	2	<	NO	5484-95	MW142	mg/L
Potassium	4.3		YES	8096-93	MW142	mg/L
Potassium	5	<	NO	5147-97	MW142	mg/L
Potassium	10.5	<	NO	5317-96	MW142	mg/L
Potassium	2	<	NO	5650-93	MW150	mg/L
Potassium	2	<	NO	4789-94	MW150	mg/L
Potassium	2.2		YES	5486-95	MW150	mg/L
Potassium	5	<	NO	5148-97	MW150	mg/L
Potassium	10.5	<	NO	5321-96	MW150	mg/L
Potassium	2	<	NO	5170-93	MW199	mg/L
Potassium	2	<	NO	7311-93	MW199	mg/L
Potassium	2	<	NO	5260-94	MW199	mg/L
Potassium	2.48		YES	4312-94	MW199	mg/L
Potassium	2.51		YES	5984-93	MW199	mg/L
Potassium	2.57		YES	8074-94	MW199	mg/L
Potassium	2.6		YES	6888-94	MW199	mg/L
Potassium	5	N<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Potassium							
	2	3.3	2	2	2	2		
	3.26	4.04	2	4.3	2	2		
	3.26	5.03	2.02	4.3	2.2	2		
	3.46	5.51	2.11	4.3	2.2	2.48		
	3.58		2.3		2.2	2.51		
	3.66		3.14			2.57		
	3.91		3.82			2.6		
	4.25					2.6		
	4.25							
	4.25							
Min	2.000	3.300	2.000	2.000	2.000	2.000	2.000	
Max	4.250	5.510	3.820	4.300	2.200	2.600	5.510	
Average	3.588	4.470	2.484	3.725	2.120	2.345	3.037	3.122
Number	10	4	7	4	5	8	38	



MW 103 - Two nondetects greater than maximum detected value set to maximum detected value.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

MW 150 - Two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

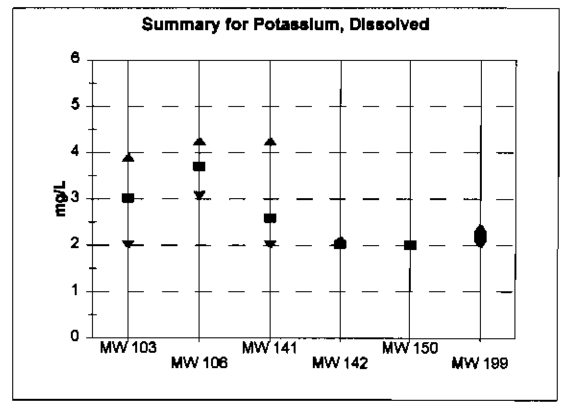
MW 199 - One nondetect greater than the maximum detected value reduced to maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Potassium, Dissolved	2	<	NO	5944-93	MW103	mg/L
Potassium, Dissolved	2.59		YES	7299-93	MW103	mg/L
Potassium, Dissolved	3.12		YES	6774-94	MW103	mg/L
Potassium, Dissolved	3.19		YES	4272-94	MW103	mg/L
Potassium, Dissolved	3.3		YES	6026-94	MW103	mg/L
Potassium, Dissolved	3.43		YES	5176-93	MW103	mg/L
Potassium, Dissolved	3.6		YES	5440-95	MW103	mg/L
Potassium, Dissolved	3.9		YES	5167-94	MW103	mg/L
Potassium, Dissolved		O	NO	5265-96	MW103	
Potassium, Dissolved	3.07		YES	7272-94	MW106	mg/L
Potassium, Dissolved	3.54		YES	5444-95	MW106	mg/L
Potassium, Dissolved	3.92		YES	4697-94	MW106	mg/L
Potassium, Dissolved	4.26		YES	5322-93	MW106	mg/L
Potassium, Dissolved	2	<	NO	7085-93	MW141	mg/L
Potassium, Dissolved	2	<	NO	4229-94	MW141	mg/L
Potassium, Dissolved	2.09		YES	5199-94	MW141	mg/L
Potassium, Dissolved	2.13		YES	6054-94	MW141	mg/L
Potassium, Dissolved	2.3		YES	6866-94	MW141	mg/L
Potassium, Dissolved	3.3		YES	6060-93	MW141	mg/L
Potassium, Dissolved	4.25		YES	6092-93	MW141	mg/L
Potassium, Dissolved	2	<	NO	6084-93	MW142	mg/L
Potassium, Dissolved	2	<	NO	7069-93	MW142	mg/L
Potassium, Dissolved	2	<	NO	4233-94	MW142	mg/L
Potassium, Dissolved	2	<	NO	5203-94	MW142	mg/L
Potassium, Dissolved	2	<	NO	6058-94	MW142	mg/L
Potassium, Dissolved	2	<	NO	6872-94	MW142	mg/L
Potassium, Dissolved	2.02		YES	6096-93	MW142	mg/L
Potassium, Dissolved	2.13		YES	5464-95	MW142	mg/L
Potassium, Dissolved		Q	NO	5317-96	MW142	
Potassium, Dissolved	2	<	NO	5650-93	MW150	mg/L
Potassium, Dissolved	2	<	NO	4769-94	MW150	mg/L
Potassium, Dissolved	2		YES	5468-95	MW150	mg/L
Potassium, Dissolved		Q	NO	5321-96	MW150	
Potassium, Dissolved	2	<	NO	5170-93	MW199	mg/L
Potassium, Dissolved	2.06		YES	7311-93	MW199	mg/L
Potassium, Dissolved	2.1		YES	6886-94	MW199	mg/L
Potassium, Dissolved	2.22		YES	4312-94	MW199	mg/L
Potassium, Dissolved	2.29		YES	5260-94	MW199	mg/L
Potassium, Dissolved	2.36		YES	6074-94	MW199	mg/L
Potassium, Dissolved	2.38		YES	5984-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Potassium, Dissolved							
	2	3.07	2	2	2	2		
	2.59	3.54	2	2	2	2.08		
	3.12	3.92	2.09	2	2	2.1		
	3.19	4.26	2.13	2	2	2.22		
	3.3		2.3	2		2.29		
	3.43		3.3	2		2.36		
	3.6		4.25	2.02		2.38		
	3.9			2.13				
	2			2				
Min	2.000	3.070	2.000	2.000	2.000	2.000	2.000	
Max	3.900	4.260	4.250	2.130	2.000	2.380	4.260	
Average	3.014	3.696	2.561	2.017	2.000	2.204	2.539	2.566
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result assigned minimum detected value for this well (2 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (2 mg/L).

MW 150 - One "Q" qualified result given value of minimum detection limit for samples from this well (2 mg/L).

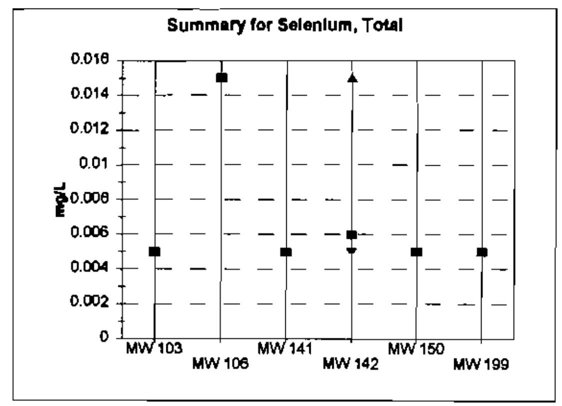
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Selenium	0.005	<	NO	5178-93	MW103	mg/L
Selenium	0.005	<	NO	5944-93	MW103	mg/L
Selenium	0.005	<	NO	7299-93	MW103	mg/L
Selenium	0.005	<	NO	4272-94	MW103	mg/L
Selenium	0.005	<	NO	5187-94	MW103	mg/L
Selenium	0.005	<	NO	6026-94	MW103	mg/L
Selenium	0.005	<	NO	6774-94	MW103	mg/L
Selenium	0.005	<S	NO	5440-95	MW103	mg/L
Selenium	0.005	<	NO	5285-96	MW103	mg/L
Selenium	0.005	<	NO	5142-97	MW103	mg/L
Selenium	0.015	<S	NO	5444-95	MW106	mg/L
Selenium	0.005	<	NO	6080-93	MW141	mg/L
Selenium	0.005	<	NO	6092-93	MW141	mg/L
Selenium	0.005	<	NO	7085-93	MW141	mg/L
Selenium	0.005	<	NO	4229-94	MW141	mg/L
Selenium	0.005	<	NO	5199-94	MW141	mg/L
Selenium	0.005	<	NO	6054-94	MW141	mg/L
Selenium	0.005	<	NO	6868-94	MW141	mg/L
Selenium	0.005	<	NO	6084-93	MW142	mg/L
Selenium	0.005	<	NO	6096-93	MW142	mg/L
Selenium	0.005	<	NO	7089-93	MW142	mg/L
Selenium	0.005	<	NO	4233-94	MW142	mg/L
Selenium	0.005	<	NO	5203-94	MW142	mg/L
Selenium	0.005	<	NO	6058-94	MW142	mg/L
Selenium	0.005	<	NO	6672-94	MW142	mg/L
Selenium	0.005	<	NO	5317-96	MW142	mg/L
Selenium	0.005	<	NO	5147-97	MW142	mg/L
Selenium	0.015	<S	NO	5464-95	MW142	mg/L
Selenium	0.005	<	NO	5468-95	MW150	mg/L
Selenium	0.005	<	NO	5321-96	MW150	mg/L
Selenium	0.005	<	NO	5148-97	MW150	mg/L
Selenium	0.005	<	NO	5170-93	MW199	mg/L
Selenium	0.005	<	NO	5984-93	MW199	mg/L
Selenium	0.005	<	NO	7311-93	MW199	mg/L
Selenium	0.005	<	NO	4312-94	MW199	mg/L
Selenium	0.005	<	NO	5260-94	MW199	mg/L
Selenium	0.005	<	NO	6074-94	MW199	mg/L
Selenium	0.005	<	NO	6868-94	MW199	mg/L
Selenium	0.005	<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Selenium							
	0.005	0.015	0.005	0.005	0.005	0.005		
	0.005		0.005	0.005	0.005	0.005		
	0.005		0.005	0.005	0.005	0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.005		0.005	0.005		0.005		
	0.005			0.005		0.005		
	0.005			0.005				
	0.005			0.015				
Min	0.005	0.015	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.015	0.005	0.015	0.005	0.005	0.015	
Average	0.005	0.015	0.005	0.006	0.005	0.005	0.006	0.007
Number	10	1	7	10	3	8	39	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

Data for Selenium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Selenium, Dissolved		Q	NO	5178-93	MW103	
Selenium, Dissolved		Q	NO	5944-93	MW103	
Selenium, Dissolved		Q	NO	7299-93	MW103	
Selenium, Dissolved		Q	NO	4272-94	MW103	
Selenium, Dissolved		Q	NO	5187-94	MW103	
Selenium, Dissolved		Q	NO	6026-94	MW103	
Selenium, Dissolved		Q	NO	6774-94	MW103	
Selenium, Dissolved		Q	NO	5440-95	MW103	
Selenium, Dissolved		Q	NO	5285-96	MW103	
Selenium, Dissolved		Q	NO	5142-97	MW103	
Selenium, Dissolved		Q	NO	5444-95	MW106	
Selenium, Dissolved		Q	NO	6080-93	MW141	
Selenium, Dissolved		Q	NO	6092-93	MW141	
Selenium, Dissolved		Q	NO	7085-93	MW141	
Selenium, Dissolved		Q	NO	4229-94	MW141	
Selenium, Dissolved		Q	NO	5199-94	MW141	
Selenium, Dissolved		Q	NO	8054-94	MW141	
Selenium, Dissolved		Q	NO	6868-94	MW141	
Selenium, Dissolved		Q	NO	6064-93	MW142	
Selenium, Dissolved		Q	NO	6096-93	MW142	
Selenium, Dissolved		Q	NO	7089-93	MW142	
Selenium, Dissolved		Q	NO	4233-94	MW142	
Selenium, Dissolved		Q	NO	5203-94	MW142	
Selenium, Dissolved		Q	NO	6056-94	MW142	
Selenium, Dissolved		Q	NO	6872-94	MW142	
Selenium, Dissolved		Q	NO	5464-95	MW142	
Selenium, Dissolved		Q	NO	5317-96	MW142	
Selenium, Dissolved		Q	NO	5147-97	MW142	
Selenium, Dissolved		Q	NO	5466-95	MW150	
Selenium, Dissolved		Q	NO	5321-96	MW150	
Selenium, Dissolved		Q	NO	5148-97	MW150	
Selenium, Dissolved		Q	NO	5170-93	MW199	
Selenium, Dissolved		Q	NO	5964-93	MW199	
Selenium, Dissolved		Q	NO	7311-93	MW199	
Selenium, Dissolved		Q	NO	4312-94	MW199	
Selenium, Dissolved		Q	NO	5260-94	MW199	
Selenium, Dissolved		Q	NO	6074-94	MW199	
Selenium, Dissolved		Q	NO	6868-94	MW199	
Selenium, Dissolved		Q	NO	5558-97	MW199	

CORRECTED DATA SET

Selenium, Dissolved

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Number	0	0	0	0	0	0	0	

Selenium, Dissolved

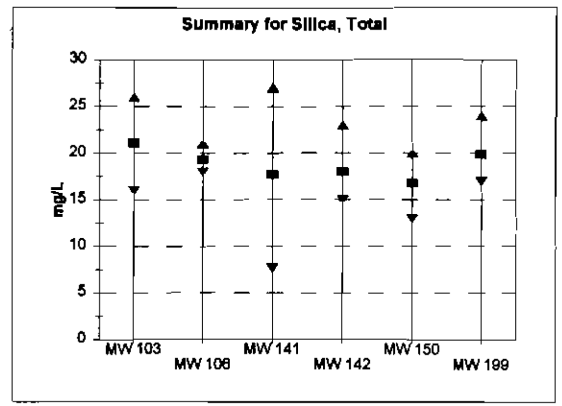
- Analysis for Selenium, Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of selenium in a filtered sample exceeds the background concentration.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Silica	16		YES	5440-95	MW103	mg/L
Silica	19		YES	5187-94	MW103	mg/L
Silica	19		YES	5142-97	MW103	mg/L
Silica	21		YES	5178-93	MW103	mg/L
Silica	21		YES	6026-94	MW103	mg/L
Silica	22		YES	5944-93	MW103	mg/L
Silica	22		YES	6774-94	MW103	mg/L
Silica	22		YES	5285-96	MW103	mg/L
Silica	23		YES	4272-94	MW103	mg/L
Silica	26		YES	7299-93	MW103	mg/L
Silica	18		YES	5444-95	MW106	mg/L
Silica	19		YES	5322-93	MW106	mg/L
Silica	21		YES	4697-94	MW106	mg/L
Silica	7.68		YES	6080-93	MW141	mg/L
Silica	16		YES	5199-94	MW141	mg/L
Silica	16		YES	6054-94	MW141	mg/L
Silica	17		YES	6092-93	MW141	mg/L
Silica	19		YES	6668-94	MW141	mg/L
Silica	21		YES	7085-93	MW141	mg/L
Silica	27		YES	4229-94	MW141	mg/L
Silica	15		YES	6058-94	MW142	mg/L
Silica	15		YES	5147-97	MW142	mg/L
Silica	16		YES	6872-94	MW142	mg/L
Silica	17		YES	6096-93	MW142	mg/L
Silica	17		YES	5203-94	MW142	mg/L
Silica	17		YES	5464-95	MW142	mg/L
Silica	18		YES	6084-93	MW142	mg/L
Silica	21		YES	7089-93	MW142	mg/L
Silica	21		YES	5317-96	MW142	mg/L
Silica	23		YES	4233-94	MW142	mg/L
Silica	13		YES	5850-93	MW150	mg/L
Silica	15		YES	5146-97	MW150	mg/L
Silica	18		YES	5468-95	MW150	mg/L
Silica	20		YES	4789-94	MW150	mg/L
Silica	20		YES	5321-96	MW150	mg/L
Silica	17		YES	5260-94	MW199	mg/L
Silica	17		YES	6074-94	MW199	mg/L
Silica	18		YES	6686-94	MW199	mg/L
Silica	18		YES	5558-97	MW199	mg/L
Silica	21		YES	4312-94	MW199	mg/L
Silica	22		YES	5170-93	MW199	mg/L
Silica	22		YES	5984-93	MW199	mg/L
Silica	24		YES	7311-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Silica							
	16	16	7.68	15	13	17		
	19	19	16	15	15	17		
	19	21	16	16	16	18		
	21		17	17	20	18		
	21		19	17	20	21		
	22		21	17		22		
	22		27	18		22		
	22			21		24		
	23			21				
	26			23				
Min	16.000	18.000	7.680	15.000	13.000	17.000	7.680	
Max	26.000	21.000	27.000	23.000	20.000	24.000	27.000	
Average	21.100	19.333	17.669	18.000	16.800	19.875	18.969	18.796
Number	10	3	7	10	5	8	43	



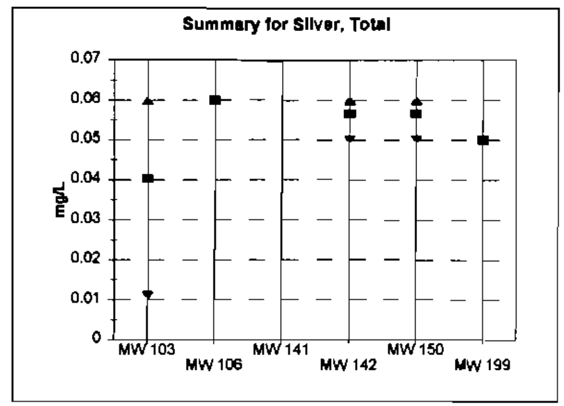
Data for Silica, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Silver	0.011	<	NO	5440-95	MW103	mg/L
Silver	0.05	<	NO	5142-97	MW103	mg/L
Silver	0.06	N*<	NO	5285-96	MW103	mg/L
Silver	0.06	<N	NO	5444-95	MW106	mg/L
Silver	0.05	<	NO	5147-97	MW142	mg/L
Silver	0.06	<N	NO	5464-95	MW142	mg/L
Silver	0.06	N*<	NO	5317-96	MW142	mg/L
Silver	0.05	<	NO	5148-97	MW150	mg/L
Silver	0.06	<N	NO	5468-95	MW150	mg/L
Silver	0.06	N*<	NO	5321-96	MW150	mg/L
Silver	0.05	N<	NO	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Silver								
	0.011	0.06		0.05	0.05	0.05		
	0.05			0.06	0.06			
	0.06			0.06	0.06			
Min	0.011	0.060	ERR	0.050	0.050	0.050	0.011	
Max	0.060	0.060	ERR	0.060	0.060	0.050	0.060	
Average	0.040	0.060	ERR	0.057	0.057	0.050	0.052	0.053
Number	3	1	0	3	3	1	11	



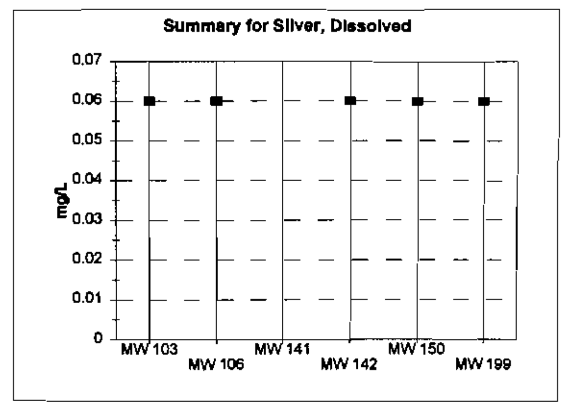
Data for Silver, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Silver, Dissolved		O	NO	5440-95	MW103	
Silver, Dissolved		O	NO	5285-96	MW103	
Silver, Dissolved		O	NO	5142-97	MW103	
Silver, Dissolved	0.06	<	NO	5444-95	MW106	mg/L
Silver, Dissolved	0.06	<	NO	5464-95	MW142	mg/L
Silver, Dissolved		Q	NO	5317-96	MW142	
Silver, Dissolved		Q	NO	5147-97	MW142	
Silver, Dissolved	0.06	<	NO	5488-95	MW150	mg/L
Silver, Dissolved		Q	NO	5321-96	MW150	
Silver, Dissolved		Q	NO	5146-97	MW150	
Silver, Dissolved		Q	NO	5556-97	MW199	

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Silver, Dissolved								
	0.06	0.06		0.06	0.06	0.06		
	0.06			0.06	0.06			
	0.06			0.06	0.06			
Min	0.060	0.060	ERR	0.060	0.060	0.060	0.060	
Max	0.060	0.080	ERR	0.060	0.060	0.060	0.060	
Average	0.060	0.060	ERR	0.060	0.060	0.060	0.060	0.060
Number	3	1	0	3	3	1	11	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

MW 103 - Three "Q" qualified results were assigned minimum detection limit across samples from all wells (0.06 mg/L).

MW 106 - Data not modified.

MW 142 - Two "Q" qualified results were assigned minimum detection limit from samples taken from this well (0.06 mg/L).

MW 150 - Two "Q" qualified results given value of minimum detection limit for samplesfrom this well (0.06 mg/l).

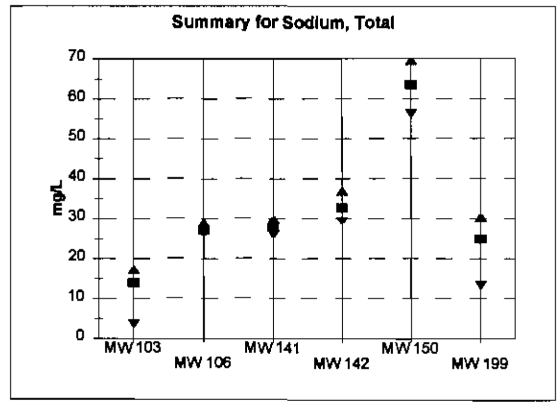
MW 199 - One "Q" qualified result assigned minimum detection limit across samples taken from all wells (0.06 mg/L).

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Sodium	3.71		YES	5944-93	MW103	mg/L
Sodium	14.2		YES	7299-93	MW103	mg/L
Sodium	14.3		YES	6774-94	MW103	mg/L
Sodium	14.66		YES	4272-94	MW103	mg/L
Sodium	14.8		YES	6026-94	MW103	mg/L
Sodium	15	N	YES	5285-96	MW103	mg/L
Sodium	15.2		YES	5187-94	MW103	mg/L
Sodium	15.2		YES	5440-95	MW103	mg/L
Sodium	16.12		YES	5178-93	MW103	mg/L
Sodium	17.3	N	YES	5142-97	MW103	mg/L
Sodium	28.1		YES	5444-95	MW106	mg/L
Sodium	26.4		YES	4897-94	MW106	mg/L
Sodium	27.5		YES	5322-93	MW106	mg/L
Sodium	29		YES	7272-94	MW106	mg/L
Sodium	26		YES	7085-93	MW141	mg/L
Sodium	27		YES	8092-93	MW141	mg/L
Sodium	27.1		YES	6054-94	MW141	mg/L
Sodium	27.4		YES	5199-94	MW141	mg/L
Sodium	28		YES	6886-94	MW141	mg/L
Sodium	29.2		YES	4229-94	MW141	mg/L
Sodium	29.93		YES	6080-93	MW141	mg/L
Sodium	29.3		YES	5203-94	MW142	mg/L
Sodium	30.4		YES	7089-93	MW142	mg/L
Sodium	31.54		YES	6084-93	MW142	mg/L
Sodium	32.4		YES	5464-95	MW142	mg/L
Sodium	32.6		YES	4233-94	MW142	mg/L
Sodium	32.7		YES	6096-93	MW142	mg/L
Sodium	33		YES	6872-94	MW142	mg/L
Sodium	33.6	N	YES	5317-96	MW142	mg/L
Sodium	33.85		YES	8058-94	MW142	mg/L
Sodium	36.9	N	YES	5147-97	MW142	mg/L
Sodium	56.3		YES	4789-94	MW150	mg/L
Sodium	82.2	N	YES	5321-96	MW150	mg/L
Sodium	63		YES	5468-95	MW150	mg/L
Sodium	66.6		YES	5650-93	MW150	mg/L
Sodium	69.6	N	YES	5148-97	MW150	mg/L
Sodium	13.31		YES	5170-93	MW199	mg/L
Sodium	22.1		YES	5260-94	MW199	mg/L
Sodium	25		YES	8888-94	MW199	mg/L
Sodium	26.6		YES	5984-93	MW199	mg/L
Sodium	26.8		YES	4312-94	MW199	mg/L
Sodium	26.9	N	YES	5558-97	MW199	mg/L
Sodium	27.8		YES	7311-93	MW199	mg/L
Sodium	30.4		YES	8074-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Sodium							
	3.71	26.1	26	29.3	56.3	13.31		
	14.2	26.4	27	30.4	62.2	22.1		
	14.3	27.5	27.1	31.54	63	25		
	14.68	29	27.4	32.4	66.6	26.6		
	14.8		28	32.6	69.6	26.8		
	15		29.2	32.7		26.9		
	15.2		29.93	33		27.8		
	15.2			33.6		30.4		
	16.12			33.85				
	17.3			36.9				
Min	3.710	26.100	26.000	29.300	56.300	13.310	3.710	
Max	17.300	29.000	29.930	36.900	69.600	30.400	69.600	
Average	14.051	27.250	27.804	32.629	63.540	24.684	29.251	31.690
Number	10	4	7	10	5	8	44	



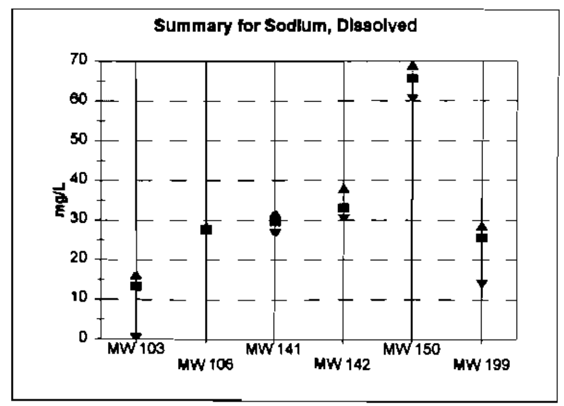
Data for Sodium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION IO	UNITS
Sodium, Dissolved	0.317		YES	5944-93	MW103	mg/L
Sodium, Dissolved	13.7		YES	7299-93	MW103	mg/L
Sodium, Dissolved	14	N*	YES	5265-96	MW103	mg/L
Sodium, Dissolved	14.4		YES	6774-94	MW103	mg/L
Sodium, Dissolved	14.7		YES	6026-94	MW103	mg/L
Sodium, Dissolved	15.2		YES	5187-94	MW103	mg/L
Sodium, Dissolved	15.7		YES	5440-95	MW103	mg/L
Sodium, Dissolved	16.2		YES	5178-93	MW103	mg/L
Sodium, Dissolved	16.2		YES	4272-94	MW103	mg/L
Sodium, Dissolved	26.8		YES	5322-93	MW106	mg/L
Sodium, Dissolved	27.4		YES	5444-95	MW106	mg/L
Sodium, Dissolved	28	J	YES	7272-94	MW106	mg/L
Sodium, Dissolved	28.4		YES	4697-94	MW106	mg/L
Sodium, Dissolved	26.6		YES	7085-93	MW141	mg/L
Sodium, Dissolved	27.5		YES	6092-93	MW141	mg/L
Sodium, Dissolved	28.3		YES	5199-94	MW141	mg/L
Sodium, Dissolved	30.56		YES	8054-94	MW141	mg/L
Sodium, Dissolved	31		YES	6868-94	MW141	mg/L
Sodium, Dissolved	31.5		YES	4229-94	MW141	mg/L
Sodium, Dissolved	31.84		YES	6080-93	MW141	mg/L
Sodium, Dissolved	30.4		YES	7089-93	MW142	mg/L
Sodium, Dissolved	30.9		YES	5203-94	MW142	mg/L
Sodium, Dissolved	31.14		YES	6084-93	MW142	mg/L
Sodium, Dissolved	31.6	N*	YES	5317-96	MW142	mg/L
Sodium, Dissolved	32		YES	6096-93	MW142	mg/L
Sodium, Dissolved	34		YES	4233-94	MW142	mg/L
Sodium, Dissolved	34.3		YES	5464-95	MW142	mg/L
Sodium, Dissolved	35.36		YES	8058-94	MW142	mg/L
Sodium, Dissolved	38	J	YES	8672-94	MW142	mg/L
Sodium, Dissolved	60.6	N*	YES	5321-96	MW150	mg/L
Sodium, Dissolved	86.4		YES	4789-94	MW150	mg/L
Sodium, Dissolved	68.7		YES	5650-93	MW150	mg/L
Sodium, Dissolved	69		YES	5468-95	MW150	mg/L
Sodium, Dissolved	13.9		YES	5170-93	MW199	mg/L
Sodium, Dissolved	26		YES	5984-93	MW199	mg/L
Sodium, Dissolved	26.9		YES	7311-93	MW199	mg/L
Sodium, Dissolved	27		YES	5280-94	MW199	mg/L
Sodium, Dissolved	28		YES	6888-94	MW199	mg/L
Sodium, Dissolved	28.4		YES	6074-94	MW199	mg/L
Sodium, Dissolved	28.5		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Sodium, Dissolved							
	0.317	26.8	26.6	30.4	60.6	13.9		
	13.7	27.4	27.5	30.9	68.4	26		
	14	28	28.3	31.14	66.7	26.9		
	14.4	28.4	30.56	31.8	69	27		
	14.7		31	32		28		
	15.2		31.5	34		28.4		
	15.7		31.84	34.3		28.5		
	16.2			35.38				
	16.2			38				
Min	0.317	26.600	26.600	30.400	60.600	13.900	0.317	
Max	16.200	28.400	31.840	38.000	69.000	28.500	69.000	
Average	13.380	27.650	29.614	33.078	65.675	25.529	29.435	32.488
Number	9	4	7	9	4	7	40	



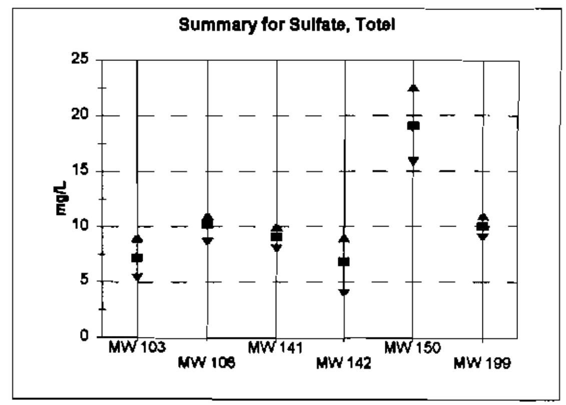
Data for Sodium, Dissolved were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Sulfate	5.4		YES	5285-96	MW103	mg/L
Sulfate	5.4		YES	5142-97	MW103	mg/L
Sulfate	6.1		YES	5440-95	MW103	mg/L
Sulfate	6.5		YES	6774-94	MW103	mg/L
Sulfate	7.2		YES	8026-94	MW103	mg/L
Sulfate	9		YES	5178-93	MW103	mg/L
Sulfate	9		YES	5944-93	MW103	mg/L
Sulfate	9		YES	5167-94	MW103	mg/L
Sulfate	8.6		YES	5444-95	MW106	mg/L
Sulfate	11		YES	5322-93	MW106	mg/L
Sulfate	11		YES	4697-94	MW106	mg/L
Sulfate	8		YES	6092-93	MW141	mg/L
Sulfate	9		YES	6866-94	MW141	mg/L
Sulfate	9.3		YES	6054-94	MW141	mg/L
Sulfate	10		YES	6080-93	MW141	mg/L
Sulfate	4		YES	6056-94	MW142	mg/L
Sulfate	6		YES	6096-93	MW142	mg/L
Sulfate	6.7		YES	5147-97	MW142	mg/L
Sulfate	7.1		YES	5464-95	MW142	mg/L
Sulfate	7.1		YES	5317-96	MW142	mg/L
Sulfate	8		YES	6672-94	MW142	mg/L
Sulfate	9		YES	6084-93	MW142	mg/L
Sulfate	15.9		YES	5468-95	MW150	mg/L
Sulfate	16		YES	5650-93	MW150	mg/L
Sulfate	19		YES	4769-94	MW150	mg/L
Sulfate	21.9		YES	5148-97	MW150	mg/L
Sulfate	22.6		YES	5321-96	MW150	mg/L
Sulfate	9		YES	5170-93	MW199	mg/L
Sulfate	9.4		YES	6868-94	MW199	mg/L
Sulfate	9.6		YES	6074-94	MW199	mg/L
Sulfate	11		YES	5984-93	MW199	mg/L
Sulfate	11		YES	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Sulfate							
	5.4	8.6	8	4	15.9	9		
	5.4	11	9	6	16	9.4		
	6.1	11	9.3	6.7	19	9.8		
	6.5		10	7.1	21.9	11		
	7.2			7.1	22.6	11		
	9			8				
	9			9				
	9							
Min	5.400	8.600	8.000	4.000	15.900	9.000	4.000	
Max	9.000	11.000	10.000	9.000	22.600	11.000	22.600	
Average	7.200	10.200	9.075	6.843	19.060	10.040	9.938	10.406
Number	8	3	4	7	5	5	32	



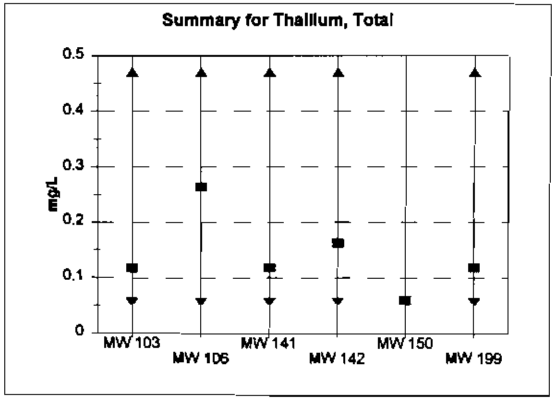
Data for Sulfate, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Thallium	0.056	<	NO	5176-93	MW103	mg/L
Thallium	0.06	<	NO	5944-93	MW103	mg/L
Thallium	0.06	<	NO	7299-93	MW103	mg/L
Thallium	0.06	<	NO	4272-94	MW103	mg/L
Thallium	0.06	<	NO	5167-94	MW103	mg/L
Thallium	0.06	<	NO	6026-94	MW103	mg/L
Thallium	0.47	<	NO	6774-94	MW103	mg/L
Thallium	0.056	<	NO	5322-93	MW106	mg/L
Thallium	0.06	<	NO	4697-94	MW106	mg/L
Thallium	0.47	<	NO	7272-94	MW106	mg/L
Thallium	0.47	<	NO	5444-95	MW106	mg/L
Thallium	0.056	<	NO	6060-93	MW141	mg/L
Thallium	0.06	<	NO	6092-93	MW141	mg/L
Thallium	0.06	<	NO	7065-93	MW141	mg/L
Thallium	0.06	<	NO	4229-94	MW141	mg/L
Thallium	0.06	<	NO	5199-94	MW141	mg/L
Thallium	0.06	<	NO	6054-94	MW141	mg/L
Thallium	0.47	<	NO	6668-94	MW141	mg/L
Thallium	0.056	<	NO	6084-93	MW142	mg/L
Thallium	0.06	<	NO	6096-93	MW142	mg/L
Thallium	0.06	<	NO	7069-93	MW142	mg/L
Thallium	0.06	<	NO	4233-94	MW142	mg/L
Thallium	0.06	<	NO	5203-94	MW142	mg/L
Thallium	0.06	<	NO	6056-94	MW142	mg/L
Thallium	0.47	<	NO	6872-94	MW142	mg/L
Thallium	0.47	<	NO	5464-95	MW142	mg/L
Thallium	0.06	<	NO	5650-93	MW150	mg/L
Thallium	0.06	<	NO	4769-94	MW150	mg/L
Thallium	0.056	<	NO	5170-93	MW199	mg/L
Thallium	0.06	<	NO	5984-93	MW199	mg/L
Thallium	0.06	<	NO	7311-93	MW199	mg/L
Thallium	0.06	<	NO	4312-94	MW199	mg/L
Thallium	0.06	<	NO	5260-94	MW199	mg/L
Thallium	0.06	<	NO	6074-94	MW199	mg/L
Thallium	0.47	<	NO	6666-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Thallium							
	0.056	0.056	0.056	0.056	0.06	0.056		
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.47	0.06	0.06		0.06		
	0.06	0.47	0.06	0.06		0.06		
	0.06		0.06	0.06		0.06		
	0.06		0.06	0.06		0.06		
	0.47		0.47	0.47		0.47		
				0.47				
Min	0.056	0.056	0.056	0.056	0.060	0.056	0.056	
Max	0.470	0.470	0.470	0.470	0.060	0.470	0.470	
Average	0.116	0.264	0.116	0.162	0.060	0.116	0.141	0.140
Number	7	4	7	8	2	7	35	



All results for this well were below their respective detection limits; therefore the plot is simply a depiction of the detection limits used for samples taken from the wells.

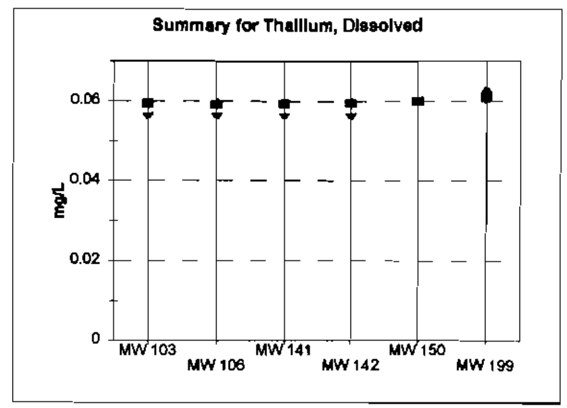
Data for Thallium, Total were not modified; however, detection limits for some samples are quite high (i.e., 0.47 mg/L).

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Thallium, Dissolved	0.056	<	NO	5178-93	MW103	mg/L
Thallium, Dissolved	0.06	<	NO	5944-93	MW103	mg/L
Thallium, Dissolved	0.06	<	NO	7299-93	MW103	mg/L
Thallium, Dissolved	0.06	<	NO	4272-94	MW103	mg/L
Thallium, Dissolved	0.06	<	NO	5167-94	MW103	mg/L
Thallium, Dissolved	0.06	<	NO	6026-94	MW103	mg/L
Thallium, Dissolved	0.47	<	NO	6774-94	MW103	mg/L
Thallium, Dissolved	0.056	<	NO	5322-93	MW106	mg/L
Thallium, Dissolved	0.06	<	NO	4697-94	MW106	mg/L
Thallium, Dissolved	0.47	<	NO	7272-94	MW106	mg/L
Thallium, Dissolved	0.47	<	NO	5444-95	MW106	mg/L
Thallium, Dissolved	0.056	<	NO	6060-93	MW141	mg/L
Thallium, Dissolved	0.06	<	NO	6092-93	MW141	mg/L
Thallium, Dissolved	0.06	<	NO	7065-93	MW141	mg/L
Thallium, Dissolved	0.06	<	NO	4229-94	MW141	mg/L
Thallium, Dissolved	0.06	<	NO	5199-94	MW141	mg/L
Thallium, Dissolved	0.06	<	NO	6054-94	MW141	mg/L
Thallium, Dissolved	0.47	<	NO	6868-94	MW141	mg/L
Thallium, Dissolved	0.056	<	NO	6084-93	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	6096-93	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	7069-93	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	4233-94	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	5203-94	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	6056-94	MW142	mg/L
Thallium, Dissolved	0.47	<	NO	6872-94	MW142	mg/L
Thallium, Dissolved	0.47	<	NO	5464-95	MW142	mg/L
Thallium, Dissolved	0.06	<	NO	5650-93	MW150	mg/L
Thallium, Dissolved	0.06	<	NO	4789-94	MW150	mg/L
Thallium, Dissolved	0.06	<	NO	5984-93	MW199	mg/L
Thallium, Dissolved	0.06	<	NO	7311-93	MW199	mg/L
Thallium, Dissolved	0.06	<	NO	5260-94	MW199	mg/L
Thallium, Dissolved	0.06	<	NO	6074-94	MW199	mg/L
Thallium, Dissolved	0.063		YES	4312-94	MW199	mg/L
Thallium, Dissolved	0.47	<	NO	6886-94	MW199	mg/L
Thallium, Dissolved		Q	NO	5170-93	MW199	

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Thallium, Dissolved							
	0.056	0.056	0.056	0.056	0.06	0.06		
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.06	0.06	0.06		0.06		
	0.06	0.06	0.06	0.06		0.06		
	0.06		0.06	0.06		0.063		
	0.06		0.06	0.06		0.063		
	0.06		0.06	0.06		0.06		
				0.06				
Min	0.056	0.056	0.056	0.056	0.060	0.060	0.056	
Max	0.060	0.060	0.060	0.060	0.060	0.063	0.063	
Average	0.059	0.059	0.059	0.060	0.060	0.061	0.060	0.060
Number	7	4	7	6	2	7	35	



MW 103 - One nondetect result with a value much greater than that for other samples from this well was reduced to the next greatest nondetect result (0.06 mg/L).

MW 106 - Two nondetect results with values much greater than that for other samples from this well were reduced the the next greatest nondetect result for this well (0.06 mg/L).

MW 141 - One nondetect result with a value much greater than that for other samples from this well was reduced to the next greatest nondetect value.

MW 142 - Two nondetect results with values much greater than that for other samples from this well were reduced to the next greatest nondetect result (0.06 mg/L).

MW 150 - Data were not modifed.

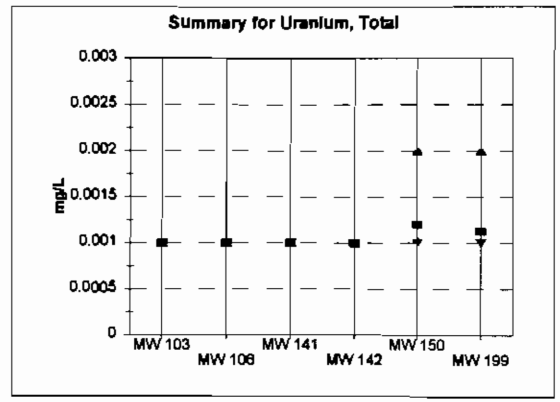
MW 199 - One "Q" qualified result assigned minimum detection limit across samples taken from all wells (0.06 mg/L), one nondetect result greater than the maximum detected value was assigned the maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Uranium	0.001	<	NO	5176-93	MW103	mg/L
Uranium	0.001	<	NO	5944-93	MW103	mg/L
Uranium	0.001	<	NO	7299-93	MW103	mg/L
Uranium	0.001	<	NO	4272-94	MW103	mg/L
Uranium	0.001	<	NO	6026-94	MW103	mg/L
Uranium	0.001	<	NO	6774-94	MW103	mg/L
Uranium	0.001	<	NO	5440-95	MW103	mg/L
Uranium	0.001	<	NO	5265-96	MW103	mg/L
Uranium	0.001	<	NO	5142-97	MW103	mg/L
Uranium	0.001	<	NO	5322-93	MW106	mg/L
Uranium	0.001	<	NO	4697-94	MW106	mg/L
Uranium	0.001	<	NO	5444-95	MW106	mg/L
Uranium	0.001	<	NO	5269-96	MW106	mg/L
Uranium	0.001	<	NO	5138-97	MW106	mg/L
Uranium	0.001	<B	NO	5768-97	MW106	mg/L
Uranium	0.001	<	NO	6060-93	MW141	mg/L
Uranium	0.001	<	NO	6092-93	MW141	mg/L
Uranium	0.001	<	NO	7065-93	MW141	mg/L
Uranium	0.001	<	NO	4229-94	MW141	mg/L
Uranium	0.001	<	NO	5199-94	MW141	mg/L
Uranium	0.001	<	NO	6054-94	MW141	mg/L
Uranium	0.001	<	NO	6866-94	MW141	mg/L
Uranium	0.001	<	NO	6064-93	MW142	mg/L
Uranium	0.001	<	NO	6098-93	MW142	mg/L
Uranium	0.001	<	NO	7069-93	MW142	mg/L
Uranium	0.001	<	NO	4233-94	MW142	mg/L
Uranium	0.001	<	NO	5203-94	MW142	mg/L
Uranium	0.001	<	NO	6056-94	MW142	mg/L
Uranium	0.001	<	NO	6672-94	MW142	mg/L
Uranium	0.001	<	NO	5464-95	MW142	mg/L
Uranium	0.001	<	NO	5317-96	MW142	mg/L
Uranium	0.001	<	NO	5147-97	MW142	mg/L
Uranium	0.001	<	NO	5797-97	MW142	mg/L
Uranium	0.001	<	NO	5650-93	MW150	mg/L
Uranium	0.001	<	NO	4789-94	MW150	mg/L
Uranium	0.001	<	NO	5466-95	MW150	mg/L
Uranium	0.001	<	NO	5321-96	MW150	mg/L
Uranium	0.002		YES	5146-97	MW150	mg/L
Uranium	0.001	<	NO	5964-93	MW199	mg/L
Uranium	0.001	<	NO	7311-93	MW199	mg/L
Uranium	0.001	<	NO	4312-94	MW199	mg/L
Uranium	0.001	<	NO	5260-94	MW199	mg/L
Uranium	0.001	<	NO	6074-94	MW199	mg/L
Uranium	0.001	<	NO	6666-94	MW199	mg/L
Uranium	0.001	<	NO	5556-97	MW199	mg/L
Uranium	0.002		YES	5170-93	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Uranium							
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.002	0.001		
	0.001	0.001	0.001	0.001		0.001		
	0.001		0.001	0.001		0.001		
	0.001			0.001		0.002		
	0.001			0.001				
				0.001				
				0.001				
Min	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
Max	0.001	0.001	0.001	0.001	0.002	0.002	0.002	
Average	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Number	9	6	7	11	5	8	46	



Data for Uranium, Total were not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Uranium, Dissolved		Q	NO	5440-95	MW103	
Uranium, Dissolved		Q	NO	5285-96	MW103	
Uranium, Dissolved		Q	NO	5444-95	MW106	
Uranium, Dissolved		Q	NO	5289-96	MW106	
Uranium, Dissolved		Q	NO	5464-95	MW142	
Uranium, Dissolved		Q	NO	5317-96	MW142	
Uranium, Dissolved		Q	NO	5468-95	MW150	
Uranium, Dissolved		Q	NO	5321-96	MW150	

CORRECTED DATA SET

Uranium, Dissolved	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Min	ERR	ERR	ERR	ERR	ERR	ERR		
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Number	0	0	0	0	0	0	ERR	0

Uranium, Dissolved

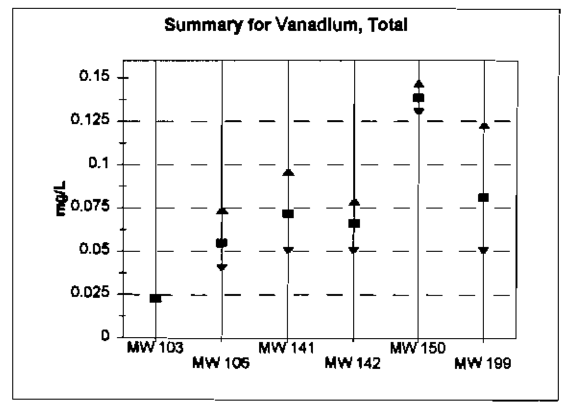
- Analysis for Uranium, Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of uranium in a filtered sample exceeds the background concentration.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Vanadium	0.023		YES	5178-93	MW103	mg/L
Vanadium	0.04	<	NO	8774-94	MW103	mg/L
Vanadium	0.05	<	NO	5944-93	MW103	mg/L
Vanadium	0.05	<	NO	7299-93	MW103	mg/L
Vanadium	0.05	<	NO	4272-94	MW103	mg/L
Vanadium	0.05	<	NO	5187-94	MW103	mg/L
Vanadium	0.05	<	NO	8026-94	MW103	mg/L
Vanadium	0.04	<	NO	7272-94	MW106	mg/L
Vanadium	0.05	<	NO	4697-94	MW106	mg/L
Vanadium	0.074		YES	5322-93	MW106	mg/L
Vanadium	0.05		YES	4229-94	MW141	mg/L
Vanadium	0.058		YES	6060-93	MW141	mg/L
Vanadium	0.064		YES	8054-94	MW141	mg/L
Vanadium	0.07		YES	5199-94	MW141	mg/L
Vanadium	0.078		YES	6868-94	MW141	mg/L
Vanadium	0.086		YES	7085-93	MW141	mg/L
Vanadium	0.096		YES	6092-93	MW141	mg/L
Vanadium	0.05	<	NO	4233-94	MW142	mg/L
Vanadium	0.053		YES	6084-93	MW142	mg/L
Vanadium	0.064		YES	5203-94	MW142	mg/L
Vanadium	0.07		YES	7089-93	MW142	mg/L
Vanadium	0.07		YES	6058-94	MW142	mg/L
Vanadium	0.076		YES	6096-93	MW142	mg/L
Vanadium	0.079		YES	6872-94	MW142	mg/L
Vanadium	0.13		YES	4789-94	MW150	mg/L
Vanadium	0.147		YES	5650-93	MW150	mg/L
Vanadium	0.05	<	NO	5170-93	MW199	mg/L
Vanadium	0.05	<	NO	6074-94	MW199	mg/L
Vanadium	0.069		YES	5260-94	MW199	mg/L
Vanadium	0.084		YES	6888-94	MW199	mg/L
Vanadium	0.086		YES	5984-93	MW199	mg/L
Vanadium	0.106		YES	7311-93	MW199	mg/L
Vanadium	0.123		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Vanadium							
	0.023	0.04	0.05	0.05	0.13	0.05		
	0.023	0.05	0.058	0.053	0.147	0.05		
	0.023	0.074	0.064	0.084		0.069		
	0.023		0.07	0.07		0.084		
	0.023		0.078	0.07		0.086		
	0.023		0.086	0.076		0.106		
	0.023		0.096	0.079		0.123		
Min	0.023	0.040	0.050	0.050	0.130	0.050	0.023	
Max	0.023	0.074	0.096	0.079	0.147	0.123	0.147	
Average	0.023	0.055	0.072	0.066	0.139	0.081	0.065	0.073
Number	7	3	7	7	2	7	33	



MW 103 - Six nondetect results greater than the maximum detected value were reduced to the maximum detected value for this well (0.023 mg/L).

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

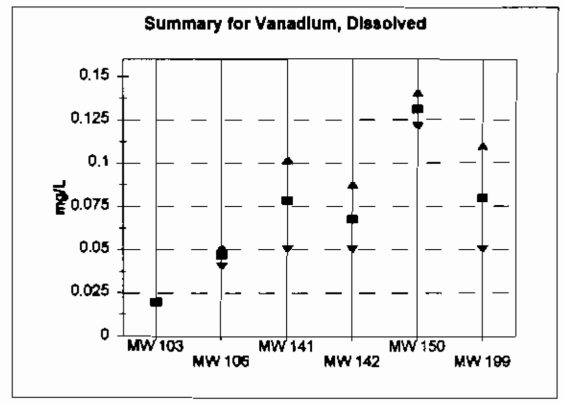
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Vanadium, Dissolved	0.02		YES	5178-93	MW103	mg/L
Vanadium, Dissolved	0.04	<	NO	8774-94	MW103	mg/L
Vanadium, Dissolved	0.05	<	NO	5944-93	MW103	mg/L
Vanadium, Dissolved	0.05	<	NO	7299-93	MW103	mg/L
Vanadium, Dissolved	0.05	<	NO	4272-94	MW103	mg/L
Vanadium, Dissolved	0.05	<	NO	5187-94	MW103	mg/L
Vanadium, Dissolved	0.05	<	NO	8026-94	MW103	mg/L
Vanadium, Dissolved	0.04	<	NO	7272-94	MW106	mg/L
Vanadium, Dissolved	0.05	<	NO	4897-94	MW106	mg/L
Vanadium, Dissolved	0.051		YES	5322-93	MW106	mg/L
Vanadium, Dissolved	0.05	<	NO	4229-94	MW141	mg/L
Vanadium, Dissolved	0.055		YES	6060-93	MW141	mg/L
Vanadium, Dissolved	0.075		YES	7065-93	MW141	mg/L
Vanadium, Dissolved	0.066		YES	6092-93	MW141	mg/L
Vanadium, Dissolved	0.069		YES	5199-94	MW141	mg/L
Vanadium, Dissolved	0.092		YES	8666-94	MW141	mg/L
Vanadium, Dissolved	0.102		YES	6054-94	MW141	mg/L
Vanadium, Dissolved	0.05	<	NO	6064-93	MW142	mg/L
Vanadium, Dissolved	0.05	<	NO	4233-94	MW142	mg/L
Vanadium, Dissolved	0.059		YES	7069-93	MW142	mg/L
Vanadium, Dissolved	0.072		YES	5203-94	MW142	mg/L
Vanadium, Dissolved	0.076		YES	8096-93	MW142	mg/L
Vanadium, Dissolved	0.079		YES	6672-94	MW142	mg/L
Vanadium, Dissolved	0.068		YES	6058-94	MW142	mg/L
Vanadium, Dissolved	0.121		YES	5650-93	MW150	mg/L
Vanadium, Dissolved	0.141		YES	4769-94	MW150	mg/L
Vanadium, Dissolved	0.05	<	NO	5170-93	MW199	mg/L
Vanadium, Dissolved	0.062		YES	8074-94	MW199	mg/L
Vanadium, Dissolved	0.062		YES	5280-94	MW199	mg/L
Vanadium, Dissolved	0.084		YES	8868-94	MW199	mg/L
Vanadium, Dissolved	0.065		YES	7311-93	MW199	mg/L
Vanadium, Dissolved	0.066		YES	5984-93	MW199	mg/L
Vanadium, Dissolved	0.11		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Vanadium, Dissolved							
	0.02	0.04	0.05	0.05	0.121	0.05		
	0.02	0.05	0.055	0.05	0.141	0.062		
	0.02	0.051	0.075	0.059		0.062		
	0.02		0.066	0.072		0.064		
	0.02		0.069	0.076		0.065		
	0.02		0.092	0.079		0.066		
	0.02		0.102	0.068		0.11		
Min	0.020	0.040	0.050	0.050	0.121	0.050	0.020	
Max	0.020	0.051	0.102	0.066	0.141	0.110	0.141	
Average	0.020	0.047	0.078	0.068	0.131	0.080	0.064	0.071
Number	7	3	7	7	2	7	33	



MW 103 - Six nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected value.

MW 106 - Data not modified.

MW 141 - Data not modified.

MW 142 - Data not modified.

MW 150 - Data were not modifed.

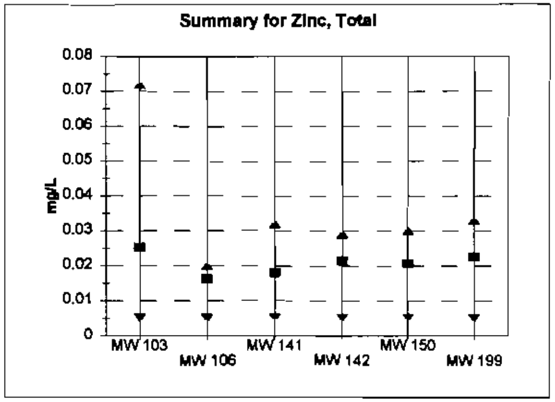
MW 199 - Data not modified.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Zinc	0.005	<	NO	5178-93	MW103	mg/L
Zinc	0.008	<	NO	5944-93	MW103	mg/L
Zinc	0.008	<	NO	7299-93	MW103	mg/L
Zinc	0.008	<	NO	4272-94	MW103	mg/L
Zinc	0.008		YES	5187-94	MW103	mg/L
Zinc	0.012		YES	6026-94	MW103	mg/L
Zinc	0.03	<	NO	5440-95	MW103	mg/L
Zinc	0.03	<	NO	5285-96	MW103	mg/L
Zinc	0.072		YES	6774-94	MW103	mg/L
Zinc	0.25	<	NO	5142-97	MW103	mg/L
Zinc	0.005	<	NO	4697-94	MW106	mg/L
Zinc	0.02		YES	5322-93	MW106	mg/L
Zinc	0.03	<	NO	7272-94	MW106	mg/L
Zinc	0.03	<	NO	5444-95	MW106	mg/L
Zinc	0.005	<	NO	4229-94	MW141	mg/L
Zinc	0.005	<	NO	6054-94	MW141	mg/L
Zinc	0.008		YES	8080-93	MW141	mg/L
Zinc	0.017		YES	5199-94	MW141	mg/L
Zinc	0.03		YES	6092-93	MW141	mg/L
Zinc	0.03	<	NO	6868-94	MW141	mg/L
Zinc	0.032		YES	7085-93	MW141	mg/L
Zinc	0.005		YES	8084-93	MW142	mg/L
Zinc	0.005	<	NO	6058-94	MW142	mg/L
Zinc	0.008		YES	4233-94	MW142	mg/L
Zinc	0.024		YES	8098-93	MW142	mg/L
Zinc	0.029		YES	7089-93	MW142	mg/L
Zinc	0.03	<	NO	6872-94	MW142	mg/L
Zinc	0.03	<	NO	5484-95	MW142	mg/L
Zinc	0.03	<	NO	5317-96	MW142	mg/L
Zinc	0.25	<	NO	5147-97	MW142	mg/L
Zinc	1.15		YES	5203-94	MW142	mg/L
Zinc	0.005	<	NO	4789-94	MW150	mg/L
Zinc	0.008	<	NO	5650-93	MW150	mg/L
Zinc	0.03	<	NO	5468-95	MW150	mg/L
Zinc	0.03	<	NO	5321-96	MW150	mg/L
Zinc	0.25	<	NO	5148-97	MW150	mg/L
Zinc	0.005	<	NO	5170-93	MW199	mg/L
Zinc	0.008	<	NO	4312-94	MW199	mg/L
Zinc	0.014		YES	6074-94	MW199	mg/L
Zinc	0.024		YES	5984-93	MW199	mg/L
Zinc	0.03	<	NO	6688-94	MW199	mg/L
Zinc	0.033		YES	7311-93	MW199	mg/L
Zinc	0.1	<	NO	5558-97	MW199	mg/L
Zinc	0.408		YES	5260-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Zinc							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.008	0.02	0.005	0.005	0.008	0.008		
	0.008	0.02	0.008	0.006	0.03	0.014		
	0.008	0.02	0.017	0.024	0.03	0.024		
	0.008		0.03	0.029	0.03	0.03		
	0.012		0.03	0.029		0.033		
	0.03		0.032	0.029		0.033		
	0.03			0.029		0.033		
	0.072			0.029				
	0.072			0.029				
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.072	0.020	0.032	0.029	0.030	0.033	0.072	
Average	0.025	0.016	0.018	0.021	0.021	0.023	0.021	0.021
Number	10	4	7	10	5	8	44	



MW 103 - One nondetect result with a value greater than the maximum detected concentration was reduced to the maximum detected concentration.

MW 106 - Two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

MW 141 - Data not modified.

MW 150 - One nondetect with a value that greatly exceeds the other nondetect values was reduced to the next greatest detected value

MW 142 - The maximum detected value was much greater than other results from this well and was reduced to the next greatest detected value; two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

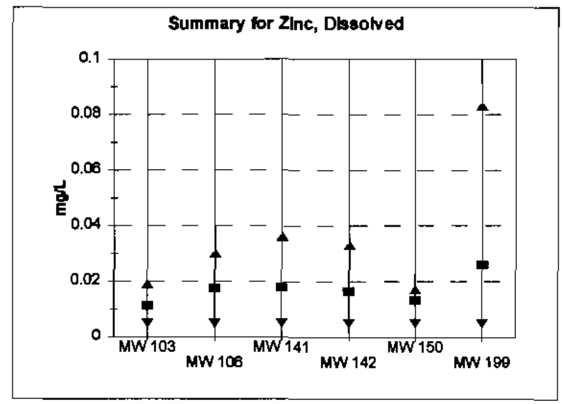
MW 199 - The maximum detected value was much greater than other results from this well and was reduced to the next greatest detected value; one nondetect result with a value greater than the maximum detected value was reduced to the maximum detected value.

Summary of RGA Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Zinc, Dissolved	0.005	<	NO	5167-94	MW103	mg/L
Zinc, Dissolved	0.005	<	NO	6026-94	MW103	mg/L
Zinc, Dissolved	0.006	<	NO	5944-93	MW103	mg/L
Zinc, Dissolved	0.006	<	NO	7299-93	MW103	mg/L
Zinc, Dissolved	0.013		YES	4272-94	MW103	mg/L
Zinc, Dissolved	0.019		YES	5178-93	MW103	mg/L
Zinc, Dissolved	0.03	<	NO	6774-94	MW103	mg/L
Zinc, Dissolved	0.03	<	NO	5440-95	MW103	mg/L
Zinc, Dissolved		Q	NO	5265-96	MW103	
Zinc, Dissolved	0.005	<	NO	4697-94	MW106	mg/L
Zinc, Dissolved	0.03	<	NO	7272-94	MW106	mg/L
Zinc, Dissolved	0.03	<	NO	5444-95	MW106	mg/L
Zinc, Dissolved		Q	NO	5322-93	MW106	
Zinc, Dissolved	0.005	<	NO	4229-94	MW141	mg/L
Zinc, Dissolved	0.005	<	NO	5199-94	MW141	mg/L
Zinc, Dissolved	0.005	<	NO	6054-94	MW141	mg/L
Zinc, Dissolved	0.021		YES	6080-93	MW141	mg/L
Zinc, Dissolved	0.022		YES	6092-93	MW141	mg/L
Zinc, Dissolved	0.03	<	NO	6666-94	MW141	mg/L
Zinc, Dissolved	0.036		YES	7085-93	MW141	mg/L
Zinc, Dissolved	0.005	<	NO	4233-94	MW142	mg/L
Zinc, Dissolved	0.005	<	NO	5203-94	MW142	mg/L
Zinc, Dissolved	0.005	<	NO	6058-94	MW142	mg/L
Zinc, Dissolved	0.008		YES	6064-93	MW142	mg/L
Zinc, Dissolved	0.027		YES	6098-93	MW142	mg/L
Zinc, Dissolved	0.03	<	NO	6872-94	MW142	mg/L
Zinc, Dissolved	0.03	<	NO	5464-95	MW142	mg/L
Zinc, Dissolved	0.033		YES	7089-93	MW142	mg/L
Zinc, Dissolved		Q	NO	5317-96	MW142	
Zinc, Dissolved	0.014		YES	5650-93	MW150	mg/L
Zinc, Dissolved	0.017		YES	4769-94	MW150	mg/L
Zinc, Dissolved	0.03	<	NO	5468-95	MW150	mg/L
Zinc, Dissolved		Q	NO	5321-96	MW150	
Zinc, Dissolved	0.005	<	NO	5170-93	MW199	mg/L
Zinc, Dissolved	0.005	<	NO	6074-94	MW199	mg/L
Zinc, Dissolved	0.006	<	NO	4312-94	MW199	mg/L
Zinc, Dissolved	0.019		YES	5984-93	MW199	mg/L
Zinc, Dissolved	0.03	<	NO	6686-94	MW199	mg/L
Zinc, Dissolved	0.032		YES	7311-93	MW199	mg/L
Zinc, Dissolved	0.063		YES	5260-94	MW199	mg/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Zinc, Dissolved							
	0.005	0.005	0.005	0.005	0.014	0.005		
	0.005	0.03	0.005	0.005	0.017	0.005		
	0.006	0.03	0.005	0.005	0.017	0.006		
	0.006	0.005	0.021	0.008	0.005	0.019		
	0.013		0.022	0.027		0.03		
	0.019		0.03	0.03		0.032		
	0.019		0.036	0.03		0.063		
	0.019			0.033				
	0.005			0.005				
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.019	0.030	0.036	0.033	0.017	0.063	0.063	
Average	0.011	0.016	0.018	0.016	0.013	0.026	0.017	0.017
Number	9	4	7	9	4	7	40	



MW 103 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L); two nondetect results with values greater than the maximum detected concentration were reduced to the maximum detected concentration.

MW 106 - One "Q" qualified result given value of minimum detection limit for samples from this well.

MW 141 - Data not modified.

MW 142 - One "Q" qualified result given value of minimum detection limit for samples from this well (0.005 mg/L).

MW 150 - One "Q" qualified result given value of minimum detected value from across samples from all wells limit (0.005 mg/L) becauee there wes no other nondetect values from this well.

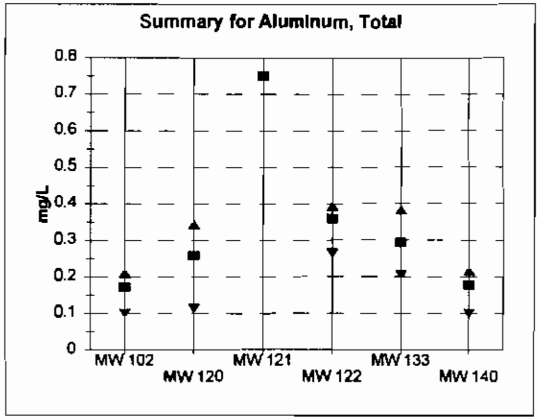
MW 199 - Data not modified.

Summary of McNalry Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Aluminum	0.1	<	NO	7295-93	MW102	mg/L
Aluminum	0.108		YES	5940-93	MW102	mg/L
Aluminum	0.108		YES	4268-94	MW102	mg/L
Aluminum	0.19		YES	5174-93	MW102	mg/L
Aluminum	0.203		YES	5183-94	MW102	mg/L
Aluminum	0.21		YES	6022-94	MW102	mg/L
Aluminum	0.625	<	NO	6770-94	MW102	mg/L
Aluminum	0.825	N*<	NO	5281-96	MW102	mg/L
Aluminum	0.75	<	NO	5141-97	MW102	mg/L
Aluminum	0.114		YES	4209-94	MW120	mg/L
Aluminum	0.167		YES	4991-94	MW120	mg/L
Aluminum	0.194		YES	5900-93	MW120	mg/L
Aluminum	0.236		YES	7065-93	MW120	mg/L
Aluminum	0.238		YES	6034-94	MW120	mg/L
Aluminum	0.344		YES	5088-93	MW120	mg/L
Aluminum	0.825	<	NO	5293-96	MW120	mg/L
Aluminum	0.625	<	NO	6928-94	MW120	mg/L
Aluminum	0.75	<	NO	5143-97	MW120	mg/L
Aluminum	0.75	<	NO	5144-97	MW121	mg/L
Aluminum	3.52		YES	5500-96	MW121	mg/L
Aluminum	6.24		YES	4664-94	MW121	mg/L
Aluminum	90.4		YES	5206-93	MW121	mg/L
Aluminum	0.265		YES	5246-93	MW122	mg/L
Aluminum	0.393		YES	4688-94	MW122	mg/L
Aluminum	0.625	N*<	NO	5301-96	MW122	mg/L
Aluminum	0.75	<	NO	5145-97	MW122	mg/L
Aluminum	0.204		YES	4761-94	MW133	mg/L
Aluminum	0.384		YES	5262-93	MW133	mg/L
Aluminum	0.1	<	NO	5195-94	MW140	mg/L
Aluminum	0.102		YES	4225-94	MW140	mg/L
Aluminum	0.126		YES	6050-94	MW140	mg/L
Aluminum	0.192		YES	6004-93	MW140	mg/L
Aluminum	0.211		YES	8086-93	MW140	mg/L
Aluminum	0.216		YES	7081-93	MW140	mg/L
Aluminum	0.62	<	NO	6664-94	MW140	mg/L
Aluminum	0.625	N*<	NO	5313-96	MW140	mg/L
Aluminum	0.75	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Aluminum							
	0.1	0.114	0.75	0.265	0.204	0.1		
	0.108	0.167	0.75	0.393	0.384	0.102		
	0.108	0.194	0.75	0.393		0.126		
	0.19	0.236	0.75	0.393		0.192		
	0.203	0.238				0.211		
	0.21	0.344				0.216		
	0.21	0.344				0.216		
	0.21	0.344				0.216		
	0.21	0.344				0.216		
Min	0.100	0.114	0.750	0.265	0.204	0.100	0.100	
Max	0.210	0.344	0.750	0.393	0.384	0.216	0.750	
Average	0.172	0.258	0.750	0.361	0.294	0.177	0.284	0.335
Number	9	9	4	4	2	9	37	



MW 102 - Three nondetects greater than maximum detected value set to maximum detected value.

MW 120 - Three nondetects greater than maximum detected value set to maximum detected value.

MW 121 - Turbidity/total solids impacted results of detected values; detected values reduced to nondetect concentration.

MW 122 - Two nondetects greater than maximum detected value set to maximum detected value.

MW 133 - Data were not modified.

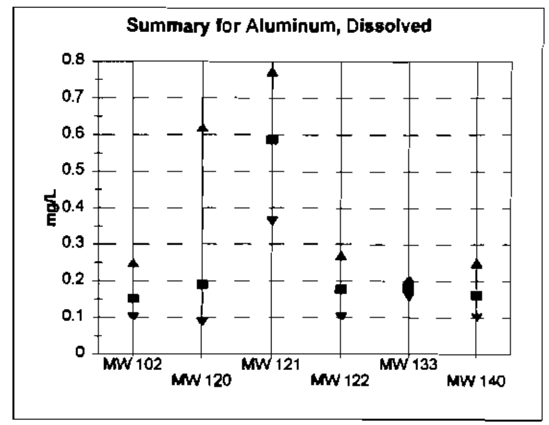
MW 140 - Three non detects greater than maximum detected value set to maximum detected value.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Aluminum, Dissolved	0.106		YES	4288-94	MW102	mg/L
Aluminum, Dissolved	0.107		YES	5940-93	MW102	mg/L
Aluminum, Dissolved	0.12		YES	7295-93	MW102	mg/L
Aluminum, Dissolved	0.134		YES	6022-94	MW102	mg/L
Aluminum, Dissolved	0.147		YES	5183-94	MW102	mg/L
Aluminum, Dissolved	0.25		YES	5174-93	MW102	mg/L
Aluminum, Dissolved	0.825	<	NO	8770-94	MW102	mg/L
Aluminum, Dissolved		Q	NO	5281-96	MW102	
Aluminum, Dissolved	0.087		YES	4991-94	MW120	mg/L
Aluminum, Dissolved	0.1	<	NO	4209-94	MW120	mg/L
Aluminum, Dissolved	0.107		YES	5900-93	MW120	mg/L
Aluminum, Dissolved	0.149		YES	8034-94	MW120	mg/L
Aluminum, Dissolved	0.152		YES	7085-93	MW120	mg/L
Aluminum, Dissolved	0.208		YES	5088-93	MW120	mg/L
Aluminum, Dissolved	0.62	<	NO	8928-94	MW120	mg/L
Aluminum, Dissolved		Q	NO	5293-96	MW120	
Aluminum, Dissolved	0.363		YES	4884-94	MW121	mg/L
Aluminum, Dissolved	0.625	<	NO	5500-96	MW121	mg/L
Aluminum, Dissolved	0.772		YES	5206-93	MW121	mg/L
Aluminum, Dissolved	0.16		YES	5246-93	MW122	mg/L
Aluminum, Dissolved	0.27		YES	4868-94	MW122	mg/L
Aluminum, Dissolved		Q	NO	5301-96	MW122	
Aluminum, Dissolved	0.156		YES	4781-94	MW133	mg/L
Aluminum, Dissolved	0.206		YES	5282-93	MW133	mg/L
Aluminum, Dissolved	0.1	<	NO	4225-94	MW140	mg/L
Aluminum, Dissolved	0.1	<	NO	5195-94	MW140	mg/L
Aluminum, Dissolved	0.123		YES	6050-94	MW140	mg/L
Aluminum, Dissolved	0.156		YES	8004-93	MW140	mg/L
Aluminum, Dissolved	0.216		YES	8088-93	MW140	mg/L
Aluminum, Dissolved	0.249		YES	7081-93	MW140	mg/L
Aluminum, Dissolved	0.62	<	NO	6864-94	MW140	mg/L
Aluminum, Dissolved		Q	NO	5313-98	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Aluminum, Dissolved							
	0.106	0.087	0.363	0.18	0.158	0.1		
	0.107	0.1	0.825	0.27	0.206	0.1		
	0.12	0.107	0.772	0.1		0.123		
	0.134	0.149				0.156		
	0.147	0.152				0.216		
	0.25	0.208				0.249		
	0.25	0.62				0.249		
	0.1	0.1				0.1		
Min	0.100	0.087	0.363	0.100	0.156	0.100	0.087	
Max	0.250	0.820	0.772	0.270	0.206	0.249	0.772	
Average	0.152	0.190	0.587	0.177	0.181	0.182	0.209	0.241
Number	8	6	3	3	2	8	32	



MW 102 - One nondetect greater than maximum detected value set to maximum detected value; one "Q" qualified result assigned the minimum detection limit across all wells.

MW 120 - One nondetect greater than maximum detected value set to maximum detected value; one "Q" qualified result assigned minimum detection limit across all wells.

MW 121 - Data were not modified.

MW 122 - One "Q" qualified result assigned minimum detection limit across all wells.

MW 133 - Data were not modified.

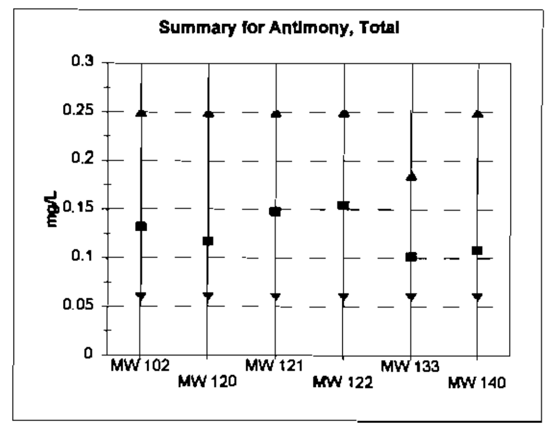
MW 140 - One nondetect greater than maximum detected value set to maximum detected value; one "Q" qualified result assigned the minimum detection limit across all wells.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Antimony	0.06	<	NO	5174-93	MW102	mg/L
Antimony	0.06	<	NO	5940-93	MW102	mg/L
Antimony	0.08	<	NO	7295-93	MW102	mg/L
Antimony	0.08	<	NO	4288-94	MW102	mg/L
Antimony	0.08	<	NO	5183-94	MW102	mg/L
Antimony	0.08	<	NO	8022-94	MW102	mg/L
Antimony	0.18	<S	NO	8770-94	MW102	mg/L
Antimony	0.185	<	NO	5619-95	MW102	mg/L
Antimony	0.185	<	NO	6592-95	MW102	mg/L
Antimony	0.185	<	NO	7467-95	MW102	mg/L
Antimony	0.185	<	NO	8285-95	MW102	mg/L
Antimony	0.185	J<	NO	5281-96	MW102	mg/L
Antimony	0.25	<	NO	5141-97	MW102	mg/L
Antimony	0.06	<	NO	4209-94	MW120	mg/L
Antimony	0.06	<	NO	4991-94	MW120	mg/L
Antimony	0.06	<	NO	5088-93	MW120	mg/L
Antimony	0.06	<	NO	5900-93	MW120	mg/L
Antimony	0.06	<	NO	6034-94	MW120	mg/L
Antimony	0.06	<	NO	7065-93	MW120	mg/L
Antimony	0.185	<	NO	5448-95	MW120	mg/L
Antimony	0.185	<	NO	5293-98	MW120	mg/L
Antimony	0.19	<	NO	6928-94	MW120	mg/L
Antimony	0.25	<	NO	5143-97	MW120	mg/L
Antimony	0.06	<	NO	5206-93	MW121	mg/L
Antimony	0.06	<	NO	4864-94	MW121	mg/L
Antimony	0.185	<	NO	5452-95	MW121	mg/L
Antimony	0.185	<	NO	5500-96	MW121	mg/L
Antimony	0.25	<	NO	5144-97	MW121	mg/L
Antimony	0.08	<	NO	5246-93	MW122	mg/L
Antimony	0.06	<	NO	4866-94	MW122	mg/L
Antimony	0.185	<	NO	5456-95	MW122	mg/L
Antimony	0.185	<	NO	6596-95	MW122	mg/L
Antimony	0.185	J<	NO	5301-96	MW122	mg/L
Antimony	0.25	<	NO	5145-97	MW122	mg/L
Antimony	0.06	<	NO	5282-93	MW133	mg/L
Antimony	0.06	<	NO	4781-94	MW133	mg/L
Antimony	0.165	<	NO	5480-95	MW133	mg/L
Antimony	0.06	<	NO	6004-93	MW140	mg/L
Antimony	0.06	<	NO	6086-93	MW140	mg/L
Antimony	0.06	<	NO	4225-94	MW140	mg/L
Antimony	0.08	<	NO	5195-94	MW140	mg/L
Antimony	0.08	<	NO	6050-94	MW140	mg/L
Antimony	0.08	<N	NO	7081-93	MW140	mg/L
Antimony	0.18	<	NO	6684-94	MW140	mg/L
Antimony	0.185	J<	NO	5313-96	MW140	mg/L
Antimony	0.25	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Antimony							
	0.08	0.06	0.06	0.06	0.06	0.06		
	0.08	0.06	0.06	0.06	0.06	0.08		
	0.06	0.06	0.185	0.185	0.185	0.08		
	0.08	0.06	0.185	0.185		0.06		
	0.08	0.06	0.25	0.185		0.06		
	0.06	0.06		0.25		0.06		
	0.18	0.185				0.18		
	0.185	0.185				0.185		
	0.185	0.19				0.25		
	0.185	0.25						
	0.185							
	0.185							
	0.25							
Min	0.060	0.060	0.060	0.080	0.080	0.080	0.060	
Max	0.250	0.250	0.250	0.250	0.185	0.250	0.250	
Average	0.132	0.117	0.148	0.154	0.102	0.108	0.127	0.127
Number	13	10	5	6	3	9	46	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

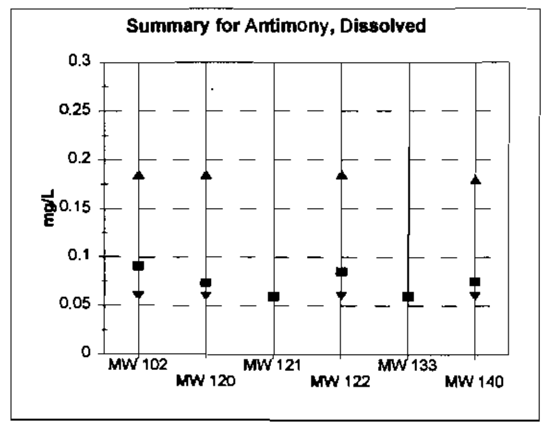
Data for Antimony, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Antimony, Dissolved	0.06	<	NO	5174-93	MW102	mg/L
Antimony, Dissolved	0.06	<	NO	7295-93	MW102	mg/L
Antimony, Dissolved	0.06	<	NO	4266-94	MW102	mg/L
Antimony, Dissolved	0.06	<	NO	5183-94	MW102	mg/L
Antimony, Dissolved	0.06	<	NO	6022-94	MW102	mg/L
Antimony, Dissolved	0.165	<	NO	6770-94	MW102	mg/L
Antimony, Dissolved	0.165	<	NO	5619-95	MW102	mg/L
Antimony, Dissolved	0.185	<	NO	6592-95	MW102	mg/L
Antimony, Dissolved		Q	NO	5940-93	MW102	
Antimony, Dissolved		Q	NO	7467-95	MW102	
Antimony, Dissolved		Q	NO	8285-95	MW102	
Antimony, Dissolved		Q	NO	5281-96	MW102	
Antimony, Dissolved	0.06	<	NO	4209-94	MW120	mg/L
Antimony, Dissolved	0.06	<	NO	4991-94	MW120	mg/L
Antimony, Dissolved	0.06	<	NO	5088-93	MW120	mg/L
Antimony, Dissolved	0.06	<	NO	5900-93	MW120	mg/L
Antimony, Dissolved	0.06	<	NO	6034-94	MW120	mg/L
Antimony, Dissolved	0.185	<	NO	6928-94	MW120	mg/L
Antimony, Dissolved		Q	NO	5448-95	MW120	
Antimony, Dissolved		Q	NO	5293-96	MW120	
Antimony, Dissolved		Q	NO	7065-93	MW120	
Antimony, Dissolved	0.06	<	NO	5206-93	MW121	mg/L
Antimony, Dissolved	0.06	<	NO	4864-94	MW121	mg/L
Antimony, Dissolved		Q	NO	5452-95	MW121	
Antimony, Dissolved		Q	NO	5500-96	MW121	
Antimony, Dissolved	0.06	<	NO	5248-93	MW122	mg/L
Antimony, Dissolved	0.06	<	NO	4868-94	MW122	mg/L
Antimony, Dissolved	0.185	<	NO	6596-95	MW122	mg/L
Antimony, Dissolved		Q	NO	5458-95	MW122	
Antimony, Dissolved		Q	NO	5301-96	MW122	
Antimony, Dissolved	0.06	<	NO	5282-93	MW133	mg/L
Antimony, Dissolved	0.06	<	NO	4761-94	MW133	mg/L
Antimony, Dissolved		Q	NO	5460-95	MW133	
Antimony, Dissolved	0.06	<	NO	6004-93	MW140	mg/L
Antimony, Dissolved	0.06	<	NO	6086-93	MW140	mg/L
Antimony, Dissolved	0.06	<	NO	7061-93	MW140	mg/L
Antimony, Dissolved	0.06	<	NO	4225-94	MW140	mg/L
Antimony, Dissolved	0.06	<	NO	5195-94	MW140	mg/L
Antimony, Dissolved	0.06	<	NO	6050-94	MW140	mg/L
Antimony, Dissolved	0.18	<	NO	6664-94	MW140	mg/L
Antimony, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Antimony, Dissolved							
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.06	0.06	0.185	0.06	0.06		
	0.06	0.06	0.06	0.06		0.06		
	0.06	0.06		0.06		0.06		
	0.185	0.185				0.06		
	0.165	0.06				0.16		
	0.185	0.06				0.06		
	0.06	0.06						
	0.06							
	0.06							
	0.06							
Min	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Max	0.185	0.165	0.060	0.165	0.060	0.160	0.165	
Average	0.091	0.074	0.060	0.085	0.060	0.075	0.078	0.074
Number	12	9	4	5	3	8	41	



MW 102 - Four "Q" qualified results assigned the minimum detection limit for samples from this well.

MW120 - Three "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 121 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 122 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 133 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

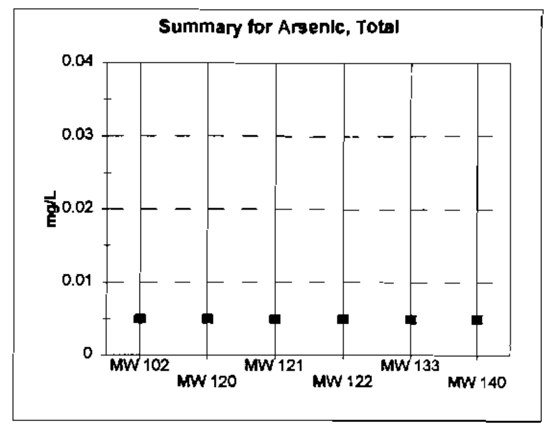
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Arsenic	0.005	<	NO	5174-93	MW102	mg/L
Arsenic	0.005	<	NO	5940-93	MW102	mg/L
Arsenic	0.005	<	NO	7295-93	MW102	mg/L
Arsenic	0.005	<	NO	4268-94	MW102	mg/L
Arsenic	0.005	<	NO	5183-94	MW102	mg/L
Arsenic	0.005	<	NO	6022-94	MW102	mg/L
Arsenic	0.005	<	NO	6770-94	MW102	mg/L
Arsenic	0.005	<	NO	6592-95	MW102	mg/L
Arsenic	0.005	<	NO	7467-95	MW102	mg/L
Arsenic	0.005	<	NO	8285-95	MW102	mg/L
Arsenic	0.005	<	NO	5281-96	MW102	mg/L
Arsenic	0.005	<	NO	5141-97	MW102	mg/L
Arsenic	0.005	<N	NO	5619-95	MW102	mg/L
Arsenic	0.005	<	NO	4209-94	MW120	mg/L
Arsenic	0.005	<	NO	5143-97	MW120	mg/L
Arsenic	0.005	<	NO	5448-95	MW120	mg/L
Arsenic	0.005	<	NO	5293-96	MW120	mg/L
Arsenic	0.005	<	NO	4991-94	MW120	mg/L
Arsenic	0.005	<	NO	5088-93	MW120	mg/L
Arsenic	0.005	<	NO	5900-93	MW120	mg/L
Arsenic	0.005	<	NO	8034-94	MW120	mg/L
Arsenic	0.005	<	NO	8926-94	MW120	mg/L
Arsenic	0.005	<	NO	7065-93	MW120	mg/L
Arsenic	0.005	<	NO	4864-94	MW121	mg/L
Arsenic	0.005	<	NO	5452-95	MW121	mg/L
Arsenic	0.005	<	NO	5500-96	MW121	mg/L
Arsenic	0.005	<	NO	5144-97	MW121	mg/L
Arsenic	0.036		YES	5208-93	MW121	mg/L
Arsenic	0.005	<	NO	5248-93	MW122	mg/L
Arsenic	0.005	<	NO	4868-94	MW122	mg/L
Arsenic	0.005	<	NO	5458-95	MW122	mg/L
Arsenic	0.005	<	NO	6598-95	MW122	mg/L
Arsenic	0.005	<	NO	5301-96	MW122	mg/L
Arsenic	0.005	<	NO	5145-97	MW122	mg/L
Arsenic	0.005	<	NO	5282-93	MW133	mg/L
Arsenic	0.005	<	NO	4761-94	MW133	mg/L
Arsenic	0.005	<	NO	5460-95	MW133	mg/L
Arsenic	0.005	<	NO	6088-93	MW140	mg/L
Arsenic	0.005	<	NO	7061-93	MW140	mg/L
Arsenic	0.005	<	NO	4225-94	MW140	mg/L
Arsenic	0.005	<	NO	5195-94	MW140	mg/L
Arsenic	0.005	<	NO	6050-94	MW140	mg/L
Arsenic	0.005	<	NO	6864-94	MW140	mg/L
Arsenic	0.005	<	NO	5313-96	MW140	mg/L
Arsenic	0.005	<	NO	5146-97	MW140	mg/L
Arsenic	0.005		YES	6004-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Arsenic							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005		0.005		0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005						
	0.005							
	0.005							
	0.005							
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Average	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Turbidity/total solids impacted result of detected value; detected value reduced to nondetect concentration.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

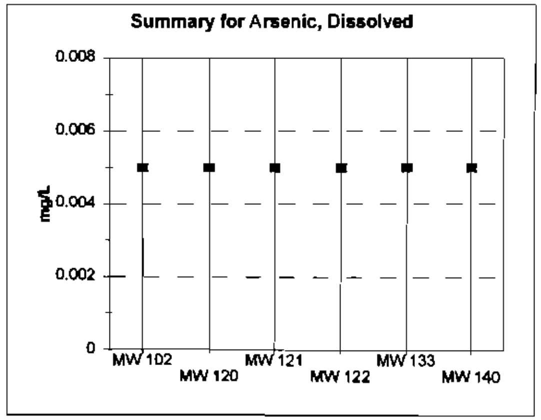
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Arsenic, Dissolved		Q	NO	5174-93	MW102	
Arsenic, Dissolved		Q	NO	5940-93	MW102	
Arsenic, Dissolved		Q	NO	7295-93	MW102	
Arsenic, Dissolved		Q	NO	4268-94	MW102	
Arsenic, Dissolved		Q	NO	5163-94	MW102	
Arsenic, Dissolved		Q	NO	6022-94	MW102	
Arsenic, Dissolved		Q	NO	6770-94	MW102	
Arsenic, Dissolved		Q	NO	5619-95	MW102	
Arsenic, Dissolved		Q	NO	6592-95	MW102	
Arsenic, Dissolved		Q	NO	7467-95	MW102	
Arsenic, Dissolved		Q	NO	8285-95	MW102	
Arsenic, Dissolved		Q	NO	5281-96	MW102	
Arsenic, Dissolved		Q	NO	5141-97	MW102	
Arsenic, Dissolved		Q	NO	4209-94	MW120	
Arsenic, Dissolved		Q	NO	5143-97	MW120	
Arsenic, Dissolved		Q	NO	5448-95	MW120	
Arsenic, Dissolved		Q	NO	5293-98	MW120	
Arsenic, Dissolved		Q	NO	4991-94	MW120	
Arsenic, Dissolved		Q	NO	5088-93	MW120	
Arsenic, Dissolved		Q	NO	5900-93	MW120	
Arsenic, Dissolved		Q	NO	8034-94	MW120	
Arsenic, Dissolved		Q	NO	6928-94	MW120	
Arsenic, Dissolved		Q	NO	7065-93	MW120	
Arsenic, Dissolved	0.005	<	NO	5206-93	MW121	mg/L
Arsenic, Dissolved		Q	NO	4864-94	MW121	
Arsenic, Dissolved		Q	NO	5452-95	MW121	
Arsenic, Dissolved		Q	NO	5500-96	MW121	
Arsenic, Dissolved		Q	NO	5144-97	MW121	
Arsenic, Dissolved		Q	NO	5248-93	MW122	
Arsenic, Dissolved		Q	NO	4868-94	MW122	
Arsenic, Dissolved		Q	NO	5456-95	MW122	
Arsenic, Dissolved		Q	NO	6596-95	MW122	
Arsenic, Dissolved		O	NO	5301-96	MW122	
Arsenic, Dissolved		Q	NO	5145-97	MW122	
Arsenic, Dissolved		Q	NO	4761-94	MW133	
Arsenic, Dissolved		Q	NO	5460-95	MW133	
Arsenic, Dissolved	0.005	<	NO	6004-93	MW140	mg/L
Arsenic, Dissolved		Q	NO	6088-93	MW140	
Arsenic, Dissolved		Q	NO	7081-93	MW140	
Arsenic, Dissolved		Q	NO	4225-94	MW140	
Arsenic, Dissolved		Q	NO	5195-94	MW140	
Arsenic, Dissolved		Q	NO	6050-94	MW140	
Arsenic, Dissolved		Q	NO	6864-94	MW140	
Arsenic, Dissolved		Q	NO	5313-96	MW140	
Arsenic, Dissolved		Q	NO	5148-97	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Arsenic, Dissolved							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005		0.005		0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005						
	0.005							
	0.005							
	0.005							
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Average	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Number	13	10	5	6	2	9	45	



MW 102 - Thirteen "Q" qualified results assigned the minimum detection limit for samples across all wells.

MW120 - Ten "Q" qualified results assigned the minimum detection limit for samples across all wells.

MW 121 - Four "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 122 - Six "Q" qualified results assigned the minimum detection limit for samples across all wells.

MW 133 - Two "Q" qualified result assigned the minimum detection limit for samples from this well.

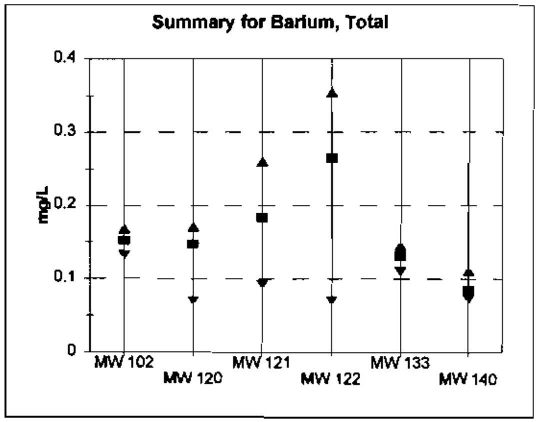
MW 140 - Eight "Q" qualified results assigned the minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Barium	0.132		YES	4268-94	MW102	mg/L
Barium	0.141		YES	7295-93	MW102	mg/L
Barium	0.143		YES	5183-94	MW102	mg/L
Barium	0.146		YES	5174-93	MW102	mg/L
Barium	0.15		YES	5940-93	MW102	mg/L
Barium	0.15		YES	5619-95	MW102	mg/L
Barium	0.15		YES	8265-95	MW102	mg/L
Barium	0.155		YES	6770-94	MW102	mg/L
Barium	0.157		YES	6022-94	MW102	mg/L
Barium	0.159		YES	7467-95	MW102	mg/L
Barium	0.162		YES	6592-95	MW102	mg/L
Barium	0.166		YES	5141-97	MW102	mg/L
Barium	0.168		YES	5281-96	MW102	mg/L
Barium	0.07	<	NO	5446-95	MW120	mg/L
Barium	0.146		YES	4209-94	MW120	mg/L
Barium	0.15		YES	6034-94	MW120	mg/L
Barium	0.15		YES	6928-94	MW120	mg/L
Barium	0.151		YES	5293-96	MW120	mg/L
Barium	0.152		YES	5088-93	MW120	mg/L
Barium	0.154		YES	7065-93	MW120	mg/L
Barium	0.162		YES	4991-94	MW120	mg/L
Barium	0.166		YES	5900-93	MW120	mg/L
Barium	0.171		YES	5143-97	MW120	mg/L
Barium	0.092		YES	5144-97	MW121	mg/L
Barium	0.148		YES	5500-96	MW121	mg/L
Barium	0.157		YES	4664-94	MW121	mg/L
Barium	0.26		YES	5452-95	MW121	mg/L
Barium	0.67		YES	5206-93	MW121	mg/L
Barium	0.07	<	NO	5456-95	MW122	mg/L
Barium	0.259		YES	5246-93	MW122	mg/L
Barium	0.268		YES	4868-94	MW122	mg/L
Barium	0.29		YES	8596-95	MW122	mg/L
Barium	0.326		YES	5301-96	MW122	mg/L
Barium	0.354		YES	5145-97	MW122	mg/L
Barium	0.11		YES	5460-95	MW133	mg/L
Barium	0.139		YES	5262-93	MW133	mg/L
Barium	0.145		YES	4761-94	MW133	mg/L
Barium	0.072		YES	5195-94	MW140	mg/L
Barium	0.072		YES	5148-97	MW140	mg/L
Barium	0.074		YES	6864-94	MW140	mg/L
Barium	0.079		YES	5313-96	MW140	mg/L
Barium	0.086		YES	8004-93	MW140	mg/L
Barium	0.086		YES	4225-94	MW140	mg/L
Barium	0.089		YES	7061-93	MW140	mg/L
Barium	0.092		YES	6050-94	MW140	mg/L
Barium	0.111		YES	6068-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Barium							
	0.132	0.07	0.092	0.07	0.11	0.072		
	0.141	0.146	0.148	0.259	0.139	0.072		
	0.143	0.15	0.157	0.286	0.145	0.074		
	0.146	0.15	0.28	0.29		0.079		
	0.15	0.151	0.26	0.326		0.086		
	0.15	0.152		0.354		0.086		
	0.15	0.154				0.089		
	0.155	0.162				0.092		
	0.157	0.166				0.111		
	0.159	0.171						
	0.162							
	0.166							
	0.168							
Min	0.132	0.070	0.092	0.070	0.110	0.072	0.070	
Max	0.168	0.171	0.260	0.354	0.145	0.111	0.354	
Average	0.152	0.147	0.183	0.265	0.131	0.085	0.155	0.161
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Turbidity/total solids impacted result of detected value; detected value reduced to nondetect concentration.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

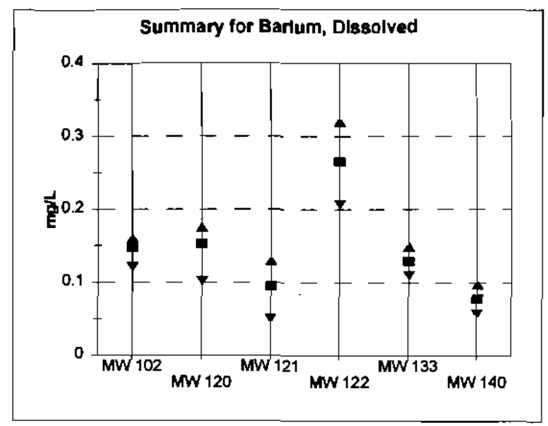
MW 140 - Data were not modified.

Summary of McNalry Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Barium, Dissolved	0.121		YES	5141-97	MW102	mg/L
Barium, Dissolved	0.14		YES	7467-95	MW102	mg/L
Barium, Dissolved	0.142		YES	7295-93	MW102	mg/L
Barium, Dissolved	0.143		YES	5163-94	MW102	mg/L
Barium, Dissolved	0.144		YES	8265-95	MW102	mg/L
Barium, Dissolved	0.146		YES	5940-93	MW102	mg/L
Barium, Dissolved	0.149		YES	5261-96	MW102	mg/L
Barium, Dissolved	0.15		YES	6592-95	MW102	mg/L
Barium, Dissolved	0.152		YES	5174-93	MW102	mg/L
Barium, Dissolved	0.154		YES	6022-94	MW102	mg/L
Barium, Dissolved	0.157		YES	4266-94	MW102	mg/L
Barium, Dissolved	0.157		YES	6770-94	MW102	mg/L
Barium, Dissolved	0.16		YES	5619-95	MW102	mg/L
Barium, Dissolved	0.102		YES	5143-97	MW120	mg/L
Barium, Dissolved	0.143		YES	5293-96	MW120	mg/L
Barium, Dissolved	0.149		YES	5088-93	MW120	mg/L
Barium, Dissolved	0.157		YES	4209-94	MW120	mg/L
Barium, Dissolved	0.157		YES	5900-93	MW120	mg/L
Barium, Dissolved	0.16		YES	5448-95	MW120	mg/L
Barium, Dissolved	0.16		YES	6928-94	MW120	mg/L
Barium, Dissolved	0.162		YES	4991-94	MW120	mg/L
Barium, Dissolved	0.163		YES	7065-93	MW120	mg/L
Barium, Dissolved	0.175		YES	6034-94	MW120	mg/L
Barium, Dissolved	0.05	<	NO	5144-97	MW121	mg/L
Barium, Dissolved	0.08		YES	5452-95	MW121	mg/L
Barium, Dissolved	0.096		YES	5500-96	MW121	mg/L
Barium, Dissolved	0.117		YES	5206-93	MW121	mg/L
Barium, Dissolved	0.13		YES	4864-94	MW121	mg/L
Barium, Dissolved	0.207		YES	5145-97	MW122	mg/L
Barium, Dissolved	0.249		YES	5246-93	MW122	mg/L
Barium, Dissolved	0.261		YES	5301-96	MW122	mg/L
Barium, Dissolved	0.27		YES	6596-95	MW122	mg/L
Barium, Dissolved	0.286		YES	4868-94	MW122	mg/L
Barium, Dissolved	0.32		YES	5456-95	MW122	mg/L
Barium, Dissolved	0.11		YES	5460-95	MW133	mg/L
Barium, Dissolved	0.128		YES	5262-93	MW133	mg/L
Barium, Dissolved	0.149		YES	4761-94	MW133	mg/L
Barium, Dissolved	0.057		YES	5146-97	MW140	mg/L
Barium, Dissolved	0.069		YES	5195-94	MW140	mg/L
Barium, Dissolved	0.07	<	NO	6864-94	MW140	mg/L
Barium, Dissolved	0.072		YES	5313-96	MW140	mg/L
Barium, Dissolved	0.074		YES	6050-94	MW140	mg/L
Barium, Dissolved	0.08		YES	6004-93	MW140	mg/L
Barium, Dissolved	0.083		YES	4225-94	MW140	mg/L
Barium, Dissolved	0.095		YES	7081-93	MW140	mg/L
Barium, Dissolved	0.097		YES	6086-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Barium, Dissolved							
	0.121	0.102	0.05	0.207	0.11	0.057		
	0.14	0.143	0.08	0.249	0.128	0.069		
	0.142	0.149	0.096	0.261	0.149	0.07		
	0.143	0.157	0.117	0.27		0.072		
	0.144	0.157	0.13	0.286		0.074		
	0.146	0.16		0.32		0.08		
	0.149	0.16				0.083		
	0.15	0.162				0.095		
	0.152	0.163				0.097		
	0.154	0.175						
	0.157							
	0.157							
	0.16							
Min	0.121	0.102	0.050	0.207	0.110	0.057	0.050	
Max	0.160	0.175	0.130	0.320	0.149	0.097	0.320	
Average	0.147	0.153	0.095	0.266	0.129	0.077	0.143	0.144
Number	13	10	5	6	3	9	46	



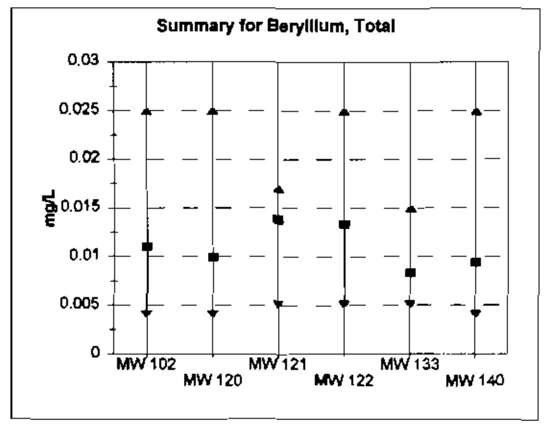
Data for Barium, Dissolved were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Beryllium	0.004	<	NO	5183-94	MW102	mg/L
Beryllium	0.004	<	NO	8022-94	MW102	mg/L
Beryllium	0.005	<	NO	5174-93	MW102	mg/L
Beryllium	0.005	<	NO	5940-93	MW102	mg/L
Beryllium	0.005	<	NO	7295-93	MW102	mg/L
Beryllium	0.005	<	NO	4268-94	MW102	mg/L
Beryllium	0.015	<	NO	8770-94	MW102	mg/L
Beryllium	0.015	<	NO	5819-95	MW102	mg/L
Beryllium	0.015	<	NO	6592-95	MW102	mg/L
Beryllium	0.015	<	NO	7467-95	MW102	mg/L
Beryllium	0.015	<	NO	8285-95	MW102	mg/L
Beryllium	0.015	<	NO	5281-96	MW102	mg/L
Beryllium	0.025	<	NO	5141-97	MW102	mg/L
Beryllium	0.004	<	NO	6034-94	MW120	mg/L
Beryllium	0.005	<	NO	4209-94	MW120	mg/L
Beryllium	0.005	<	NO	4991-94	MW120	mg/L
Beryllium	0.005	<	NO	5066-93	MW120	mg/L
Beryllium	0.005	<	NO	5900-93	MW120	mg/L
Beryllium	0.005	<	NO	7065-93	MW120	mg/L
Beryllium	0.015	<	NO	5448-95	MW120	mg/L
Beryllium	0.015	<	NO	5293-96	MW120	mg/L
Beryllium	0.015	<	NO	6926-94	MW120	mg/L
Beryllium	0.025	<	NO	5143-97	MW120	mg/L
Beryllium	0.005	<	NO	4664-94	MW121	mg/L
Beryllium	0.015	<	NO	5452-95	MW121	mg/L
Beryllium	0.015	<	NO	5500-96	MW121	mg/L
Beryllium	0.017		YES	5206-93	MW121	mg/L
Beryllium	0.025	<	NO	5144-97	MW121	mg/L
Beryllium	0.005	<	NO	5246-93	MW122	mg/L
Beryllium	0.005	<	NO	4686-94	MW122	mg/L
Beryllium	0.015	<	NO	5456-95	MW122	mg/L
Beryllium	0.015	<	NO	6596-95	MW122	mg/L
Beryllium	0.015	<	NO	5301-96	MW122	mg/L
Beryllium	0.025	<	NO	5145-97	MW122	mg/L
Beryllium	0.005	<	NO	5262-93	MW133	mg/L
Beryllium	0.005	<	NO	4761-94	MW133	mg/L
Beryllium	0.015	<	NO	5460-95	MW133	mg/L
Beryllium	0.004	<	NO	6050-94	MW140	mg/L
Beryllium	0.005	<	NO	6004-93	MW140	mg/L
Beryllium	0.005	<	NO	6086-93	MW140	mg/L
Beryllium	0.005	<	NO	7081-93	MW140	mg/L
Beryllium	0.005	<	NO	4225-94	MW140	mg/L
Beryllium	0.005	<	NO	5195-94	MW140	mg/L
Beryllium	0.015	<	NO	6864-94	MW140	mg/L
Beryllium	0.015	<	NO	5313-96	MW140	mg/L
Beryllium	0.025	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Beryllium							
	0.004	0.004	0.005	0.005	0.005	0.004		
	0.004	0.005	0.015	0.005	0.005	0.005		
	0.005	0.005	0.015	0.015	0.015	0.005		
	0.005	0.005	0.017	0.015		0.005		
	0.005	0.005	0.017	0.015		0.005		
	0.005	0.005		0.025		0.005		
	0.015	0.015				0.015		
	0.015	0.015				0.015		
	0.015	0.015				0.025		
	0.015	0.025						
	0.015							
	0.015							
	0.025							
Min	0.004	0.004	0.005	0.005	0.005	0.004	0.004	
Max	0.025	0.025	0.017	0.025	0.015	0.025	0.025	
Average	0.011	0.010	0.014	0.013	0.008	0.009	0.011	0.011
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW120 - Data were not modified.

MW 121 - One nondetect with a value greater than maximum detected value set to maximum detected value.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

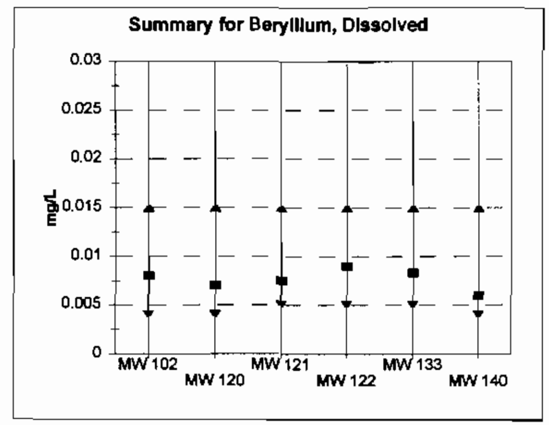
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Beryllium, Dissolved	0.004	<	NO	5163-94	MW102	mg/L
Beryllium, Dissolved	0.004	<	NO	6022-94	MW102	mg/L
Beryllium, Dissolved	0.005	<	NO	5174-93	MW102	mg/L
Beryllium, Dissolved	0.005	<	NO	5940-93	MW102	mg/L
Beryllium, Dissolved	0.005	<	NO	7295-93	MW102	mg/L
Beryllium, Dissolved	0.005	<	NO	4266-94	MW102	mg/L
Beryllium, Dissolved	0.015	<	NO	6770-94	MW102	mg/L
Beryllium, Dissolved	0.015	<	NO	5619-95	MW102	mg/L
Beryllium, Dissolved	0.015	<	NO	6592-95	MW102	mg/L
Beryllium, Dissolved	0.015	<	NO	7467-95	MW102	mg/L
Beryllium, Dissolved		Q	NO	8285-95	MW102	
Beryllium, Dissolved		Q	NO	5261-96	MW102	
Beryllium, Dissolved	0.004	<	NO	6034-94	MW120	mg/L
Beryllium, Dissolved	0.005	<	NO	4209-94	MW120	mg/L
Beryllium, Dissolved	0.005	<	NO	4991-94	MW120	mg/L
Beryllium, Dissolved	0.005	<	NO	5088-93	MW120	mg/L
Beryllium, Dissolved	0.005	<	NO	5900-93	MW120	mg/L
Beryllium, Dissolved	0.005	<	NO	7065-93	MW120	mg/L
Beryllium, Dissolved	0.015	<	NO	5446-95	MW120	mg/L
Beryllium, Dissolved	0.015	<	NO	6928-94	MW120	mg/L
Beryllium, Dissolved		Q	NO	5293-96	MW120	
Beryllium, Dissolved	0.005	<	NO	5208-93	MW121	mg/L
Beryllium, Dissolved	0.005	<	NO	4884-94	MW121	mg/L
Beryllium, Dissolved	0.015	<	NO	5452-95	MW121	mg/L
Beryllium, Dissolved		Q	NO	5500-96	MW121	
Beryllium, Dissolved	0.005	<	NO	5248-93	MW122	mg/L
Beryllium, Dissolved	0.005	<	NO	4868-94	MW122	mg/L
Beryllium, Dissolved	0.015	<	NO	5456-95	MW122	mg/L
Beryllium, Dissolved	0.015	<	NO	6596-95	MW122	mg/L
Beryllium, Dissolved		Q	NO	5301-96	MW122	
Beryllium, Dissolved	0.005	<	NO	5262-93	MW133	mg/L
Beryllium, Dissolved	0.005	<	NO	4761-94	MW133	mg/L
Beryllium, Dissolved	0.015	<	NO	5460-95	MW133	mg/L
Beryllium, Dissolved	0.004	<	NO	8050-94	MW140	mg/L
Beryllium, Dissolved	0.005	<	NO	6004-93	MW140	mg/L
Beryllium, Dissolved	0.005	<	NO	6086-93	MW140	mg/L
Beryllium, Dissolved	0.005	<	NO	7061-93	MW140	mg/L
Beryllium, Dissolved	0.005	<	NO	4225-94	MW140	mg/L
Beryllium, Dissolved	0.005	<	NO	5195-94	MW140	mg/L
Beryllium, Dissolved	0.015	<	NO	8864-94	MW140	mg/L
Beryllium, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Beryllium, Dissolved							
	0.004	0.004	0.005	0.005	0.005	0.004		
	0.004	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.015	0.015	0.015	0.005		
	0.005	0.005	0.005	0.015		0.005		
	0.005	0.005		0.005		0.005		
	0.005	0.005				0.005		
	0.015	0.015				0.015		
	0.015	0.015				0.004		
	0.015	0.004						
	0.015							
	0.004							
	0.004							
Min	0.004	0.004	0.005	0.005	0.005	0.004	0.004	
Max	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
Average	0.008	0.007	0.008	0.009	0.008	0.006	0.007	0.008
Number	12	9	4	5	3	8	41	



MW 102 - Two "Q" qualified results assigned minimum detection limit for samples from this well.

MW120 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 121 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 122 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 133 - Data were not modified.

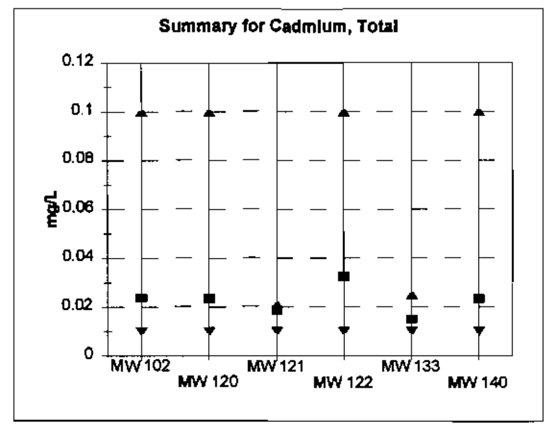
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Cadmium	0.01	<	NO	5174-93	MW102	mg/L
Cadmium	0.01	<	NO	5940-93	MW102	mg/L
Cadmium	0.01	<	NO	7295-93	MW102	mg/L
Cadmium	0.01	<	NO	4268-94	MW102	mg/L
Cadmium	0.01	<	NO	5183-94	MW102	mg/L
Cadmium	0.01	<	NO	6022-94	MW102	mg/L
Cadmium	0.025	<	NO	6770-94	MW102	mg/L
Cadmium	0.025	<	NO	5619-95	MW102	mg/L
Cadmium	0.025	<	NO	8592-95	MW102	mg/L
Cadmium	0.025	<	NO	7467-95	MW102	mg/L
Cadmium	0.025	<	NO	8285-95	MW102	mg/L
Cadmium	0.025	<	NO	5281-96	MW102	mg/L
Cadmium	0.1	<	NO	5141-97	MW102	mg/L
Cadmium	0.01	<	NO	4209-94	MW120	mg/L
Cadmium	0.01	<	NO	4991-94	MW120	mg/L
Cadmium	0.01	<	NO	5086-93	MW120	mg/L
Cadmium	0.01	<	NO	5900-93	MW120	mg/L
Cadmium	0.01	<	NO	6034-94	MW120	mg/L
Cadmium	0.01	<	NO	7065-93	MW120	mg/L
Cadmium	0.025	<	NO	5448-95	MW120	mg/L
Cadmium	0.025	<	NO	5293-96	MW120	mg/L
Cadmium	0.025	<	NO	6928-94	MW120	mg/L
Cadmium	0.1	<	NO	5143-97	MW120	mg/L
Cadmium	0.01	<	NO	4864-94	MW121	mg/L
Cadmium	0.021		YES	5206-93	MW121	mg/L
Cadmium	0.025	<	NO	5452-95	MW121	mg/L
Cadmium	0.025	<	NO	5500-96	MW121	mg/L
Cadmium	0.1	<	NO	5144-97	MW121	mg/L
Cadmium	0.01	<	NO	5246-93	MW122	mg/L
Cadmium	0.01	<	NO	4868-94	MW122	mg/L
Cadmium	0.025	<	NO	5456-95	MW122	mg/L
Cadmium	0.025	<	NO	6598-95	MW122	mg/L
Cadmium	0.025	<	NO	5301-96	MW122	mg/L
Cadmium	0.1	<	NO	5145-97	MW122	mg/L
Cadmium	0.01	<	NO	5282-93	MW133	mg/L
Cadmium	0.01	<	NO	4761-94	MW133	mg/L
Cadmium	0.025	<	NO	5480-95	MW133	mg/L
Cadmium	0.01	<	NO	6004-93	MW140	mg/L
Cadmium	0.01	<	NO	6088-93	MW140	mg/L
Cadmium	0.01	<	NO	7061-93	MW140	mg/L
Cadmium	0.01	<	NO	4225-94	MW140	mg/L
Cadmium	0.01	<	NO	5195-94	MW140	mg/L
Cadmium	0.01	<	NO	6050-94	MW140	mg/L
Cadmium	0.025	<	NO	6864-94	MW140	mg/L
Cadmium	0.025	<	NO	5313-96	MW140	mg/L
Cadmium	0.1	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Cadmium							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.021	0.01	0.01	0.01		
	0.01	0.01	0.021	0.025	0.025	0.01		
	0.01	0.01	0.021	0.025		0.01		
	0.01	0.01	0.021	0.025		0.01		
	0.01	0.01		0.1		0.01		
	0.025	0.025				0.025		
	0.025	0.025				0.025		
	0.025	0.025				0.1		
	0.025	0.1						
	0.025							
	0.025							
	0.1							
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.100	0.100	0.021	0.100	0.025	0.100	0.100	
Average	0.024	0.024	0.019	0.033	0.015	0.023	0.024	0.023
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW120 - Data were not modified.

MW 121 - Three nondetects with values greater than maximum detected value reduced to maximum detected value.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

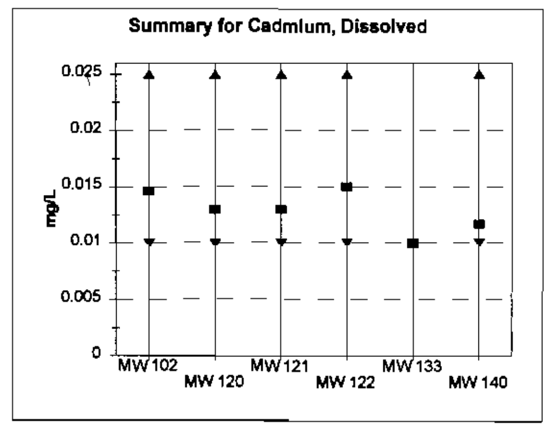
MW 140 - Data were not modified.

Summary of McNalry Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Cadmium, Dissolved	0.01	<	NO	5174-93	MW102	mg/L
Cadmium, Dissolved	0.01	<	NO	5940-93	MW102	mg/L
Cadmium, Dissolved	0.01	<	NO	7295-93	MW102	mg/L
Cadmium, Dissolved	0.01	<	NO	4268-94	MW102	mg/L
Cadmium, Dissolved	0.01	<	NO	5163-94	MW102	mg/L
Cadmium, Dissolved	0.01	<	NO	6022-94	MW102	mg/L
Cadmium, Dissolved	0.025	<	NO	6770-94	MW102	mg/L
Cadmium, Dissolved	0.025	<	NO	5619-95	MW102	mg/L
Cadmium, Dissolved	0.025	<	NO	6592-95	MW102	mg/L
Cadmium, Dissolved	0.025	<	NO	7467-95	MW102	mg/L
Cadmium, Dissolved		Q	NO	6265-95	MW102	
Cadmium, Dissolved		Q	NO	5281-96	MW102	
Cadmium, Dissolved		Q	NO	5141-97	MW102	
Cadmium, Dissolved	0.01	<	NO	4209-94	MW120	mg/L
Cadmium, Dissolved	0.01	<	NO	4991-94	MW120	mg/L
Cadmium, Dissolved	0.01	<	NO	5088-93	MW120	mg/L
Cadmium, Dissolved	0.01	<	NO	5900-93	MW120	mg/L
Cadmium, Dissolved	0.01	<	NO	6034-94	MW120	mg/L
Cadmium, Dissolved	0.01	<	NO	7065-93	MW120	mg/L
Cadmium, Dissolved	0.025	<	NO	5448-95	MW120	mg/L
Cadmium, Dissolved	0.025	<	NO	6926-94	MW120	mg/L
Cadmium, Dissolved		Q	NO	5143-97	MW120	
Cadmium, Dissolved		Q	NO	5293-96	MW120	
Cadmium, Dissolved	0.01	<	NO	5208-93	MW121	mg/L
Cadmium, Dissolved	0.01	<	NO	4864-94	MW121	mg/L
Cadmium, Dissolved	0.025	<	NO	5452-95	MW121	mg/L
Cadmium, Dissolved		Q	NO	5500-96	MW121	
Cadmium, Dissolved		Q	NO	5144-97	MW121	
Cadmium, Dissolved	0.01	<	NO	5246-93	MW122	mg/L
Cadmium, Dissolved	0.01	<	NO	4866-94	MW122	mg/L
Cadmium, Dissolved	0.025	<	NO	5456-95	MW122	mg/L
Cadmium, Dissolved	0.025	<	NO	6596-95	MW122	mg/L
Cadmium, Dissolved		Q	NO	5301-96	MW122	
Cadmium, Dissolved		Q	NO	5145-97	MW122	
Cadmium, Dissolved	0.01	<	NO	5262-93	MW133	mg/L
Cadmium, Dissolved	0.01	<	NO	4761-94	MW133	mg/L
Cadmium, Dissolved		Q	NO	5460-95	MW133	
Cadmium, Dissolved	0.01	<	NO	6004-93	MW140	mg/L
Cadmium, Dissolved	0.01	<	NO	6088-93	MW140	mg/L
Cadmium, Dissolved	0.01	<	NO	7061-93	MW140	mg/L
Cadmium, Dissolved	0.01	<	NO	4225-94	MW140	mg/L
Cadmium, Dissolved	0.01	<	NO	5195-94	MW140	mg/L
Cadmium, Dissolved	0.01	<	NO	6050-94	MW140	mg/L
Cadmium, Dissolved	0.025	<	NO	6664-94	MW140	mg/L
Cadmium, Dissolved		Q	NO	5313-96	MW140	
Cadmium, Dissolved		Q	NO	5146-97	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Cadmium, Dissolved							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.025	0.025	0.01	0.01		
	0.01	0.01	0.01	0.025		0.01		
	0.01	0.01	0.01	0.01		0.01		
	0.01	0.01		0.01		0.01		
	0.025	0.025				0.025		
	0.025	0.025				0.01		
	0.025	0.01				0.01		
	0.025	0.01						
	0.01							
	0.01							
	0.01							
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.025	0.025	0.025	0.025	0.010	0.025	0.025	
Average	0.015	0.013	0.013	0.015	0.010	0.012	0.013	0.013
Number	13	10	5	6	3	9	46	



MW 102 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW120 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 121 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 122 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 133 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

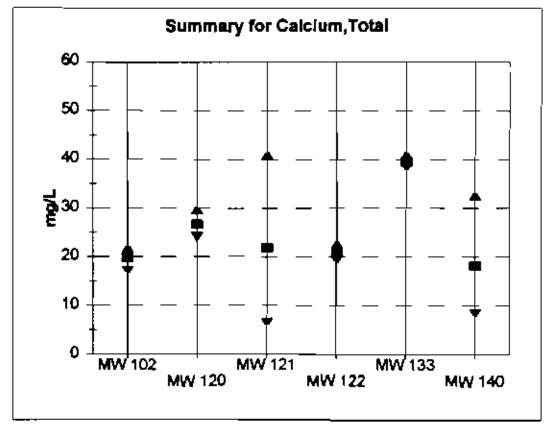
MW 140 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Calcium	17.1		YES	6022-94	MW102	mg/L
Calcium	18.9		YES	7295-93	MW102	mg/L
Calcium	19.04		YES	5174-93	MW102	mg/L
Calcium	19.2		YES	5183-94	MW102	mg/L
Calcium	19.3		YES	5940-93	MW102	mg/L
Calcium	19.8	N	YES	5141-97	MW102	mg/L
Calcium	19.8		YES	4268-94	MW102	mg/L
Calcium	19.9	N	YES	7467-95	MW102	mg/L
Calcium	20	N	YES	6592-95	MW102	mg/L
Calcium	20	N	YES	8285-95	MW102	mg/L
Calcium	20.93		YES	6770-94	MW102	mg/L
Calcium	21		YES	5619-95	MW102	mg/L
Calcium	21.8	N	YES	5281-96	MW102	mg/L
Calcium	24.1		YES	4991-94	MW120	mg/L
Calcium	25.3		YES	5088-93	MW120	mg/L
Calcium	25.6		YES	5448-95	MW120	mg/L
Calcium	26		YES	7065-93	MW120	mg/L
Calcium	26.3		YES	4209-94	MW120	mg/L
Calcium	27.1		YES	5293-96	MW120	mg/L
Calcium	27.1		YES	6926-94	MW120	mg/L
Calcium	27.4		YES	5900-93	MW120	mg/L
Calcium	27.7	N	YES	5143-97	MW120	mg/L
Calcium	29.8		YES	6034-94	MW120	mg/L
Calcium	6.48	N	YES	5144-97	MW121	mg/L
Calcium	11.9		YES	4864-94	MW121	mg/L
Calcium	17.4		YES	5500-96	MW121	mg/L
Calcium	32.6		YES	5208-93	MW121	mg/L
Calcium	41		YES	5452-95	MW121	mg/L
Calcium	19.19		YES	5246-93	MW122	mg/L
Calcium	19.5		YES	4868-94	MW122	mg/L
Calcium	20.6		YES	8596-95	MW122	mg/L
Calcium	21		YES	5458-95	MW122	mg/L
Calcium	21.3	N	YES	5145-97	MW122	mg/L
Calcium	22.6	N	YES	5301-96	MW122	mg/L
Calcium	38.4		YES	4761-94	MW133	mg/L
Calcium	39		YES	5460-95	MW133	mg/L
Calcium	41		YES	5282-93	MW133	mg/L
Calcium	8.43	N	YES	5148-97	MW140	mg/L
Calcium	11.6	N	YES	5313-96	MW140	mg/L
Calcium	13		YES	5195-94	MW140	mg/L
Calcium	13		YES	6864-94	MW140	mg/L
Calcium	15.85		YES	6050-94	MW140	mg/L
Calcium	19.52		YES	6004-93	MW140	mg/L
Calcium	21.5		YES	4225-94	MW140	mg/L
Calcium	28		YES	7081-93	MW140	mg/L
Calcium	32.6		YES	6088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Calcium							
	17.1	24.1	6.48	19.19	38.4	8.43		
	18.9	25.3	11.9	19.5	39	11.6		
	19.04	25.6	17.4	20.6	41	13		
	19.2	26	32.6	21		13		
	19.3	26.3	41	21.3		15.85		
	19.8	27.1		22.6		19.52		
	19.8	27.1				21.5		
	19.9	27.4				28		
	20	27.7				32.6		
	20	29.8						
	20.93							
	21							
	21.8							
Min	17.100	24.100	6.480	19.190	38.400	8.430	6.480	
Max	21.800	29.800	41.000	22.600	41.000	32.600	41.000	
Average	19.752	26.640	21.676	20.696	39.467	16.167	22.579	24.433
Number	13	10	5	6	3	9	48	



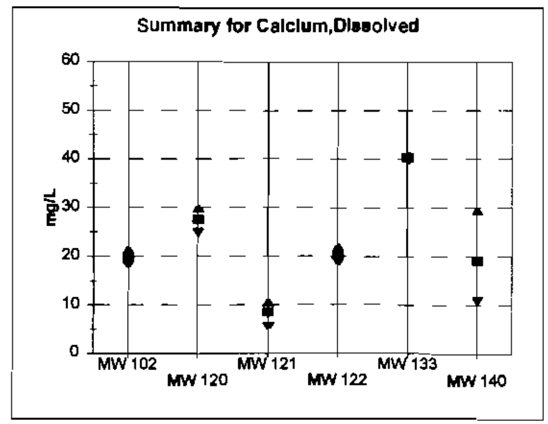
Data for Calcium, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Calcium, Dissolved	18.2	N	YES	7467-95	MW102	mg/L
Calcium, Dissolved	19		YES	5940-93	MW102	mg/L
Calcium, Dissolved	19.1		YES	7295-93	MW102	mg/L
Calcium, Dissolved	19.2	N	YES	6592-95	MW102	mg/L
Calcium, Dissolved	19.2	N	YES	8285-95	MW102	mg/L
Calcium, Dissolved	19.26		YES	5174-93	MW102	mg/L
Calcium, Dissolved	19.3	N	YES	5281-96	MW102	mg/L
Calcium, Dissolved	19.5		YES	6022-94	MW102	mg/L
Calcium, Dissolved	19.6		YES	5163-94	MW102	mg/L
Calcium, Dissolved	20.9		YES	4268-94	MW102	mg/L
Calcium, Dissolved	21.2		YES	5619-95	MW102	mg/L
Calcium, Dissolved	21.5		YES	6770-94	MW102	mg/L
Calcium, Dissolved	24.9		YES	5066-93	MW120	mg/L
Calcium, Dissolved	25.3		YES	4991-94	MW120	mg/L
Calcium, Dissolved	26.5	N	YES	5293-96	MW120	mg/L
Calcium, Dissolved	26.8		YES	5900-93	MW120	mg/L
Calcium, Dissolved	27.7		YES	4209-94	MW120	mg/L
Calcium, Dissolved	28		YES	5446-95	MW120	mg/L
Calcium, Dissolved	29.1		YES	8034-94	MW120	mg/L
Calcium, Dissolved	29.62		YES	7065-93	MW120	mg/L
Calcium, Dissolved	30		YES	8926-94	MW120	mg/L
Calcium, Dissolved	5.5		YES	5452-95	MW121	mg/L
Calcium, Dissolved	8.46	N	YES	5500-96	MW121	mg/L
Calcium, Dissolved	9.56		YES	4864-94	MW121	mg/L
Calcium, Dissolved	10.7		YES	5206-93	MW121	mg/L
Calcium, Dissolved	18.65		YES	5246-93	MW122	mg/L
Calcium, Dissolved	19.9	N	YES	5301-96	MW122	mg/L
Calcium, Dissolved	20.1		YES	6596-95	MW122	mg/L
Calcium, Dissolved	20.6		YES	4666-94	MW122	mg/L
Calcium, Dissolved	22		YES	5456-95	MW122	mg/L
Calcium, Dissolved	39.3		YES	5282-93	MW133	mg/L
Calcium, Dissolved	40.4	*	YES	5480-95	MW133	mg/L
Calcium, Dissolved	41.1		YES	4781-94	MW133	mg/L
Calcium, Dissolved	10.8	N	YES	5313-96	MW140	mg/L
Calcium, Dissolved	13		YES	6664-94	MW140	mg/L
Calcium, Dissolved	13.77		YES	8050-94	MW140	mg/L
Calcium, Dissolved	15.2		YES	5195-94	MW140	mg/L
Calcium, Dissolved	16.77		YES	6004-93	MW140	mg/L
Calcium, Dissolved	22.8		YES	4225-94	MW140	mg/L
Calcium, Dissolved	28.8		YES	7061-93	MW140	mg/L
Calcium, Dissolved	29.5		YES	6068-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Calcium, Dissolved							
	18.2	24.9	5.5	18.65	39.3	10.8		
	19	25.3	8.46	19.9	40.4	13		
	19.1	26.5	9.56	20.1	41.1	13.77		
	19.2	26.8	10.7	20.6		15.2		
	19.2	27.7		22		16.77		
	19.26	28				22.8		
	19.3	29.1				28.8		
	19.5	29.62				29.5		
	19.6	30						
	20.9							
	21.2							
	21.5							
Min	18.200	24.900	5.500	18.650	39.300	10.800	5.500	
Max	21.500	30.000	10.700	22.000	41.100	29.500	41.100	
Average	19.663	27.547	8.555	20.250	40.267	19.060	21.775	22.560
Number	12	9	4	5	3	8	41	



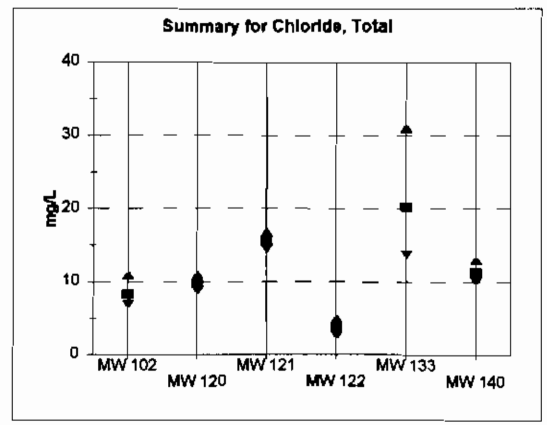
Data for Calcium, Dissolved were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Chloride	6.9		YES	6592-95	MW102	mg/L
Chloride	7.1		YES	6285-95	MW102	mg/L
Chloride	7.5		YES	5141-97	MW102	mg/L
Chloride	7.6		YES	6022-94	MW102	mg/L
Chloride	7.6		YES	5619-95	MW102	mg/L
Chloride	7.6		YES	7467-95	MW102	mg/L
Chloride	7.7		YES	5281-96	MW102	mg/L
Chloride	7.9		YES	6770-94	MW102	mg/L
Chloride	9		YES	5174-93	MW102	mg/L
Chloride	9		YES	4268-94	MW102	mg/L
Chloride	9		YES	5163-94	MW102	mg/L
Chloride	10		YES	5940-93	MW102	mg/L
Chloride	11		YES	7295-93	MW102	mg/L
Chloride	8.8		YES	5143-97	MW120	mg/L
Chloride	9		YES	5900-93	MW120	mg/L
Chloride	9.1		YES	6034-94	MW120	mg/L
Chloride	9.3		YES	6928-94	MW120	mg/L
Chloride	9.4		YES	5448-95	MW120	mg/L
Chloride	9.6		YES	5293-96	MW120	mg/L
Chloride	10		YES	4209-94	MW120	mg/L
Chloride	10		YES	5088-93	MW120	mg/L
Chloride	11		YES	4991-94	MW120	mg/L
Chloride	11		YES	7065-93	MW120	mg/L
Chloride	14.5		YES	5452-95	MW121	mg/L
Chloride	15		YES	4864-94	MW121	mg/L
Chloride	15.5		YES	5144-97	MW121	mg/L
Chloride	16.8		YES	5500-96	MW121	mg/L
Chloride	2.8		YES	6596-95	MW122	mg/L
Chloride	2.8		YES	5145-97	MW122	mg/L
Chloride	3		YES	5301-96	MW122	mg/L
Chloride	3.3		YES	5456-95	MW122	mg/L
Chloride	5		YES	5248-93	MW122	mg/L
Chloride	5		YES	4868-94	MW122	mg/L
Chloride	13.7		YES	5460-95	MW133	mg/L
Chloride	16		YES	4761-94	MW133	mg/L
Chloride	31		YES	5282-93	MW133	mg/L
Chloride	10		YES	6088-93	MW140	mg/L
Chloride	10.9		YES	6664-94	MW140	mg/L
Chloride	11		YES	6004-93	MW140	mg/L
Chloride	11		YES	4225-94	MW140	mg/L
Chloride	11		YES	6050-94	MW140	mg/L
Chloride	11.1		YES	5146-97	MW140	mg/L
Chloride	11.4		YES	5313-96	MW140	mg/L
Chloride	12		YES	5195-94	MW140	mg/L
Chloride	13		YES	7061-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Chloride							
	6.9	8.8	14.5	2.6	13.7	10		
	7.1	9	15	2.8	16	10.9		
	7.5	9.1	15.5	3	31	11		
	7.6	9.3	16.6	3.3		11		
	7.6	9.4		5		11		
	7.6	9.6		5		11.1		
	7.7	10				11.4		
	7.9	10				12		
	9	11				13		
	9	11						
	9							
	10							
	11							
Min	6.900	8.800	14.500	2.600	13.700	10.000	2.600	
Max	11.000	11.000	16.800	5.000	31.000	13.000	31.000	
Average	8.300	9.720	15.450	3.617	20.233	11.267	10.016	11.431
Number	13	10	4	6	3	9	45	



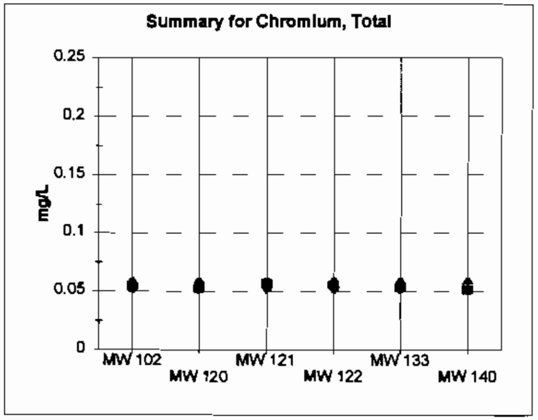
Data for Chloride, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Chromium	0.05	<	NO	5174-93	MW102	mg/L
Chromium	0.05	<	NO	5940-93	MW102	mg/L
Chromium	0.05	<	NO	7295-93	MW102	mg/L
Chromium	0.05	<	NO	4266-94	MW102	mg/L
Chromium	0.05	<	NO	5183-94	MW102	mg/L
Chromium	0.05	<	NO	8022-94	MW102	mg/L
Chromium	0.06	<	NO	8770-94	MW102	mg/L
Chromium	0.06	<	NO	5619-95	MW102	mg/L
Chromium	0.08	<	NO	8592-95	MW102	mg/L
Chromium	0.06	<	NO	7467-95	MW102	mg/L
Chromium	0.08	<	NO	8265-95	MW102	mg/L
Chromium	0.05	<	NO	4209-94	MW120	mg/L
Chromium	0.05	<	NO	4991-94	MW120	mg/L
Chromium	0.05	<	NO	5088-93	MW120	mg/L
Chromium	0.05	<	NO	5900-93	MW120	mg/L
Chromium	0.05	<	NO	6034-94	MW120	mg/L
Chromium	0.05	<	NO	7065-93	MW120	mg/L
Chromium	0.06	<	NO	5448-95	MW120	mg/L
Chromium	0.08	<	NO	6928-94	MW120	mg/L
Chromium	0.05	<	NO	4864-94	MW121	mg/L
Chromium	0.08	<	NO	5452-95	MW121	mg/L
Chromium	0.232		YES	5206-93	MW121	mg/L
Chromium	0.05	<	NO	5246-93	MW122	mg/L
Chromium	0.05	<	NO	4868-94	MW122	mg/L
Chromium	0.06	<	NO	5456-95	MW122	mg/L
Chromium	0.06	<	NO	6596-95	MW122	mg/L
Chromium	0.05	<	NO	5282-93	MW133	mg/L
Chromium	0.05	<	NO	4781-94	MW133	mg/L
Chromium	0.06	<	NO	5460-95	MW133	mg/L
Chromium	0.05	<	NO	6004-93	MW140	mg/L
Chromium	0.05	<	NO	6088-93	MW140	mg/L
Chromium	0.05	<	NO	7081-93	MW140	mg/L
Chromium	0.05	<	NO	4225-94	MW140	mg/L
Chromium	0.05	<	NO	5195-94	MW140	mg/L
Chromium	0.05	<	NO	8050-94	MW140	mg/L
Chromium	0.06	<	NO	6864-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Chromium							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.06	0.05	0.05	0.05		
	0.05	0.05	0.06	0.06	0.06	0.05		
	0.05	0.05		0.06		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.06	0.06				0.06		
	0.06	0.06						
	0.08							
	0.06							
	0.06							
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.060	0.060	0.060	0.060	0.060	0.080	0.080	
Average	0.055	0.053	0.057	0.055	0.053	0.051	0.054	0.054
Number	11	8	3	4	3	7	36	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Turbidity/total solids impacted result of detected value; detected value reduced to nondetect concentration.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

MW 140 - Data were not modified.

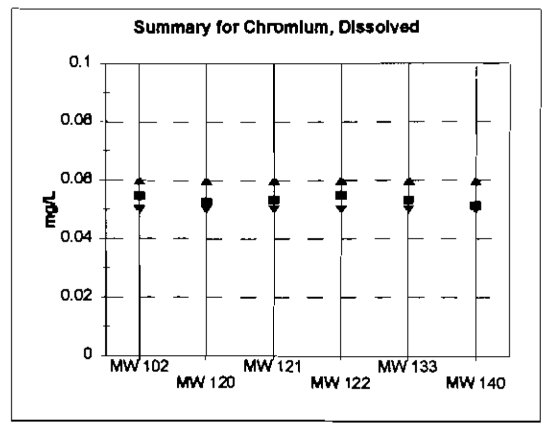
Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Chromium, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	5940-93	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	7295-93	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	4268-94	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	5183-94	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	6022-94	MW102	mg/L
Chromium, Dissolved	0.06	<	NO	6770-94	MW102	mg/L
Chromium, Dissolved	0.06	<	NO	5619-95	MW102	mg/L
Chromium, Dissolved	0.06	<	NO	6592-95	MW102	mg/L
Chromium, Dissolved	0.06	<	NO	7467-95	MW102	mg/L
Chromium, Dissolved	0.06	<	NO	8265-95	MW102	mg/L
Chromium, Dissolved	0.05	<	NO	4209-94	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	4991-94	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	5066-93	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	5900-93	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	6034-94	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	7065-93	MW120	mg/L
Chromium, Dissolved	0.06	<	NO	5446-95	MW120	mg/L
Chromium, Dissolved	0.06	<	NO	6926-94	MW120	mg/L
Chromium, Dissolved	0.05	<	NO	5206-93	MW121	mg/L
Chromium, Dissolved	0.05	<	NO	4864-94	MW121	mg/L
Chromium, Dissolved	0.06	<	NO	5452-95	MW121	mg/L
Chromium, Dissolved	0.05	<	NO	5246-93	MW122	mg/L
Chromium, Dissolved	0.05	<	NO	4868-94	MW122	mg/L
Chromium, Dissolved	0.06	<	NO	5456-95	MW122	mg/L
Chromium, Dissolved	0.06	<	NO	6596-95	MW122	mg/L
Chromium, Dissolved	0.05	<	NO	5282-93	MW133	mg/L
Chromium, Dissolved	0.05	<	NO	4761-94	MW133	mg/L
Chromium, Dissolved	0.06	<	NO	5460-95	MW133	mg/L
Chromium, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Chromium, Dissolved	0.05	<	NO	6068-93	MW140	mg/L
Chromium, Dissolved	0.05	<	NO	7061-93	MW140	mg/L
Chromium, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Chromium, Dissolved	0.05	<	NO	5195-94	MW140	mg/L
Chromium, Dissolved	0.05	<	NO	6050-94	MW140	mg/L
Chromium, Dissolved	0.06	<	NO	6864-94	MW140	mg/L

CORRECTED DATA SET

Chromium, Dissolved

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.06	0.06	0.06	0.05		
	0.05	0.05		0.06		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.06	0.06				0.06		
	0.06	0.06						
	0.06							
	0.06							
	0.06							
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Average	0.055	0.053	0.053	0.055	0.053	0.051	0.053	0.053
Number	11	8	3	4	3	7	36	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

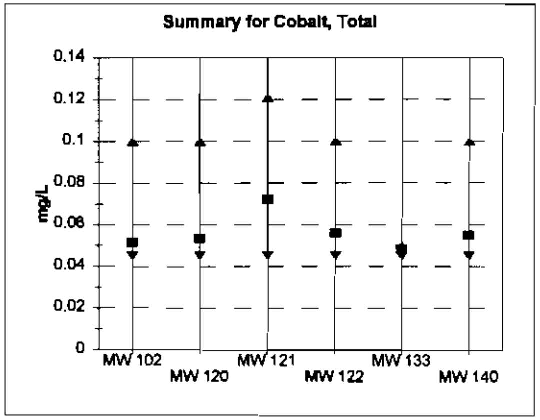
Data for Chromium, Dissolved were not modified.

Summary of McNalry Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Cobalt	0.045	<	NO	6770-94	MW102	mg/L
Cobalt	0.045	<	NO	5619-95	MW102	mg/L
Cobalt	0.045	<	NO	6592-95	MW102	mg/L
Cobalt	0.045	<	NO	7467-95	MW102	mg/L
Cobalt	0.045	<	NO	6265-95	MW102	mg/L
Cobalt	0.045	<	NO	5261-96	MW102	mg/L
Cobalt	0.05	<	NO	5174-93	MW102	mg/L
Cobalt	0.05	<	NO	5940-93	MW102	mg/L
Cobalt	0.05	<	NO	7295-93	MW102	mg/L
Cobalt	0.05	<	NO	4268-94	MW102	mg/L
Cobalt	0.05	<	NO	5183-94	MW102	mg/L
Cobalt	0.05	<	NO	6022-94	MW102	mg/L
Cobalt	0.1	<	NO	5141-97	MW102	mg/L
Cobalt	0.045	<	NO	5448-95	MW120	mg/L
Cobalt	0.045	<	NO	5293-96	MW120	mg/L
Cobalt	0.045	<	NO	6928-94	MW120	mg/L
Cobalt	0.05	<	NO	4209-94	MW120	mg/L
Cobalt	0.05	<	NO	4991-94	MW120	mg/L
Cobalt	0.05	<	NO	5088-93	MW120	mg/L
Cobalt	0.05	<	NO	5900-93	MW120	mg/L
Cobalt	0.05	<	NO	6034-94	MW120	mg/L
Cobalt	0.05	<	NO	7085-93	MW120	mg/L
Cobalt	0.1	<	NO	5143-97	MW120	mg/L
Cobalt	0.045	<	NO	5452-95	MW121	mg/L
Cobalt	0.045	<	NO	5500-96	MW121	mg/L
Cobalt	0.05	<	NO	4864-94	MW121	mg/L
Cobalt	0.1	<	NO	5144-97	MW121	mg/L
Cobalt	0.121		YES	5206-93	MW121	mg/L
Cobalt	0.045	<	NO	5456-95	MW122	mg/L
Cobalt	0.045	<	NO	6596-95	MW122	mg/L
Cobalt	0.045	<	NO	5301-96	MW122	mg/L
Cobalt	0.05	<	NO	5248-93	MW122	mg/L
Cobalt	0.05	<	NO	4868-94	MW122	mg/L
Cobalt	0.1	<	NO	5145-97	MW122	mg/L
Cobalt	0.045	<	NO	5460-95	MW133	mg/L
Cobalt	0.05	<	NO	5282-93	MW133	mg/L
Cobalt	0.05	<	NO	4761-94	MW133	mg/L
Cobalt	0.045	<	NO	5313-96	MW140	mg/L
Cobalt	0.05	<	NO	6004-93	MW140	mg/L
Cobalt	0.05	<	NO	6088-93	MW140	mg/L
Cobalt	0.05	<	NO	7081-93	MW140	mg/L
Cobalt	0.05	<	NO	4225-94	MW140	mg/L
Cobalt	0.05	<	NO	5195-94	MW140	mg/L
Cobalt	0.05	<	NO	6050-94	MW140	mg/L
Cobalt	0.05	<	NO	6864-94	MW140	mg/L
Cobalt	0.1	<	NO	5148-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Cobalt							
	0.045	0.045	0.045	0.045	0.045	0.045		
	0.045	0.045	0.045	0.045	0.05	0.05		
	0.045	0.045	0.05	0.045	0.05	0.05		
	0.045	0.05	0.1	0.05		0.05		
	0.045	0.05	0.121	0.05		0.05		
	0.045	0.05		0.1		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.1		
	0.05	0.1						
	0.05							
	0.05							
	0.1							
Min	0.045	0.045	0.045	0.045	0.045	0.045	0.045	
Max	0.100	0.100	0.121	0.100	0.050	0.100	0.121	
Average	0.052	0.053	0.072	0.056	0.048	0.055	0.055	0.056
Number	13	10	5	6	3	9	46	



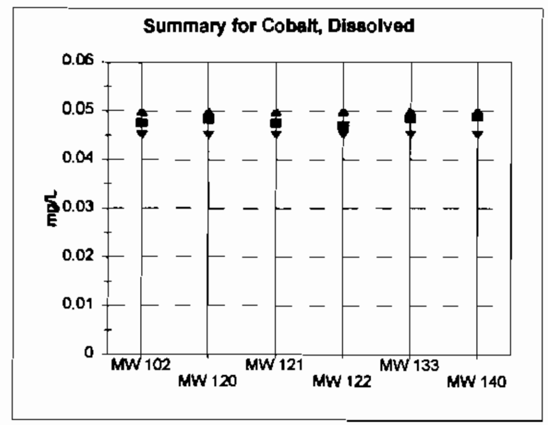
Data for Cobalt, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Cobalt, Dissolved	0.045	<	NO	6770-94	MW102	mg/L
Cobalt, Dissolved	0.045	<	NO	5619-95	MW102	mg/L
Cobalt, Dissolved	0.045	<	NO	6592-95	MW102	mg/L
Cobalt, Dissolved	0.045	<	NO	7467-95	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	5940-93	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	7295-93	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	4268-94	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	5183-94	MW102	mg/L
Cobalt, Dissolved	0.05	<	NO	6022-94	MW102	mg/L
Cobalt, Dissolved		Q	NO	8285-95	MW102	
Cobalt, Dissolved		Q	NO	5281-96	MW102	
Cobalt, Dissolved	0.045	<	NO	5448-95	MW120	mg/L
Cobalt, Dissolved	0.045	<	NO	6928-94	MW120	mg/L
Cobalt, Dissolved	0.05	<	NO	4209-94	MW120	mg/L
Cobalt, Dissolved	0.05	<	NO	4991-94	MW120	mg/L
Cobalt, dissolved	0.05	<	NO	5088-93	MW120	mg/L
Cobalt, Dissolved	0.05	<	NO	5900-93	MW120	mg/L
Cobalt, Dissolved	0.05	<	NO	8034-94	MW120	mg/L
Cobalt, Dissolved	0.05	<	NO	7065-93	MW120	mg/L
Cobalt, Dissolved		Q	NO	5293-96	MW120	
Cobalt, Dissolved	0.045	<	NO	5452-95	MW121	mg/L
Cobalt, Dissolved	0.05	<	NO	5206-93	MW121	mg/L
Cobalt, Dissolved	0.05	<	NO	4864-94	MW121	mg/L
Cobalt, Dissolved		Q	NO	5500-96	MW121	
Cobalt, Dissolved	0.045	<	NO	5458-95	MW122	mg/L
Cobalt, Dissolved	0.045	<	NO	8596-95	MW122	mg/L
Cobalt, Dissolved	0.05	<	NO	5246-93	MW122	mg/L
Cobalt, Dissolved	0.05	<	NO	4866-94	MW122	mg/L
Cobalt, Dissolved		Q	NO	5301-96	MW122	
Cobalt, Dissolved	0.045	<	NO	5460-95	MW133	mg/L
Cobalt, Dissolved	0.05	<	NO	5282-93	MW133	mg/L
Cobalt, Dissolved	0.05	<	NO	4761-94	MW133	mg/L
Cobalt, Dissolved	0.045	<	NO	6864-94	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	6088-93	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	7081-93	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	5195-94	MW140	mg/L
Cobalt, Dissolved	0.05	<	NO	6050-94	MW140	mg/L
Cobalt, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Cobalt, Dissolved							
	0.045	0.045	0.045	0.045	0.045	0.045		
	0.045	0.045	0.05	0.045	0.05	0.05		
	0.045	0.05	0.05	0.05	0.05	0.05		
	0.045	0.05	0.045	0.05		0.05		
	0.05	0.05		0.045		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.045		
	0.05	0.045						
	0.05							
	0.045							
	0.045							
Min	0.045	0.045	0.045	0.045	0.045	0.045	0.045	
Max	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Average	0.048	0.048	0.046	0.047	0.048	0.049	0.048	0.048
Number	12	9	4	5	3	8	41	



MW 102 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 121 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 122 - One "Q" qualified result assigned minimum detection limit for samples from this well

MW 133 - Data were not modified.

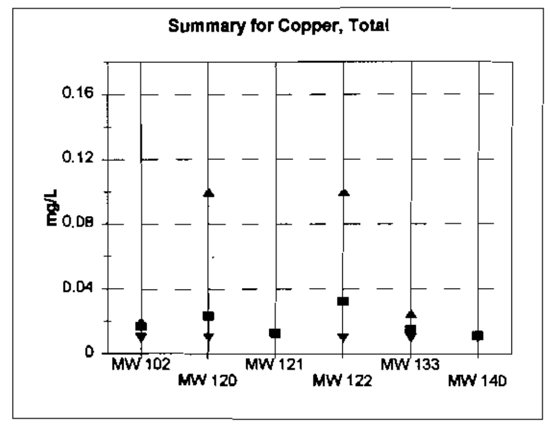
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Copper	0.01	<	NO	5174-93	MW102	mg/L
Copper	0.01	<	NO	5940-93	MW102	mg/L
Copper	0.01	<	NO	7295-93	MW102	mg/L
Copper	0.01	<	NO	4268-94	MW102	mg/L
Copper	0.016		YES	6022-94	MW102	mg/L
Copper	0.02		YES	5163-94	MW102	mg/L
Copper	0.025	<	NO	8770-94	MW102	mg/L
Copper	0.025	<	NO	5619-95	MW102	mg/L
Copper	0.025	<	NO	6592-95	MW102	mg/L
Copper	0.025	<	NO	7467-95	MW102	mg/L
Copper	0.025	<	NO	6285-95	MW102	mg/L
Copper	0.025	<	NO	5281-96	MW102	mg/L
Copper	0.1	<	NO	5141-97	MW102	mg/L
Copper	0.01	<	NO	4209-94	MW120	mg/L
Copper	0.01	<	NO	4991-94	MW120	mg/L
Copper	0.01	<	NO	5088-93	MW120	mg/L
Copper	0.01	<	NO	5900-93	MW120	mg/L
Copper	0.01	<	NO	6034-94	MW120	mg/L
Copper	0.01	<	NO	7065-93	MW120	mg/L
Copper	0.025	<	NO	5448-95	MW120	mg/L
Copper	0.025	<	NO	5293-96	MW120	mg/L
Copper	0.025	<	NO	6928-94	MW120	mg/L
Copper	0.1	<	NO	5143-97	MW120	mg/L
Copper	0.013		YES	4864-94	MW121	mg/L
Copper	0.025	<	NO	5452-95	MW121	mg/L
Copper	0.025	<	NO	5500-96	MW121	mg/L
Copper	0.1	<	NO	5144-97	MW121	mg/L
Copper	0.163		YES	5206-93	MW121	mg/L
Copper	0.01	<	NO	5246-93	MW122	mg/L
Copper	0.01	<	NO	4866-94	MW122	mg/L
Copper	0.025	<	NO	5456-95	MW122	mg/L
Copper	0.025	<	NO	6596-95	MW122	mg/L
Copper	0.025	<	NO	5301-96	MW122	mg/L
Copper	0.1	<	NO	5145-97	MW122	mg/L
Copper	0.01	<	NO	5282-93	MW133	mg/L
Copper	0.01	<	NO	4761-94	MW133	mg/L
Copper	0.025	<	NO	5480-95	MW133	mg/L
Copper	0.01	<	NO	6004-93	MW140	mg/L
Copper	0.01	<	NO	6088-93	MW140	mg/L
Copper	0.01	<	NO	4225-94	MW140	mg/L
Copper	0.01	<	NO	5195-94	MW140	mg/L
Copper	0.01	<	NO	8050-94	MW140	mg/L
Copper	0.013		YES	7081-93	MW140	mg/L
Copper	0.025	<	NO	6664-94	MW140	mg/L
Copper	0.025	<	NO	5313-96	MW140	mg/L
Copper	0.1	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Copper							
	0.01	0.01	0.013	0.01	0.01	0.01		
	0.01	0.01	0.013	0.01	0.01	0.01		
	0.01	0.01	0.013	0.025	0.025	0.01		
	0.01	0.01	0.013	0.025		0.01		
	0.016	0.01	0.013	0.025		0.01		
	0.02	0.01		0.1		0.013		
	0.02	0.025				0.013		
	0.02	0.025				0.013		
	0.02	0.025				0.013		
	0.02	0.1						
	0.02							
	0.02							
	0.02							
Min	0.010	0.010	0.013	0.010	0.010	0.010	0.010	
Max	0.020	0.100	0.013	0.100	0.025	0.013	0.100	
Average	0.017	0.024	0.013	0.033	0.015	0.011	0.019	0.019
Number	13	10	5	6	3	9	46	



MW 102 - Seven nondetects with values greater than maximum detected value reduced to maximum detected value.

MW 120 - Data were not modified.

MW 121 - Turbidity/total solids impacted result of detected value; detected value reduced to next greatest detected value; three nondetect values greater than maximum detected concentration reduced to maximum detected concentration.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

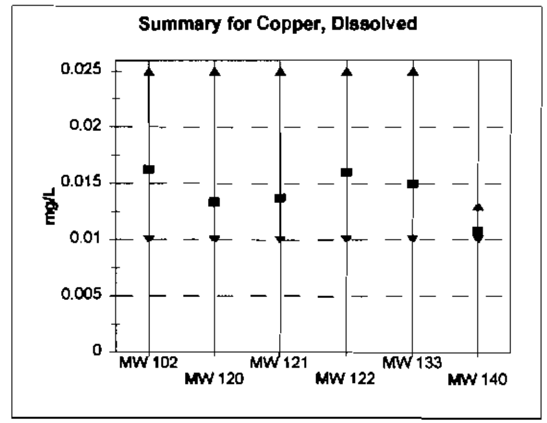
MW 140 - Three nondetects greater than maximum detected value set to maximum detected value.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Copper, Dissolved	0.01	<	NO	5174-93	MW102	mg/L
Copper, Dissolved	0.01	<	NO	5940-93	MW102	mg/L
Copper, Dissolved	0.01	<	NO	7295-93	MW102	mg/L
Copper, Dissolved	0.01	<	NO	4268-94	MW102	mg/L
Copper, Dissolved	0.01	<	NO	5183-94	MW102	mg/L
Copper, Dissolved	0.01	<	NO	6022-94	MW102	mg/L
Copper, Dissolved	0.025	<	NO	6770-94	MW102	mg/L
Copper, Dissolved	0.025	<	NO	5619-95	MW102	mg/L
Copper, Dissolved	0.025	<	NO	6592-95	MW102	mg/L
Copper, Dissolved	0.025	<	NO	7467-95	MW102	mg/L
Copper, Dissolved	0.025	<	NO	8265-95	MW102	mg/L
Copper, Dissolved		Q	NO	5261-96	MW102	
Copper, Dissolved	0.01	<	NO	4209-94	MW120	mg/L
Copper, Dissolved	0.01	<	NO	4991-94	MW120	mg/L
Copper, Dissolved	0.01	<	NO	5068-93	MW120	mg/L
Copper, Dissolved	0.01	<	NO	5900-93	MW120	mg/L
Copper, Dissolved	0.01	<	NO	6034-94	MW120	mg/L
Copper, Dissolved	0.01	<	NO	7065-93	MW120	mg/L
Copper, Dissolved	0.025	<	NO	5446-95	MW120	mg/L
Copper, Dissolved	0.025	<	NO	6926-94	MW120	mg/L
Copper, Dissolved		Q	NO	5293-96	MW120	
Copper, Dissolved	0.01	<	NO	5206-93	MW121	mg/L
Copper, Dissolved	0.01	<	NO	4664-94	MW121	mg/L
Copper, Dissolved	0.025	<	NO	5452-95	MW121	mg/L
Copper, Dissolved		Q	NO	5500-96	MW121	
Copper, Dissolved	0.01	<	NO	5246-93	MW122	mg/L
Copper, Dissolved	0.01	<	NO	4668-94	MW122	mg/L
Copper, Dissolved	0.025	<	NO	5456-95	MW122	mg/L
Copper, Dissolved	0.025	<	NO	6596-95	MW122	mg/L
Copper, Dissolved		Q	NO	5301-96	MW122	
Copper, Dissolved	0.01	<	NO	5262-93	MW133	mg/L
Copper, Dissolved	0.01	<	NO	4761-94	MW133	mg/L
Copper, Dissolved	0.025	<	NO	5460-95	MW133	mg/L
Copper, Dissolved	0.01	<	NO	6004-93	MW140	mg/L
Copper, Dissolved	0.01	<	NO	8068-93	MW140	mg/L
Copper, Dissolved	0.01	<	NO	4225-94	MW140	mg/L
Copper, Dissolved	0.01	<	NO	5195-94	MW140	mg/L
Copper, Dissolved	0.01	<	NO	6050-94	MW140	mg/L
Copper, Dissolved	0.013		YES	7061-93	MW140	mg/L
Copper, Dissolved	0.025	<	NO	6864-94	MW140	mg/L
Copper, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Copper, Dissolved							
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.01	0.01	0.01	0.01		
	0.01	0.01	0.025	0.025	0.025	0.01		
	0.01	0.01	0.01	0.025		0.01		
	0.01	0.01		0.01		0.01		
	0.01	0.01				0.013		
	0.025	0.025				0.013		
	0.025	0.025				0.01		
	0.025	0.01						
	0.025							
	0.025							
	0.01							
Min	0.010	0.010	0.010	0.010	0.010	0.010	0.010	
Max	0.025	0.025	0.025	0.025	0.025	0.013	0.025	
Average	0.016	0.013	0.014	0.016	0.015	0.011	0.014	0.014
Number	12	9	4	5	3	8	41	



MW 102 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 121 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

Mw 122 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 133 - Data were not modified.

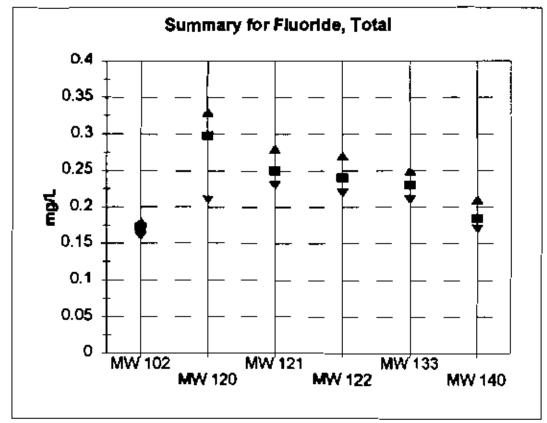
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well; one nondetected result with a concentration greater then the maximum detected concentration reduced to maximum detected concentration

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Fluoride	0.16		YES	7295-93	MW102	mg/L
Fluoride	0.16		YES	5281-96	MW102	mg/L
Fluoride	0.17		YES	5183-94	MW102	mg/L
Fluoride	0.17		YES	6022-94	MW102	mg/L
Fluoride	0.17		YES	6592-95	MW102	mg/L
Fluoride	0.17		YES	7467-95	MW102	mg/L
Fluoride	0.18		YES	5940-93	MW102	mg/L
Fluoride	0.18		YES	4268-94	MW102	mg/L
Fluoride	0.18		YES	6770-94	MW102	mg/L
Fluoride	0.18		YES	5619-95	MW102	mg/L
Fluoride	0.18		YES	8285-95	MW102	mg/L
Fluoride	0.21		YES	4209-94	MW120	mg/L
Fluoride	0.28		YES	7065-93	MW120	mg/L
Fluoride	0.29		YES	5068-93	MW120	mg/L
Fluoride	0.31		YES	4991-94	MW120	mg/L
Fluoride	0.31		YES	5900-93	MW120	mg/L
Fluoride	0.31		YES	8928-94	MW120	mg/L
Fluoride	0.32		YES	5448-95	MW120	mg/L
Fluoride	0.32		YES	5293-96	MW120	mg/L
Fluoride	0.33		YES	6034-94	MW120	mg/L
Fluoride	0.23		YES	5500-96	MW121	mg/L
Fluoride	0.24		YES	4864-94	MW121	mg/L
Fluoride	0.28		YES	5452-95	MW121	mg/L
Fluoride	0.22		YES	5301-96	MW122	mg/L
Fluoride	0.23		YES	5246-93	MW122	mg/L
Fluoride	0.24		YES	4868-94	MW122	mg/L
Fluoride	0.24		YES	6596-95	MW122	mg/L
Fluoride	0.27		YES	5456-95	MW122	mg/L
Fluoride	0.21		YES	4761-94	MW133	mg/L
Fluoride	0.23		YES	5282-93	MW133	mg/L
Fluoride	0.25		YES	5460-95	MW133	mg/L
Fluoride	0.17		YES	5313-98	MW140	mg/L
Fluoride	0.18		YES	6088-93	MW140	mg/L
Fluoride	0.16		YES	4225-94	MW140	mg/L
Fluoride	0.16		YES	5195-94	MW140	mg/L
Fluoride	0.18		YES	6864-94	MW140	mg/L
Fluoride	0.19		YES	6050-94	MW140	mg/L
Fluoride	0.21		YES	7081-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Fluoride							
	0.16	0.21	0.23	0.22	0.21	0.17		
	0.16	0.28	0.24	0.23	0.23	0.18		
	0.17	0.29	0.28	0.24	0.25	0.18		
	0.17	0.31		0.24		0.18		
	0.17	0.31		0.27		0.18		
	0.17	0.31				0.19		
	0.18	0.32				0.21		
	0.18	0.32						
	0.18	0.33						
	0.18							
	0.18							
Min	0.160	0.210	0.230	0.220	0.210	0.170	0.160	
Max	0.180	0.330	0.280	0.270	0.250	0.210	0.330	
Average	0.173	0.298	0.250	0.240	0.230	0.184	0.224	0.229
Number	11	9	3	5	3	7	38	



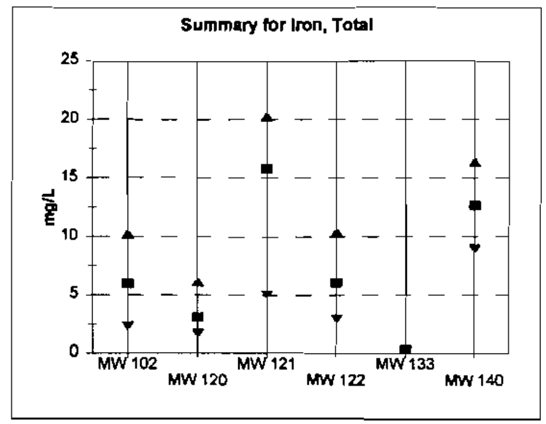
Data for Fluoride, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Iron	2.34	*	YES	8285-95	MW102	mg/L
Iron	3.38	N	YES	5619-95	MW102	mg/L
Iron	3.85	N	YES	5281-96	MW102	mg/L
Iron	4.33		YES	4266-94	MW102	mg/L
Iron	4.66		YES	6770-94	MW102	mg/L
Iron	5.5		YES	6592-95	MW102	mg/L
Iron	5.66		YES	7295-93	MW102	mg/L
Iron	5.86	N	YES	7467-95	MW102	mg/L
Iron	7.01		YES	5174-93	MW102	mg/L
Iron	7.31		YES	6022-94	MW102	mg/L
Iron	7.32		YES	5940-93	MW102	mg/L
Iron	9.91	N	YES	5141-97	MW102	mg/L
Iron	10.2		YES	5183-94	MW102	mg/L
Iron	1.68		YES	6034-94	MW120	mg/L
Iron	1.94		YES	4209-94	MW120	mg/L
Iron	2.37		YES	4991-94	MW120	mg/L
Iron	2.49		YES	5900-93	MW120	mg/L
Iron	2.49		YES	6926-94	MW120	mg/L
Iron	2.59		YES	5068-93	MW120	mg/L
Iron	3.02		YES	7065-93	MW120	mg/L
Iron	3.86	B	YES	5293-96	MW120	mg/L
Iron	4.26		YES	5446-95	MW120	mg/L
Iron	6.14	N	YES	5143-97	MW120	mg/L
Iron	5.04	N	YES	5144-97	MW121	mg/L
Iron	15		YES	5452-95	MW121	mg/L
Iron	18.5		YES	4864-94	MW121	mg/L
Iron	20.3		YES	5500-96	MW121	mg/L
Iron	178.6		YES	5206-93	MW121	mg/L
Iron	2.95		YES	5248-93	MW122	mg/L
Iron	3.62		YES	4668-94	MW122	mg/L
Iron	5.6		YES	5456-95	MW122	mg/L
Iron	6.7		YES	6596-95	MW122	mg/L
Iron	7.27	N	YES	5301-96	MW122	mg/L
Iron	10.4	N	YES	5145-97	MW122	mg/L
Iron	0.222		YES	4761-94	MW133	mg/L
Iron	0.36	<	NO	5460-95	MW133	mg/L
Iron	0.401		YES	5282-93	MW133	mg/L
Iron	8.94		YES	4225-94	MW140	mg/L
Iron	11.3	N	YES	7081-93	MW140	mg/L
Iron	11.48		YES	6004-93	MW140	mg/L
Iron	11.7		YES	5195-94	MW140	mg/L
Iron	12		YES	6664-94	MW140	mg/L
Iron	13.4		YES	6068-93	MW140	mg/L
Iron	13.66		YES	6050-94	MW140	mg/L
Iron	15.2	N	YES	5146-97	MW140	mg/L
Iron	16.4	N	YES	5313-96	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Iron							
	2.34	1.68	5.04	2.95	0.222	8.94		
	3.38	1.94	15	3.62	0.36	11.3		
	3.85	2.37	18.5	5.6	0.401	11.48		
	4.33	2.49	20.3	6.7		11.7		
	4.66	2.49	20.3	7.27		12		
	5.5	2.59		10.4		13.4		
	5.66	3.02				13.66		
	5.86	3.86				15.2		
	7.01	4.26				16.4		
	7.31	6.14						
	7.32							
	9.91							
	10.2							
Min	2.340	1.680	5.040	2.950	0.222	8.940	0.222	
Max	10.200	6.140	20.300	10.400	0.401	16.400	20.300	
Average	5.950	3.066	15.626	6.090	0.328	12.676	7.369	7.326
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Turbidity/total solids impacted result of detected value; detected value reduced to next greatest detected concentration.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

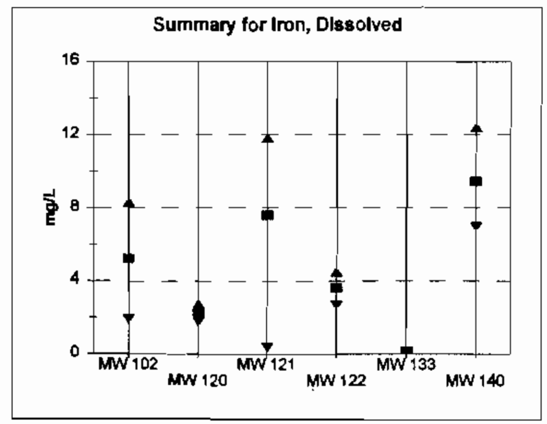
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Iron, Dissolved	1.91		YES	6265-95	MW102	mg/L
Iron, Dissolved	3.2	N	YES	5819-95	MW102	mg/L
Iron, Dissolved	3.32	N	YES	5261-96	MW102	mg/L
Iron, Dissolved	4.54		YES	6770-94	MW102	mg/L
Iron, Dissolved	5.03	N	YES	6592-95	MW102	mg/L
Iron, Dissolved	5.18		YES	7467-95	MW102	mg/L
Iron, Dissolved	5.24		YES	7295-93	MW102	mg/L
Iron, Dissolved	5.37		YES	4268-94	MW102	mg/L
Iron, Dissolved	6.59		YES	8022-94	MW102	mg/L
Iron, Dissolved	6.84		YES	5174-93	MW102	mg/L
Iron, Dissolved	7.06		YES	5940-93	MW102	mg/L
Iron, Dissolved	8.31		YES	5163-94	MW102	mg/L
Iron, Dissolved	1.75		YES	8034-94	MW120	mg/L
Iron, Dissolved	1.86		YES	4991-94	MW120	mg/L
Iron, Dissolved	1.98		YES	7065-93	MW120	mg/L
Iron, Dissolved	2		YES	4209-94	MW120	mg/L
Iron, Dissolved	2.2		YES	5068-93	MW120	mg/L
Iron, Dissolved	2.4		YES	6926-94	MW120	mg/L
Iron, Dissolved	2.49		YES	5900-93	MW120	mg/L
Iron, Dissolved	2.56		YES	5446-95	MW120	mg/L
Iron, Dissolved	2.72	N	YES	5293-96	MW120	mg/L
Iron, Dissolved	0.355	<	NO	5452-95	MW121	mg/L
Iron, Dissolved	8.52		YES	5206-93	MW121	mg/L
Iron, Dissolved	9.66	N	YES	5500-96	MW121	mg/L
Iron, Dissolved	11.6		YES	4864-94	MW121	mg/L
Iron, Dissolved	2.66		YES	5246-93	MW122	mg/L
Iron, Dissolved	3.22	N	YES	5301-96	MW122	mg/L
Iron, Dissolved	3.37		YES	4666-94	MW122	mg/L
Iron, Dissolved	4.36		YES	5458-95	MW122	mg/L
Iron, Dissolved	4.5		YES	8596-95	MW122	mg/L
Iron, Dissolved	0.024		YES	4761-94	MW133	mg/L
Iron, Dissolved	0.235		YES	5282-93	MW133	mg/L
Iron, Dissolved	0.36	<	NO	5460-95	MW133	mg/L
Iron, Dissolved	6.96		YES	6088-93	MW140	mg/L
Iron, Dissolved	7.66		YES	6004-93	MW140	mg/L
Iron, Dissolved	8.25		YES	7061-93	MW140	mg/L
Iron, Dissolved	9.07		YES	4225-94	MW140	mg/L
Iron, Dissolved	9.29		YES	5195-94	MW140	mg/L
Iron, Dissolved	10.94		YES	8050-94	MW140	mg/L
Iron, Dissolved	11		YES	6664-94	MW140	mg/L
Iron, Dissolved	12.4	N	YES	5313-96	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Iron, Dissolved							
	1.91	1.75	0.355	2.66	0.024	6.96		
	3.2	1.86	8.52	3.22	0.235	7.66		
	3.32	1.98	9.66	3.37	0.235	8.25		
	4.54	2	11.6	4.36		9.07		
	5.03	2.2		4.5		9.29		
	5.18	2.4				10.94		
	5.24	2.49				11		
	5.37	2.56				12.4		
	6.59	2.72						
	6.84							
	7.06							
	6.31							
Min	1.910	1.750	0.355	2.660	0.024	6.960	0.024	
Max	8.310	2.720	11.600	4.500	0.235	12.400	12.400	
Average	5.216	2.220	7.589	3.626	0.165	9.446	5.052	4.710
Number	12	9	4	5	3	8	41	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - One nondetect value greater than maximum detected value reduced to maximum detected value.

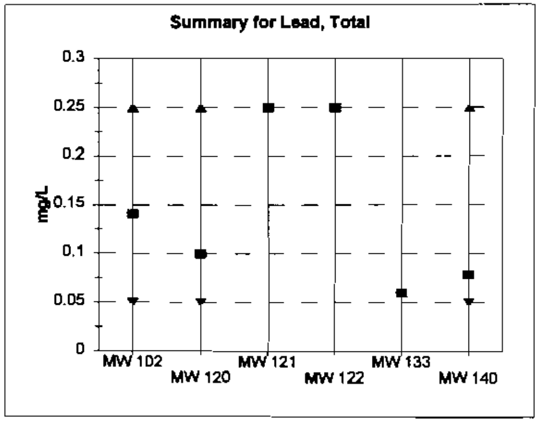
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Lead	0.05	<	NO	5174-93	MW102	mg/L
Lead	0.05	<	NO	5940-93	MW102	mg/L
Lead	0.05	<	NO	7295-93	MW102	mg/L
Lead	0.05	<	NO	4268-94	MW102	mg/L
Lead	0.05	<	NO	5183-94	MW102	mg/L
Lead	0.05	<	NO	6022-94	MW102	mg/L
Lead	0.25	<	NO	6770-94	MW102	mg/L
Lead	0.25	<	NO	5819-95	MW102	mg/L
Lead	0.25	<	NO	6592-95	MW102	mg/L
Lead	0.25	<	NO	7467-95	MW102	mg/L
Lead	0.25	<	NO	8285-95	MW102	mg/L
Lead	0.05	<	NO	4209-94	MW120	mg/L
Lead	0.05	<	NO	4991-94	MW120	mg/L
Lead	0.05	<	NO	5088-93	MW120	mg/L
Lead	0.05	<	NO	5900-93	MW120	mg/L
Lead	0.05	<	NO	8034-94	MW120	mg/L
Lead	0.05	<	NO	7065-93	MW120	mg/L
Lead	0.25	<	NO	5448-95	MW120	mg/L
Lead	0.25	<	NO	6928-94	MW120	mg/L
Lead	0.25	<	NO	5452-95	MW121	mg/L
Lead	0.25	<	NO	5456-95	MW122	mg/L
Lead	0.25	<	NO	8598-95	MW122	mg/L
Lead	0.06	<	NO	5460-95	MW133	mg/L
Lead	0.05	<	NO	6004-93	MW140	mg/L
Lead	0.05	<	NO	8088-93	MW140	mg/L
Lead	0.05	<	NO	7081-93	MW140	mg/L
Lead	0.05	<	NO	4225-94	MW140	mg/L
Lead	0.05	<	NO	5195-94	MW140	mg/L
Lead	0.05	<	NO	6050-94	MW140	mg/L
Lead	0.25	<	NO	8884-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Lead							
	0.05	0.05	0.25	0.25	0.06	0.05		
	0.05	0.05		0.25		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.25	0.25				0.25		
	0.25	0.25						
	0.25							
	0.25							
	0.25							
Min	0.050	0.050	0.250	0.250	0.060	0.050	0.050	
Max	0.250	0.250	0.250	0.250	0.060	0.250	0.250	
Average	0.141	0.100	0.250	0.250	0.060	0.079	0.124	0.147
Number	11	8	1	2	1	7	30	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

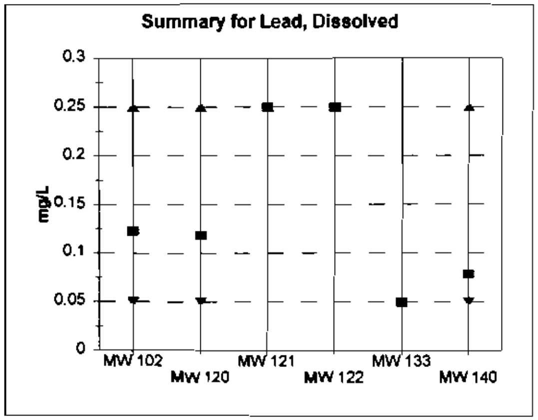
Data for Lead, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Lead, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Lead, Dissolved	0.05	<	NO	7295-93	MW102	mg/L
Lead, Dissolved	0.05	<	NO	4268-94	MW102	mg/L
Lead, Dissolved	0.05	<	NO	5183-94	MW102	mg/L
Lead, Dissolved	0.05	<	NO	8022-94	MW102	mg/L
Lead, Dissolved	0.25	<	NO	8770-94	MW102	mg/L
Lead, Dissolved	0.25	<	NO	5619-95	MW102	mg/L
Lead, Dissolved	0.25	<	NO	6592-95	MW102	mg/L
Lead, Dissolved	0.25	<	NO	7467-95	MW102	mg/L
Lead, Dissolved		Q	NO	5940-93	MW102	
Lead, Dissolved		Q	NO	8285-95	MW102	
Lead, Dissolved	0.05	<	NO	4209-94	MW120	mg/L
Lead, Dissolved	0.05	<	NO	4991-94	MW120	mg/L
Lead, Dissolved	0.05	<	NO	5066-93	MW120	mg/L
Lead, Dissolved	0.05	<	NO	6034-94	MW120	mg/L
Lead, Dissolved	0.05	<	NO	7065-93	MW120	mg/L
Lead, Dissolved	0.2	<	NO	5900-93	MW120	mg/L
Lead, Dissolved	0.25	<	NO	5446-95	MW120	mg/L
Lead, Dissolved	0.25	<	NO	8928-94	MW120	mg/L
Lead, Dissolved	0.25	<	NO	5452-95	MW121	mg/L
Lead, Dissolved	0.25	<	NO	5456-95	MW122	mg/L
Lead, Dissolved	0.25	<	NO	6596-95	MW122	mg/L
Lead, Dissolved		Q	NO	5460-95	MW133	
Lead, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Lead, Dissolved	0.05	<	NO	7081-93	MW140	mg/L
Lead, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Lead, Dissolved	0.05	<	NO	5195-94	MW140	mg/L
Lead, Dissolved	0.25	<	NO	8864-94	MW140	mg/L
Lead, Dissolved		Q	NO	6066-93	MW140	
Lead, Dissolved		Q	NO	6050-94	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Lead, Dissolved							
	0.05	0.05	0.25	0.25	0.05	0.05		
	0.05	0.05		0.25		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.25		
	0.25	0.2				0.05		
	0.25	0.25				0.05		
	0.25	0.25						
	0.25							
	0.05							
	0.05							
Min	0.050	0.050	0.250	0.250	0.050	0.050	0.050	
Max	0.250	0.250	0.250	0.250	0.050	0.250	0.250	
Average	0.123	0.119	0.250	0.250	0.050	0.079	0.122	0.145
Number	11	8	1	2	1	7	30	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

MW 102 - Two "Q" qualified results assigned minimum detection limit for samples from this well.

MW 120 - Data were not modified.

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - "O" qualified result assigned minimum detection limit across all wells

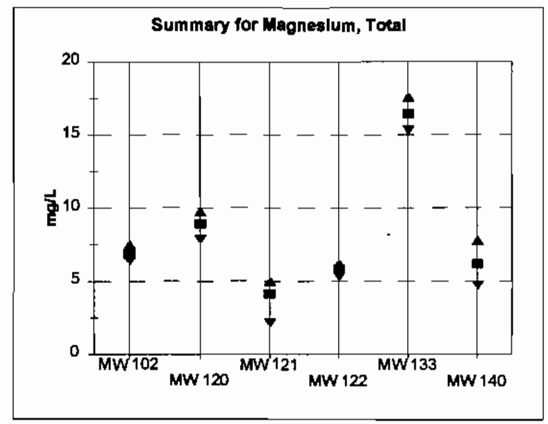
MW 140 - Two "Q" qualified results assigned minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Magnesium	6.4		YES	5174-93	MW102	mg/L
Magnesium	6.4		YES	7295-93	MW102	mg/L
Magnesium	6.54		YES	5183-94	MW102	mg/L
Magnesium	6.61		YES	4288-94	MW102	mg/L
Magnesium	6.69	N	YES	5141-97	MW102	mg/L
Magnesium	6.75		YES	6022-94	MW102	mg/L
Magnesium	6.8		YES	5940-93	MW102	mg/L
Magnesium	6.89		YES	6592-95	MW102	mg/L
Magnesium	7		YES	5619-95	MW102	mg/L
Magnesium	7.02	N	YES	7467-95	MW102	mg/L
Magnesium	7.08		YES	6770-94	MW102	mg/L
Magnesium	7.09	N	YES	8285-95	MW102	mg/L
Magnesium	7.51	N	YES	5281-96	MW102	mg/L
Magnesium	7.84		YES	6034-94	MW120	mg/L
Magnesium	8.43		YES	4209-94	MW120	mg/L
Magnesium	8.66		YES	7065-93	MW120	mg/L
Magnesium	8.74		YES	5088-93	MW120	mg/L
Magnesium	9.02	N	YES	5143-97	MW120	mg/L
Magnesium	9.02		YES	6926-94	MW120	mg/L
Magnesium	9.17		YES	4991-94	MW120	mg/L
Magnesium	9.18		YES	5900-93	MW120	mg/L
Magnesium	9.7		YES	5448-95	MW120	mg/L
Magnesium	9.76		YES	5293-96	MW120	mg/L
Magnesium	2.14	N	YES	5144-97	MW121	mg/L
Magnesium	4		YES	4864-94	MW121	mg/L
Magnesium	4.59		YES	5500-96	MW121	mg/L
Magnesium	5		YES	5452-95	MW121	mg/L
Magnesium	21.6		YES	5206-93	MW121	mg/L
Magnesium	5.31		YES	5246-93	MW122	mg/L
Magnesium	5.66	N	YES	5145-97	MW122	mg/L
Magnesium	5.67		YES	4868-94	MW122	mg/L
Magnesium	5.9		YES	6596-95	MW122	mg/L
Magnesium	6.16	N	YES	5301-96	MW122	mg/L
Magnesium	6.2		YES	5458-95	MW122	mg/L
Magnesium	15.3		YES	5460-95	MW133	mg/L
Magnesium	16.47		YES	5262-93	MW133	mg/L
Magnesium	17.6		YES	4761-94	MW133	mg/L
Magnesium	4.68		YES	5195-94	MW140	mg/L
Magnesium	5.02	N	YES	5148-97	MW140	mg/L
Magnesium	5.72		YES	7061-93	MW140	mg/L
Magnesium	6.11		YES	4225-94	MW140	mg/L
Magnesium	6.14		YES	6004-93	MW140	mg/L
Magnesium	6.2		YES	6884-94	MW140	mg/L
Magnesium	6.52	N	YES	5313-96	MW140	mg/L
Magnesium	7.23		YES	6088-93	MW140	mg/L
Magnesium	7.79		YES	6050-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Magnesium							
	6.4	7.84	2.14	5.31	15.3	4.68		
	6.4	8.43	4	5.66	16.47	5.02		
	6.54	8.66	4.59	5.67	17.6	5.72		
	6.61	8.74	5	5.9		6.11		
	6.69	9.02	5	6.16		6.14		
	6.75	9.02		6.2		6.2		
	6.8	9.17				6.52		
	6.89	9.18				7.23		
	7	9.7				7.79		
	7.02	9.76						
	7.08							
	7.09							
	7.51							
Min	6.400	7.840	2.140	5.310	15.300	4.680	2.140	
Max	7.510	9.760	5.000	6.200	17.600	7.790	17.600	
Average	6.829	8.952	4.146	5.817	16.457	6.157	7.363	6.060
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Maximum detected value impacted by turbidity of sample. Value reduced to next greatest detected value.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

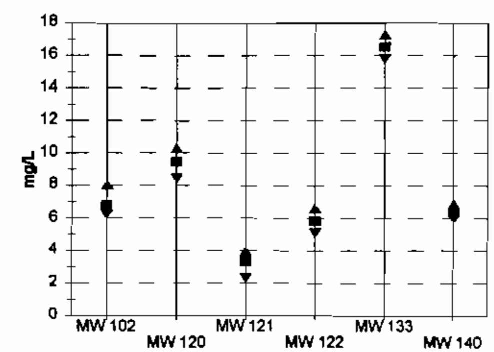
MW 140 - Data were not modified.

Summary of McNalry Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Magnesium, Dissolved	6.23	N	YES	7467-95	MW102	mg/L
Magnesium, Dissolved	6.49		YES	7295-93	MW102	mg/L
Magnesium, Dissolved	6.51		YES	5174-93	MW102	mg/L
Magnesium, Dissolved	6.53	N	YES	6592-95	MW102	mg/L
Magnesium, Dissolved	6.56	N	YES	8285-95	MW102	mg/L
Magnesium, Dissolved	6.56	N	YES	5281-98	MW102	mg/L
Magnesium, Dissolved	6.73		YES	5940-93	MW102	mg/L
Magnesium, Dissolved	6.74		YES	5183-94	MW102	mg/L
Magnesium, Dissolved	6.9		YES	5619-95	MW102	mg/L
Magnesium, Dissolved	7.11		YES	4268-94	MW102	mg/L
Magnesium, Dissolved	7.32		YES	8770-94	MW102	mg/L
Magnesium, Dissolved	6.06		YES	6022-94	MW102	mg/L
Magnesium, Dissolved	6.46		YES	5068-93	MW120	mg/L
Magnesium, Dissolved	9.04		YES	5900-93	MW120	mg/L
Magnesium, Dissolved	9.09		YES	4209-94	MW120	mg/L
Magnesium, Dissolved	9.24	N	YES	5293-96	MW120	mg/L
Magnesium, Dissolved	9.45		YES	7065-93	MW120	mg/L
Magnesium, Dissolved	9.61		YES	4991-94	MW120	mg/L
Magnesium, Dissolved	9.73		YES	6034-94	MW120	mg/L
Magnesium, Dissolved	10		YES	6928-94	MW120	mg/L
Magnesium, Dissolved	10.3		YES	5448-95	MW120	mg/L
Magnesium, Dissolved	2.3		YES	5452-95	MW121	mg/L
Magnesium, Dissolved	3.41	N	YES	5500-96	MW121	mg/L
Magnesium, Dissolved	3.72		YES	4864-94	MW121	mg/L
Magnesium, Dissolved	3.96		YES	5206-93	MW121	mg/L
Magnesium, Dissolved	5.1		YES	5246-93	MW122	mg/L
Magnesium, Dissolved	5.45	N	YES	5301-96	MW122	mg/L
Magnesium, Dissolved	5.8		YES	6596-95	MW122	mg/L
Magnesium, Dissolved	6.15		YES	4888-94	MW122	mg/L
Magnesium, Dissolved	6.6		YES	5456-95	MW122	mg/L
Magnesium, Dissolved	15.8		YES	5282-93	MW133	mg/L
Magnesium, Dissolved	16.5		YES	5460-95	MW133	mg/L
Magnesium, Dissolved	17.3		YES	4761-94	MW133	mg/L
Magnesium, Dissolved	5.97		YES	5195-94	MW140	mg/L
Magnesium, Dissolved	6.01		YES	7081-93	MW140	mg/L
Magnesium, Dissolved	6.08	N	YES	5313-96	MW140	mg/L
Magnesium, Dissolved	6.11		YES	6004-93	MW140	mg/L
Magnesium, Dissolved	6.3		YES	4225-94	MW140	mg/L
Magnesium, Dissolved	6.66		YES	8050-94	MW140	mg/L
Magnesium, Dissolved	6.8		YES	6664-94	MW140	mg/L
Magnesium, Dissolved	6.66		YES	8088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Magnesium, Dissolved							
	6.23	8.46	2.3	5.1	15.8	5.97		
	6.49	9.04	3.41	5.45	16.5	6.01		
	6.51	9.09	3.72	5.8	17.3	6.08		
	6.53	9.24	3.96	6.15		6.11		
	6.58	9.45		6.6		6.3		
	6.56	9.61				6.66		
	8.73	9.73				6.8		
	8.74	10				6.66		
	6.9	10.3						
	7.11							
	7.32							
	8.06							
Min	6.230	8.460	2.300	5.100	15.800	5.970	2.300	
Max	6.060	10.300	3.960	6.800	17.300	6.860	17.300	
Average	6.612	9.436	3.348	5.820	16.533	6.349	7.550	8.049
Number	12	9	4	5	3	8	41	



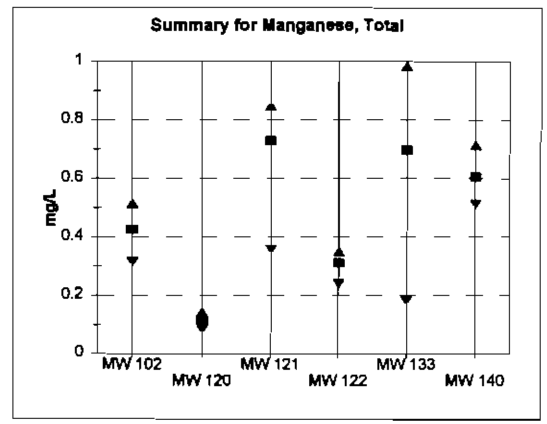
Data for Magnesium, Dissolved were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Manganese	0.314		YES	8285-95	MW102	mg/L
Manganese	0.33		YES	5619-95	MW102	mg/L
Manganese	0.367		YES	7467-95	MW102	mg/L
Manganese	0.37		YES	6592-95	MW102	mg/L
Manganese	0.404		YES	5281-96	MW102	mg/L
Manganese	0.423		YES	6022-94	MW102	mg/L
Manganese	0.427		YES	6770-94	MW102	mg/L
Manganese	0.436		YES	4268-94	MW102	mg/L
Manganese	0.456		YES	7295-93	MW102	mg/L
Manganese	0.486		YES	5183-94	MW102	mg/L
Manganese	0.491		YES	5174-93	MW102	mg/L
Manganese	0.51		YES	5141-97	MW102	mg/L
Manganese	0.514		YES	5940-93	MW102	mg/L
Manganese	0.082		YES	6034-94	MW120	mg/L
Manganese	0.102		YES	7065-93	MW120	mg/L
Manganese	0.103		YES	5900-93	MW120	mg/L
Manganese	0.104		YES	4209-94	MW120	mg/L
Manganese	0.111		YES	6928-94	MW120	mg/L
Manganese	0.113		YES	4991-94	MW120	mg/L
Manganese	0.117		YES	5088-93	MW120	mg/L
Manganese	0.12		YES	5448-95	MW120	mg/L
Manganese	0.138		YES	5293-98	MW120	mg/L
Manganese	0.141		YES	5143-97	MW120	mg/L
Manganese	0.357		YES	5144-97	MW121	mg/L
Manganese	0.781		YES	4864-94	MW121	mg/L
Manganese	0.83		YES	5452-95	MW121	mg/L
Manganese	0.848		YES	5500-96	MW121	mg/L
Manganese	3.91		YES	5206-93	MW121	mg/L
Manganese	0.24		YES	5145-97	MW122	mg/L
Manganese	0.282		YES	5301-98	MW122	mg/L
Manganese	0.32		YES	8596-95	MW122	mg/L
Manganese	0.33		YES	5456-95	MW122	mg/L
Manganese	0.347		YES	4888-94	MW122	mg/L
Manganese	0.35		YES	5246-93	MW122	mg/L
Manganese	0.18		YES	5460-95	MW133	mg/L
Manganese	0.924		YES	4781-94	MW133	mg/L
Manganese	0.983		YES	5282-93	MW133	mg/L
Manganese	0.511		YES	5146-97	MW140	mg/L
Manganese	0.55		YES	6864-94	MW140	mg/L
Manganese	0.567		YES	7081-93	MW140	mg/L
Manganese	0.582		YES	4225-94	MW140	mg/L
Manganese	0.6		YES	5195-94	MW140	mg/L
Manganese	0.607		YES	8004-93	MW140	mg/L
Manganese	0.63		YES	5313-96	MW140	mg/L
Manganese	0.682		YES	6088-93	MW140	mg/L
Manganese	0.714		YES	6050-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Manganese							
	0.314	0.082	0.357	0.24	0.18	0.511		
	0.33	0.102	0.761	0.282	0.924	0.55		
	0.367	0.103	0.83	0.32	0.983	0.567		
	0.37	0.104	0.848	0.33		0.582		
	0.404	0.111	0.846	0.347		0.6		
	0.423	0.113		0.35		0.607		
	0.427	0.117				0.63		
	0.436	0.12				0.682		
	0.456	0.138				0.714		
	0.488	0.141						
	0.491							
	0.51							
	0.514							
Min	0.314	0.082	0.357	0.240	0.180	0.511	0.082	
Max	0.514	0.141	0.848	0.350	0.983	0.714	0.963	
Average	0.425	0.113	0.729	0.312	0.696	0.605	0.428	0.480
Number	13	10	5	6	3	9	46	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Maximum detected value impacted by turbidity of sample. Value reduced to next greatest detected value.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

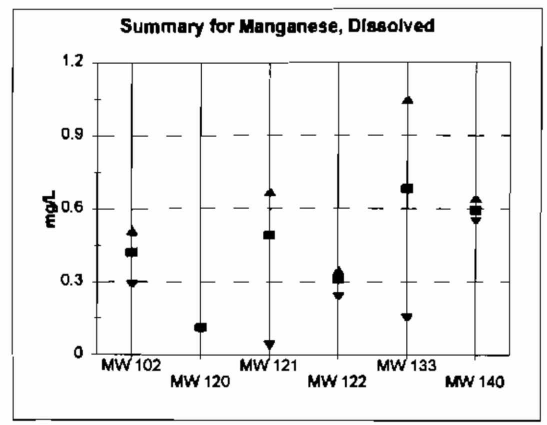
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Manganese, Dissolved	0.287		YES	8285-95	MW102	mg/L
Manganese, Dissolved	0.33		YES	5619-95	MW102	mg/L
Manganese, Dissolved	0.345		YES	6592-95	MW102	mg/L
Manganese, Dissolved	0.345		YES	7467-95	MW102	mg/L
Manganese, Dissolved	0.349		YES	5281-96	MW102	mg/L
Manganese, Dissolved	0.454		YES	6770-94	MW102	mg/L
Manganese, Dissolved	0.462		YES	7295-93	MW102	mg/L
Manganese, Dissolved	0.477		YES	4288-94	MW102	mg/L
Manganese, Dissolved	0.486		YES	6022-94	MW102	mg/L
Manganese, Dissolved	0.5		YES	5183-94	MW102	mg/L
Manganese, Dissolved	0.504		YES	5174-93	MW102	mg/L
Manganese, Dissolved	0.51		YES	5940-93	MW102	mg/L
Manganese, Dissolved	0.103		YES	6034-94	MW120	mg/L
Manganese, Dissolved	0.106		YES	5900-93	MW120	mg/L
Manganese, Dissolved	0.108		YES	4991-94	MW120	mg/L
Manganese, Dissolved	0.11		YES	4209-94	MW120	mg/L
Manganese, Dissolved	0.114		YES	5088-93	MW120	mg/L
Manganese, Dissolved	0.115		YES	7065-93	MW120	mg/L
Manganese, Dissolved	0.119		YES	5293-96	MW120	mg/L
Manganese, Dissolved	0.12		YES	5448-95	MW120	mg/L
Manganese, Dissolved	0.12		YES	6928-94	MW120	mg/L
Manganese, Dissolved	0.04		YES	5452-95	MW121	mg/L
Manganese, Dissolved	0.588		YES	5500-96	MW121	mg/L
Manganese, Dissolved	0.663		YES	5206-93	MW121	mg/L
Manganese, Dissolved	0.671		YES	4864-94	MW121	mg/L
Manganese, Dissolved	0.239		YES	5301-96	MW122	mg/L
Manganese, Dissolved	0.32		YES	8596-95	MW122	mg/L
Manganese, Dissolved	0.325		YES	5246-93	MW122	mg/L
Manganese, Dissolved	0.33		YES	5458-95	MW122	mg/L
Manganese, Dissolved	0.348		YES	4888-94	MW122	mg/L
Manganese, Dissolved	0.15		YES	5460-95	MW133	mg/L
Manganese, Dissolved	0.847		YES	5282-93	MW133	mg/L
Manganese, Dissolved	1.05		YES	4761-94	MW133	mg/L
Manganese, Dissolved	0.547		YES	5195-94	MW140	mg/L
Manganese, Dissolved	0.558		YES	5313-96	MW140	mg/L
Manganese, Dissolved	0.589		YES	7081-93	MW140	mg/L
Manganese, Dissolved	0.595		YES	4225-94	MW140	mg/L
Manganese, Dissolved	0.598		YES	6004-93	MW140	mg/L
Manganese, Dissolved	0.8		YES	8884-94	MW140	mg/L
Manganese, Dissolved	0.808		YES	6050-94	MW140	mg/L
Manganese, Dissolved	0.844		YES	8088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Manganese, Dissolved							
	0.287	0.103	0.04	0.239	0.15	0.547		
	0.33	0.106	0.588	0.32	0.847	0.558		
	0.345	0.108	0.663	0.325	1.05	0.589		
	0.345	0.11	0.671	0.33		0.595		
	0.349	0.114		0.348		0.596		
	0.454	0.115				0.6		
	0.482	0.119				0.808		
	0.477	0.12				0.644		
	0.486	0.12						
	0.5							
	0.504							
	0.51							
Min	0.287	0.103	0.040	0.239	0.150	0.547	0.040	
Max	0.510	0.120	0.671	0.348	1.050	0.644	1.050	
Average	0.421	0.113	0.491	0.312	0.682	0.592	0.399	0.435
Number	12	9	4	5	3	8	41	



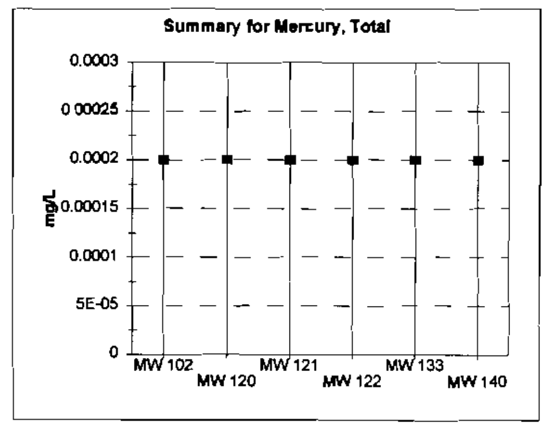
Data for Manganese, Dissolved were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Mercury	0.0002	<	NO	5174-93	MW102	mg/L
Mercury	0.0002	<	NO	5940-93	MW102	mg/L
Mercury	0.0002	<	NO	7295-93	MW102	mg/L
Mercury	0.0002	<	NO	4268-94	MW102	mg/L
Mercury	0.0002	<	NO	5183-94	MW102	mg/L
Mercury	0.0002	<	NO	6022-94	MW102	mg/L
Mercury	0.0002	<	NO	6770-94	MW102	mg/L
Mercury	0.0002	<	NO	5619-95	MW102	mg/L
Mercury	0.0002	<	NO	6592-95	MW102	mg/L
Mercury	0.0002	<	NO	7467-95	MW102	mg/L
Mercury	0.0002	<	NO	8285-95	MW102	mg/L
Mercury	0.0002	<	NO	4209-94	MW120	mg/L
Mercury	0.0002	<	NO	5448-95	MW120	mg/L
Mercury	0.0002	<	NO	4991-94	MW120	mg/L
Mercury	0.0002	<	NO	5088-93	MW120	mg/L
Mercury	0.0002	<	NO	5900-93	MW120	mg/L
Mercury	0.0002	<	NO	8034-94	MW120	mg/L
Mercury	0.0002	<	NO	8928-94	MW120	mg/L
Mercury	0.0002	<	NO	7085-93	MW120	mg/L
Mercury	0.0002	<	NO	5452-95	MW121	mg/L
Mercury	0.0002	<	NO	5456-95	MW122	mg/L
Mercury	0.0002	<	NO	8596-95	MW122	mg/L
Mercury	0.0002	<	NO	5460-95	MW133	mg/L
Mercury	0.0002	<	NO	8004-93	MW140	mg/L
Mercury	0.0002	<	NO	8068-93	MW140	mg/L
Mercury	0.0002	<	NO	7081-93	MW140	mg/L
Mercury	0.0002	<	NO	4225-94	MW140	mg/L
Mercury	0.0002	<	NO	5195-94	MW140	mg/L
Mercury	0.0002	<	NO	8864-94	MW140	mg/L
Mercury	0.0045		YES	6050-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Mercury							
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002		
	0.0002	0.0002		0.0002		0.0002		
	0.0002	0.0002				0.0002		
	0.0002	0.0002				0.0002		
	0.0002	0.0002				0.0002		
	0.0002	0.0002				0.0002		
	0.0002	0.0002				0.0002		
	0.0002	0.0002						
	0.0002							
	0.0002							
	0.0002							
Min	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
Max	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
Average	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Number	11	8	1	2	1	7	30	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified

MW 140 - Maximum detected value is inconsistent with other observations. Reduced to next greatest value.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Mercury, dissolved		Q	NO	5174-93	MW102	
Mercury, Dissolved		Q	NO	5940-93	MW102	
Mercury, Dissolved		Q	NO	7295-93	MW102	
Mercury, Dissolved		Q	NO	4268-94	MW102	
Mercury, Dissolved		Q	NO	5163-94	MW102	
Mercury, Dissolved		Q	NO	6022-94	MW102	
Mercury, Dissolved		Q	NO	6770-94	MW102	
Mercury, Dissolved		Q	NO	5619-95	MW102	
Mercury, Dissolved		Q	NO	6592-95	MW102	
Mercury, Dissolved		Q	NO	7467-95	MW102	
Mercury, Dissolved		Q	NO	6285-95	MW102	
Mercury, Dissolved		Q	NO	4209-94	MW120	
Mercury, Dissolved		Q	NO	5446-95	MW120	
Mercury, Dissolved		Q	NO	4991-94	MW120	
Mercury, dissolved		Q	NO	5068-93	MW120	
Mercury, Dissolved		Q	NO	5900-93	MW120	
Mercury, Dissolved		Q	NO	6034-94	MW120	
Mercury, Dissolved		Q	NO	6928-94	MW120	
Mercury, Dissolved		Q	NO	7065-93	MW120	
Mercury, Dissolved		Q	NO	5452-95	MW121	
Mercury, Dissolved		Q	NO	5456-95	MW122	
Mercury, Dissolved		Q	NO	6598-95	MW122	
Mercury, Dissolved		Q	NO	5460-95	MW133	
Mercury, dissolved		Q	NO	6004-93	MW140	
Mercury, Dissolved		Q	NO	6088-93	MW140	
Mercury, Dissolved		Q	NO	7081-93	MW140	
Mercury, Dissolved		Q	NO	4225-94	MW140	
Mercury, Dissolved		Q	NO	5195-94	MW140	
Mercury, Dissolved		Q	NO	6050-94	MW140	
Mercury, Dissolved		Q	NO	8864-94	MW140	

CORRECTED DATA SET

Mercury, Dissolved

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Number	0	0	0	0	0	0	0	

Mercury, Dissolved

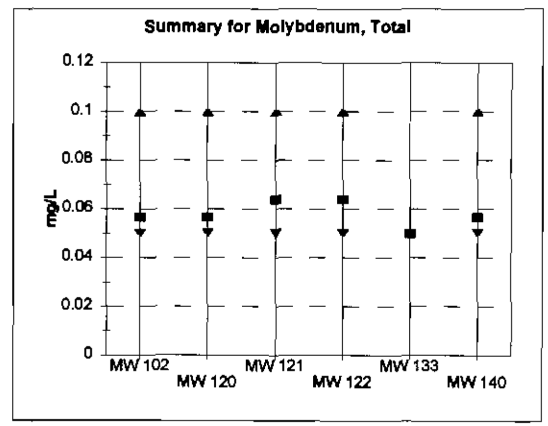
- Analysis for Mercury, Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of mercury in a filtered sample exceeds the background concentration.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Molybdenum	0.05	<	NO	5174-93	MW102	mg/L
Molybdenum	0.05	<	NO	5940-93	MW102	mg/L
Molybdenum	0.05	<	NO	7295-93	MW102	mg/L
Molybdenum	0.05	<	NO	4288-94	MW102	mg/L
Molybdenum	0.05	<	NO	5163-94	MW102	mg/L
Molybdenum	0.05	<	NO	6022-94	MW102	mg/L
Molybdenum	0.055	<	NO	6770-94	MW102	mg/L
Molybdenum	0.055	<	NO	5281-96	MW102	mg/L
Molybdenum	0.1	<	NO	5141-97	MW102	mg/L
Molybdenum	0.05	<	NO	4209-94	MW120	mg/L
Molybdenum	0.05	<	NO	4991-94	MW120	mg/L
Molybdenum	0.05	<	NO	5088-93	MW120	mg/L
Molybdenum	0.05	<	NO	5900-93	MW120	mg/L
Molybdenum	0.05	<	NO	6034-94	MW120	mg/L
Molybdenum	0.05	<	NO	7065-93	MW120	mg/L
Molybdenum	0.055	<	NO	5293-96	MW120	mg/L
Molybdenum	0.055	<	NO	6928-94	MW120	mg/L
Molybdenum	0.1	<	NO	5143-97	MW120	mg/L
Molybdenum	0.05	<	NO	5206-93	MW121	mg/L
Molybdenum	0.05	<	NO	4664-94	MW121	mg/L
Molybdenum	0.055	<	NO	5500-96	MW121	mg/L
Molybdenum	0.1	<	NO	5144-97	MW121	mg/L
Molybdenum	0.05	<	NO	5246-93	MW122	mg/L
Molybdenum	0.05	<	NO	4868-94	MW122	mg/L
Molybdenum	0.055	<	NO	5301-96	MW122	mg/L
Molybdenum	0.1	<	NO	5145-97	MW122	mg/L
Molybdenum	0.05	<	NO	5262-93	MW133	mg/L
Molybdenum	0.05	<	NO	4761-94	MW133	mg/L
Molybdenum	0.05	<	NO	6004-93	MW140	mg/L
Molybdenum	0.05	<	NO	6088-93	MW140	mg/L
Molybdenum	0.05	<	NO	7081-93	MW140	mg/L
Molybdenum	0.05	<	NO	4225-94	MW140	mg/L
Molybdenum	0.05	<	NO	5195-94	MW140	mg/L
Molybdenum	0.05	<	NO	6050-94	MW140	mg/L
Molybdenum	0.055	<	NO	6864-94	MW140	mg/L
Molybdenum	0.055	<	NO	5313-96	MW140	mg/L
Molybdenum	0.1	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Molybdenum							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.055	0.055		0.05		
	0.05	0.05	0.1	0.1		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.055	0.055				0.055		
	0.055	0.055				0.055		
	0.1	0.1				0.1		
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.100	0.100	0.100	0.100	0.050	0.100	0.100	
Average	0.057	0.057	0.064	0.064	0.050	0.057	0.058	0.058
Number	9	9	4	4	2	9	37	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

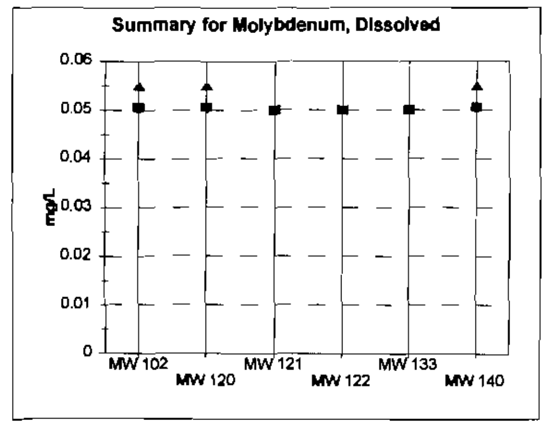
Data for Molybdenum, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Molybdenum, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Molybdenum, Dissolved	0.05	<	NO	7295-93	MW102	mg/L
Molybdenum, Dissolved	0.05	<	NO	4268-94	MW102	mg/L
Molybdenum, Dissolved	0.05	<	NO	5163-94	MW102	mg/L
Molybdenum, Dissolved	0.05	<	NO	6022-94	MW102	mg/L
Molybdenum, Dissolved	0.055	<	NO	6770-94	MW102	mg/L
Molybdenum, Dissolved		Q	NO	5940-93	MW102	
Molybdenum, Dissolved		Q	NO	5281-96	MW102	
Molybdenum, Dissolved	0.05	<	NO	4209-94	MW120	mg/L
Molybdenum, Dissolved	0.05	<	NO	4991-94	MW120	mg/L
Molybdenum, Dissolved	0.05	<	NO	5088-93	MW120	mg/L
Molybdenum, Dissolved	0.05	<	NO	5900-93	MW120	mg/L
Molybdenum, Dissolved	0.05	<	NO	6034-94	MW120	mg/L
Molybdenum, Dissolved	0.05	<	NO	7065-93	MW120	mg/L
Molybdenum, Dissolved	0.055	<	NO	6928-94	MW120	mg/L
Molybdenum, Dissolved		Q	NO	5293-96	MW120	
Molybdenum, Dissolved	0.05	<	NO	5206-93	MW121	mg/L
Molybdenum, Dissolved	0.05	<	NO	4864-94	MW121	mg/L
Molybdenum, Dissolved		Q	NO	5500-96	MW121	
Molybdenum, Dissolved	0.05	<	NO	5246-93	MW122	mg/L
Molybdenum, Dissolved	0.05	<	NO	4888-94	MW122	mg/L
Molybdenum, Dissolved		Q	NO	5301-96	MW122	
Molybdenum, Dissolved	0.05	<	NO	5262-93	MW133	mg/L
Molybdenum, Dissolved	0.05	<	NO	4761-94	MW133	mg/L
Molybdenum, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Molybdenum, Dissolved	0.05	<	NO	7061-93	MW140	mg/L
Molybdenum, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Molybdenum, Dissolved	0.05	<	NO	5195-94	MW140	mg/L
Molybdenum, Dissolved	0.05	<	NO	8050-94	MW140	mg/L
Molybdenum, Dissolved	0.055	<	NO	6864-94	MW140	mg/L
Molybdenum, Dissolved		Q	NO	6088-93	MW140	
Molybdenum, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Molybdenum, Dissolved							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05		0.05		
	0.05	0.05				0.05		
	0.05	0.05				0.05		
	0.055	0.05				0.055		
	0.05	0.055				0.05		
	0.05	0.05				0.05		
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.055	0.055	0.050	0.050	0.050	0.055	0.055	
Average	0.051	0.051	0.050	0.050	0.050	0.051	0.050	0.050
Number	8	8	3	3	2	8	32	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

MW 102 - Two "Q" qualified results assigned minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples from this well

MW 121 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 122 - One "Q" qualified result assigned minimum detection limit for samples from this well

MW 133 - Data were not modified.

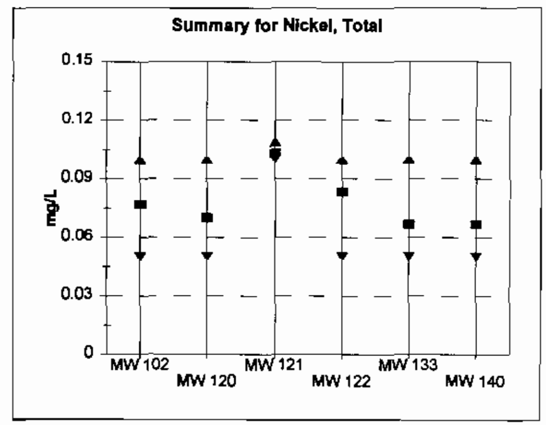
MW 140 - Two "Q" qualified results assigned minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Nickel	0.05	<	NO	5174-93	MW102	mg/L
Nickel	0.05	<	NO	5940-93	MW102	mg/L
Nickel	0.05	<	NO	7295-93	MW102	mg/L
Nickel	0.05	<	NO	4266-94	MW102	mg/L
Nickel	0.05	<	NO	5163-94	MW102	mg/L
Nickel	0.05	<	NO	6022-94	MW102	mg/L
Nickel	0.1	<	NO	6770-94	MW102	mg/L
Nickel	0.1	<	NO	5619-95	MW102	mg/L
Nickel	0.1	<	NO	6592-95	MW102	mg/L
Nickel	0.1	<	NO	7467-95	MW102	mg/L
Nickel	0.1	<	NO	6265-95	MW102	mg/L
Nickel	0.1	<	NO	5261-96	MW102	mg/L
Nickel	0.1	<	NO	5141-97	MW102	mg/L
Nickel	0.05	<	NO	4209-94	MW120	mg/L
Nickel	0.05	<	NO	4991-94	MW120	mg/L
Nickel	0.05	<	NO	5066-93	MW120	mg/L
Nickel	0.05	<	NO	5900-93	MW120	mg/L
Nickel	0.05	<	NO	6034-94	MW120	mg/L
Nickel	0.05	<	NO	7065-93	MW120	mg/L
Nickel	0.1	<	NO	5143-97	MW120	mg/L
Nickel	0.1	<	NO	5446-95	MW120	mg/L
Nickel	0.1	<	NO	5293-96	MW120	mg/L
Nickel	0.1	<	NO	6926-94	MW120	mg/L
Nickel	0.1	<	NO	5452-95	MW121	mg/L
Nickel	0.1	<	NO	5500-96	MW121	mg/L
Nickel	0.1	<	NO	5144-97	MW121	mg/L
Nickel	0.107		YES	5206-93	MW121	mg/L
Nickel	0.109		YES	4664-94	MW121	mg/L
Nickel	0.05	<	NO	5246-93	MW122	mg/L
Nickel	0.05	<	NO	4666-94	MW122	mg/L
Nickel	0.1	<	NO	5456-95	MW122	mg/L
Nickel	0.1	<	NO	6596-95	MW122	mg/L
Nickel	0.1	<	NO	5301-96	MW122	mg/L
Nickel	0.1	<	NO	5145-97	MW122	mg/L
Nickel	0.05	<	NO	5262-93	MW133	mg/L
Nickel	0.05	<	NO	4761-94	MW133	mg/L
Nickel	0.1	<	NO	5460-95	MW133	mg/L
Nickel	0.05	<	NO	6004-93	MW140	mg/L
Nickel	0.05	<	NO	6066-93	MW140	mg/L
Nickel	0.05	<	NO	7061-93	MW140	mg/L
Nickel	0.05	<	NO	4225-94	MW140	mg/L
Nickel	0.05	<	NO	5195-94	MW140	mg/L
Nickel	0.05	<	NO	6050-94	MW140	mg/L
Nickel	0.1	<	NO	6664-94	MW140	mg/L
Nickel	0.1	<	NO	5313-96	MW140	mg/L
Nickel	0.1	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Nickel							
	0.05	0.05	0.1	0.05	0.05	0.05		
	0.05	0.05	0.1	0.05	0.05	0.05		
	0.05	0.05	0.1	0.1	0.1	0.05		
	0.05	0.05	0.107	0.1		0.05		
	0.05	0.05	0.109	0.1		0.05		
	0.05	0.05		0.1		0.05		
	0.1	0.1				0.1		
	0.1	0.1				0.1		
	0.1	0.1				0.1		
	0.1	0.1						
	0.1							
	0.1							
	0.1							
Min	0.050	0.050	0.100	0.050	0.050	0.050	0.050	
Max	0.100	0.100	0.109	0.100	0.100	0.100	0.109	
Average	0.077	0.070	0.103	0.083	0.067	0.067	0.076	0.076
Number	13	10	5	6	3	9	46	



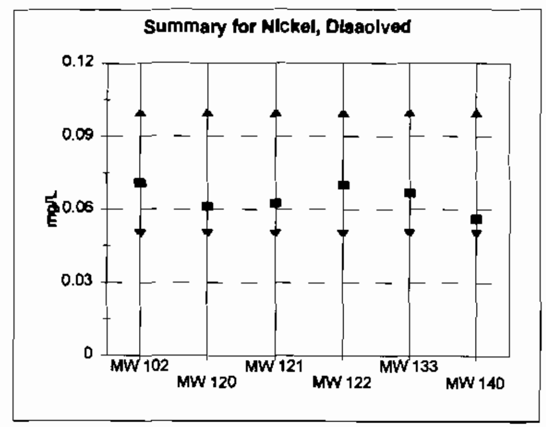
Data for Nickel, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Nickel, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Nickel, Dissolved	0.05	<	NO	5940-93	MW102	mg/L
Nickel, Dissolved	0.05	<	NO	7295-93	MW102	mg/L
Nickel, Dissolved	0.05	<	NO	4268-94	MW102	mg/L
Nickel, Dissolved	0.05	<	NO	5183-94	MW102	mg/L
Nickel, Dissolved	0.05	<	NO	6022-94	MW102	mg/L
Nickel, Dissolved	0.1	<	NO	8770-94	MW102	mg/L
Nickel, Dissolved	0.1	<	NO	5619-95	MW102	mg/L
Nickel, Dissolved	0.1	<	NO	6592-95	MW102	mg/L
Nickel, Dissolved	0.1	<	NO	7467-95	MW102	mg/L
Nickel, Dissolved	0.1	<	NO	8285-95	MW102	mg/L
Nickel, Dissolved		Q	NO	5281-96	MW102	
Nickel, Dissolved	0.05	<	NO	4209-94	MW120	mg/L
Nickel, Dissolved	0.05	<	NO	4991-94	MW120	mg/L
Nickel, Dissolved	0.05	<	NO	5086-93	MW120	mg/L
Nickel, Dissolved	0.05	<	NO	5900-93	MW120	mg/L
Nickel, Dissolved	0.05	<	NO	6034-94	MW120	mg/L
Nickel, Dissolved	0.05	<	NO	7065-93	MW120	mg/L
Nickel, Dissolved	0.1	<	NO	5448-95	MW120	mg/L
Nickel, Dissolved	0.1	<	NO	8928-94	MW120	mg/L
Nickel, Dissolved		Q	NO	5293-96	MW120	
Nickel, Dissolved	0.05	<	NO	5206-93	MW121	mg/L
Nickel, Dissolved	0.05	<	NO	4864-94	MW121	mg/L
Nickel, Dissolved	0.1	<	NO	5452-95	MW121	mg/L
Nickel, Dissolved		Q	NO	5500-96	MW121	
Nickel, Dissolved	0.05	<	NO	5248-93	MW122	mg/L
Nickel, Dissolved	0.05	<	NO	4868-94	MW122	mg/L
Nickel, Dissolved	0.1	<	NO	5456-95	MW122	mg/L
Nickel, Dissolved	0.1	<	NO	8596-95	MW122	mg/L
Nickel, Dissolved		Q	NO	5301-96	MW122	
Nickel, Dissolved	0.05	<	NO	5282-93	MW133	mg/L
Nickel, Dissolved	0.05	<	NO	4761-94	MW133	mg/L
Nickel, Dissolved	0.1	<	NO	5460-95	MW133	mg/L
Nickel, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Nickel, Dissolved	0.05	<	NO	8088-93	MW140	mg/L
Nickel, Dissolved	0.05	<	NO	7081-93	MW140	mg/L
Nickel, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Nickel, Dissolved	0.05	<	NO	5195-94	MW140	mg/L
Nickel, Dissolved	0.05	<	NO	6050-94	MW140	mg/L
Nickel, Dissolved	0.1	<	NO	6884-94	MW140	mg/L
Nickel, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Nickel, Dissolved							
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.05	0.05	0.05	0.05		
	0.05	0.05	0.1	0.1	0.1	0.05		
	0.05	0.05	0.05	0.1		0.05		
	0.05	0.05		0.05		0.05		
	0.05	0.05				0.05		
	0.1	0.1				0.1		
	0.1	0.1				0.05		
	0.1	0.05						
	0.1							
	0.1							
	0.05							
Min	0.050	0.050	0.050	0.050	0.050	0.050	0.050	
Max	0.100	0.100	0.100	0.100	0.100	0.100	0.100	
Average	0.071	0.061	0.063	0.070	0.067	0.056	0.065	0.065
Number	12	9	4	5	3	8	41	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

MW 102 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 121 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 122 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 133 - Data were not modified.

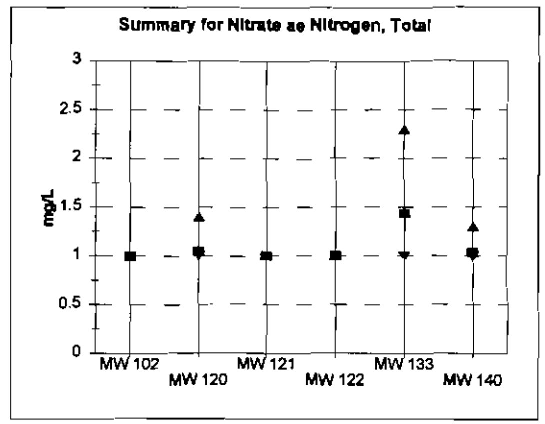
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Nitrate as Nitrogen	1	<	NO	5174-93	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	5940-93	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	7295-93	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	4268-94	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	5183-94	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	6022-94	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	6770-94	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	5619-95	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	6592-95	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	7467-95	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	8285-95	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	5281-96	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	5141-97	MW102	mg/L
Nitrate as Nitrogen	1	<	NO	4209-94	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	5143-97	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	5448-95	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	5293-96	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	5088-93	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	5900-93	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	6034-94	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	6928-94	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	7065-93	MW120	mg/L
Nitrate as Nitrogen	1.4		YES	4991-94	MW120	mg/L
Nitrate as Nitrogen	1	<	NO	4864-94	MW121	mg/L
Nitrate as Nitrogen	1	<	NO	5452-95	MW121	mg/L
Nitrate as Nitrogen	1	<	NO	5500-96	MW121	mg/L
Nitrate as Nitrogen	1	<	NO	5144-97	MW121	mg/L
Nitrate as Nitrogen	1	<	NO	5246-93	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	4866-94	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	5456-95	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	6596-95	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	5301-96	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	5145-97	MW122	mg/L
Nitrate as Nitrogen	1	<	NO	4781-94	MW133	mg/L
Nitrate as Nitrogen	1	<	NO	5460-95	MW133	mg/L
Nitrate es Nitrogen	2.3		YES	5282-93	MW133	mg/L
Nitrate as Nitrogen	1	<	NO	6004-93	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	6088-93	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	7081-93	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	4225-94	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	6050-94	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	6864-94	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	5313-96	MW140	mg/L
Nitrate as Nitrogen	1	<	NO	5146-97	MW140	mg/L
Nitrate as Nitrogen	1.3		YES	5195-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Nitrate as Nitrogen							
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	2.3	1		
	1	1	1	1		1		
	1	1		1		1		
	1	1		1		1		
	1	1				1		
	1	1				1		
	1	1				1.3		
	1	1.4						
	1							
	1							
	1							
Min	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Max	1.000	1.400	1.000	1.000	2.300	1.300	2.300	
Average	1.000	1.040	1.000	1.000	1.433	1.033	1.044	1.084
Number	13	10	4	6	3	9	45	



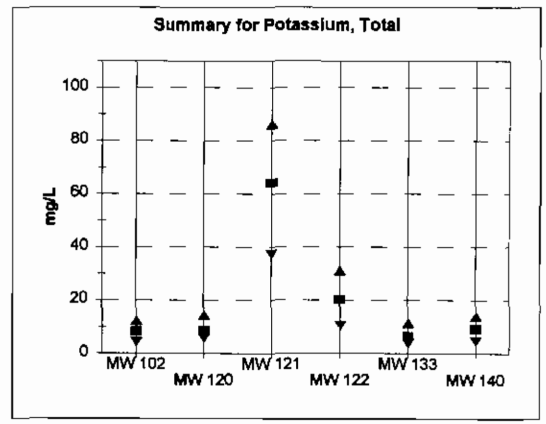
Data for Nitrate as Nitrogen, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Potassium	4.37		YES	5183-94	MW102	mg/L
Potassium	4.64		YES	5174-93	MW102	mg/L
Potassium	4.66		YES	5940-93	MW102	mg/L
Potassium	8.45		YES	7295-93	MW102	mg/L
Potassium	7.41		YES	6022-94	MW102	mg/L
Potassium	8.24		YES	5141-97	MW102	mg/L
Potassium	9.12		YES	4268-94	MW102	mg/L
Potassium	9.31		YES	6770-94	MW102	mg/L
Potassium	10.5	<	NO	7467-95	MW102	mg/L
Potassium	10.5	<	NO	5261-96	MW102	mg/L
Potassium	10.5	J<	NO	8285-95	MW102	mg/L
Potassium	12.3		YES	5619-95	MW102	mg/L
Potassium		QX	NO	6592-95	MW102	
Potassium	5.8		YES	6928-94	MW120	mg/L
Potassium	6.2		YES	5448-95	MW120	mg/L
Potassium	6.63		YES	5143-97	MW120	mg/L
Potassium	6.99		YES	5068-93	MW120	mg/L
Potassium	7.31		YES	4209-94	MW120	mg/L
Potassium	6.69		YES	4991-94	MW120	mg/L
Potassium	9.99		YES	6034-94	MW120	mg/L
Potassium	10.21		YES	7065-93	MW120	mg/L
Potassium	10.5	<	NO	5293-96	MW120	mg/L
Potassium	14.4		YES	5900-93	MW120	mg/L
Potassium	37.3		YES	5500-96	MW121	mg/L
Potassium	42		YES	4864-94	MW121	mg/L
Potassium	77		YES	5452-95	MW121	mg/L
Potassium	76		YES	5206-93	MW121	mg/L
Potassium	86.1		YES	5144-97	MW121	mg/L
Potassium	17.5		YES	4868-94	MW122	mg/L
Potassium	18.98		YES	5246-93	MW122	mg/L
Potassium	19		YES	5456-95	MW122	mg/L
Potassium	24.2		YES	5301-96	MW122	mg/L
Potassium	31.1		YES	5145-97	MW122	mg/L
Potassium		QX	NO	6596-95	MW122	
Potassium	3.62		YES	5282-93	MW133	mg/L
Potassium	4.1		YES	4761-94	MW133	mg/L
Potassium	11.4		YES	5460-95	MW133	mg/L
Potassium	4.75		YES	4225-94	MW140	mg/L
Potassium	7.6		YES	6050-94	MW140	mg/L
Potassium	7.67		YES	5195-94	MW140	mg/L
Potassium	6.26		YES	7081-93	MW140	mg/L
Potassium	8.4		YES	6864-94	MW140	mg/L
Potassium	8.82		YES	5146-97	MW140	mg/L
Potassium	10.5	<	NO	5313-96	MW140	mg/L
Potassium	13.23		YES	6004-93	MW140	mg/L
Potassium	13.9		YES	6088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Potassium							
	4.37	5.8	37.3	17.5	3.82	4.75		
	4.64	6.2	42	18.98	4.1	7.6		
	4.66	6.63	77	19	11.4	7.67		
	6.45	6.99	78	24.2		8.26		
	7.41	7.31	86.1	31.1		8.4		
	8.24	8.69		10.5		8.82		
	9.12	9.99				10.5		
	9.31	10.21				13.23		
	10.5	10.5				13.9		
	10.5	14.4						
	10.5							
	12.3							
	10.5							
Min	4.370	5.800	37.300	10.500	3.820	4.750	3.820	
Max	12.300	14.400	86.100	31.100	11.400	13.900	86.100	
Average	8.346	8.672	64.080	20.213	6.440	9.237	16.073	19.498
Number	13	10	5	6	3	9	46	



MW 102 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 120 - Data were not modified.

MW 121 - High values for samples from this well do not appear to be directly related to tubdity and were not modified.

MW 122 - One "Q" qualified result assigned value detected in a sample from this well because there is no minimum detection limit.

MW 133 - Data were not modified.

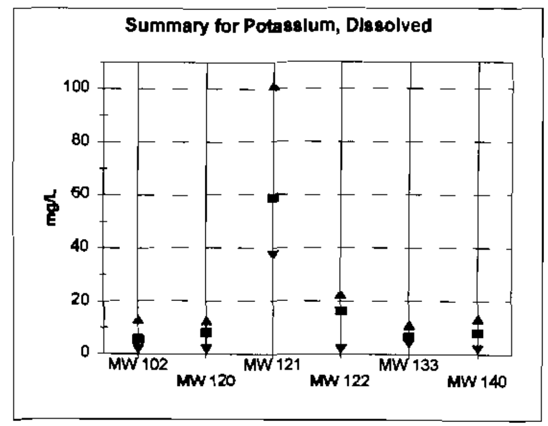
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Potassium, Dissolved	2	<	NO	4268-94	MW102	mg/L
Potassium, Dissolved	4.38		YES	5174-93	MW102	mg/L
Potassium, Dissolved	4.54		YES	5940-93	MW102	mg/L
Potassium, Dissolved	4.91		YES	5183-94	MW102	mg/L
Potassium, Dissolved	5.83		YES	7295-93	MW102	mg/L
Potassium, Dissolved	7.66		YES	6022-94	MW102	mg/L
Potassium, Dissolved	9.47		YES	6770-94	MW102	mg/L
Potassium, Dissolved	10.5	*N<	NO	7467-95	MW102	mg/L
Potassium, Dissolved	13.1		YES	5619-95	MW102	mg/L
Potassium, Dissolved		Q	NO	8285-95	MW102	
Potassium, Dissolved		Q	NO	5281-96	MW102	
Potassium, Dissolved		QX	NO	6592-95	MW102	
Potassium, Dissolved	8.37		YES	5086-93	MW120	mg/L
Potassium, Dissolved	6.5		YES	5446-95	MW120	mg/L
Potassium, Dissolved	6.7		YES	6928-94	MW120	mg/L
Potassium, Dissolved	7.44		YES	4209-94	MW120	mg/L
Potassium, Dissolved	9.41		YES	4991-94	MW120	mg/L
Potassium, Dissolved	9.86		YES	7065-93	MW120	mg/L
Potassium, Dissolved	12.5		YES	6034-94	MW120	mg/L
Potassium, Dissolved	12.7		YES	5900-93	MW120	mg/L
Potassium, Dissolved		Q	NO	5293-96	MW120	
Potassium, Dissolved	37.2		YES	5500-96	MW121	mg/L
Potassium, Dissolved	43.5		YES	4864-94	MW121	mg/L
Potassium, Dissolved	53.3		YES	5208-93	MW121	mg/L
Potassium, Dissolved	101		YES	5452-95	MW121	mg/L
Potassium, Dissolved	16.06		YES	5246-93	MW122	mg/L
Potassium, Dissolved	19.8		YES	4668-94	MW122	mg/L
Potassium, Dissolved	21		YES	5456-95	MW122	mg/L
Potassium, Dissolved	22.6		YES	5301-96	MW122	mg/L
Potassium, Dissolved		QX	NO	6596-95	MW122	
Potassium, Dissolved	4.03		YES	5262-93	MW133	mg/L
Potassium, Dissolved	4.57		YES	4761-94	MW133	mg/L
Potassium, Dissolved	11.1		YES	5460-95	MW133	mg/L
Potassium, Dissolved	5.28		YES	4225-94	MW140	mg/L
Potassium, Dissolved	7.14		YES	7061-93	MW140	mg/L
Potassium, Dissolved	7.44		YES	6050-94	MW140	mg/L
Potassium, Dissolved	7.81		YES	5195-94	MW140	mg/L
Potassium, Dissolved	8.7		YES	6864-94	MW140	mg/L
Potassium, Dissolved	13.16		YES	6004-93	MW140	mg/L
Potassium, Dissolved	13.4		YES	6088-93	MW140	mg/L
Potassium, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Potassium, Dissolved							
	2	6.37	37.2	16.06	4.03	5.28		
	4.38	6.5	43.5	19.8	4.57	7.14		
	4.54	6.7	53.3	21	11.1	7.44		
	4.91	7.44	101	22.6		7.81		
	5.83	9.41		2		8.7		
	7.66	9.86				13.16		
	9.47	12.5				13.4		
	10.5	12.7				2		
	13.1	2						
	2							
	2							
	2							
Min	2.000	2.000	37.200	2.000	4.030	2.000	2.000	
Max	13.100	12.700	101.000	22.800	11.100	13.400	101.000	
Average	5.699	8.142	58.750	16.292	6.567	8.116	13.238	17.261
Number	12	9	4	5	3	8	41	



MW 102 - Three "Q" qualified results assigned minimum detection limit for samples from this well

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples across all wells.

MW 121 - Data were not modified.

MW 122 - One "Q" qualified result assigned the minimum detection limit for samples across all wells.

MW 133 - Data were not modified.

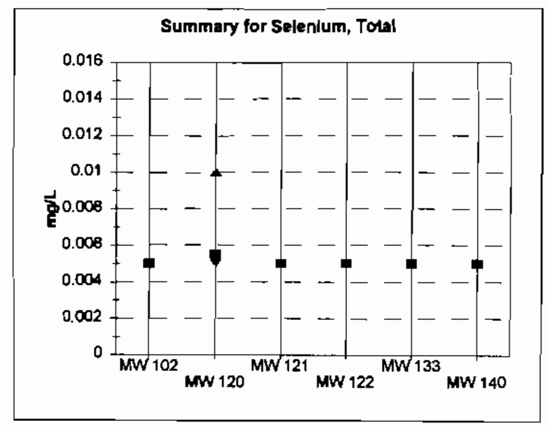
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples across all wells.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Selenium	0.005	<	NO	5174-93	MW102	mg/L
Selenium	0.005	<	NO	5940-93	MW102	mg/L
Selenium	0.005	<	NO	7295-93	MW102	mg/L
Selenium	0.005	<	NO	4268-94	MW102	mg/L
Selenium	0.005	<	NO	5183-94	MW102	mg/L
Selenium	0.005	<	NO	6022-94	MW102	mg/L
Selenium	0.005	<	NO	6770-94	MW102	mg/L
Selenium	0.005	<	NO	6592-95	MW102	mg/L
Selenium	0.005	<	NO	7467-95	MW102	mg/L
Selenium	0.005	<	NO	8285-95	MW102	mg/L
Selenium	0.005	<	NO	5261-96	MW102	mg/L
Selenium	0.005	<	NO	5141-97	MW102	mg/L
Selenium	0.005	<N	NO	5619-95	MW102	mg/L
Selenium	0.005	<	NO	4209-94	MW120	mg/L
Selenium	0.005	<	NO	5143-97	MW120	mg/L
Selenium	0.005	<	NO	5448-95	MW120	mg/L
Selenium	0.005	<	NO	4991-94	MW120	mg/L
Selenium	0.005	<	NO	5900-93	MW120	mg/L
Selenium	0.005	<	NO	6034-94	MW120	mg/L
Selenium	0.005	<	NO	6928-94	MW120	mg/L
Selenium	0.005	<	NO	7065-93	MW120	mg/L
Selenium	0.005	<B	NO	5293-96	MW120	mg/L
Selenium	0.01	<	NO	5088-93	MW120	mg/L
Selenium	0.005	<	NO	5452-95	MW121	mg/L
Selenium	0.005	<	NO	5144-97	MW121	mg/L
Selenium	0.005	<B	NO	5500-96	MW121	mg/L
Selenium	0.005	<	NO	5456-95	MW122	mg/L
Selenium	0.005	<	NO	8596-95	MW122	mg/L
Selenium	0.005	<	NO	5301-96	MW122	mg/L
Selenium	0.005	<	NO	5145-97	MW122	mg/L
Selenium	0.005	<	NO	5460-95	MW133	mg/L
Selenium	0.005	<	NO	6004-93	MW140	mg/L
Selenium	0.005	<	NO	6068-93	MW140	mg/L
Selenium	0.005	<	NO	7081-93	MW140	mg/L
Selenium	0.005	<	NO	4225-94	MW140	mg/L
Selenium	0.005	<	NO	5195-94	MW140	mg/L
Selenium	0.005	<	NO	6050-94	MW140	mg/L
Selenium	0.005	<	NO	6864-94	MW140	mg/L
Selenium	0.005	<	NO	5313-96	MW140	mg/L
Selenium	0.005	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Selenium							
	0.005	0.005	0.005	0.005	0.005	0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005	0.005	0.005		0.005		
	0.005	0.005		0.005		0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.005				0.005		
	0.005	0.01						
	0.005							
	0.005							
	0.005							
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005	
Max	0.005	0.010	0.005	0.005	0.005	0.005	0.010	
Average	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.005
Number	13	10	3	4	1	9	40	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction of the detection limits used for samples taken from these wells.

Data for Selenium, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Selenium, Dissolved		Q	NO	5174-93	MW102	
Selenium, Dissolved		Q	NO	5940-93	MW102	
Selenium, Dissolved		Q	NO	7295-93	MW102	
Selenium, Dissolved		Q	NO	4266-94	MW102	
Selenium, Dissolved		Q	NO	5183-94	MW102	
Selenium, Dissolved		Q	NO	6022-94	MW102	
Selenium, Dissolved		Q	NO	6770-94	MW102	
Selenium, Dissolved		Q	NO	5619-95	MW102	
Selenium, Dissolved		Q	NO	6592-95	MW102	
Selenium, Dissolved		Q	NO	7467-95	MW102	
Selenium, Dissolved		Q	NO	6265-95	MW102	
Selenium, Dissolved		Q	NO	5281-96	MW102	
Selenium, Dissolved		Q	NO	5141-97	MW102	
Selenium, Dissolved		Q	NO	4209-94	MW120	
Selenium, Dissolved		Q	NO	5143-97	MW120	
Selenium, Dissolved		Q	NO	5448-95	MW120	
Selenium, Dissolved		Q	NO	5293-96	MW120	
Selenium, Dissolved		Q	NO	4991-94	MW120	
Selenium, Dissolved		Q	NO	5068-93	MW120	
Selenium, Dissolved		Q	NO	5900-93	MW120	
Selenium, Dissolved		Q	NO	6034-94	MW120	
Selenium, Dissolved		Q	NO	6928-94	MW120	
Selenium, Dissolved		Q	NO	7065-93	MW120	
Selenium, Dissolved		Q	NO	5452-95	MW121	
Selenium, Dissolved		Q	NO	5500-96	MW121	
Selenium, Dissolved		Q	NO	5144-97	MW121	
Selenium, Dissolved		Q	NO	5456-95	MW122	
Selenium, Dissolved		Q	NO	6596-95	MW122	
Selenium, Dissolved		Q	NO	5301-96	MW122	
Selenium, Dissolved		Q	NO	5145-97	MW122	
Selenium, Dissolved		Q	NO	5460-95	MW133	
Selenium, Dissolved		Q	NO	6004-93	MW140	
Selenium, Dissolved		Q	NO	6066-93	MW140	
Selenium, Dissolved		Q	NO	7061-93	MW140	
Selenium, Dissolved		Q	NO	4225-94	MW140	
Selenium, Dissolved		Q	NO	5195-94	MW140	
Selenium, Dissolved		Q	NO	6050-94	MW140	
Selenium, Dissolved		Q	NO	6864-94	MW140	
Selenium, Dissolved		Q	NO	5313-96	MW140	
Selenium, Dissolved		Q	NO	5146-97	MW140	

CORRECTED DATA SET

Selenium, Dissolved

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Number	0	0	0	0	0	0	0	

Selenium, Dissolved

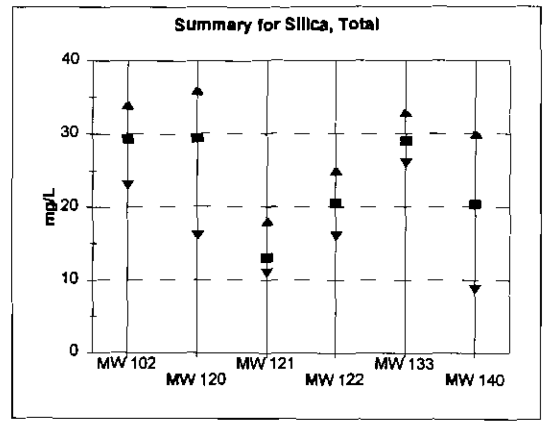
▷ Analysis for Selenium, Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of selenium in a filtered sample exceeds the background concentration.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Silica	23		YES	5174-93	MW102	mg/L
Silica	24		YES	6022-94	MW102	mg/L
Silica	25		YES	5183-94	MW102	mg/L
Silica	25		YES	6770-94	MW102	mg/L
Silica	25		YES	5141-97	MW102	mg/L
Silica	31		YES	4268-94	MW102	mg/L
Silica	31		YES	5619-95	MW102	mg/L
Silica	31		YES	6592-95	MW102	mg/L
Silica	32		YES	5940-93	MW102	mg/L
Silica	32		YES	8285-95	MW102	mg/L
Silica	34		YES	7295-93	MW102	mg/L
Silica	34		YES	7467-95	MW102	mg/L
Silica	34		YES	5281-96	MW102	mg/L
Silica	16		YES	5143-97	MW120	mg/L
Silica	25		YES	4991-94	MW120	mg/L
Silica	27		YES	6034-94	MW120	mg/L
Silica	29		YES	5900-93	MW120	mg/L
Silica	29		YES	6926-94	MW120	mg/L
Silica	32		YES	5448-95	MW120	mg/L
Silica	32		YES	7065-93	MW120	mg/L
Silica	33		YES	5088-93	MW120	mg/L
Silica	35		YES	4209-94	MW120	mg/L
Silica	36		YES	5293-96	MW120	mg/L
Silica	11		YES	4884-94	MW121	mg/L
Silica	11		YES	5144-97	MW121	mg/L
Silica	12		YES	5452-95	MW121	mg/L
Silica	18		YES	5500-96	MW121	mg/L
Silica	16		YES	5145-97	MW122	mg/L
Silica	19		YES	5301-96	MW122	mg/L
Silica	20		YES	5246-93	MW122	mg/L
Silica	21		YES	5456-95	MW122	mg/L
Silica	22		YES	6596-95	MW122	mg/L
Silica	25		YES	4868-94	MW122	mg/L
Silica	26		YES	4761-94	MW133	mg/L
Silica	28		YES	5262-93	MW133	mg/L
Silica	33		YES	5460-95	MW133	mg/L
Silica	8.73		YES	6004-93	MW140	mg/L
Silica	19		YES	5195-94	MW140	mg/L
Silica	19		YES	6050-94	MW140	mg/L
Silica	19		YES	6664-94	MW140	mg/L
Silica	19		YES	5146-97	MW140	mg/L
Silica	21		YES	6066-93	MW140	mg/L
Silica	22		YES	7061-93	MW140	mg/L
Silica	25		YES	4225-94	MW140	mg/L
Silica	30		YES	5313-96	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Silica							
	23	16	11	16	26	8.73		
	24	25	11	19	28	19		
	25	27	12	20	33	19		
	25	29	18	21		19		
	25	29		22		19		
	31	32		25		21		
	31	32				22		
	31	33				25		
	32	35				30		
	32	36						
	34							
	34							
	34							
Min	23.000	16.000	11.000	16.000	26.000	8.730	8.730	
Max	34.000	36.000	18.000	25.000	33.000	30.000	36.000	
Average	29.308	29.400	13.000	20.500	29.000	20.303	24.883	23.585
Number	13	10	4	6	3	9	45	



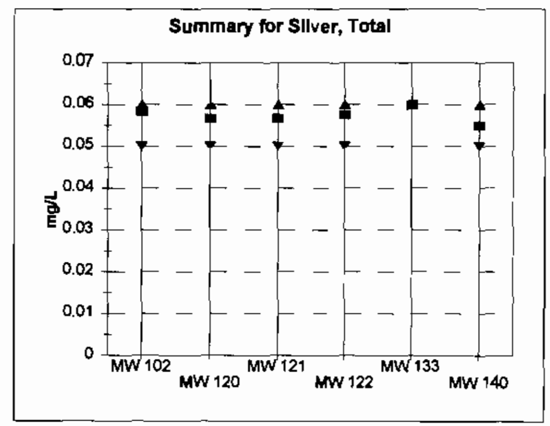
Data for Silica, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Silver	0.05	<	NO	5141-97	MW102	mg/L
Silver	0.06	<	NO	5619-95	MW102	mg/L
Silver	0.06	<	NO	6592-95	MW102	mg/L
Silver	0.06	<	NO	7467-95	MW102	mg/L
Silver	0.06	<	NO	6265-95	MW102	mg/L
Silver	0.06	N*<	NO	5261-96	MW102	mg/L
Silver	0.05	<	NO	5143-97	MW120	mg/L
Silver	0.06	<N	NO	5446-95	MW120	mg/L
Silver	0.06	<X	NO	5293-96	MW120	mg/L
Silver	0.05	<	NO	5144-97	MW121	mg/L
Silver	0.06	<N	NO	5452-95	MW121	mg/L
Silver	0.06	<X	NO	5500-96	MW121	mg/L
Silver	0.05	<	NO	5145-97	MW122	mg/L
Silver	0.06	<	NO	6596-95	MW122	mg/L
Silver	0.06	<N	NO	5456-95	MW122	mg/L
Silver	0.06	N*<	NO	5301-96	MW122	mg/L
Silver	0.06	<	NO	5460-95	MW133	mg/L
Silver	0.05	<	NO	5146-97	MW140	mg/L
Silver	0.06	N*<	NO	5313-96	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Silver							
	0.05	0.05	0.05	0.05	0.06	0.05		
	0.06	0.06	0.06	0.06		0.06		
	0.06	0.06	0.06	0.06				
	0.06			0.06				
	0.06							
	0.06							
Min	0.050	0.050	0.050	0.050	0.060	0.050	0.050	
Max	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Average	0.056	0.057	0.057	0.056	0.060	0.055	0.057	0.057
Number	6	3	3	4	1	2	19	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

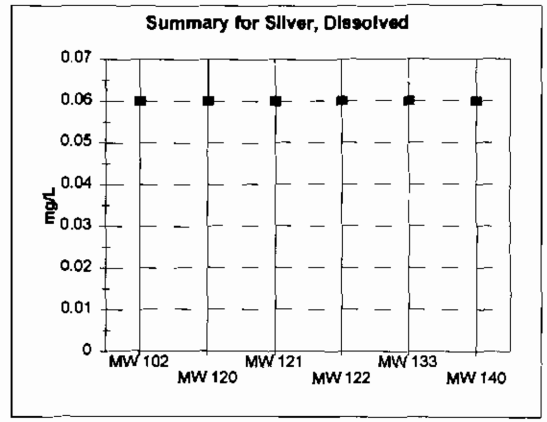
Data for Silver, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Silver, Dissolved	0.06	<	NO	5619-95	MW102	mg/L
Silver, Dissolved	0.06	<	NO	6592-95	MW102	mg/L
Silver, Dissolved	0.06	<	NO	7467-95	MW102	mg/L
Silver, Dissolved		Q	NO	8265-95	MW102	
Silver, Dissolved		Q	NO	5261-96	MW102	
Silver, Dissolved		Q	NO	5141-97	MW102	
Silver, Dissolved	0.06	<	NO	5448-95	MW120	mg/L
Silver, Dissolved		Q	NO	5143-97	MW120	
Silver, Dissolved		Q	NO	5293-96	MW120	
Silver, Dissolved	0.06	<	NO	5452-95	MW121	mg/L
Silver, Dissolved		Q	NO	5500-96	MW121	
Silver, Dissolved		Q	NO	5144-97	MW121	
Silver, Dissolved	0.06	<	NO	5456-95	MW122	mg/L
Silver, Dissolved		Q	NO	6596-95	MW122	
Silver, Dissolved		Q	NO	5301-96	MW122	
Silver, Dissolved		Q	NO	5145-97	MW122	
Silver, Dissolved	0.06	<	NO	5460-95	MW133	mg/L
Silver, Dissolved		Q	NO	5313-96	MW140	
Silver, Dissolved		Q	NO	5146-97	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Silver, Dissolved							
	0.06	0.06	0.06	0.06	0.06	0.06		
	0.06	0.06	0.06	0.06		0.06		
	0.06	0.06	0.06	0.06				
	0.06			0.06				
	0.06							
	0.06							
Min	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Max	0.060	0.060	0.060	0.060	0.060	0.060	0.060	
Average	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
Number	6	3	3	4	1	2	19	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

MW 102 - Three "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 120 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 121 - Two "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 122 - Three "Q" qualified results assigned the minimum detection limit for samples from this well.

MW 133 - Data were not modified.

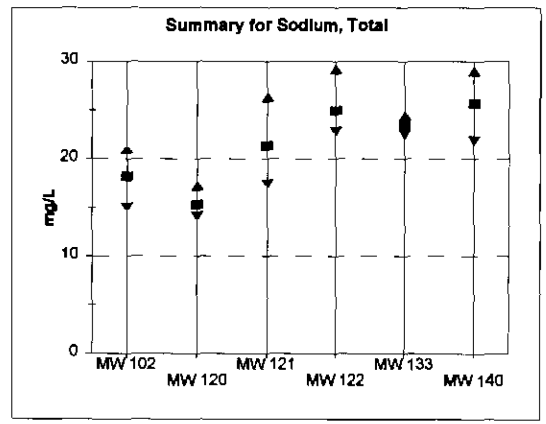
MW 140 - Two "Q" qualified results assigned the minimum detection limit for samples across all wells.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Sodium	15		YES	5163-94	MW102	mg/L
Sodium	16.2		YES	5940-93	MW102	mg/L
Sodium	16.5		YES	7295-93	MW102	mg/L
Sodium	16.6		YES	6022-94	MW102	mg/L
Sodium	17.26		YES	5174-93	MW102	mg/L
Sodium	17.6		YES	4266-94	MW102	mg/L
Sodium	18.6	*N	YES	7467-95	MW102	mg/L
Sodium	16.8	N	YES	5141-97	MW102	mg/L
Sodium	19.54		YES	6770-94	MW102	mg/L
Sodium	19.6		YES	6592-95	MW102	mg/L
Sodium	20	B	YES	5619-95	MW102	mg/L
Sodium	20	N	YES	8285-95	MW102	mg/L
Sodium	21	N	YES	5281-96	MW102	mg/L
Sodium	14.1		YES	5088-93	MW120	mg/L
Sodium	14.7	N	YES	5293-96	MW120	mg/L
Sodium	14.9		YES	5900-93	MW120	mg/L
Sodium	15		YES	5448-95	MW120	mg/L
Sodium	15.1		YES	4209-94	MW120	mg/L
Sodium	15.3		YES	4991-94	MW120	mg/L
Sodium	15.4		YES	6034-94	MW120	mg/L
Sodium	15.5	N	YES	5143-97	MW120	mg/L
Sodium	15.8		YES	6928-94	MW120	mg/L
Sodium	17.2		YES	7065-93	MW120	mg/L
Sodium	17.4		YES	4864-94	MW121	mg/L
Sodium	19	N	YES	5500-96	MW121	mg/L
Sodium	20.8		YES	5206-93	MW121	mg/L
Sodium	23		YES	5452-95	MW121	mg/L
Sodium	26.3	N	YES	5144-97	MW121	mg/L
Sodium	22.8	J	YES	6596-95	MW122	mg/L
Sodium	23.23		YES	5246-93	MW122	mg/L
Sodium	24		YES	4868-94	MW122	mg/L
Sodium	24		YES	5456-95	MW122	mg/L
Sodium	28.3	N	YES	5301-96	MW122	mg/L
Sodium	29.2	N	YES	5145-97	MW122	mg/L
Sodium	22.5		YES	5282-93	MW133	mg/L
Sodium	23.3		YES	4781-94	MW133	mg/L
Sodium	24.4		YES	5460-95	MW133	mg/L
Sodium	21.9	N	YES	5313-96	MW140	mg/L
Sodium	24		YES	6884-94	MW140	mg/L
Sodium	24.5		YES	5195-94	MW140	mg/L
Sodium	24.7	N	YES	5146-97	MW140	mg/L
Sodium	25		YES	7081-93	MW140	mg/L
Sodium	25.8		YES	4225-94	MW140	mg/L
Sodium	28.11		YES	8004-93	MW140	mg/L
Sodium	28.4		YES	6050-94	MW140	mg/L
Sodium	29		YES	8088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Sodium							
	15	14.1	17.4	22.6	22.5	21.9		
	16.2	14.7	19	23.23	23.3	24		
	16.5	14.9	20.6	24	24.4	24.5		
	16.6	15	23	24		24.7		
	17.26	15.1	26.3	26.3		25		
	17.6	15.3		29.2		25.6		
	18.6	15.4				28.11		
	18.8	15.5				28.4		
	19.54	15.6				29		
	19.6	17.2						
	20							
	20							
	21							
Min	15.000	14.100	17.400	22.800	22.500	21.900	14.100	
Max	21.000	17.200	26.300	29.200	24.400	29.000	29.200	
Average	18.208	15.280	21.300	24.922	23.400	25.690	20.586	21.467
Number	13	10	5	6	3	9	46	



Data for Sodium, Total were not modified.

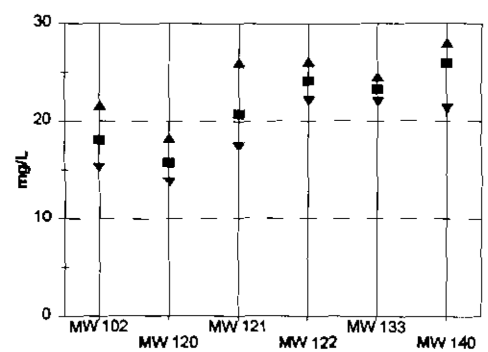
Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Sodium, Dissolved	15.2	N	YES	7467-95	MW102	mg/L
Sodium, Dissolved	15.7		YES	5940-93	MW102	mg/L
Sodium, Dissolved	15.7		YES	5183-94	MW102	mg/L
Sodium, Dissolved	16.8		YES	7295-93	MW102	mg/L
Sodium, Dissolved	18		YES	5174-93	MW102	mg/L
Sodium, Dissolved	18.3		YES	6022-94	MW102	mg/L
Sodium, Dissolved	18.6	N	YES	6592-95	MW102	mg/L
Sodium, Dissolved	18.8	N*	YES	5281-96	MW102	mg/L
Sodium, Dissolved	18.9	N*	YES	8285-95	MW102	mg/L
Sodium, Dissolved	19.4		YES	6770-94	MW102	mg/L
Sodium, Dissolved	19.9		YES	4268-94	MW102	mg/L
Sodium, Dissolved	21.6	B	YES	5619-95	MW102	mg/L
Sodium, Dissolved	13.7	N	YES	5293-96	MW120	mg/L
Sodium, Dissolved	13.8		YES	5088-93	MW120	mg/L
Sodium, Dissolved	14.9		YES	5900-93	MW120	mg/L
Sodium, Dissolved	15.5		YES	4991-94	MW120	mg/L
Sodium, Dissolved	15.9		YES	4209-94	MW120	mg/L
Sodium, Dissolved	16		YES	5448-95	MW120	mg/L
Sodium, Dissolved	16		YES	6928-94	MW120	mg/L
Sodium, Dissolved	17.4		YES	6034-94	MW120	mg/L
Sodium, Dissolved	18.23		YES	7065-93	MW120	mg/L
Sodium, Dissolved	17.4	N	YES	5500-96	MW121	mg/L
Sodium, Dissolved	19.5		YES	4664-94	MW121	mg/L
Sodium, Dissolved	20.1		YES	5206-93	MW121	mg/L
Sodium, Dissolved	26		YES	5452-95	MW121	mg/L
Sodium, Dissolved	22.07		YES	5246-93	MW122	mg/L
Sodium, Dissolved	22.8		YES	6596-95	MW122	mg/L
Sodium, Dissolved	23.7	N	YES	5301-96	MW122	mg/L
Sodium, Dissolved	26		YES	5458-95	MW122	mg/L
Sodium, Dissolved	26.1		YES	4668-94	MW122	mg/L
Sodium, Dissolved	22.03		YES	5282-93	MW133	mg/L
Sodium, Dissolved	23.2		YES	4761-94	MW133	mg/L
Sodium, Dissolved	24.6	B	YES	5460-95	MW133	mg/L
Sodium, Dissolved	21.3	N*	YES	5313-96	MW140	mg/L
Sodium, Dissolved	25.3		YES	5195-94	MW140	mg/L
Sodium, Dissolved	25.7		YES	7061-93	MW140	mg/L
Sodium, Dissolved	25.83		YES	6050-94	MW140	mg/L
Sodium, Dissolved	28.5		YES	4225-94	MW140	mg/L
Sodium, Dissolved	27	J	YES	6864-94	MW140	mg/L
Sodium, Dissolved	27.6		YES	6088-93	MW140	mg/L
Sodium, Dissolved	27.98		YES	6004-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Sodium, Dissolved							
	15.2	13.7	17.4	22.07	22.03	21.3		
	15.7	13.8	19.5	22.8	23.2	25.3		
	15.7	14.9	20.1	23.7	24.6	25.7		
	16.8	15.5	26	26		25.83		
	18	15.9		26.1		26.5		
	18.3	16				27		
	18.6	16				27.6		
	18.8	17.4				27.98		
	18.9	18.23						
	19.4							
	19.9							
	21.6							
Min	15.200	13.700	17.400	22.070	22.030	21.300	13.700	
Max	21.600	18.230	26.000	26.100	24.600	27.980	27.980	
Average	18.075	15.714	20.750	24.134	23.277	25.901	20.464	21.309
Number	12	9	4	5	3	8	41	

Summary for Sodium, Dissolved



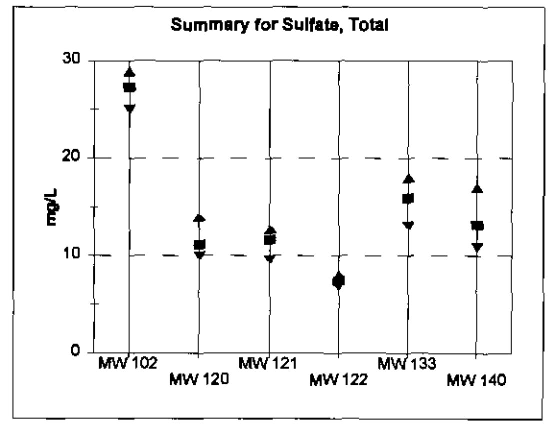
Data for Sodium, Dissolved were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Sulfate	25		YES	5174-93	MW102	mg/L
Sulfate	25		YES	5940-93	MW102	mg/L
Sulfate	26.2		YES	6022-94	MW102	mg/L
Sulfate	27.4		YES	7467-95	MW102	mg/L
Sulfate	27.5		YES	5619-95	MW102	mg/L
Sulfate	27.7		YES	6770-94	MW102	mg/L
Sulfate	27.8		YES	5141-97	MW102	mg/L
Sulfate	28.4		YES	6592-95	MW102	mg/L
Sulfate	28.8		YES	6265-95	MW102	mg/L
Sulfate	28.9		YES	5261-96	MW102	mg/L
Sulfate	10		YES	5900-93	MW120	mg/L
Sulfate	10.1		YES	5143-97	MW120	mg/L
Sulfate	10.4		YES	5293-96	MW120	mg/L
Sulfate	10.6		YES	5446-95	MW120	mg/L
Sulfate	10.9		YES	6926-94	MW120	mg/L
Sulfate	11.1		YES	6034-94	MW120	mg/L
Sulfate	12		YES	5068-93	MW120	mg/L
Sulfate	14		YES	4991-94	MW120	mg/L
Sulfate	9.6		YES	5452-95	MW121	mg/L
Sulfate	12		YES	4864-94	MW121	mg/L
Sulfate	12.2		YES	5144-97	MW121	mg/L
Sulfate	12.7		YES	5500-96	MW121	mg/L
Sulfate	6.9		YES	5145-97	MW122	mg/L
Sulfate	7.1		YES	6596-95	MW122	mg/L
Sulfate	7.1		YES	5301-96	MW122	mg/L
Sulfate	7.3		YES	5456-95	MW122	mg/L
Sulfate	8		YES	5246-93	MW122	mg/L
Sulfate	8		YES	4666-94	MW122	mg/L
Sulfate	13		YES	5262-93	MW133	mg/L
Sulfate	16.8		YES	5460-95	MW133	mg/L
Sulfate	18		YES	4761-94	MW133	mg/L
Sulfate	10.9		YES	5146-97	MW140	mg/L
Sulfate	11.2		YES	5313-96	MW140	mg/L
Sulfate	12.2		YES	6864-94	MW140	mg/L
Sulfate	12.9		YES	6050-94	MW140	mg/L
Sulfate	15		YES	6068-93	MW140	mg/L
Sulfate	17		YES	6004-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Sulfate							
	25	10	9.6	6.9	13	10.9		
	25	10.1	12	7.1	16.8	11.2		
	26.2	10.4	12.2	7.1	18	12.2		
	27.4	10.6	12.7	7.3		12.9		
	27.5	10.9		8		15		
	27.7	11.1		8		17		
	27.8	12						
	28.4	14						
	28.8							
	28.9							
Min	25.000	10.000	9.600	6.900	13.000	10.900	6.900	
Max	28.900	14.000	12.700	8.000	18.000	17.000	28.900	
Average	27.270	11.136	11.625	7.400	15.933	13.200	15.668	14.426
Number	10	8	4	6	3	6	37	



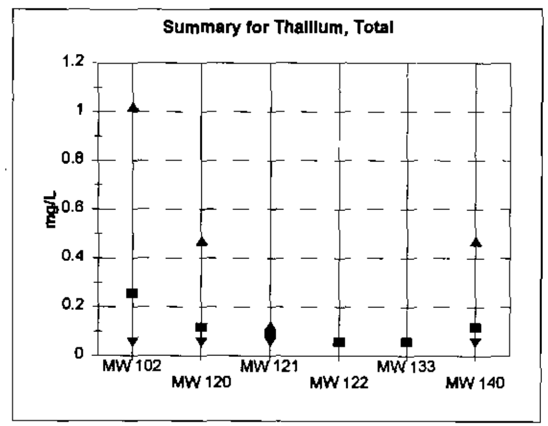
Data for Sulfate, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Thallium	0.056	<	NO	5174-93	MW102	mg/L
Thallium	0.06	<	NO	5940-93	MW102	mg/L
Thallium	0.06	<	NO	7295-93	MW102	mg/L
Thallium	0.06	<	NO	4268-94	MW102	mg/L
Thallium	0.06	<	NO	5183-94	MW102	mg/L
Thallium	0.47	<	NO	6770-94	MW102	mg/L
Thallium	1.02		YES	6022-94	MW102	mg/L
Thallium	0.056	<	NO	5088-93	MW120	mg/L
Thallium	0.06	<	NO	4209-94	MW120	mg/L
Thallium	0.06	<	NO	4991-94	MW120	mg/L
Thallium	0.06	<	NO	5900-93	MW120	mg/L
Thallium	0.06	<	NO	6034-94	MW120	mg/L
Thallium	0.06	<	NO	7065-93	MW120	mg/L
Thallium	0.47	<	NO	6928-94	MW120	mg/L
Thallium	0.06	<	NO	4864-94	MW121	mg/L
Thallium	0.123		YES	5206-93	MW121	mg/L
Thallium	0.06	<	NO	5246-93	MW122	mg/L
Thallium	0.06	<	NO	4866-94	MW122	mg/L
Thallium	0.056	<	NO	5262-93	MW133	mg/L
Thallium	0.06	<	NO	4761-94	MW133	mg/L
Thallium	0.056	<	NO	6004-93	MW140	mg/L
Thallium	0.06	<	NO	6066-93	MW140	mg/L
Thallium	0.06	<	NO	7081-93	MW140	mg/L
Thallium	0.06	<	NO	4225-94	MW140	mg/L
Thallium	0.06	<	NO	5195-94	MW140	mg/L
Thallium	0.06	<	NO	8050-94	MW140	mg/L
Thallium	0.47	<	NO	6664-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Thallium							
	0.056	0.056	0.06	0.06	0.056	0.056		
	0.06	0.06	0.123	0.06	0.06	0.06		
	0.06	0.06				0.06		
	0.06	0.06				0.06		
	0.06	0.06				0.06		
	0.47	0.06				0.06		
	1.02	0.47				0.47		
Min	0.056	0.056	0.060	0.060	0.056	0.056	0.056	
Max	1.020	0.470	0.123	0.060	0.060	0.470	1.020	
Average	0.255	0.118	0.092	0.060	0.058	0.118	0.143	0.117
Number	7	7	2	2	2	7	27	



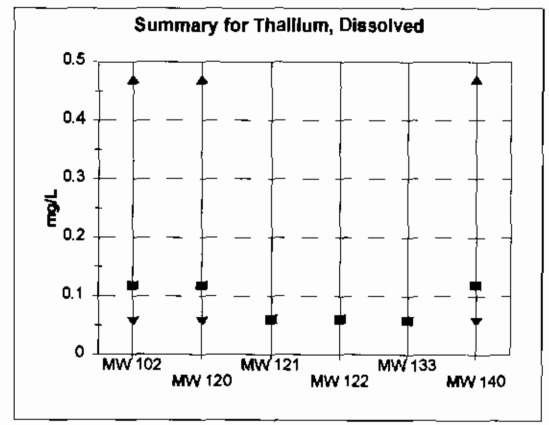
Data for Thallium, Total were not modified. The two detected values which appear to be anomolous do not seem to be related to sample turbidity.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Thallium, Dissolved	0.056	<	NO	5174-93	MW102	mg/L
Thallium, Dissolved	0.06	<	NO	7295-93	MW102	mg/L
Thallium, Dissolved	0.06	<	NO	4268-94	MW102	mg/L
Thallium, Dissolved	0.06	<	NO	5183-94	MW102	mg/L
Thallium, Dissolved	0.06	<	NO	6022-94	MW102	mg/L
Thallium, Dissolved	0.47	<	NO	6770-94	MW102	mg/L
Thallium, Dissolved		Q	NO	5940-93	MW102	
Thallium, Dissolved	0.056	<	NO	5068-93	MW120	mg/L
Thallium, Dissolved	0.06	<	NO	4209-94	MW120	mg/L
Thallium, Dissolved	0.06	<	NO	4991-94	MW120	mg/L
Thallium, Dissolved	0.06	<	NO	5900-93	MW120	mg/L
Thallium, Dissolved	0.06	<	NO	6034-94	MW120	mg/L
Thallium, Dissolved	0.47	<	NO	6926-94	MW120	mg/L
Thallium, Dissolved		Q	NO	7065-93	MW120	
Thallium, Dissolved	0.06	<	NO	4864-94	MW121	mg/L
Thallium, Dissolved	0.06	<	NO	5246-93	MW122	mg/L
Thallium, Dissolved	0.06	<	NO	4866-94	MW122	mg/L
Thallium, Dissolved	0.056	<	NO	5262-93	MW133	mg/L
Thallium, Dissolved	0.06	<	NO	4761-94	MW133	mg/L
Thallium, Dissolved	0.056	<	NO	6004-93	MW140	mg/L
Thallium, Dissolved	0.06	<	NO	6068-93	MW140	mg/L
Thallium, Dissolved	0.06	<	NO	7081-93	MW140	mg/L
Thallium, Dissolved	0.06	<	NO	4225-94	MW140	mg/L
Thallium, Dissolved	0.06	<	NO	5195-94	MW140	mg/L
Thallium, Dissolved	0.06	<	NO	6050-94	MW140	mg/L
Thallium, Dissolved	0.47	<	NO	6864-94	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Thallium, Dissolved							
	0.056	0.056	0.06	0.06	0.056	0.056		
	0.06	0.06		0.06	0.06	0.06		
	0.06	0.06				0.06		
	0.06	0.06				0.06		
	0.06	0.06				0.06		
	0.47	0.47				0.06		
	0.056	0.056				0.47		
Min	0.056	0.056	0.060	0.060	0.056	0.056	0.056	
Max	0.470	0.470	0.060	0.060	0.060	0.470	0.470	
Average	0.117	0.117	0.060	0.060	0.056	0.118	0.106	0.088
Number	7	7	1	2	2	7	26	



All results for this well are below their respective detection limits; therefore, the plot is simply a depiction if the detection limits used for samples taken from these wells.

MW 102 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

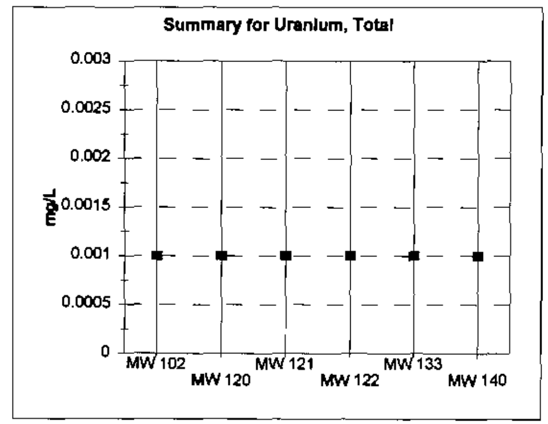
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Uranium	0.001	<	NO	5174-93	MW102	mg/L
Uranium	0.001	<	NO	5940-93	MW102	mg/L
Uranium	0.001	<	NO	7295-93	MW102	mg/L
Uranium	0.001	<	NO	4266-94	MW102	mg/L
Uranium	0.001	<	NO	5163-94	MW102	mg/L
Uranium	0.001	<	NO	6022-94	MW102	mg/L
Uranium	0.001	<	NO	6770-94	MW102	mg/L
Uranium	0.001	<	NO	5619-95	MW102	mg/L
Uranium	0.001	<	NO	6592-95	MW102	mg/L
Uranium	0.001	<	NO	7467-95	MW102	mg/L
Uranium	0.001	<	NO	8285-95	MW102	mg/L
Uranium	0.001	<	NO	5261-96	MW102	mg/L
Uranium	0.001	<	NO	5141-97	MW102	mg/L
Uranium	0.001	<	NO	4209-94	MW120	mg/L
Uranium	0.001	<	NO	5143-97	MW120	mg/L
Uranium	0.001	<	NO	5448-95	MW120	mg/L
Uranium	0.001	<	NO	5293-96	MW120	mg/L
Uranium	0.001	<	NO	4991-94	MW120	mg/L
Uranium	0.001	<	NO	5900-93	MW120	mg/L
Uranium	0.001	<	NO	6034-94	MW120	mg/L
Uranium	0.001	<	NO	1766-91	MW120	mg/L
Uranium	0.001	<	NO	6928-94	MW120	mg/L
Uranium	0.001	<	NO	7065-93	MW120	mg/L
Uranium	0.001	<	NO	5793-97	MW120	mg/L
Uranium	0.001	<	NO	4864-94	MW121	mg/L
Uranium	0.001	<	NO	5452-95	MW121	mg/L
Uranium	0.001	<	NO	5500-96	MW121	mg/L
Uranium	0.001	<	NO	5144-97	MW121	mg/L
Uranium	0.001	<	NO	5794-97	MW121	mg/L
Uranium	0.001	<	NO	5246-93	MW122	mg/L
Uranium	0.001	<	NO	4868-94	MW122	mg/L
Uranium	0.001	<	NO	5456-95	MW122	mg/L
Uranium	0.001	<	NO	6596-95	MW122	mg/L
Uranium	0.001	<	NO	5301-96	MW122	mg/L
Uranium	0.001	<	NO	5145-97	MW122	mg/L
Uranium	0.001	<	NO	5795-97	MW122	mg/L
Uranium	0.001	<	NO	4761-94	MW133	mg/L
Uranium	0.001	<	NO	5460-95	MW133	mg/L
Uranium	0.001	<	NO	5305-96	MW133	mg/L
Uranium	0.001	<	NO	5139-97	MW133	mg/L
Uranium	0.001	<B	NO	5789-97	MW133	mg/L
Uranium	0.001		YES	5282-93	MW133	mg/L
Uranium	0.001	<	NO	6004-93	MW140	mg/L
Uranium	0.001	<	NO	6066-93	MW140	mg/L
Uranium	0.001	<	NO	7081-93	MW140	mg/L
Uranium	0.001	<	NO	4225-94	MW140	mg/L
Uranium	0.001	<	NO	5195-94	MW140	mg/L
Uranium	0.001	<	NO	6050-94	MW140	mg/L
Uranium	0.001	<	NO	6864-94	MW140	mg/L
Uranium	0.001	<	NO	5313-96	MW140	mg/L
Uranium	0.001	<	NO	5146-97	MW140	mg/L
Uranium	0.001	<	NO	5796-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Uranium							
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001	0.001	0.001	0.001	0.001		
	0.001	0.001		0.001	0.001	0.001		
	0.001	0.001		0.001		0.001		
	0.001	0.001				0.001		
	0.001	0.001				0.001		
	0.001	0.001				0.001		
	0.001	0.001						
	0.001							
	0.001							
Min	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
Max	0.001	0.001	0.001	0.001	0.001	0.001	0.001	
Average	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Number	13	11	5	7	6	10	52	



Data for Uranium, Total were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Uranium, Dissolved		Q	NO	5619-95	MW102	
Uranium, Dissolved		Q	NO	6592-95	MW102	
Uranium, Dissolved		Q	NO	7467-95	MW102	
Uranium, Dissolved		Q	NO	8285-95	MW102	
Uranium, Dissolved		Q	NO	5281-96	MW102	
Uranium, Dissolved		Q	NO	5448-95	MW120	
Uranium, Dissolved		Q	NO	5293-96	MW120	
Uranium, Dissolved		Q	NO	5452-95	MW121	
Uranium, Dissolved		Q	NO	5500-96	MW121	
Uranium, Dissolved		Q	NO	5456-95	MW122	
Uranium, Dissolved		Q	NO	6596-95	MW122	
Uranium, Dissolved		Q	NO	5301-96	MW122	
Uranium, Dissolved		Q	NO	5460-95	MW133	
Uranium, Dissolved		Q	NO	5305-96	MW133	
Uranium, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Uranium, Dissolved							
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	
Average	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Number	0	0	0	0	0	0	0	

Uranium, Dissolved

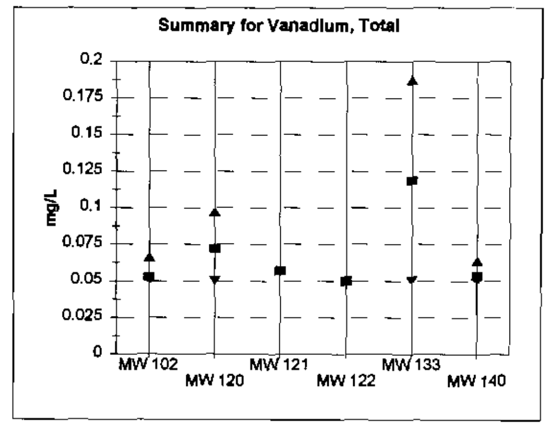
- Analysis for Uranium Dissolved was not performed for any sample; therefore, no value can be assigned to any sample. Generally, this indicates that any detection of uranium in a filtered sample exceeds the background concentration.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Vanadium	0.05	<	NO	5174-93	MW102	mg/L
Vanadium	0.05	<	NO	5183-94	MW102	mg/L
Vanadium	0.05	<	NO	6022-94	MW102	mg/L
Vanadium	0.051		YES	5940-93	MW102	mg/L
Vanadium	0.051		YES	4268-94	MW102	mg/L
Vanadium	0.051		YES	6770-94	MW102	mg/L
Vanadium	0.066		YES	7295-93	MW102	mg/L
Vanadium	0.05	<	NO	5068-93	MW120	mg/L
Vanadium	0.052		YES	4991-94	MW120	mg/L
Vanadium	0.065		YES	6034-94	MW120	mg/L
Vanadium	0.075		YES	5900-93	MW120	mg/L
Vanadium	0.08		YES	7065-93	MW120	mg/L
Vanadium	0.084		YES	6928-94	MW120	mg/L
Vanadium	0.097		YES	4209-94	MW120	mg/L
Vanadium	0.057		YES	4864-94	MW121	mg/L
Vanadium	0.636		YES	5208-93	MW121	mg/L
Vanadium	0.05	<	NO	5246-93	MW122	mg/L
Vanadium	0.05	<	NO	4868-94	MW122	mg/L
Vanadium	0.05	<	NO	5282-93	MW133	mg/L
Vanadium	0.187		YES	4761-94	MW133	mg/L
Vanadium	0.05	<	NO	6004-93	MW140	mg/L
Vanadium	0.05	<	NO	4225-94	MW140	mg/L
Vanadium	0.05	<	NO	5195-94	MW140	mg/L
Vanadium	0.053		YES	7081-93	MW140	mg/L
Vanadium	0.053		YES	6050-94	MW140	mg/L
Vanadium	0.055		YES	6864-94	MW140	mg/L
Vanadium	0.064		YES	6088-93	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Vanadium							
	0.05	0.05	0.057	0.05	0.05	0.05		
	0.05	0.052	0.057	0.05	0.187	0.05		
	0.05	0.065				0.05		
	0.051	0.075				0.053		
	0.051	0.08				0.053		
	0.051	0.084				0.055		
	0.066	0.097				0.064		
Min	0.050	0.050	0.057	0.050	0.050	0.050	0.050	
Max	0.066	0.097	0.057	0.050	0.187	0.064	0.187	
Average	0.053	0.072	0.057	0.050	0.119	0.054	0.063	0.067
Number	7	7	2	2	2	7	27	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Maximum detected value appears to be affected by turbidity of sample and was reduced to next greatest maximum detected concentration.

MW 122 - Data were not modified.

MW 133 - Maximum detected value was not related to turbidity of sample.

MW 140 - Data were not modified.

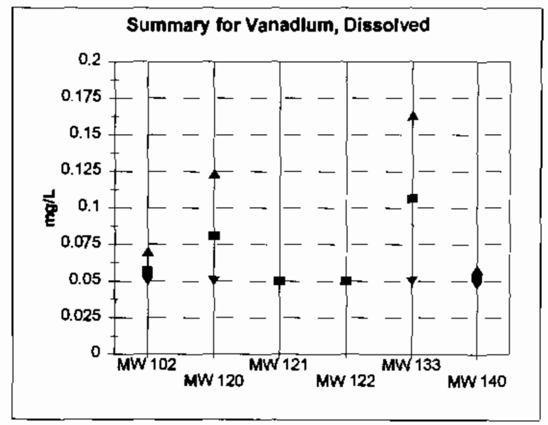
Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Vanadium, Dissolved	0.05	<	NO	5174-93	MW102	mg/L
Vanadium, Dissolved	0.05	<	NO	5940-93	MW102	mg/L
Vanadium, Dissolved	0.05	<	NO	5183-94	MW102	mg/L
Vanadium, Dissolved	0.05	<	NO	6022-94	MW102	mg/L
Vanadium, Dissolved	0.061		YES	7295-93	MW102	mg/L
Vanadium, Dissolved	0.065		YES	4268-94	MW102	mg/L
Vanadium, Dissolved	0.07		YES	6770-94	MW102	mg/L
Vanadium, Dissolved	0.052		YES	4991-94	MW120	mg/L
Vanadium, Dissolved	0.076		YES	6928-94	MW120	mg/L
Vanadium, Dissolved	0.078		YES	5900-93	MW120	mg/L
Vanadium, Dissolved	0.089		YES	6034-94	MW120	mg/L
Vanadium, Dissolved	0.097		YES	4209-94	MW120	mg/L
Vanadium, Dissolved	0.123		YES	7065-93	MW120	mg/L
Vanadium, Dissolved		Q	NO	5088-93	MW120	
Vanadium, Dissolved	0.05	<	NO	5206-93	MW121	mg/L
Vanadium, Dissolved	0.05	<	NO	4864-94	MW121	mg/L
Vanadium, Dissolved	0.05	<	NO	5246-93	MW122	mg/L
Vanadium, Dissolved	0.05	<	NO	4866-94	MW122	mg/L
Vanadium, Dissolved	0.05	<	NO	5282-93	MW133	mg/L
Vanadium, Dissolved	0.163		YES	4761-94	MW133	mg/L
Vanadium, Dissolved	0.048		YES	7081-93	MW140	mg/L
Vanadium, Dissolved	0.05	<	NO	6004-93	MW140	mg/L
Vanadium, Dissolved	0.05	<	NO	4225-94	MW140	mg/L
Vanadium, Dissolved	0.052		YES	5195-94	MW140	mg/L
Vanadium, Dissolved	0.054		YES	6088-93	MW140	mg/L
Vanadium, Dissolved	0.056		YES	6864-94	MW140	mg/L
Vanadium, Dissolved	0.058		YES	6050-94	MW140	mg/L

CORRECTED DATA SET

Vanadium, Dissolved

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	0.05	0.052	0.05	0.05	0.05	0.048		
	0.05	0.076	0.05	0.05	0.163	0.05		
	0.05	0.078				0.05		
	0.05	0.089				0.052		
	0.061	0.097				0.054		
	0.065	0.123				0.056		
	0.07	0.05				0.058		
Min	0.050	0.050	0.050	0.050	0.050	0.048	0.048	
Max	0.070	0.123	0.050	0.050	0.163	0.058	0.163	
Average	0.057	0.081	0.050	0.050	0.107	0.053	0.065	0.066
Number	7	7	2	2	2	7	27	



MW 102 - Data were not modified.

MW 120 - One "Q" qualified result assigned minimum detection limit for samples across wells.

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

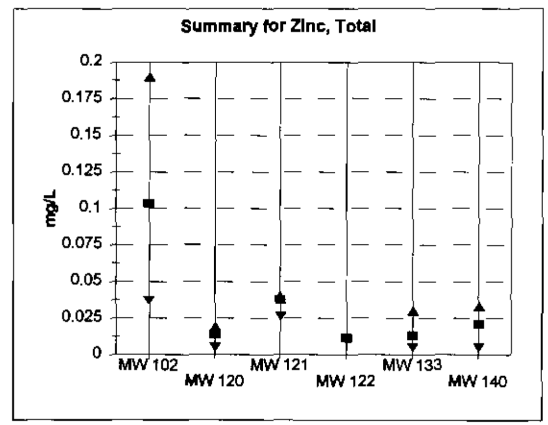
MW 140 - Data were not modified.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Zinc	0.037		YES	5940-93	MW102	mg/L
Zinc	0.04		YES	5174-93	MW102	mg/L
Zinc	0.058		YES	7467-95	MW102	mg/L
Zinc	0.071		YES	5183-94	MW102	mg/L
Zinc	0.076		YES	6022-94	MW102	mg/L
Zinc	0.088		YES	8285-95	MW102	mg/L
Zinc	0.103		YES	5281-96	MW102	mg/L
Zinc	0.109		YES	7295-93	MW102	mg/L
Zinc	0.124		YES	6770-94	MW102	mg/L
Zinc	0.125		YES	4268-94	MW102	mg/L
Zinc	0.133		YES	6592-95	MW102	mg/L
Zinc	0.19		YES	5819-95	MW102	mg/L
Zinc	0.25	<	NO	5141-97	MW102	mg/L
Zinc	0.005	<	NO	6034-94	MW120	mg/L
Zinc	0.006		YES	4991-94	MW120	mg/L
Zinc	0.007		YES	5068-93	MW120	mg/L
Zinc	0.008	<	NO	4209-94	MW120	mg/L
Zinc	0.016		YES	7065-93	MW120	mg/L
Zinc	0.019		YES	5900-93	MW120	mg/L
Zinc	0.03	<	NO	5448-95	MW120	mg/L
Zinc	0.03	<	NO	6928-94	MW120	mg/L
Zinc	0.03	B<	NO	5293-96	MW120	mg/L
Zinc	0.25	<	NO	5143-97	MW120	mg/L
Zinc	0.026		YES	4864-94	MW121	mg/L
Zinc	0.04		YES	5452-95	MW121	mg/L
Zinc	0.063	B	YES	5500-96	MW121	mg/L
Zinc	0.25	<	NO	5144-97	MW121	mg/L
Zinc	0.564		YES	5206-93	MW121	mg/L
Zinc	0.01		YES	4868-94	MW122	mg/L
Zinc	0.012		YES	5248-93	MW122	mg/L
Zinc	0.03	<	NO	5456-95	MW122	mg/L
Zinc	0.03	<	NO	5301-96	MW122	mg/L
Zinc	0.25	<	NO	5145-97	MW122	mg/L
Zinc	0.34	B	YES	6598-95	MW122	mg/L
Zinc	0.005	<	NO	5282-93	MW133	mg/L
Zinc	0.005	<	NO	4761-94	MW133	mg/L
Zinc	0.03	<	NO	5460-95	MW133	mg/L
Zinc	0.005	<	NO	5195-94	MW140	mg/L
Zinc	0.005	<	NO	6050-94	MW140	mg/L
Zinc	0.005		YES	4225-94	MW140	mg/L
Zinc	0.017		YES	6004-93	MW140	mg/L
Zinc	0.029		YES	6088-93	MW140	mg/L
Zinc	0.03	<	NO	6864-94	MW140	mg/L
Zinc	0.03	<	NO	5313-96	MW140	mg/L
Zinc	0.033		YES	7081-93	MW140	mg/L
Zinc	0.25	<	NO	5146-97	MW140	mg/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Zinc							
	0.037	0.005	0.026	0.01	0.005	0.005		
	0.04	0.006	0.04	0.012	0.005	0.005		
	0.058	0.007	0.04	0.012	0.03	0.005		
	0.071	0.008	0.04	0.012		0.017		
	0.076	0.016	0.04	0.012		0.029		
	0.088	0.019		0.012		0.03		
	0.103	0.019				0.03		
	0.109	0.019				0.033		
	0.124	0.019				0.033		
	0.125	0.019						
	0.133							
	0.19							
	0.19							
Min	0.037	0.005	0.026	0.010	0.005	0.005	0.005	
Max	0.190	0.019	0.040	0.012	0.030	0.033	0.190	
Average	0.104	0.014	0.037	0.012	0.013	0.021	0.043	0.033
Number	13	10	5	6	3	9	46	



MW 102 - One nondetect greater than maximum detected value set to maximum detected value.

MW 120 - Four nondetects greater than maximum detected value set to maximum detected value.

MW 121 - Maximum detected value appears to be releted to turbidity of sample and reduced to next greatest value; two nondetects with values greater than maximum detected value reduced to maximum detected value.

MW 122 - Maximum detected value is "B" qualified; result reduced to next greatest detected value; three nondetects greater than maximum detected value reduced to maximum detected value.

MW 133 - Data were not modified.

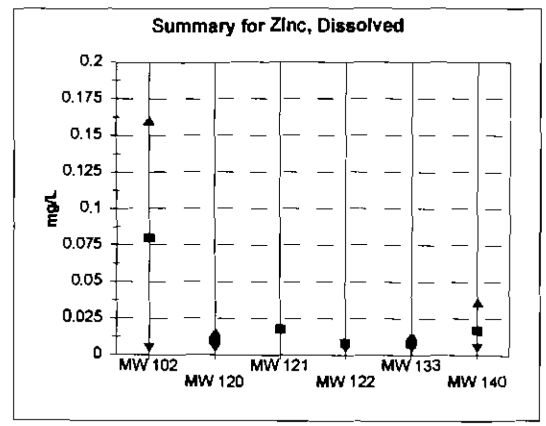
MW 140 - One nondetect with a value greater than the maximum detected value was reduced to the maximum detected value.

Summary of McNairy Background Well Inorganic Chemical Data

ANALYSIS	RESULT	QUALIFIER	DETECT?	SMPID	STATION ID	UNITS
Zinc, Dissolved	0.041		YES	5174-93	MW102	mg/L
Zinc, Dissolved	0.043		YES	5940-93	MW102	mg/L
Zinc, Dissolved	0.047		YES	5183-94	MW102	mg/L
Zinc, Dissolved	0.067		YES	7467-95	MW102	mg/L
Zinc, Dissolved	0.073		YES	8285-95	MW102	mg/L
Zinc, Dissolved	0.08		YES	8022-94	MW102	mg/L
Zinc, Dissolved	0.091		YES	7295-93	MW102	mg/L
Zinc, Dissolved	0.097		YES	6592-95	MW102	mg/L
Zinc, Dissolved	0.107		YES	6770-94	MW102	mg/L
Zinc, Dissolved	0.147		YES	4266-94	MW102	mg/L
Zinc, Dissolved	0.16		YES	5819-95	MW102	mg/L
Zinc, Dissolved		Q	NO	5281-96	MW102	
Zinc, Dissolved	0.005	<	NO	4991-94	MW120	mg/L
Zinc, Dissolved	0.005	<	NO	6034-94	MW120	mg/L
Zinc, Dissolved	0.008	<	NO	4209-94	MW120	mg/L
Zinc, Dissolved	0.008		YES	5088-93	MW120	mg/L
Zinc, Dissolved	0.01		YES	5900-93	MW120	mg/L
Zinc, Dissolved	0.015		YES	7065-93	MW120	mg/L
Zinc, Dissolved	0.03	<	NO	5448-95	MW120	mg/L
Zinc, Dissolved	0.03	<	NO	6928-94	MW120	mg/L
Zinc, Dissolved		Q	NO	5293-96	MW120	
Zinc, Dissolved	0.016		YES	4864-94	MW121	mg/L
Zinc, Dissolved	0.018		YES	5206-93	MW121	mg/L
Zinc, Dissolved	0.03	<	NO	5452-95	MW121	mg/L
Zinc, Dissolved	0.03	<	NO	5500-96	MW121	mg/L
Zinc, Dissolved	0.005	<	NO	4868-94	MW122	mg/L
Zinc, Dissolved	0.01		YES	5246-93	MW122	mg/L
Zinc, Dissolved	0.03	<	NO	5456-95	MW122	mg/L
Zinc, Dissolved	0.03	<	NO	8596-95	MW122	mg/L
Zinc, Dissolved		Q	NO	5301-96	MW122	
Zinc, Dissolved	0.005	<	NO	4761-94	MW133	mg/L
Zinc, Dissolved	0.013		YES	5282-93	MW133	mg/L
Zinc, Dissolved		Q	NO	5460-95	MW133	
Zinc, Dissolved	0.005	<	NO	6050-94	MW140	mg/L
Zinc, Dissolved	0.008		YES	5195-94	MW140	mg/L
Zinc, Dissolved	0.011		YES	6004-93	MW140	mg/L
Zinc, Dissolved	0.012		YES	4225-94	MW140	mg/L
Zinc, Dissolved	0.026		YES	8088-93	MW140	mg/L
Zinc, Dissolved	0.03	<	NO	6864-94	MW140	mg/L
Zinc, Dissolved	0.036		YES	7061-93	MW140	mg/L
Zinc, Dissolved		Q	NO	5313-96	MW140	

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Zinc, Dissolved							
	0.041	0.005	0.016	0.005	0.005	0.005		
	0.043	0.005	0.018	0.01	0.013	0.008		
	0.047	0.008	0.018	0.01	0.005	0.011		
	0.067	0.008	0.018	0.01		0.012		
	0.073	0.01		0.005		0.026		
	0.08	0.015				0.03		
	0.091	0.015				0.036		
	0.097	0.015				0.005		
	0.107	0.005						
	0.147							
	0.16	.						
	0.005							
Min	0.005	0.005	0.016	0.005	0.005	0.005	0.005	
Max	0.160	0.015	0.018	0.010	0.013	0.036	0.160	
Average	0.080	0.010	0.018	0.006	0.006	0.017	0.032	0.023
Number	12	9	4	5	3	8	41	



MW 102 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 120 - One "Q" qualified result assigned minimum detection limit across all wells; two nondetects with values greater than the maximum detected value reduced to maximum detected value.

MW 121 - Two nondetects with values greater than the maximum detected value reduced to maximum detected value.

MW 122 - One "Q" qualified result assigned minimum detection limit across all wells; two nondetects with values greater than maximum detected value reduced to maximum detected value.

MW 133 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

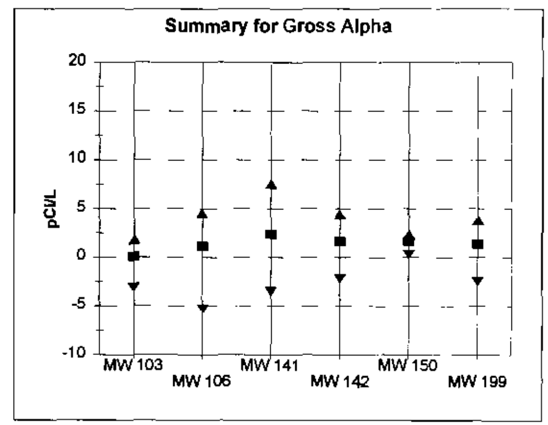
MW 140 - One "Q" qualified result assigned the minimum detection limit for samples from this well.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Alpha	-3.1	1.5		YES	7299-93	MW103	pCi/L
Gross Alpha	-1.4	0.9		YES	5944-93	MW103	pCi/L
Gross Alpha	-0.6	0		YES	5178-93	MW103	pCi/L
Gross Alpha	-0.2	0.1		YES	4272-94	MW103	pCi/L
Gross Alpha	0.4	0.7		YES	5187-94	MW103	pCi/L
Gross Alpha	0.7	0.4		YES	5142-97	MW103	pCi/L
Gross Alpha	0.8	0.5		YES	8774-94	MW103	pCi/L
Gross Alpha	1	0.6		YES	6026-94	MW103	pCi/L
Gross Alpha	1.5	0.9		YES	5440-95	MW103	pCi/L
Gross Alpha	1.8	1.1		YES	5285-96	MW103	pCi/L
Gross Alpha	-5.3	2.6		YES	6579-93	MW106	pCi/L
Gross Alpha	0.3	0.7		YES	4697-94	MW106	pCi/L
Gross Alpha	0.5	0.2		YES	5136-97	MW106	pCi/L
Gross Alpha	0.7	0.6		YES	7272-94	MW106	pCi/L
Gross Alpha	0.8	0.7		YES	5444-95	MW106	pCi/L
Gross Alpha	0.8	0.7		YES	6640-94	MW106	pCi/L
Gross Alpha	1.2	0.6		YES	6782-94	MW106	pCi/L
Gross Alpha	1.3	0.8		YES	5513-94	MW106	pCi/L
Gross Alpha	2	1		YES	5788-97	MW106	pCi/L
Gross Alpha	2.3	1.4		YES	5289-96	MW106	pCi/L
Gross Alpha	4.5	2.5		YES	7862-93	MW106	pCi/L
Gross Alpha	7.9	3		YES	5322-93	MW106	pCi/L
Gross Alpha	-3.5	1.8		YES	7085-93	MW141	pCi/L
Gross Alpha	0.7	0		YES	6092-93	MW141	pCi/L
Gross Alpha	1.2	0.8		YES	6054-94	MW141	pCi/L
Gross Alpha	1.2	0.7		YES	6868-94	MW141	pCi/L
Gross Alpha	2.3	1		YES	5199-94	MW141	pCi/L
Gross Alpha	7.1	2.7		YES	4229-94	MW141	pCi/L
Gross Alpha	7.5	3		YES	6080-93	MW141	pCi/L
Gross Alpha	-2.2	0.8		YES	7089-93	MW142	pCi/L
Gross Alpha	0.1	0.7		YES	5203-94	MW142	pCi/L
Gross Alpha	0.9	0.7		YES	5464-95	MW142	pCi/L
Gross Alpha	0.9	0.6		YES	6872-94	MW142	pCi/L
Gross Alpha	1.4	0.7		YES	5797-97	MW142	pCi/L
Gross Alpha	1.7	0		YES	6084-93	MW142	pCi/L
Gross Alpha	1.9	0.9		YES	5147-97	MW142	pCi/L
Gross Alpha	2.2	1		YES	6058-94	MW142	pCi/L
Gross Alpha	2.8	1.3		YES	4233-94	MW142	pCi/L
Gross Alpha	3.7	1		YES	6096-93	MW142	pCi/L
Gross Alpha	4.4	2.2		YES	5317-96	MW142	pCi/L
Gross Alpha	-7.6	3.7		YES	6764-93	MW150	pCi/L
Gross Alpha	-3.2	1.6		YES	7724-93	MW150	pCi/L
Gross Alpha	0.3	0.8		YES	5576-94	MW150	pCi/L
Gross Alpha	0.9	0.9		YES	7366-94	MW150	pCi/L
Gross Alpha	1.3	0.9		YES	5466-95	MW150	pCi/L
Gross Alpha	1.5	1		YES	6501-94	MW150	pCi/L
Gross Alpha	2	1.5		YES	5321-96	MW150	pCi/L
Gross Alpha	2.2	1.2		YES	4789-94	MW150	pCi/L
Gross Alpha	2.3	1		YES	5650-93	MW150	pCi/L
Gross Alpha	16.8	7		YES	5148-97	MW150	pCi/L
Gross Alpha	-2.5	1.1		YES	7311-93	MW199	pCi/L
Gross Alpha	-0.3	0.2		YES	5984-93	MW199	pCi/L
Gross Alpha	0.7	0.8		YES	6688-94	MW199	pCi/L
Gross Alpha	1.2	0.9		YES	6074-94	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
Gross Alpha								
	-3.1	-5.3	-3.5	-2.2	0.3	-2.5		
	-1.4	0.3	0.7	0.1	0.9	-0.3		
	-0.6	0.5	1.2	0.9	1.3	0.7		
	-0.2	0.7	1.2	0.9	1.5	1.2		
	0.4	0.8	2.3	1.4	2	1.6		
	0.7	0.8	7.1	1.7	2.2	2.6		
	0.8	1.2	7.5	1.9	2.3	3.8		
	1	1.3		2.2	2.3	3.8		
	1.5	2		2.8				
	1.8	2.3		3.7				
		4.5		4.4				
		4.5						
Min	-3.10	-5.30	-3.50	-2.20	0.30	-2.50	-5.30	
Max	1.80	4.50	7.50	4.40	2.30	3.80	7.50	
Average	0.09	1.13	2.36	1.62	1.60	1.36	1.29	1.36
Number	10	12	7	11	8	8	56	



MW 103 - Data were not modified.

MW 106 - Maximum detected value was related to turbidity of sample; result was reduced to next greatest detected value.

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Maximum detected value was related to turbidity of sample; result was reduced to next greatest detected value.

MW 199 - Maximum detected value was related to turbidity of sample; result was reduced to next greatest detected value.

Summary of RGA Background Wells Radionuclide Data

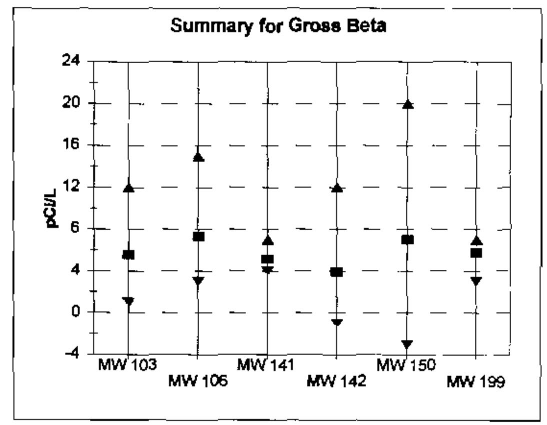
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Alpha	1.6	0.9		YES	4312-94	MW199	pCi/L
Gross Alpha	2.6	1.1		YES	5260-94	MW199	pCi/L
Gross Alpha	3.6	1.3		YES	5558-97	MW199	pCi/L
Gross Alpha	9.9	3		YES	5170-93	MW199	pCi/L

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Beta	1	0		YES	5142-97	MW103	pCi/L
Gross Beta	3	2		YES	6026-94	MW103	pCi/L
Gross Beta	3	1		YES	5178-93	MW103	pCi/L
Gross Beta	4	1		YES	6774-94	MW103	pCi/L
Gross Beta	4	1		YES	5944-93	MW103	pCi/L
Gross Beta	6	3		YES	5440-95	MW103	pCi/L
Gross Beta	6	2		YES	5167-94	MW103	pCi/L
Gross Beta	7	2		YES	4272-94	MW103	pCi/L
Gross Beta	10	2		YES	7299-93	MW103	pCi/L
Gross Beta	12	2		YES	5265-96	MW103	pCi/L
Gross Beta	3	1		YES	6579-93	MW106	pCi/L
Gross Beta	4	2		YES	6762-94	MW106	pCi/L
Gross Beta	4	1		YES	5322-93	MW106	pCi/L
Gross Beta	6	1		YES	5136-97	MW106	pCi/L
Gross Beta	6	2		YES	5444-95	MW106	pCi/L
Gross Beta	6	3		YES	5513-94	MW106	pCi/L
Gross Beta	6	1		YES	5788-97	MW106	pCi/L
Gross Beta	7	2		YES	6640-94	MW106	pCi/L
Gross Beta	9	4		YES	7272-94	MW106	pCi/L
Gross Beta	11	2		YES	7862-93	MW106	pCi/L
Gross Beta	11	3		YES	4697-94	MW106	pCi/L
Gross Beta	15	3		YES	5289-96	MW106	pCi/L
Gross Beta	4	1		YES	6060-93	MW141	pCi/L
Gross Beta	4	2		YES	5199-94	MW141	pCi/L
Gross Beta	5	2		YES	6668-94	MW141	pCi/L
Gross Beta	5	1		YES	7085-93	MW141	pCi/L
Gross Beta	5	1		YES	6092-93	MW141	pCi/L
Gross Beta	6	1		YES	4229-94	MW141	pCi/L
Gross Beta	7	3		YES	6054-94	MW141	pCi/L
Gross Beta	-1	0		YES	5797-97	MW142	pCi/L
Gross Beta	-1	0		YES	5147-97	MW142	pCi/L
Gross Beta	0	0		NO	4233-94	MW142	pCi/L
Gross Beta	3	1		YES	5464-95	MW142	pCi/L
Gross Beta	3	1		YES	6672-94	MW142	pCi/L
Gross Beta	3	2		YES	5203-94	MW142	pCi/L
Gross Beta	4	1		YES	6096-93	MW142	pCi/L
Gross Beta	5	1		YES	6084-93	MW142	pCi/L
Gross Beta	7	2		YES	7089-93	MW142	pCi/L
Gross Beta	8	3		YES	6058-94	MW142	pCi/L
Gross Beta	12	3		YES	5317-96	MW142	pCi/L
Gross Beta	-3	1		YES	6764-93	MW150	pCi/L
Gross Beta	2	1		YES	5578-94	MW150	pCi/L
Gross Beta	3	1		YES	5650-93	MW150	pCi/L
Gross Beta	4	1		YES	6501-94	MW150	pCi/L
Gross Beta	5	2		YES	5468-95	MW150	pCi/L
Gross Beta	7	1		YES	7724-93	MW150	pCi/L
Gross Beta	6	3		YES	7366-94	MW150	pCi/L
Gross Beta	10	3		YES	5321-96	MW150	pCi/L
Gross Beta	14	2		YES	5146-97	MW150	pCi/L
Gross Beta	20	7		YES	4769-94	MW150	pCi/L
Gross Beta	3	2		YES	6074-94	MW199	pCi/L
Gross Beta	5	1		YES	5984-93	MW199	pCi/L
Gross Beta	5	2		YES	6868-94	MW199	pCi/L
Gross Beta	6	3		YES	5260-94	MW199	pCi/L
Gross Beta	6	1		YES	7311-93	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Gross Beta							
	1	3	4	-1	-3	3		
	3	4	4	-1	2	5		
	3	4	5	0	3	5		
	4	6	5	3	4	6		
	4	6	5	3	5	6		
	6	6	6	3	7	7		
	6	6	7	4	8	7		
	7	7		5	10	7		
	10	9		7	14			
	12	11		8	20			
		11		12				
		15						
Min	1.00	3.00	4.00	-1.00	-3.00	3.00	-3.00	
Max	12.00	15.00	7.00	12.00	20.00	7.00	20.00	
Average	5.60	7.33	5.14	3.91	7.00	5.75	5.84	5.79
Number	10	12	7	11	10	8	58	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

MW 199 - Two greatest detected values appear to be related to turbidity of sample; values were reduced to next greatest value.

Summary of RGA Background Wells Radionuclide Data

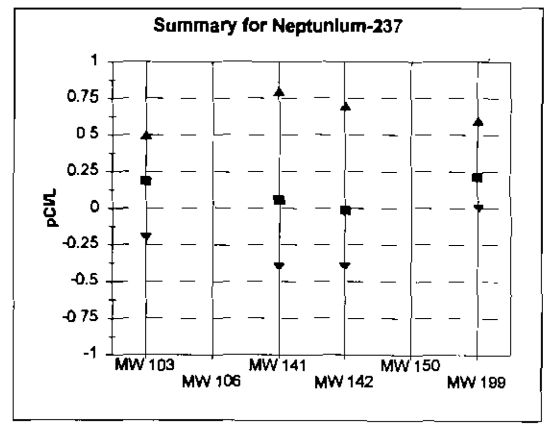
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Beta	7	3		YES	4312-94	MW199	pCi/L
Gross Beta	20	4		YES	5170-93	MW199	pCi/L
Gross Beta	36	4		YES	5558-97	MW199	pCi/L

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Neptunium-237	-0.2	0		YES	5178-93	MW103	pCi/L
Neptunium-237	0.1	0.1		YES	6774-94	MW103	pCi/L
Neptunium-237	0.1	0.1		YES	7299-93	MW103	pCi/L
Neptunium-237	0.2	0.1		YES	5944-93	MW103	pCi/L
Neptunium-237	0.3	0.1		YES	6026-94	MW103	pCi/L
Neptunium-237	0.3	0.2		YES	5187-94	MW103	pCi/L
Neptunium-237	0.5	0.2		YES	4272-94	MW103	pCi/L
Neptunium-237	-0.4	0		YES	6092-93	MW141	pCi/L
Neptunium-237	-0.3	0.3		YES	7085-93	MW141	pCi/L
Neptunium-237	-0.1	0		YES	6054-94	MW141	pCi/L
Neptunium-237	0	0		NO	5199-94	MW141	pCi/L
Neptunium-237	0.2	0.1		YES	6868-94	MW141	pCi/L
Neptunium-237	0.2	0.1		YES	4229-94	MW141	pCi/L
Neptunium-237	0.8	0		YES	6060-93	MW141	pCi/L
Neptunium-237	-0.4	0.2		YES	6058-94	MW142	pCi/L
Neptunium-237	-0.3	0.2		YES	5203-94	MW142	pCi/L
Neptunium-237	-0.3	0		YES	6096-93	MW142	pCi/L
Neptunium-237	-0.1	0.1		YES	7089-93	MW142	pCi/L
Neptunium-237	0.1	0.1		YES	4233-94	MW142	pCi/L
Neptunium-237	0.2	0		YES	6084-93	MW142	pCi/L
Neptunium-237	0.7	0.3		YES	6672-94	MW142	pCi/L
Neptunium-237	0	0		NO	6074-94	MW199	pCi/L
Neptunium-237	0	0		NO	4312-94	MW199	pCi/L
Neptunium-237	0.1	0		YES	5170-93	MW199	pCi/L
Neptunium-237	0.1	0.1		YES	7311-93	MW199	pCi/L
Neptunium-237	0.2	0.1		YES	5260-94	MW199	pCi/L
Neptunium-237	0.5	0.2		YES	6888-94	MW199	pCi/L
Neptunium-237	0.6	0.3		YES	5984-93	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Neptunium-237							
	-0.2		-0.4	-0.4		0		
	0.1		-0.3	-0.3		0		
	0.1		-0.1	-0.3		0.1		
	0.2		0	-0.1		0.1		
	0.3		0.2	0.1		0.2		
	0.3		0.2	0.2		0.5		
	0.5		0.8	0.7		0.6		
Min	-0.20	ERR	-0.40	-0.40	ERR	0.00	-0.40	
Max	0.50	ERR	0.80	0.70	ERR	0.60	0.80	
Average	0.19	ERR	0.06	-0.01	ERR	0.21	0.11	0.11
Number	7	0	7	7	0	7	28	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

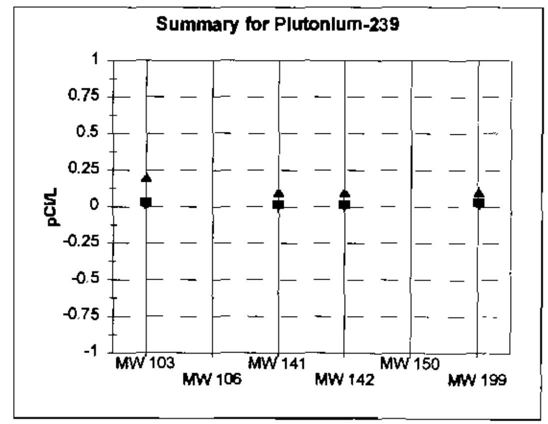
MW 199 - Data were not modified.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Plutonium-239	0	0		NO	5944-93	MW103	pCi/L
Plutonium-239	0	0		NO	6774-94	MW103	pCi/L
Plutonium-239	0	0		NO	7299-93	MW103	pCi/L
Plutonium-239	0	0		NO	4272-94	MW103	pCi/L
Plutonium-239	0	0		NO	6026-94	MW103	pCi/L
Plutonium-239	0	0		NO	5167-94	MW103	pCi/L
Plutonium-239	0.2	0		YES	5178-93	MW103	pCi/L
Plutonium-239	0	0		NO	4229-94	MW141	pCi/L
Plutonium-239	0	0		NO	6054-94	MW141	pCi/L
Plutonium-239	0	0		NO	7085-93	MW141	pCi/L
Plutonium-239	0	0		NO	6868-94	MW141	pCi/L
Plutonium-239	0	0		NO	5199-94	MW141	pCi/L
Plutonium-239	0	0		NO	8092-93	MW141	pCi/L
Plutonium-239	0.1	0		YES	8080-93	MW141	pCi/L
Plutonium-239	0	0		NO	8872-94	MW142	pCi/L
Plutonium-239	0	0		NO	5203-94	MW142	pCi/L
Plutonium-239	0	0		NO	7089-93	MW142	pCi/L
Plutonium-239	0	0		NO	4233-94	MW142	pCi/L
Plutonium-239	0	0		NO	6098-93	MW142	pCi/L
Plutonium-239	0	0		NO	6058-94	MW142	pCi/L
Plutonium-239	0.1	0		YES	6084-93	MW142	pCi/L
Plutonium-239	0	0		NO	7311-93	MW199	pCi/L
Plutonium-239	0	0		NO	8888-94	MW199	pCi/L
Plutonium-239	0	0		NO	6074-94	MW199	pCi/L
Plutonium-239	0	0		NO	5260-94	MW199	pCi/L
Plutonium-239	0	0		NO	4312-94	MW199	pCi/L
Plutonium-239	0.1	0		YES	5170-93	MW199	pCi/L
Plutonium-239	0.1	0.1		YES	5984-93	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Plutonium-239							
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0		0	0		0.1		
	0.2		0.1	0.1		0.1		
Min	0.00	ERR	0.00	0.00	ERR	0.00	0.00	
Max	0.20	ERR	0.10	0.10	ERR	0.10	0.20	
Average	0.03	ERR	0.01	0.01	ERR	0.03	0.02	0.02
Number	7	0	7	7	0	7	28	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

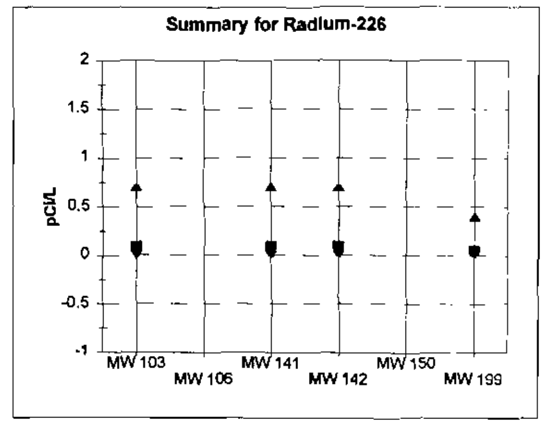
MW 199 - Data were not modified.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Radium-226	0			NO	6774-94	MW103	pCi/L
Radium-226	0			NO	4272-94	MW103	pCi/L
Radium-226	0			NO	6026-94	MW103	pCi/L
Radium-226	0			NO	7299-93	MW103	pCi/L
Radium-226	0			NO	5187-94	MW103	pCi/L
Radium-226	0.7	0		YES	5176-93	MW103	pCi/L
Radium-226			Q	NO	5944-93	MW103	pCi/L
Radium-226	0			NO	5199-94	MW141	pCi/L
Radium-226	0	0.1		YES	6092-93	MW141	pCi/L
Radium-226	0			NO	6054-94	MW141	pCi/L
Radium-226	0			NO	7085-93	MW141	pCi/L
Radium-226	0			NO	6668-94	MW141	pCi/L
Radium-226	0			NO	4229-94	MW141	pCi/L
Radium-226	0.7	0		YES	6060-93	MW141	pCi/L
Radium-226	0			NO	6872-94	MW142	pCi/L
Radium-226	0			NO	7089-93	MW142	pCi/L
Radium-226	0			NO	6056-94	MW142	pCi/L
Radium-226	0			NO	5203-94	MW142	pCi/L
Radium-226	0	0		NO	6096-93	MW142	pCi/L
Radium-226	0			NO	4233-94	MW142	pCi/L
Radium-226	0.7	0		YES	6084-93	MW142	pCi/L
Radium-226	0			NO	4312-94	MW199	pCi/L
Radium-226	0			NO	6886-94	MW199	pCi/L
Radium-226	0			NO	6074-94	MW199	pCi/L
Radium-226	0			NO	5260-94	MW199	pCi/L
Radium-226	0			NO	7311-93	MW199	pCi/L
Radium-226	0.4	0		YES	5170-93	MW199	pCi/L
Radium-226			Q	NO	5984-93	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Radium-226							
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0		0	0		0		
	0.7		0	0		0.4		
	0		0.7	0.7		0		
Min	0.00	ERR	0.00	0.00	ERR	0.00	0.00	
Max	0.70	ERR	0.70	0.70	ERR	0.40	0.70	
Average	0.10	ERR	0.10	0.10	ERR	0.06	0.09	0.09
Number	7	0	7	7	0	7	28	



MW 103 - One "Q" qualified result was assigned the minimum detection limit for samples from this well.

MW 106 - Data were not modified

MW 141 - Data were not modified

MW 142 - Data were not modified.

MW 150 - Data were not modified.

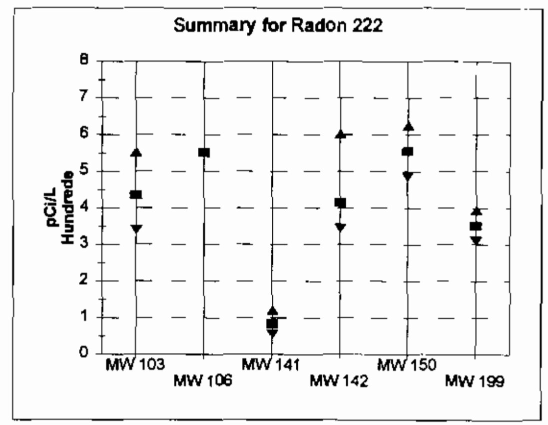
MW 199 - One "Q" qualified result was assigned the minimum detection limit for samples from this well.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Radon 222	340	63		YES	7299-93	MW103	pCi/L
Radon 222	403	64		YES	5944-93	MW103	pCi/L
Radon 222	417	64		YES	6026-94	MW103	pCi/L
Radon 222	424	64		YES	5142-97	MW103	pCi/L
Radon 222	424	52		YES	5178-93	MW103	pCi/L
Radon 222	426	91		YES	6774-94	MW103	pCi/L
Radon 222	433	57		YES	5285-96	MW103	pCi/L
Radon 222	436	67		YES	4272-94	MW103	pCi/L
Radon 222	481	81		YES	5187-94	MW103	pCi/L
Radon 222	552	74		YES	5440-95	MW103	pCi/L
Radon 222	422	68		YES	5444-95	MW106	pCi/L
Radon 222	55	58		YES	4229-94	MW141	pCi/L
Radon 222	58	39		YES	6092-93	MW141	pCi/L
Radon 222	60	50		YES	7085-93	MW141	pCi/L
Radon 222	94	66		YES	5199-94	MW141	pCi/L
Radon 222	95	61		YES	8054-94	MW141	pCi/L
Radon 222	96	40		YES	6080-93	MW141	pCi/L
Radon 222	120	56		YES	6868-94	MW141	pCi/L
Radon 222	344	54		YES	8084-93	MW142	pCi/L
Radon 222	346	61		YES	5147-97	MW142	pCi/L
Radon 222	362	61		YES	7089-93	MW142	pCi/L
Radon 222	370	57		YES	6096-93	MW142	pCi/L
Radon 222	374	65		YES	5464-95	MW142	pCi/L
Radon 222	375	88		YES	4233-94	MW142	pCi/L
Radon 222	424	62		YES	6672-94	MW142	pCi/L
Radon 222	464	71		YES	5203-94	MW142	pCi/L
Radon 222	483	72		YES	6058-94	MW142	pCi/L
Radon 222	802	73		YES	5317-98	MW142	pCi/L
Radon 222	488	54		YES	5321-96	MW150	pCi/L
Radon 222	554	81		YES	5468-95	MW150	pCi/L
Radon 222	626	71		YES	5148-97	MW150	pCi/L
Radon 222	310	65		YES	4312-94	MW199	pCi/L
Radon 222	326	61		YES	7311-93	MW199	pCi/L
Radon 222	326	63		YES	5964-93	MW199	pCi/L
Radon 222	338	60		YES	6074-94	MW199	pCi/L
Radon 222	364	71		YES	5556-97	MW199	pCi/L
Radon 222	371	76		YES	5260-94	MW199	pCi/L
Radon 222	379	82		YES	6888-94	MW199	pCi/L
Radon 222	393	61		YES	5170-93	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Radon 222							
	340	552	55	344	486	310		
	403		58	346	554	326		
	417		80	382	826	326		
	424		94	370		338		
	424		95	374		364		
	428		96	375		371		
	433		120	424		379		
	436			464		393		
	481			483				
	552			802				
Min	340.0	552.0	55.0	344.0	486.0	310.0	55.0	
Max	552.0	552.0	120.0	602.0	626.0	393.0	628.0	
Average	433.8	552.0	82.6	414.4	555.3	351.1	381.2	398.2
Number	10	1	7	10	3	8	39	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

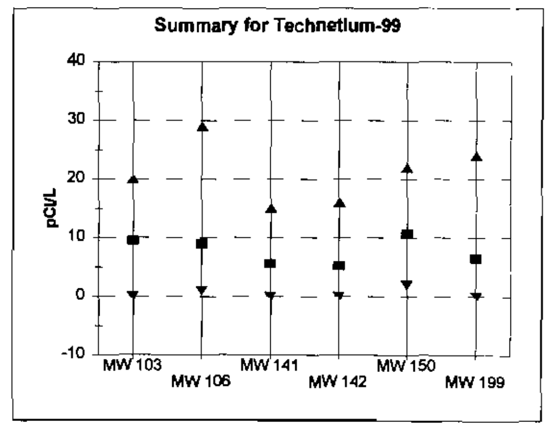
MW 199 - Data were not modified.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Technetium-99	0	0		NO	5187-94	MW103	pCi/L
Technetium-99	4	18		YES	5440-95	MW103	pCi/L
Technetium-99	4	11		YES	5142-97	MW103	pCi/L
Technetium-99	5	11		YES	5372-97	MW103	pCi/L
Technetium-99	5	93		YES	5178-93	MW103	pCi/L
Technetium-99	10	45		YES	4272-94	MW103	pCi/L
Technetium-99	12	19		YES	7299-93	MW103	pCi/L
Technetium-99	13	34		YES	5944-93	MW103	pCi/L
Technetium-99	13	10		YES	5265-96	MW103	pCi/L
Technetium-99	18	20		YES	6774-94	MW103	pCi/L
Technetium-99	20	18		YES	6028-94	MW103	pCi/L
Technetium-99	1	2		YES	8640-94	MW108	pCi/L
Technetium-99	1	10		YES	5289-96	MW106	pCi/L
Technetium-99	3	8		YES	4697-94	MW108	pCi/L
Technetium-99	5	7		YES	5444-95	MW108	pCi/L
Technetium-99	5	17		YES	8782-94	MW106	pCi/L
Technetium-99	5	11		YES	5138-97	MW108	pCi/L
Technetium-99	6	12		YES	5788-97	MW108	pCi/L
Technetium-99	7	6		YES	7272-94	MW106	pCi/L
Technetium-99	10	24		YES	7862-93	MW106	pCi/L
Technetium-99	11	21		YES	5513-94	MW106	pCi/L
Technetium-99	25	19		YES	6579-93	MW108	pCi/L
Technetium-99	29	23		YES	5322-93	MW108	pCi/L
Technetium-99	0	14		YES	6054-94	MW141	pCi/L
Technetium-99	0	0		NO	5199-94	MW141	pCi/L
Technetium-99	1	3		YES	8092-93	MW141	pCi/L
Technetium-99	7	33		YES	7085-93	MW141	pCi/L
Technetium-99	8	24		YES	8868-94	MW141	pCi/L
Technetium-99	8	35		YES	8080-93	MW141	pCi/L
Technetium-99	15	20		YES	4229-94	MW141	pCi/L
Technetium-99	0	0		NO	5203-94	MW142	pCi/L
Technetium-99	0	16		YES	6096-93	MW142	pCi/L
Technetium-99	0	13		YES	7089-93	MW142	pCi/L
Technetium-99	0	0		NO	5147-97	MW142	pCi/L
Technetium-99	1	1		YES	6058-94	MW142	pCi/L
Technetium-99	3	10		YES	5317-98	MW142	pCi/L
Technetium-99	8	17		YES	8672-94	MW142	pCi/L
Technetium-99	9	8		YES	8084-93	MW142	pCi/L
Technetium-99	10	12		YES	5797-97	MW142	pCi/L
Technetium-99	10	19		YES	4233-94	MW142	pCi/L
Technetium-99	16	19		YES	5464-95	MW142	pCi/L
Technetium-99	2	4		YES	4789-94	MW150	pCi/L
Technetium-99	4	8		YES	6501-94	MW150	pCi/L
Technetium-99	4	11		YES	5148-97	MW150	pCi/L
Technetium-99	6	10		YES	5321-96	MW150	pCi/L
Technetium-99	8	42		YES	5578-94	MW150	pCi/L
Technetium-99	10	18		YES	7724-93	MW150	pCi/L
Technetium-99	15	21		YES	7366-94	MW150	pCi/L
Technetium-99	18	19		YES	8764-93	MW150	pCi/L
Technetium-99	19	20		YES	5650-93	MW150	pCi/L
Technetium-99	22	19		YES	5468-95	MW150	pCi/L
Technetium-99	0	0		NO	4312-94	MW199	pCi/L
Technetium-99	0	14		YES	5964-93	MW199	pCi/L
Technetium-99	3	12		YES	5556-97	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Technetium-99							
	0	1	0	0	2	0		
	4	1	0	0	4	0		
	4	3	1	0	4	3		
	5	5	7	0	6	4		
	5	5	8	1	8	4		
	10	5	8	3	10	7		
	12	6	15	8	15	10		
	13	7		9	18	24		
	13	10		10	19			
	18	11		10	22			
	20	25		18				
		29						
Min	0.00	1.00	0.00	0.00	2.00	0.00	0.00	
Max	20.00	29.00	15.00	18.00	22.00	24.00	29.00	
Average	9.45	9.00	5.57	5.18	10.80	6.50	7.93	7.75
Number	11	12	7	11	10	8	59	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

MW 199 - Data were not modified.

Summary of RGA Background Wells Radionuclide Data

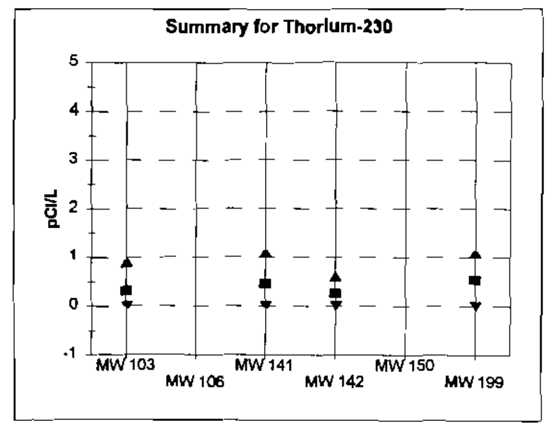
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Technetium-99	4	6		YES	5170-93	MW199	pCi/L
Technetium-99	4	21		YES	5260-94	MW199	pCi/L
Technetium-99	7	20		YES	7311-93	MW199	pCi/L
Technetium-99	10	18		YES	6888-94	MW199	pCi/L
Technetium-99	24	20		YES	8074-94	MW199	pCi/L

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Thorium-230	0	0.1		YES	6774-94	MW103	pCi/L
Thorium-230	0.1	0.1		YES	7299-93	MW103	pCi/L
Thorium-230	0.1	0		YES	6026-94	MW103	pCi/L
Thorium-230	0.2	0.2		YES	5944-93	MW103	pCi/L
Thorium-230	0.3	0.1		YES	4272-94	MW103	pCi/L
Thorium-230	0.6	0		YES	5178-93	MW103	pCi/L
Thorium-230	0.9	0.2		YES	5187-94	MW103	pCi/L
Thorium-230	0	0		NO	6868-94	MW141	pCi/L
Thorium-230	0	0		NO	7085-93	MW141	pCi/L
Thorium-230	0.1	0		YES	6054-94	MW141	pCi/L
Thorium-230	0.5	0.2		YES	4229-94	MW141	pCi/L
Thorium-230	0.6	0		YES	6080-93	MW141	pCi/L
Thorium-230	0.9	0.2		YES	5199-94	MW141	pCi/L
Thorium-230	1.1	0		YES	6092-93	MW141	pCi/L
Thorium-230	0	0		NO	7089-93	MW142	pCi/L
Thorium-230	0.1	0.1		YES	5203-94	MW142	pCi/L
Thorium-230	0.1	0.1		YES	6672-94	MW142	pCi/L
Thorium-230	0.1	0		YES	6058-94	MW142	pCi/L
Thorium-230	0.3	0.1		YES	4233-94	MW142	pCi/L
Thorium-230	0.6	0		YES	6098-93	MW142	pCi/L
Thorium-230	0.6	0		YES	6084-93	MW142	pCi/L
Thorium-230	0	0		NO	6074-94	MW199	pCi/L
Thorium-230	0.1	0		YES	6886-94	MW199	pCi/L
Thorium-230	0.2	0.1		YES	7311-93	MW199	pCi/L
Thorium-230	0.5	0.3		YES	5984-93	MW199	pCi/L
Thorium-230	0.9	0.2		YES	4312-94	MW199	pCi/L
Thorium-230	1	0		YES	5170-93	MW199	pCi/L
Thorium-230	1.1	0.2		YES	5260-94	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Thorium-230							
	0		0	0		0		
	0.1		0	0.1		0.1		
	0.1		0.1	0.1		0.2		
	0.2		0.5	0.1		0.5		
	0.3		0.6	0.3		0.9		
	0.6		0.9	0.6		1		
	0.9		1.1	0.6		1.1		
Min	0.00	ERR	0.00	0.00	ERR	0.00	0.00	
Max	0.90	ERR	1.10	0.60	ERR	1.10	1.10	
Average	0.31	ERR	0.46	0.26	ERR	0.54	0.39	0.39
Number	7	0	7	7	0	7	28	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

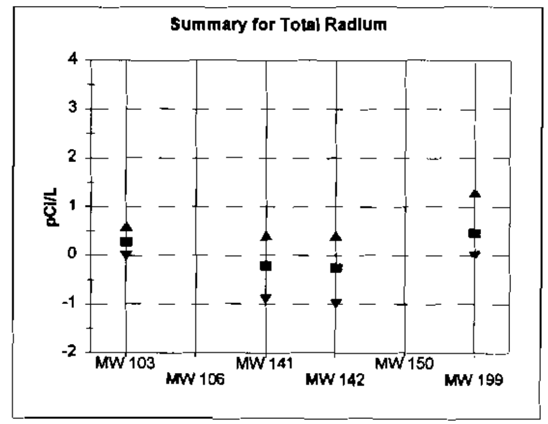
MW 199 - Data were not modified.

Summary of RGA Background Wells Radionuclide Data

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Radium	0	0		NO	6026-94	MW103	pCi/L
Total Radium	0.1	0.1		YES	6774-94	MW103	pCi/L
Total Radium	0.2	0.1		YES	7299-93	MW103	pCi/L
Total Radium	0.5	0.1		YES	5187-94	MW103	pCi/L
Total Radium	0.6	0.1		YES	4272-94	MW103	pCi/L
Total Radium	-0.9	0		YES	6868-94	MW141	pCi/L
Total Radium	-0.6	0		YES	6054-94	MW141	pCi/L
Total Radium	0	0.2		YES	7065-93	MW141	pCi/L
Total Radium	0.2	0.1		YES	5199-94	MW141	pCi/L
Total Radium	0.4	0.1		YES	4229-94	MW141	pCi/L
Total Radium	-1	0		YES	6872-94	MW142	pCi/L
Total Radium	-1	0		YES	6058-94	MW142	pCi/L
Total Radium	0	0		NO	7089-93	MW142	pCi/L
Total Radium	0.3	0.1		YES	5203-94	MW142	pCi/L
Total Radium	0.4	0.1		YES	4233-94	MW142	pCi/L
Total Radium	0	0		NO	7311-93	MW199	pCi/L
Total Radium	0.2	0.1		YES	6868-94	MW199	pCi/L
Total Radium	0.4	0.1		YES	4312-94	MW199	pCi/L
Total Radium	0.4	0.1		YES	5260-94	MW199	pCi/L
Total Radium	1.3	0.5		YES	6074-94	MW199	pCi/L

CORRECTED DATA SET

	MW 103	MW 106	MW 141	MW 142	MW 150	MW 199	Overall	Weighted
	Total Radium							
	0		-0.9	-1		0		
	0.1		-0.6	-1		0.2		
	0.2		0	0		0.4		
	0.5		0.2	0.3		0.4		
	0.6		0.4	0.4		1.3		
Min	0.00	ERR	-0.90	-1.00	ERR	0.00	-1.00	
Max	0.60	ERR	0.40	0.40	ERR	1.30	1.30	
Average	0.28	ERR	-0.22	-0.26	ERR	0.46	0.07	0.06
Number	5	0	5	5	0	5	20	



MW 103 - Data were not modified.

MW 106 - Data were not modified

MW 141 - Data were not modified.

MW 142 - Data were not modified.

MW 150 - Data were not modified.

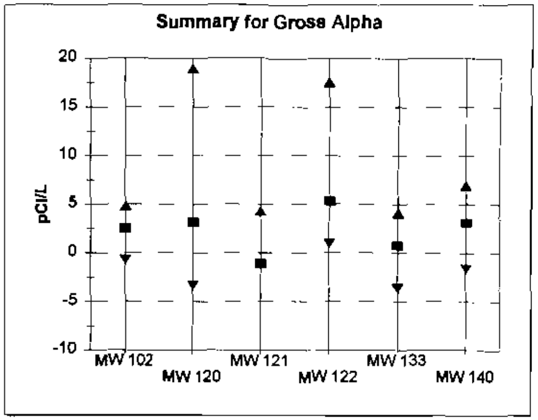
MW 199 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Alpha	-0.7	-0.4		YES	6285-95	MW102	pCi/L
Gross Alpha	0	0		NO	7295-93	MW102	pCi/L
Gross Alpha	1.8	0.8		YES	6770-94	MW102	pCi/L
Gross Alpha	2.2	1		YES	6022-94	MW102	pCi/L
Gross Alpha	2.2	0.9		YES	5183-94	MW102	pCi/L
Gross Alpha	2.3	0.9		YES	4266-94	MW102	pCi/L
Gross Alpha	2.4	1.4		YES	5619-95	MW102	pCi/L
Gross Alpha	2.8	1		YES	5174-93	MW102	pCi/L
Gross Alpha	3.3	1.3		YES	5940-93	MW102	pCi/L
Gross Alpha	3.5	1.4		YES	5141-97	MW102	pCi/L
Gross Alpha	3.7	1.8		YES	5281-96	MW102	pCi/L
Gross Alpha	3.9	1.5		YES	7467-95	MW102	pCi/L
Gross Alpha	4.8	1.2		YES	6592-95	MW102	pCi/L
Gross Alpha	-3.3	-1.8		YES	5143-97	MW120	pCi/L
Gross Alpha	-1.4	0.5		YES	7065-93	MW120	pCi/L
Gross Alpha	-1.2	-1		YES	5293-98	MW120	pCi/L
Gross Alpha	0.9	0.7		YES	5448-95	MW120	pCi/L
Gross Alpha	1.3	0.9		YES	4209-94	MW120	pCi/L
Gross Alpha	1.8	0.9		YES	6928-94	MW120	pCi/L
Gross Alpha	2	1		YES	6034-94	MW120	pCi/L
Gross Alpha	3	1		YES	4991-94	MW120	pCi/L
Gross Alpha	4.4	1.6		YES	5793-97	MW120	pCi/L
Gross Alpha	8	3		YES	5900-93	MW120	pCi/L
Gross Alpha	18.9	8		YES	5088-93	MW120	pCi/L
Gross Alpha	-18	9.6		YES	6656-93	MW121	pCi/L
Gross Alpha	-8	3		YES	7782-93	MW121	pCi/L
Gross Alpha	-1.7	-0.8		YES	5144-97	MW121	pCi/L
Gross Alpha	0.5	0.2		YES	5794-97	MW121	pCi/L
Gross Alpha	1.2	1		YES	4884-94	MW121	pCi/L
Gross Alpha	1.8	1.4		YES	6453-94	MW121	pCi/L
Gross Alpha	2.7	1.6		YES	5452-95	MW121	pCi/L
Gross Alpha	2.8	1.8		YES	7278-94	MW121	pCi/L
Gross Alpha	3.1	1.3		YES	5500-96	MW121	pCi/L
Gross Alpha	4.3	1.3		YES	5517-94	MW121	pCi/L
Gross Alpha	1	0.4		YES	6862-93	MW122	pCi/L
Gross Alpha	1.8	1.1		YES	5456-95	MW122	pCi/L
Gross Alpha	1.9	1.1		YES	8457-94	MW122	pCi/L
Gross Alpha	2.5	1.1		YES	7200-94	MW122	pCi/L
Gross Alpha	3.4	1.2		YES	5145-97	MW122	pCi/L
Gross Alpha	3.5	1.2		YES	5521-94	MW122	pCi/L
Gross Alpha	4.4	1.6		YES	5795-97	MW122	pCi/L
Gross Alpha	5.8	2.1		YES	6596-95	MW122	pCi/L
Gross Alpha	6.1	1.3		YES	4868-94	MW122	pCi/L
Gross Alpha	6.5	2.5		YES	5301-96	MW122	pCi/L
Gross Alpha	8.8	2		YES	5248-93	MW122	pCi/L
Gross Alpha	17.5	4.6		YES	7768-93	MW122	pCi/L
Gross Alpha	-3.8	1.7		YES	6740-93	MW133	pCi/L
Gross Alpha	-2.9	-1.5		YES	5139-97	MW133	pCi/L
Gross Alpha	0.7	0.8		YES	5611-94	MW133	pCi/L
Gross Alpha	1.3	1		YES	8848-94	MW133	pCi/L
Gross Alpha	1.4	1		YES	5460-95	MW133	pCi/L
Gross Alpha	1.8	0.9		YES	5789-97	MW133	pCi/L
Gross Alpha	1.9	1.3		YES	5305-98	MW133	pCi/L
Gross Alpha	2	0		YES	5282-93	MW133	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Gross Alpha							
	-0.7	-3.3	-18	1	-3.8	-1.6		
	0	-1.4	-8	1.8	-2.9	0.9		
	1.8	-1.2	-1.7	1.9	0.7	1.1		
	2.2	0.9	0.5	2.5	1.3	1.9		
	2.2	1.3	1.2	3.4	1.4	3.4		
	2.3	1.8	1.8	3.5	1.8	3.5		
	2.4	2	2.7	4.4	1.9	3.9		
	2.8	3	2.8	5.8	2	5		
	3.3	4.4	3.1	6.1	4.1	6		
	3.5	8	4.3	6.5		6.9		
	3.7	18.9		8.8				
	3.9			17.5				
	4.8							
Min	-0.70	-3.30	-18.00	1.00	-3.80	-1.60	-18.00	
Max	4.80	18.90	4.30	17.50	4.10	6.90	18.90	
Average	2.46	3.13	-1.13	5.27	0.74	3.10	2.40	2.26
Number	13	11	10	12	9	10	65	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

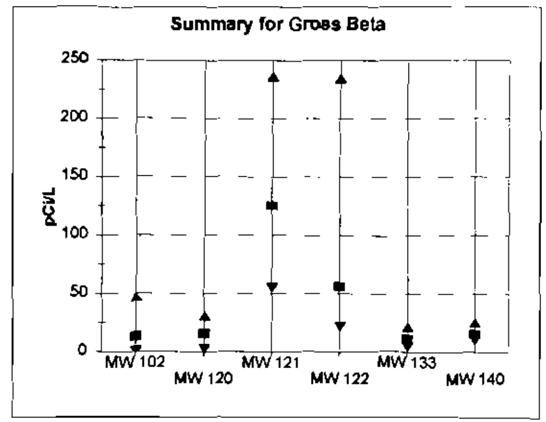
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Alpha	4.1	1.2		YES	4761-94	MW133	pCi/L
Gross Alpha	-1.6	0.6		YES	7081-93	MW140	pCi/L
Gross Alpha	0.9	0.8		YES	5195-94	MW140	pCi/L
Gross Alpha	1.1	0.8		YES	6664-94	MW140	pCi/L
Gross Alpha	1.9	0.9		YES	5146-97	MW140	pCi/L
Gross Alpha	3.4	1		YES	6004-93	MW140	pCi/L
Gross Alpha	3.5	1.1		YES	6050-94	MW140	pCi/L
Gross Alpha	3.9	1.4		YES	4225-94	MW140	pCi/L
Gross Alpha	5	1.7		YES	6088-93	MW140	pCi/L
Gross Alpha	6	2		YES	5796-97	MW140	pCi/L
Gross Alpha	6.9	2.8		YES	5313-96	MW140	pCi/L

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Beta	1	1		YES	5619-95	MW102	pCi/L
Gross Beta	6	1		YES	8285-95	MW102	pCi/L
Gross Beta	6	2		YES	5183-94	MW102	pCi/L
Gross Beta	7	1		YES	5940-93	MW102	pCi/L
Gross Beta	9	3		YES	6770-94	MW102	pCi/L
Gross Beta	9	4		YES	6022-94	MW102	pCi/L
Gross Beta	9	1		YES	5141-97	MW102	pCi/L
Gross Beta	12	2		YES	7295-93	MW102	pCi/L
Gross Beta	12	2		YES	5174-93	MW102	pCi/L
Gross Beta	14	2		YES	7467-95	MW102	pCi/L
Gross Beta	17	1		YES	6592-95	MW102	pCi/L
Gross Beta	24	4		YES	5281-96	MW102	pCi/L
Gross Beta	47	8		YES	4268-94	MW102	pCi/L
Gross Beta	3	1		YES	5293-96	MW120	pCi/L
Gross Beta	9	2		YES	6928-94	MW120	pCi/L
Gross Beta	10	4		YES	5448-95	MW120	pCi/L
Gross Beta	11	2		YES	7065-93	MW120	pCi/L
Gross Beta	11	2		YES	5143-97	MW120	pCi/L
Gross Beta	12	2		YES	5793-97	MW120	pCi/L
Gross Beta	20	5		YES	4209-94	MW120	pCi/L
Gross Beta	20	3		YES	5900-93	MW120	pCi/L
Gross Beta	20	4		YES	4991-94	MW120	pCi/L
Gross Beta	26	5		YES	6034-94	MW120	pCi/L
Gross Beta	31	5		YES	5088-93	MW120	pCi/L
Gross Beta	55	5		YES	5500-96	MW121	pCi/L
Gross Beta	65	10		YES	5517-94	MW121	pCi/L
Gross Beta	105	7		YES	5794-97	MW121	pCi/L
Gross Beta	118	22		YES	4864-94	MW121	pCi/L
Gross Beta	119	33		YES	7276-94	MW121	pCi/L
Gross Beta	120	9		YES	5144-97	MW121	pCi/L
Gross Beta	122	6		YES	6453-94	MW121	pCi/L
Gross Beta	123	42		YES	5452-95	MW121	pCi/L
Gross Beta	191	10		YES	6658-93	MW121	pCi/L
Gross Beta	236	14		YES	7782-93	MW121	pCi/L
Gross Beta	22	6		YES	7200-94	MW122	pCi/L
Gross Beta	24	3		YES	5246-93	MW122	pCi/L
Gross Beta	24	8		YES	5456-95	MW122	pCi/L
Gross Beta	25	3		YES	6457-94	MW122	pCi/L
Gross Beta	28	3		YES	6596-95	MW122	pCi/L
Gross Beta	30	3		YES	6662-93	MW122	pCi/L
Gross Beta	38	6		YES	4868-94	MW122	pCi/L
Gross Beta	44	5		YES	5301-96	MW122	pCi/L
Gross Beta	44	4		YES	5795-97	MW122	pCi/L
Gross Beta	45	5		YES	5145-97	MW122	pCi/L
Gross Beta	113	9		YES	7786-93	MW122	pCi/L
Gross Beta	234	58		YES	5521-94	MW122	pCi/L
Gross Beta	4	1		YES	5789-97	MW133	pCi/L
Gross Beta	6	1		YES	5139-97	MW133	pCi/L
Gross Beta	7	1		YES	5262-93	MW133	pCi/L
Gross Beta	9	5		YES	5811-94	MW133	pCi/L
Gross Beta	9	2		YES	6646-94	MW133	pCi/L
Gross Beta	11	2		YES	6740-93	MW133	pCi/L
Gross Beta	16	3		YES	5305-96	MW133	pCi/L
Gross Beta	16	6		YES	5460-95	MW133	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Gross Beta							
	1	3	55	22	4	10		
	6	9	65	24	6	11		
	6	10	105	24	7	13		
	7	11	118	25	9	15		
	9	11	119	28	9	15		
	9	12	120	30	11	15		
	9	20	122	38	16	15		
	12	20	123	44	18	16		
	12	20	191	44	21	17		
	14	26	236	45		25		
	17	31		113				
	24			234				
	47							
Min	1.00	3.00	55.00	22.00	4.00	10.00	1.00	
Max	47.00	31.00	236.00	234.00	21.00	25.00	236.00	
Average	13.31	15.73	125.40	55.92	11.22	15.20	38.83	39.46
Number	13	11	10	12	9	10	65	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

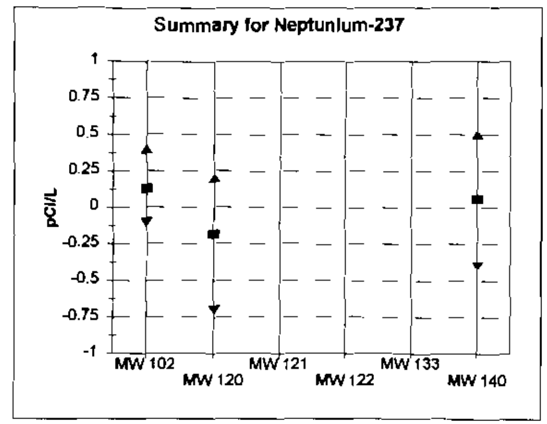
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Gross Beta	21	5		YES	4761-94	MW133	pCi/L
Gross Beta	10	2		YES	5146-97	MW140	pCi/L
Gross Beta	11	3		YES	6864-94	MW140	pCi/L
Gross Beta	13	2		YES	7081-93	MW140	pCi/L
Gross Beta	15	2		YES	6004-93	MW140	pCi/L
Gross Beta	15	2		YES	5796-97	MW140	pCi/L
Gross Beta	15	2		YES	4225-94	MW140	pCi/L
Gross Beta	15	4		YES	6050-94	MW140	pCi/L
Gross Beta	16	4		YES	5195-94	MW140	pCi/L
Gross Beta	17	2		YES	6088-93	MW140	pCi/L
Gross Beta	25	4		YES	5313-96	MW140	pCi/L

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Neptunium-237	-0.1	0.1		YES	5183-94	MW102	pCi/L
Neptunium-237	0	0		NO	6022-94	MW102	pCi/L
Neptunium-237	0	0		NO	5940-93	MW102	pCi/L
Neptunium-237	0.1	0.1		YES	7295-93	MW102	pCi/L
Neptunium-237	0.2	0.1		YES	4268-94	MW102	pCi/L
Neptunium-237	0.3	0.2		YES	6770-94	MW102	pCi/L
Neptunium-237	0.4	0		YES	5174-93	MW102	pCi/L
Neptunium-237	-0.7	0.3		YES	6928-94	MW120	pCi/L
Neptunium-237	-0.4	0.2		YES	6034-94	MW120	pCi/L
Neptunium-237	-0.2	0.2		YES	7065-93	MW120	pCi/L
Neptunium-237	-0.2	0.1		YES	5900-93	MW120	pCi/L
Neptunium-237	-0.1	0.1		YES	4991-94	MW120	pCi/L
Neptunium-237	0.1	0		YES	5088-93	MW120	pCi/L
Neptunium-237	0.2	0.1		YES	4209-94	MW120	pCi/L
Neptunium-237	-0.4	0.2		YES	6088-93	MW140	pCi/L
Neptunium-237	-0.3	0.2		YES	7081-93	MW140	pCi/L
Neptunium-237	-0.1	0.1		YES	5195-94	MW140	pCi/L
Neptunium-237	0.1	0.1		YES	4225-94	MW140	pCi/L
Neptunium-237	0.1	0		YES	6050-94	MW140	pCi/L
Neptunium-237	0.5	0.2		YES	6864-94	MW140	pCi/L
Neptunium-237	0.5	0		YES	6004-93	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Neptunium-237							
	-0.1	-0.7				-0.4		
	0	-0.4				-0.3		
	0	-0.2				-0.1		
	0.1	-0.2				0.1		
	0.2	-0.1				0.1		
	0.3	0.1				0.5		
	0.4	0.2				0.5		
Min	-0.10	-0.70	ERR	ERR	ERR	-0.40	-0.70	
Max	0.40	0.20	ERR	ERR	ERR	0.50	0.50	
Average	0.13	-0.19	ERR	ERR	ERR	0.06	0.00	0.00
Number	7	7	0	0	0	7	21	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

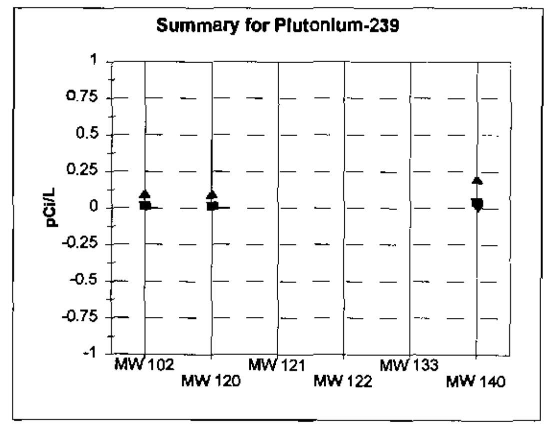
MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Plutonium-239	0	0		NO	7295-93	MW102	pCi/L
Plutonium-239	0	0		NO	6022-94	MW102	pCi/L
Plutonium-239	0	0		NO	4268-94	MW102	pCi/L
Plutonium-239	0	0		NO	6770-94	MW102	pCi/L
Plutonium-239	0	0		NO	5940-93	MW102	pCi/L
Plutonium-239	0	0		NO	5183-94	MW102	pCi/L
Plutonium-239	0.1	0		YES	5174-93	MW102	pCi/L
Plutonium-239	0	0		NO	5088-93	MW120	pCi/L
Plutonium-239	0	0		NO	7065-93	MW120	pCi/L
Plutonium-239	0	0		NO	4209-94	MW120	pCi/L
Plutonium-239	0	0		NO	4991-94	MW120	pCi/L
Plutonium-239	0	0		NO	6928-94	MW120	pCi/L
Plutonium-239	0	0		NO	6034-94	MW120	pCi/L
Plutonium-239	0.1	0.1		YES	5900-93	MW120	pCi/L
Plutonium-239	0	0		NO	6864-94	MW140	pCi/L
Plutonium-239	0	0		NO	5195-94	MW140	pCi/L
Plutonium-239	0	0		NO	7081-93	MW140	pCi/L
Plutonium-239	0	0		NO	6050-94	MW140	pCi/L
Plutonium-239	0	0		NO	4225-94	MW140	pCi/L
Plutonium-239	0.1	0		YES	6088-93	MW140	pCi/L
Plutonium-239	0.2	0		YES	6004-93	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Plutonium-239							
	0	0				0		
	0	0				0		
	0	0				0		
	0	0				0		
	0	0				0		
	0	0				0.1		
	0.1	0.1				0.2		
Min	0.00	0.00	ERR	ERR	ERR	0.00	0.00	
Max	0.10	0.10	ERR	ERR	ERR	0.20	0.20	
Average	0.01	0.01	ERR	ERR	ERR	0.04	0.02	0.02
Number	7	7	0	0	0	7	21	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

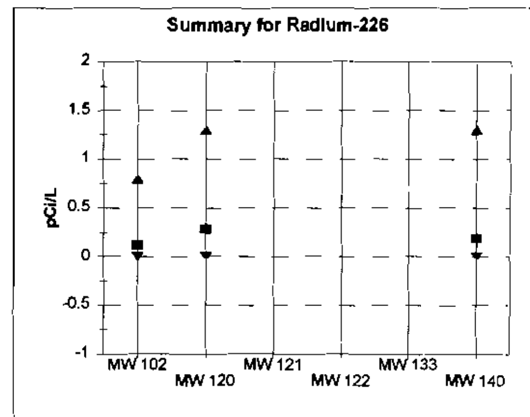
MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Radium-226	0			NO	7295-93	MW102	pCi/L
Radium-226	0			NO	6022-94	MW102	pCi/L
Radium-226	0			NO	4268-94	MW102	pCi/L
Radium-226	0			NO	5183-94	MW102	pCi/L
Radium-226	0			NO	8770-94	MW102	pCi/L
Radium-226	0.8	0		YES	5174-93	MW102	pCi/L
Radium-226			Q	NO	5940-93	MW102	pCi/L
Radium-226	0			NO	4991-94	MW120	pCi/L
Radium-226	0			NO	4209-94	MW120	pCi/L
Radium-226	0			NO	6034-94	MW120	pCi/L
Radium-226	0			NO	7065-93	MW120	pCi/L
Radium-226	0			NO	6928-94	MW120	pCi/L
Radium-226	0.7	0		YES	5086-93	MW120	pCi/L
Radium-226	1.3	0.2		YES	5900-93	MW120	pCi/L
Radium-226	0			NO	6864-94	MW140	pCi/L
Radium-226	0			NO	4225-94	MW140	pCi/L
Radium-226	0			NO	5195-94	MW140	pCi/L
Radium-226	0	0		NO	6086-93	MW140	pCi/L
Radium-226	0			NO	6050-94	MW140	pCi/L
Radium-228	0			NO	7061-93	MW140	pCi/L
Radium-226	1.3	0		YES	6004-93	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Radium-226							
	0	0				0		
	0	0				0		
	0	0				0		
	0	0				0		
	0	0				0		
	0.8	0.7				0		
	0	1.3				1.3		
Min	0.00	0.00	ERR	ERR	ERR	0.00	0.00	
Max	0.80	1.30	ERR	ERR	ERR	1.30	1.30	
Average	0.11	0.29	ERR	ERR	ERR	0.19	0.20	0.20
Number	7	7	0	0	0	7	21	



MW 102 - One "Q" qualified result assigned minimum detection limit for samples from this well.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified

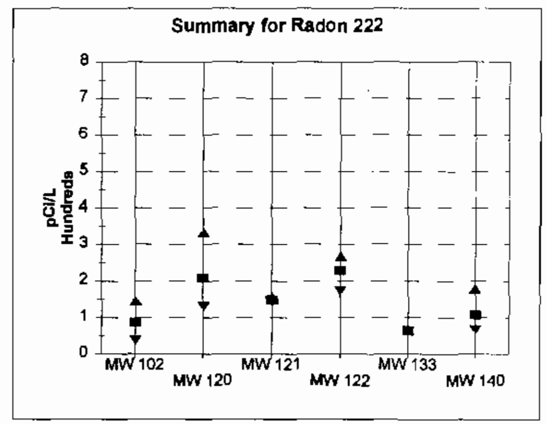
MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Radon 222	37	9		YES	7467-95	MW102	pCi/L
Radon 222	38	48		YES	6770-94	MW102	pCi/L
Radon 222	60	50		YES	4268-94	MW102	pCi/L
Radon 222	75	46		YES	8265-95	MW102	pCi/L
Radon 222	75	52		YES	5940-93	MW102	pCi/L
Radon 222	80	67		YES	6592-95	MW102	pCi/L
Radon 222	94	52		YES	6022-94	MW102	pCi/L
Radon 222	96	52		YES	5141-97	MW102	pCi/L
Radon 222	96	34		YES	5174-93	MW102	pCi/L
Radon 222	105	52		YES	5619-95	MW102	pCi/L
Radon 222	105	40		YES	5281-96	MW102	pCi/L
Radon 222	113	63		YES	7295-93	MW102	pCi/L
Radon 222	145	72		YES	5183-94	MW102	pCi/L
Radon 222	0			NO	5293-96	MW120	pCi/L
Radon 222	130	53		YES	5900-93	MW120	pCi/L
Radon 222	135	47		YES	4991-94	MW120	pCi/L
Radon 222	148	40		YES	5086-93	MW120	pCi/L
Radon 222	206	55		YES	7065-93	MW120	pCi/L
Radon 222	220	52		YES	5143-97	MW120	pCi/L
Radon 222	230	62		YES	4209-94	MW120	pCi/L
Radon 222	286	61		YES	6034-94	MW120	pCi/L
Radon 222	286	71		YES	5446-95	MW120	pCi/L
Radon 222	333	59		YES	6928-94	MW120	pCi/L
Radon 222	0			NO	5500-96	MW121	pCi/L
Radon 222	143	50		YES	5144-97	MW121	pCi/L
Radon 222	157	34		YES	5452-95	MW121	pCi/L
Radon 222	173	34		YES	5456-95	MW122	pCi/L
Radon 222	218	48		YES	5301-96	MW122	pCi/L
Radon 222	255	60		YES	5145-97	MW122	pCi/L
Radon 222	267	53		YES	6596-95	MW122	pCi/L
Radon 222	64	49		YES	5460-95	MW133	pCi/L
Radon 222	67	53		YES	7081-93	MW140	pCi/L
Radon 222	74	40		YES	6088-93	MW140	pCi/L
Radon 222	79	46		YES	5146-97	MW140	pCi/L
Radon 222	83	64		YES	5195-94	MW140	pCi/L
Radon 222	97	53		YES	4225-94	MW140	pCi/L
Radon 222	101	48		YES	5313-96	MW140	pCi/L
Radon 222	114	44		YES	6004-93	MW140	pCi/L
Radon 222	172	51		YES	6864-94	MW140	pCi/L
Radon 222	178	61		YES	6050-94	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Radon 222							
	37	130	143	173	64	67		
	38	130	143	218		74		
	60	135	157	255		79		
	75	148		267		83		
	75	206				97		
	80	220				101		
	94	230				114		
	96	266				172		
	96	286				178		
	105	333						
	105							
	113							
	145							
Min	37.00	130.00	143.00	173.00	64.00	67.00	37.00	
Max	145.00	333.00	157.00	267.00	64.00	178.00	333.00	
Average	86.08	208.40	147.67	228.25	64.00	107.22	139.70	140.27
Number	13	10	3	4	1	9	40	



MW 102 - Data were not modified.

MW 120 - "0" value appears anomalous and increased to next smallest value.

MW 121 - "0" value appears anomalous and increased to next smallest value.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

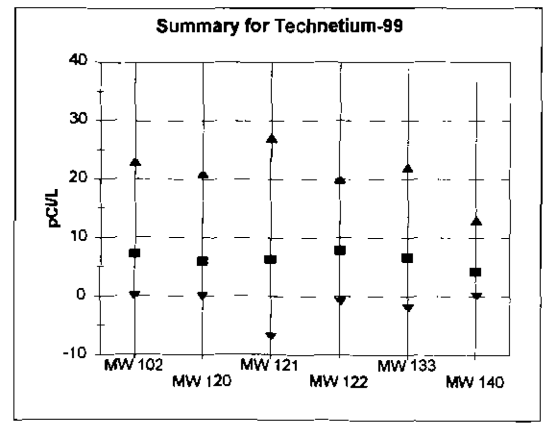
MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Technetium-99	0	0		NO	8285-95	MW102	pCi/L
Technetium-99	0	0		NO	5141-97	MW102	pCi/L
Technetium-99	0	0		NO	6022-94	MW102	pCi/L
Technetium-99	2	10		YES	7467-95	MW102	pCi/L
Technetium-99	4	22		YES	5619-95	MW102	pCi/L
Technetium-99	5	10		YES	5281-96	MW102	pCi/L
Technetium-99	6	37		YES	4268-94	MW102	pCi/L
Technetium-99	9	18		YES	5174-93	MW102	pCi/L
Technetium-99	9	27		YES	5940-93	MW102	pCi/L
Technetium-99	9	37		YES	7295-93	MW102	pCi/L
Technetium-99	10	10		YES	6592-95	MW102	pCi/L
Technetium-99	17	21		YES	6770-94	MW102	pCi/L
Technetium-99	23	19		YES	5183-94	MW102	pCi/L
Technetium-99	0	0		NO	4209-94	MW120	pCi/L
Technetium-99	0	0		NO	5293-96	MW120	pCi/L
Technetium-99	0	0		NO	6928-94	MW120	pCi/L
Technetium-99	1	12		YES	5793-97	MW120	pCi/L
Technetium-99	3	18		YES	4991-94	MW120	pCi/L
Technetium-99	4	19		YES	6034-94	MW120	pCi/L
Technetium-99	5	40		YES	5086-93	MW120	pCi/L
Technetium-99	8	28		YES	5900-93	MW120	pCi/L
Technetium-99	11	11		YES	5143-97	MW120	pCi/L
Technetium-99	12	21		YES	7065-93	MW120	pCi/L
Technetium-99	21	20		YES	5448-95	MW120	pCi/L
Technetium-99	-7	0		YES	5794-97	MW121	pCi/L
Technetium-99	0	0		NO	5500-96	MW121	pCi/L
Technetium-99	0	0		NO	5144-97	MW121	pCi/L
Technetium-99	0	0		NO	7276-94	MW121	pCi/L
Technetium-99	4	10		YES	6658-93	MW121	pCi/L
Technetium-99	7	16		YES	5452-95	MW121	pCi/L
Technetium-99	8	21		YES	6453-94	MW121	pCi/L
Technetium-99	9	33		YES	4864-94	MW121	pCi/L
Technetium-99	15	20		YES	7762-93	MW121	pCi/L
Technetium-99	27	23		YES	5517-94	MW121	pCi/L
Technetium-99	-1	0		YES	5795-97	MW122	pCi/L
Technetium-99	0	0		NO	7200-94	MW122	pCi/L
Technetium-99	0	0		NO	4868-94	MW122	pCi/L
Technetium-99	1	11		YES	5145-97	MW122	pCi/L
Technetium-99	2	10		YES	5301-96	MW122	pCi/L
Technetium-99	5	34		YES	5246-93	MW122	pCi/L
Technetium-99	11	11		YES	6596-95	MW122	pCi/L
Technetium-99	11	31		YES	5521-94	MW122	pCi/L
Technetium-99	13	17		YES	6457-94	MW122	pCi/L
Technetium-99	15	23		YES	7766-93	MW122	pCi/L
Technetium-99	17	19		YES	6662-93	MW122	pCi/L
Technetium-99	20	20		YES	5456-95	MW122	pCi/L
Technetium-99	-2	0		YES	5789-97	MW133	pCi/L
Technetium-99	0	0		NO	5139-97	MW133	pCi/L
Technetium-99	3	6		YES	6648-94	MW133	pCi/L
Technetium-99	3	10		YES	5305-96	MW133	pCi/L
Technetium-99	4	12		YES	5282-93	MW133	pCi/L
Technetium-99	8	25		YES	5460-95	MW133	pCi/L
Technetium-99	9	20		YES	5611-94	MW133	pCi/L
Technetium-99	13	26		YES	4761-94	MW133	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Technetium-99							
	0	0	-7	-1	-2	0		
	0	0	0	0	0	0		
	0	0	0	0	3	0		
	2	1	0	1	3	0		
	4	3	4	2	4	4		
	5	4	7	5	8	4		
	6	5	8	11	9	5		
	9	8	9	11	13	6		
	9	11	15	13	22	10		
	9	12	27	15		13		
	10	21		17				
	17			20				
	23							
Min	0.00	0.00	-7.00	-1.00	-2.00	0.00	-7.00	
Max	23.00	21.00	27.00	20.00	22.00	13.00	27.00	
Average	7.23	5.91	8.30	7.83	8.67	4.20	6.43	6.36
Number	13	11	10	12	9	10	65	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

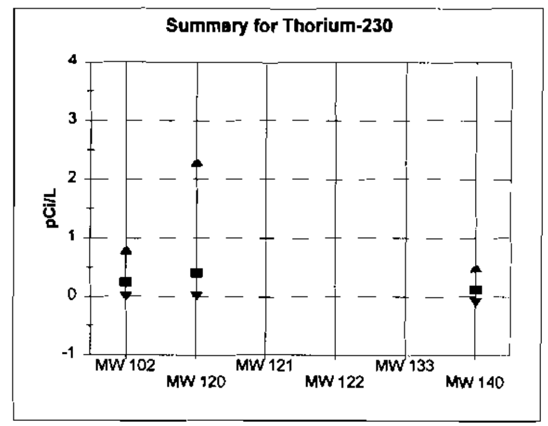
ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Technetium-99	22	22		YES	6740-93	MW133	pCi/L
Technetium-99	0	0		NO	6050-94	MW140	pCi/L
Technetium-99	0	0		NO	5313-96	MW140	pCi/L
Technetium-99	0	11		YES	5146-97	MW140	pCi/L
Technetium-99	0	0		NO	5195-94	MW140	pCi/L
Technetium-99	4	9		YES	7081-93	MW140	pCi/L
Technetium-99	4	11		YES	6088-93	MW140	pCi/L
Technetium-99	5	16		YES	4225-94	MW140	pCi/L
Technetium-99	6	38		YES	6864-94	MW140	pCi/L
Technetium-99	10	31		YES	6004-93	MW140	pCi/L
Technetium-99	13	11		YES	5796-97	MW140	pCi/L

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Thorium-230	0	0		NO	7295-93	MW102	pCi/L
Thorium-230	0	0		NO	6022-94	MW102	pCi/L
Thorium-230	0.1	0.1		YES	5940-93	MW102	pCi/L
Thorium-230	0.1	0.1		YES	6770-94	MW102	pCi/L
Thorium-230	0.3	0		YES	5174-93	MW102	pCi/L
Thorium-230	0.4	0.1		YES	4268-94	MW102	pCi/L
Thorium-230	0.8	0.2		YES	5183-94	MW102	pCi/L
Thorium-230	0	0		NO	6034-94	MW120	pCi/L
Thorium-230	0	0		NO	5088-93	MW120	pCi/L
Thorium-230	0	0		NO	6928-94	MW120	pCi/L
Thorium-230	0.1	0.1		YES	4209-94	MW120	pCi/L
Thorium-230	0.2	0.2		YES	5900-93	MW120	pCi/L
Thorium-230	0.2	0		YES	7065-93	MW120	pCi/L
Thorium-230	2.3	0.6		YES	4991-94	MW120	pCi/L
Thorium-230	-0.1	0.1		YES	6088-93	MW140	pCi/L
Thorium-230	0	0		NO	7081-93	MW140	pCi/L
Thorium-230	0	0		NO	6050-94	MW140	pCi/L
Thorium-230	0.1	0		YES	6004-93	MW140	pCi/L
Thorium-230	0.1	0.1		YES	6864-94	MW140	pCi/L
Thorium-230	0.2	0.1		YES	5195-94	MW140	pCi/L
Thorium-230	0.5	0.2		YES	4225-94	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Thorium-230							
	0	0				-0.1		
	0	0				0		
	0.1	0				0		
	0.1	0.1				0.1		
	0.3	0.2				0.1		
	0.4	0.2				0.2		
	0.8	2.3				0.5		
Min	0.00	0.00	ERR	ERR	ERR	-0.10	-0.10	
Max	0.80	2.30	ERR	ERR	ERR	0.50	2.30	
Average	0.24	0.40	ERR	ERR	ERR	0.11	0.25	0.25
Number	7	7	0	0	0	7	21	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

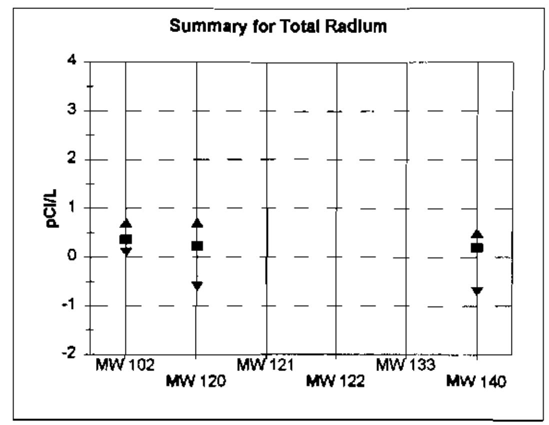
MW 140 - Data were not modified.

Summary of McNairy Background Wells Radionuclides

ANALYSIS	RESULT	ERROR	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Radium	0.1			YES	7295-93	MW102	pCi/L
Total Radium	0.3	0.1		YES	6770-94	MW102	pCi/L
Total Radium	0.3	0.1		YES	6022-94	MW102	pCi/L
Total Radium	0.4	0.1		YES	5183-94	MW102	pCi/L
Total Radium	0.7	0.1		YES	4268-94	MW102	pCi/L
Total Radium	-0.6	0		YES	6034-94	MW120	pCi/L
Total Radium	0.2	0.1		YES	7065-93	MW120	pCi/L
Total Radium	0.4	0.1		YES	4209-94	MW120	pCi/L
Total Radium	0.4	0.2		YES	6928-94	MW120	pCi/L
Total Radium	0.7	0.1		YES	4991-94	MW120	pCi/L
Total Radium	-0.7	0		YES	6050-94	MW140	pCi/L
Total Radium	0.3	0.2		YES	7081-93	MW140	pCi/L
Total Radium	0.4	0.1		YES	6864-94	MW140	pCi/L
Total Radium	0.5	0.1		YES	5195-94	MW140	pCi/L
Total Radium	0.5	0.1		YES	4225-94	MW140	pCi/L

CORRECTED DATA SET

	MW 102	MW 120	MW 121	MW 122	MW 133	MW 140	Overall	Weighted
	Total Radium							
	0.1	-0.6				-0.7		
	0.3	0.2				0.3		
	0.3	0.4				0.4		
	0.4	0.4				0.5		
	0.7	0.7				0.5		
Min	0.10	-0.60	ERR	ERR	ERR	-0.70	-0.70	
Max	0.70	0.70	ERR	ERR	ERR	0.50	0.70	
Average	0.36	0.22	ERR	ERR	ERR	0.20	0.26	0.26
Number	5	5	0	0	0	5	15	



MW 102 - Data were not modified.

MW 120 - Data were not modified

MW 121 - Data were not modified.

MW 122 - Data were not modified.

MW 133 - Data were not modified.

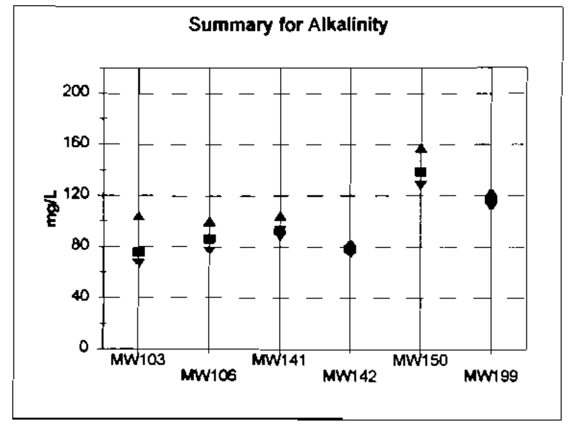
MW 140 - Data were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Alkalinity	87		YES	6026-94	MW103	mg/L
Alkalinity	69		YES	7299-93	MW103	mg/L
Alkalinity	69		YES	4272-94	MW103	mg/L
Alkalinity	69		YES	6774-94	MW103	mg/L
Alkalinity	70		YES	5440-95	MW103	mg/L
Alkalinity	71		YES	5187-94	MW103	mg/L
Alkalinity	72		YES	5944-93	MW103	mg/L
Alkalinity	78		YES	5178-93	MW103	mg/L
Alkalinity	86		YES	5142-97	MW103	mg/L
Alkalinity	104		YES	5285-96	MW103	mg/L
Alkalinity	77		YES	5444-95	MW108	mg/L
Alkalinity	82		YES	4697-94	MW106	mg/L
Alkalinity	100		YES	5322-93	MW106	mg/L
Alkalinity	88		YES	5199-94	MW141	mg/L
Alkalinity	90		YES	6888-94	MW141	mg/L
Alkalinity	90		YES	6054-94	MW141	mg/L
Alkalinity	91		YES	7085-93	MW141	mg/L
Alkalinity	92		YES	4229-94	MW141	mg/L
Alkalinity	93		YES	6092-93	MW141	mg/L
Alkalinity	104		YES	8080-93	MW141	mg/L
Alkalinity	74		YES	7089-93	MW142	mg/L
Alkalinity	75		YES	5464-95	MW142	mg/L
Alkalinity	76		YES	8096-93	MW142	mg/L
Alkalinity	77		YES	4233-94	MW142	mg/L
Alkalinity	78		YES	6056-94	MW142	mg/L
Alkalinity	80		YES	6672-94	MW142	mg/L
Alkalinity	80		YES	6084-93	MW142	mg/L
Alkalinity	80		YES	5203-94	MW142	mg/L
Alkalinity	81		YES	5147-97	MW142	mg/L
Alkalinity	83		YES	5317-96	MW142	mg/L
Alkalinity	126		YES	5468-95	MW150	mg/L
Alkalinity	130		YES	4789-94	MW150	mg/L
Alkalinity	136		YES	5321-96	MW150	mg/L
Alkalinity	140		YES	5650-93	MW150	mg/L
Alkalinity	157		YES	5148-97	MW150	mg/L
Alkalinity	111		YES	7311-93	MW199	mg/L
Alkalinity	113		YES	5984-93	MW199	mg/L
Alkalinity	117		YES	8888-94	MW199	mg/L
Alkalinity	117		YES	5558-97	MW199	mg/L
Alkalinity	118		YES	5260-94	MW199	mg/L
Alkalinity	118		YES	8074-94	MW199	mg/L
Alkalinity	120		YES	5170-93	MW199	mg/L
Alkalinity	123		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Alkalinity							
	67	77	88	74	128	111		
	69	82	90	75	130	113		
	69	100	90	76	138	117		
	69		91	77	140	117		
	70		92	78	157	118		
	71		93	80		118		
	72		104	80		120		
	78			80		123		
	86			81				
	104			83				
Min	67.00	77.00	88.00	74.00	128.00	111.00	67.00	
Max	104.00	100.00	104.00	83.00	157.00	123.00	157.00	
Average	75.50	86.33	92.57	78.40	138.60	117.13	94.79	98.09
Number	10	3	7	10	5	8	43	



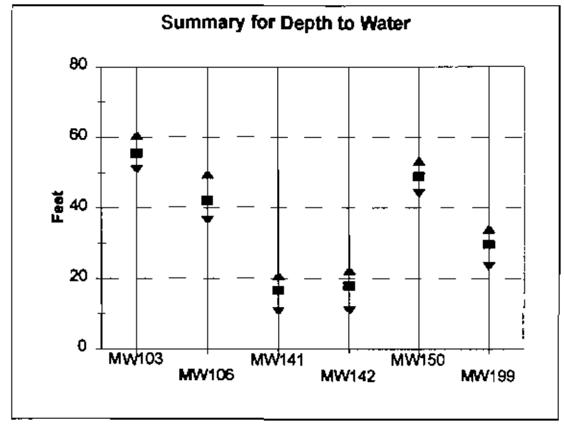
Data for Alkalinity were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Depth to Water	50.76		YES	5187-94	MW103	Feet
Depth to Water	52.62		YES	5178-93	MW103	Feet
Depth to Water	52.65		YES	6026-94	MW103	Feet
Depth to Water	53.29		YES	5944-93	MW103	Feet
Depth to Water	55.05		YES	5142-97	MW103	Feet
Depth to Water	55.42		YES	4272-94	MW103	Feet
Depth to Water	56		YES	7299-93	MW103	Feet
Depth to Water	56.02		YES	6774-94	MW103	Feet
Depth to Water	56.61		YES	5440-95	MW103	Feet
Depth to Water	59.44		YES	5285-96	MW103	Feet
Depth to Water	60.65		YES	5372-97	MW103	Feet
Depth to Water	36.39		YES	5513-94	MW106	Feet
Depth to Water	37.65		YES	5322-93	MW106	Feet
Depth to Water	37.68		YES	4697-94	MW106	Feet
Depth to Water	39.89		YES	5138-97	MW106	Feet
Depth to Water	40.49		YES	6579-93	MW106	Feet
Depth to Water	41.13		YES	6640-94	MW106	Feet
Depth to Water	42.95		YES	6762-94	MW106	Feet
Depth to Water	43.86		YES	5444-95	MW106	Feet
Depth to Water	44.54		YES	5768-97	MW106	Feet
Depth to Water	44.74		YES	7272-94	MW106	Feet
Depth to Water	44.95		YES	5269-96	MW106	Feet
Depth to Water	49.81		YES	7862-93	MW106	Feet
Depth to Water	10.64		YES	5199-94	MW141	Feet
Depth to Water	14.32		YES	6080-93	MW141	Feet
Depth to Water	15.67		YES	6092-93	MW141	Feet
Depth to Water	17.39		YES	4229-94	MW141	Feet
Depth to Water	17.85		YES	6054-94	MW141	Feet
Depth to Water	19.26		YES	7085-93	MW141	Feet
Depth to Water	20.75		YES	6666-94	MW141	Feet
Depth to Water	10.6		YES	5203-94	MW142	Feet
Depth to Water	14.63		YES	6064-93	MW142	Feet
Depth to Water	15.97		YES	6096-93	MW142	Feet
Depth to Water	16.71		YES	6058-94	MW142	Feet
Depth to Water	17.64		YES	4233-94	MW142	Feet
Depth to Water	19.55		YES	7089-93	MW142	Feet
Depth to Water	20.44		YES	5464-95	MW142	Feet
Depth to Water	21.03		YES	6672-94	MW142	Feet
Depth to Water	21.58		YES	5797-97	MW142	Feet
Depth to Water	22.24		YES	5317-96	MW142	Feet
Depth to Water	1539		YES	5147-97	MW142	Feet
Depth to Water	44.09		YES	5578-94	MW150	Feet
Depth to Water	44.79		YES	7724-93	MW150	Feet
Depth to Water	46.42		YES	5650-93	MW150	Feet
Depth to Water	46.63		YES	4769-94	MW150	Feet
Depth to Water	47.5		YES	5148-97	MW150	Feet
Depth to Water	49.5		YES	6764-93	MW150	Feet
Depth to Water	50.46		YES	6501-94	MW150	Feet
Depth to Water	52.74		YES	5468-95	MW150	Feet
Depth to Water	53.15		YES	5321-96	MW150	Feet
Depth to Water	53.34		YES	7366-94	MW150	Feet
Depth to Water	23.3		YES	5260-94	MW199	Feet
Depth to Water	27.5		YES	5170-93	MW199	Feet
Depth to Water	29.52		YES	5984-93	MW199	Feet
Depth to Water	30.2		YES	5558-97	MW199	Feet

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Depth to Water							
	50.78	36.39	10.64	10.8	44.09	23.3		
	52.62	37.65	14.32	14.63	44.79	27.5		
	52.65	37.68	15.67	15.97	48.42	29.52		
	53.29	39.89	17.39	16.71	46.63	30.2		
	55.05	40.49	17.65	17.64	47.5	30.27		
	55.42	41.13	19.28	19.55	49.5	30.28		
	56	42.95	20.75	20.44	50.46	32.1		
	56.02	43.66		21.03	52.74	34.07		
	56.81	44.54		21.58	53.15			
	59.44	44.74		22.24	53.34			
	60.65	44.95		15.39				
		49.61						
Min	50.780	36.390	10.640	10.800	44.090	23.300	10.640	
Max	60.650	49.610	20.750	22.240	53.340	34.070	60.650	
Average	55.521	41.990	16.529	17.616	46.662	29.655	36.477	35.082
Number	11	12	7	11	10	8	59	



MW103 - Data were not modified.

MW106 - Data were not modified.

MW141 - Data were not modified.

MW142 - Maximum value modified by insertion of decimal point.

MW150 - Data were not modified.

MW199 - Data were not modified.

Summary of RGA Background Wells Physical Parameters

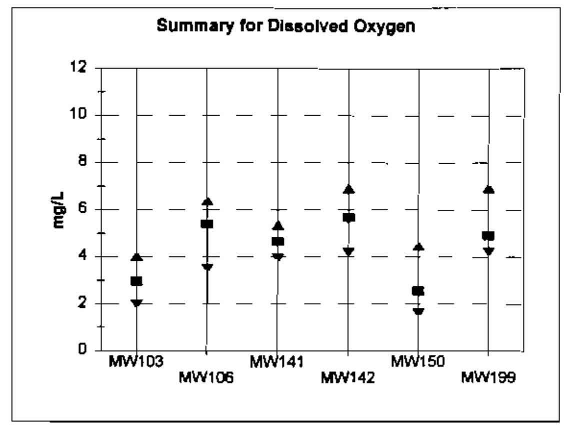
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Depth to Water	30.27		YES	4312-94	MW199	Feet
Depth to Water	30.28		YES	8074-94	MW199	Feet
Depth to Water	32.1		YES	7311-93	MW199	Feet
Depth to Water	34.07		YES	6868-94	MW199	Feet

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Dissolved Oxygen	1.97	J	YES	5944-93	MW103	mg/L
Dissolved Oxygen	2.14		YES	6026-94	MW103	mg/L
Dissolved Oxygen	2.43		YES	4272-94	MW103	mg/L
Dissolved Oxygen	2.46		YES	5285-96	MW103	mg/L
Dissolved Oxygen	2.6		YES	5178-93	MW103	mg/L
Dissolved Oxygen	3.05		YES	7299-93	MW103	mg/L
Dissolved Oxygen	3.11		YES	5187-94	MW103	mg/L
Dissolved Oxygen	3.31		YES	5142-97	MW103	mg/L
Dissolved Oxygen	3.66		YES	5372-97	MW103	mg/L
Dissolved Oxygen	3.83		YES	5440-95	MW103	mg/L
Dissolved Oxygen	4.02		YES	6774-94	MW103	mg/L
Dissolved Oxygen	3.49		YES	5138-97	MW106	mg/L
Dissolved Oxygen	5.11		YES	7882-93	MW106	mg/L
Dissolved Oxygen	5.17		YES	7272-94	MW106	mg/L
Dissolved Oxygen	5.18	J	YES	6579-93	MW106	mg/L
Dissolved Oxygen	5.3		YES	5444-95	MW106	mg/L
Dissolved Oxygen	5.41		YES	5788-97	MW106	mg/L
Dissolved Oxygen	5.52		YES	6640-94	MW106	mg/L
Dissolved Oxygen	5.6		YES	5322-93	MW106	mg/L
Dissolved Oxygen	5.64		YES	4697-94	MW106	mg/L
Dissolved Oxygen	5.6		YES	5513-94	MW106	mg/L
Dissolved Oxygen	5.95		YES	8782-94	MW106	mg/L
Dissolved Oxygen	6.37		YES	5289-96	MW106	mg/L
Dissolved Oxygen	3.95		YES	6888-94	MW141	mg/L
Dissolved Oxygen	3.99		YES	4229-94	MW141	mg/L
Dissolved Oxygen	4.2		YES	6080-93	MW141	mg/L
Dissolved Oxygen	4.83		YES	7085-93	MW141	mg/L
Dissolved Oxygen	4.98		YES	5199-94	MW141	mg/L
Dissolved Oxygen	5.28		YES	6092-93	MW141	mg/L
Dissolved Oxygen	5.35		YES	6054-94	MW141	mg/L
Dissolved Oxygen	4.2		YES	5147-97	MW142	mg/L
Dissolved Oxygen	5.37		YES	7069-93	MW142	mg/L
Dissolved Oxygen	5.43		YES	4233-94	MW142	mg/L
Dissolved Oxygen	5.5		YES	6064-93	MW142	mg/L
Dissolved Oxygen	5.5		YES	5317-96	MW142	mg/L
Dissolved Oxygen	5.54		YES	5464-95	MW142	mg/L
Dissolved Oxygen	5.57		YES	5797-97	MW142	mg/L
Dissolved Oxygen	5.61		YES	6672-94	MW142	mg/L
Dissolved Oxygen	5.99		YES	5203-94	MW142	mg/L
Dissolved Oxygen	6.42		YES	6056-94	MW142	mg/L
Dissolved Oxygen	6.91		YES	6096-93	MW142	mg/L
Dissolved Oxygen	1.6		YES	6501-94	MW150	mg/L
Dissolved Oxygen	1.62		YES	5321-96	MW150	mg/L
Dissolved Oxygen	1.71		YES	7724-93	MW150	mg/L
Dissolved Oxygen	1.81		YES	5466-95	MW150	mg/L
Dissolved Oxygen	1.89		YES	5576-94	MW150	mg/L
Dissolved Oxygen	1.92		YES	5148-97	MW150	mg/L
Dissolved Oxygen	2.89		YES	5650-93	MW150	mg/L
Dissolved Oxygen	3.33		YES	6764-93	MW150	mg/L
Dissolved Oxygen	4.29		YES	4789-94	MW150	mg/L
Dissolved Oxygen	4.46		YES	7366-94	MW150	mg/L
Dissolved Oxygen	4.2		YES	5556-97	MW199	mg/L
Dissolved Oxygen	4.31		YES	5260-94	MW199	mg/L
Dissolved Oxygen	4.46		YES	4312-94	MW199	mg/L

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Dissolved Oxygen							
	1.97	3.49	3.95	4.2	1.6	4.2		
	2.14	5.11	3.99	5.37	1.62	4.31		
	2.43	5.17	4.2	5.43	1.71	4.46		
	2.46	5.16	4.83	5.5	1.81	4.5		
	2.6	5.3	4.98	5.5	1.69	4.84		
	3.05	5.41	5.28	5.54	1.92	4.9		
	3.11	5.52	5.35	5.57	2.89	5.17		
	3.31	5.6		5.61	3.33	6.92		
	3.66	5.64		5.99	4.29			
	3.83	5.6		6.42	4.46			
	4.02	5.95		6.91				
		6.37						
Min	1.970	3.490	3.950	4.200	1.600	4.200	1.600	
Max	4.020	6.370	5.350	6.910	4.460	6.920	6.920	
Average	2.964	5.376	4.654	5.858	2.552	4.913	4.352	4.353
Number	11	12	7	11	10	6	59	



Data for Dissolved Oxygen were not modified.

Summary of RGA Background Wells Physical Parameters

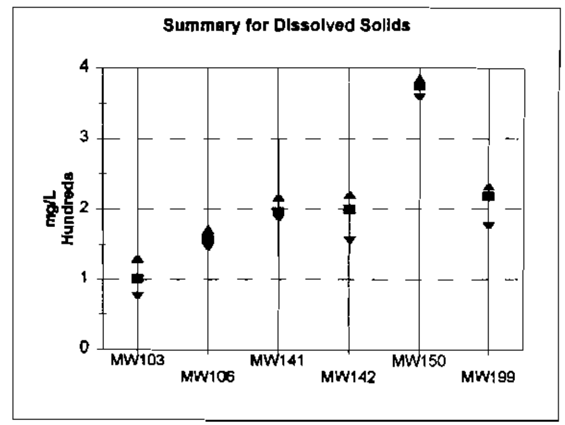
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Dissolved Oxygen	4.5	J	YES	5984-93	MW199	mg/L
Dissolved Oxygen	4.84		YES	8888-94	MW199	mg/L
Dissolved Oxygen	4.9		YES	5170-93	MW199	mg/L
Dissolved Oxygen	5.17		YES	6074-94	MW199	mg/L
Dissolved Oxygen	6.92		YES	7311-93	MW199	mg/L

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Dissolved Solids	75		YES	5285-96	MW103	mg/L
Dissolved Solids	89		YES	6774-94	MW103	mg/L
Dissolved Solids	94		YES	4272-94	MW103	mg/L
Dissolved Solids	96		YES	5440-95	MW103	mg/L
Dissolved Solids	97		YES	7299-93	MW103	mg/L
Dissolved Solids	101		YES	5187-94	MW103	mg/L
Dissolved Solids	108		YES	5944-93	MW103	mg/L
Dissolved Solids	116		YES	5178-93	MW103	mg/L
Dissolved Solids	130		YES	5142-97	MW103	mg/L
Dissolved Solids	136		YES	6026-94	MW103	mg/L
Dissolved Solids	145		YES	5444-95	MW106	mg/L
Dissolved Solids	155		YES	4697-94	MW106	mg/L
Dissolved Solids	171		YES	5322-93	MW106	mg/L
Dissolved Solids	186		YES	6080-93	MW141	mg/L
Dissolved Solids	187		YES	5199-94	MW141	mg/L
Dissolved Solids	189		YES	4229-94	MW141	mg/L
Dissolved Solids	189		YES	6054-94	MW141	mg/L
Dissolved Solids	195		YES	7085-93	MW141	mg/L
Dissolved Solids	210		YES	6868-94	MW141	mg/L
Dissolved Solids	217		YES	6092-93	MW141	mg/L
Dissolved Solids	155		YES	5464-95	MW142	mg/L
Dissolved Solids	173		YES	6084-93	MW142	mg/L
Dissolved Solids	192		YES	5147-97	MW142	mg/L
Dissolved Solids	203		YES	6058-94	MW142	mg/L
Dissolved Solids	207		YES	4233-94	MW142	mg/L
Dissolved Solids	210		YES	6872-94	MW142	mg/L
Dissolved Solids	210		YES	5203-94	MW142	mg/L
Dissolved Solids	211		YES	5317-98	MW142	mg/L
Dissolved Solids	214		YES	7089-93	MW142	mg/L
Dissolved Solids	221		YES	6096-93	MW142	mg/L
Dissolved Solids	358		YES	4789-94	MW150	mg/L
Dissolved Solids	370		YES	5321-96	MW150	mg/L
Dissolved Solids	378		YES	5148-97	MW150	mg/L
Dissolved Solids	380		YES	5650-93	MW150	mg/L
Dissolved Solids	385		YES	5466-95	MW150	mg/L
Dissolved Solids	175		YES	4312-94	MW199	mg/L
Dissolved Solids	210		YES	7311-93	MW199	mg/L
Dissolved Solids	212		YES	5556-97	MW199	mg/L
Dissolved Solids	220		YES	6686-94	MW199	mg/L
Dissolved Solids	229		YES	5984-93	MW199	mg/L
Dissolved Solids	231		YES	6074-94	MW199	mg/L
Dissolved Solids	233		YES	5170-93	MW199	mg/L
Dissolved Solids	233		YES	5260-94	MW199	mg/L

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Dissolved Solids							
	75	145	186	155	358	175		
	89	155	187	173	370	210		
	94	171	189	192	378	212		
	96		189	203	380	220		
	97		195	207	385	229		
	101		210	210		231		
	108		217	210		233		
	116			211		233		
	130			214				
				221				
Min	75.00	145.00	186.00	155.00	358.00	175.00	75.00	
Max	130.00	171.00	217.00	221.00	385.00	233.00	385.00	
Average	100.67	157.00	196.14	199.60	374.20	217.88	199.05	207.58
Number	9	3	7	10	5	8	42	



Data for Dissolved Solids were not modified.

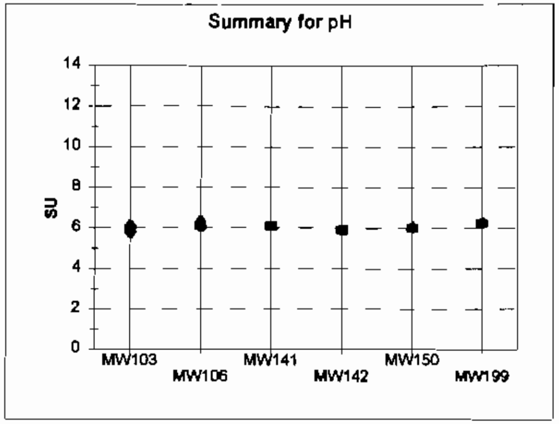
Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS	CORRECTED DATA SET								
pH	5.6		YES	5286-96	MW103	SU		MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
pH	5.6		YES	5266-96	MW103	SU		pH							
pH	5.6		YES	5267-96	MW103	SU		5.6	5.9	6	5.8	5.9	6.1		
pH	5.6		YES	5265-96	MW103	SU		5.8	5.9	6	5.8	5.9	6.1		
pH	5.6		YES	7302-93	MW103	SU		5.8	5.9	6	5.8	5.9	6.1		
pH	5.6		YES	7300-93	MW103	SU		5.6	5.9	6	5.8	5.9	6.1		
pH	5.6		YES	7301-93	MW103	SU		5.8	5.9	6	5.8	5.9	6.1		
pH	5.9		YES	7299-93	MW103	SU		5.6	5.9	6	5.8	5.9	6.1		
pH	5.9		YES	6029-94	MW103	SU		5.6	5.9	6	5.8	5.9	6.1		
pH	5.9		YES	4274-94	MW103	SU		5.9	5.9	6	5.6	5.9	6.1		
pH	5.9		YES	6026-94	MW103	SU		5.9	5.9	6.1	5.8	6	6.1		
pH	5.9		YES	6027-94	MW103	SU		5.9	5.9	6.1	5.9	6	6.2		
pH	5.9		YES	6026-94	MW103	SU		5.9	5.9	6.1	5.9	6	6.2		
pH	5.9		YES	4273-94	MW103	SU		5.9	6	6.1	5.9	6	6.2		
pH	5.9		YES	4275-94	MW103	SU		5.9	6	6.1	5.9	6	6.2		
pH	6		YES	5186-94	MW103	SU		5.9	6	6.1	5.9	6	6.3		
pH	6		YES	5189-94	MW103	SU		5.9	6	6.1	5.9	6	6.3		
pH	6		YES	5167-94	MW103	SU		6	6	6.1	5.9	6	6.3		
pH	6		YES	5441-95	MW103	SU		6	6.1	6.1	5.9	6	6.3		
pH	6		YES	5440-95	MW103	SU		6	6.1	6.1	6	6	6.3		
pH	6		YES	5442-95	MW103	SU		6	6.1	6.1	6	6	6.3		
pH	6		YES	5190-94	MW103	SU		6	6.1	6.1	6	6	6.3		
pH	6		YES	5443-95	MW103	SU		6	6.1	6.2	6	6	6.3		
pH	6		YES	6777-94	MW103	SU		6	6.1	6.2	6	6	6.3		
pH	6		YES	4272-94	MW103	SU		6	6.1	6.2	6	6	6.3		
pH	6.1		YES	5179-93	MW103	SU		6	6.1	6.2	6	6	6.3		
pH	6.1		YES	5945-93	MW103	SU		6	6.1	6.2	6	6	6.4		
pH	6.1		YES	5944-93	MW103	SU		6.1	6.1	6.2	6	6	6.4		
pH	6.1		YES	5160-93	MW103	SU		6.1	6.1	6.2	6	6	6.4		
pH	6.1		YES	5947-93	MW103	SU		6.1	6.1	6.2	6	6	6.4		
pH	6.1		YES	5161-93	MW103	SU		6.1	6.13		6	6	6.4		
pH	6.1		YES	6776-94	MW103	SU		6.1	6.2		6	6.1			
pH	6.1		YES	6775-94	MW103	SU		6.1	6.2		6	6.1			
pH	6.1		YES	6774-94	MW103	SU		6.1	6.2		6	6.1			
pH	6.1		YES	5946-93	MW103	SU		6.1	6.2		6	6.1			
pH	6.2		YES	5176-93	MW103	SU		6.1	6.2		6	6.1			
pH	6.2		YES	5372-97	MW103	SU		6.1	6.2		6	6.2			
pH	6.3		YES	5142-97	MW103	SU		6.2	6.2		6	6.2			
pH	5.9		YES	5324-93	MW106	SU		6.2	6.2		6	6.2			
pH	5.9		YES	5323-93	MW106	SU		6.3	6.4		6	6.2			
pH	5.9		YES	5513-94	MW106	SU			6.4						
pH	5.9		YES	5322-93	MW106	SU			6.4						
pH	5.9		YES	5516-94	MW106	SU			6.4						
pH	5.9		YES	5514-94	MW106	SU			6.5						
pH	5.9		YES	5325-93	MW106	SU									
pH	5.9		YES	5515-94	MW106	SU	Min	5.60	5.90	6.00	5.60	5.90	6.10	5.60	
pH	5.9		YES	6784-94	MW106	SU	Max	6.30	6.50	6.20	6.00	6.20	6.40	6.50	
pH	5.9		YES	6765-94	MW106	SU	Average	5.97	6.09	6.10	5.93	6.01	6.24	6.05	6.06
pH	5.9		YES	6762-94	MW106	SU	Number	38	42	28	38	36	29	213	

Summary of RGA Background Wells Physical Parameters

CORRECTED DATA SET

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
pH	6		YES	5291-96	MW106	SU
pH	6		YES	5292-96	MW106	SU
pH	6		YES	5269-96	MW106	SU
pH	6		YES	6763-94	MW106	SU
pH	6		YES	5290-96	MW106	SU
pH	6.1		YES	7275-94	MW106	SU
pH	6.1		YES	7272-94	MW106	SU
pH	6.1		YES	7274-94	MW106	SU
pH	6.1		YES	7273-94	MW106	SU
pH	6.1		YES	6643-94	MW106	SU
pH	6.1		YES	6641-94	MW106	SU
pH	6.1		YES	6642-94	MW106	SU
pH	6.1		YES	7863-93	MW106	SU
pH	6.1		YES	7862-93	MW106	SU
pH	6.1		YES	7664-93	MW106	SU
pH	6.1		YES	6640-94	MW106	SU
pH	6.1		YES	7665-93	MW106	SU
pH	6.13		YES	5766-97	MW106	SU
pH	6.2		YES	4697-94	MW106	SU
pH	6.2		YES	5447-95	MW106	SU
pH	6.2		YES	5446-95	MW106	SU
pH	6.2		YES	4699-94	MW106	SU
pH	6.2		YES	4700-94	MW106	SU
pH	6.2		YES	5444-95	MW106	SU
pH	6.2		YES	5445-95	MW106	SU
pH	8.2		YES	4698-94	MW106	SU
pH	6.4		YES	6562-93	MW106	SU
pH	6.4		YES	6560-93	MW106	SU
pH	6.4		YES	6561-93	MW106	SU
pH	6.4		YES	5138-97	MW106	SU
pH	6.5		YES	6579-93	MW106	SU
pH	6		YES	4231-94	MW141	SU
pH	6		YES	7066-93	MW141	SU
pH	6		YES	7067-93	MW141	SU
pH	6		YES	4229-94	MW141	SU
pH	6		YES	4230-94	MW141	SU
pH	6		YES	4232-94	MW141	SU
pH	6		YES	7066-93	MW141	SU
pH	6		YES	7065-93	MW141	SU
pH	6.1		YES	6671-94	MW141	SU
pH	6.1		YES	6669-94	MW141	SU
pH	6.1		YES	5200-94	MW141	SU
pH	6.1		YES	5199-94	MW141	SU
pH	8.1		YES	6054-94	MW141	SU
pH	6.1		YES	5202-94	MW141	SU
pH	6.1		YES	6056-94	MW141	SU
pH	6.1		YES	6055-94	MW141	SU
pH	6.1		YES	6666-94	MW141	SU
pH	6.1		YES	6670-94	MW141	SU
pH	6.1		YES	6057-94	MW141	SU
pH	6.1		YES	5201-94	MW141	SU
pH	6.2		YES	6082-93	MW141	SU
pH	6.2		YES	6061-93	MW141	SU
pH	6.2		YES	6080-93	MW141	SU



Data for pH were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
pH	6.2		YES	6094-93	MW141	SU
pH	6.2		YES	6093-93	MW141	SU
pH	6.2		YES	6092-93	MW141	SU
pH	6.2		YES	6095-93	MW141	SU
pH	6.2		YES	6083-93	MW141	SU
pH	5.8		YES	7091-93	MW142	SU
pH	5.8		YES	5797-97	MW142	SU
pH	5.8		YES	4233-94	MW142	SU
pH	5.8		YES	4234-94	MW142	SU
pH	5.8		YES	4235-94	MW142	SU
pH	5.6		YES	7089-93	MW142	SU
pH	5.6		YES	4236-94	MW142	SU
pH	5.8		YES	7090-93	MW142	SU
pH	5.8		YES	7092-93	MW142	SU
pH	5.9		YES	6058-94	MW142	SU
pH	5.9		YES	6060-94	MW142	SU
pH	5.9		YES	5318-96	MW142	SU
pH	5.9		YES	6059-94	MW142	SU
pH	5.9		YES	5319-96	MW142	SU
pH	5.9		YES	5320-96	MW142	SU
pH	5.9		YES	6061-94	MW142	SU
pH	5.9		YES	5317-96	MW142	SU
pH	6		YES	6098-93	MW142	SU
pH	6		YES	6875-94	MW142	SU
pH	6		YES	6873-94	MW142	SU
pH	6		YES	6872-94	MW142	SU
pH	6		YES	5464-95	MW142	SU
pH	6		YES	5147-97	MW142	SU
pH	6		YES	5465-95	MW142	SU
pH	6		YES	5466-95	MW142	SU
pH	6		YES	6084-93	MW142	SU
pH	6		YES	6874-94	MW142	SU
pH	6		YES	5467-95	MW142	SU
pH	6		YES	6096-93	MW142	SU
pH	6		YES	6067-93	MW142	SU
pH	8		YES	6099-93	MW142	SU
pH	8		YES	5203-94	MW142	SU
pH	6		YES	6086-93	MW142	SU
pH	6		YES	5206-94	MW142	SU
pH	6		YES	6097-93	MW142	SU
pH	6		YES	5204-94	MW142	SU
pH	6		YES	6065-93	MW142	SU
pH	6		YES	5205-94	MW142	SU
pH	5.9		YES	5652-93	MW150	SU
pH	5.9		YES	5651-93	MW150	SU
pH	5.9		YES	5650-93	MW150	SU
pH	5.9		YES	5653-93	MW150	SU
pH	5.9		YES	7369-94	MW150	SU
pH	5.9		YES	7367-94	MW150	SU
pH	5.9		YES	7368-94	MW150	SU
pH	5.9		YES	7366-94	MW150	SU
pH	6		YES	5322-96	MW150	SU
pH	6		YES	5321-96	MW150	SU
pH	6		YES	5580-94	MW150	SU

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
pH	6		YES	6767-93	MW150	SU
pH	6		YES	5470-95	MW150	SU
pH	6		YES	5578-94	MW150	SU
pH	6		YES	5323-96	MW150	SU
pH	6		YES	5468-95	MW150	SU
pH	6		YES	4790-94	MW150	SU
pH	6		YES	4769-94	MW150	SU
pH	6		YES	4791-94	MW150	SU
pH	6		YES	4792-94	MW150	SU
pH	6		YES	5649-93	MW150	SU
pH	6		YES	6764-93	MW150	SU
pH	6		YES	5561-94	MW150	SU
pH	6		YES	6765-93	MW150	SU
pH	6		YES	6766-93	MW150	SU
pH	6		YES	5471-95	MW150	SU
pH	6		YES	5469-95	MW150	SU
pH	6		YES	5579-94	MW150	SU
pH	6		YES	5324-96	MW150	SU
pH	6.1		YES	6502-94	MW150	SU
pH	6.1		YES	6501-94	MW150	SU
pH	6.1		YES	6503-94	MW150	SU
pH	6.1		YES	6504-94	MW150	SU
pH	6.1		YES	5146-97	MW150	SU
pH	6.2		YES	7725-93	MW150	SU
pH	6.2		YES	7726-93	MW150	SU
pH	6.2		YES	7727-93	MW150	SU
pH	6.2		YES	7724-93	MW150	SU
pH	6.1		YES	5556-97	MW199	SU
pH	6.1		YES	5171-93	MW199	SU
pH	6.1		YES	4312-94	MW199	SU
pH	6.1		YES	4315-94	MW199	SU
pH	6.1		YES	4313-94	MW199	SU
pH	6.1		YES	5170-93	MW199	SU
pH	6.1		YES	5173-93	MW199	SU
pH	6.1		YES	5172-93	MW199	SU
pH	6.1		YES	4314-94	MW199	SU
pH	6.2		YES	6077-94	MW199	SU
pH	6.2		YES	6076-94	MW199	SU
pH	6.2		YES	6075-94	MW199	SU
pH	6.2		YES	6074-94	MW199	SU
pH	6.3		YES	6890-94	MW199	SU
pH	6.3		YES	6891-94	MW199	SU
pH	6.3		YES	7313-93	MW199	SU
pH	6.3		YES	7311-93	MW199	SU
pH	6.3		YES	6889-94	MW199	SU
pH	6.3		YES	7312-93	MW199	SU
pH	6.3		YES	5260-94	MW199	SU
pH	6.3		YES	5262-94	MW199	SU
pH	6.3		YES	7314-93	MW199	SU
pH	6.3		YES	5261-94	MW199	SU
pH	6.3		YES	5263-94	MW199	SU
pH	6.4		YES	5985-93	MW199	SU
pH	6.4		YES	6888-94	MW199	SU
pH	6.4		YES	5987-93	MW199	SU

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
pH	6.4		YES	5986-93	MW199	SU
pH	6.4		YES	5984-93	MW199	SU

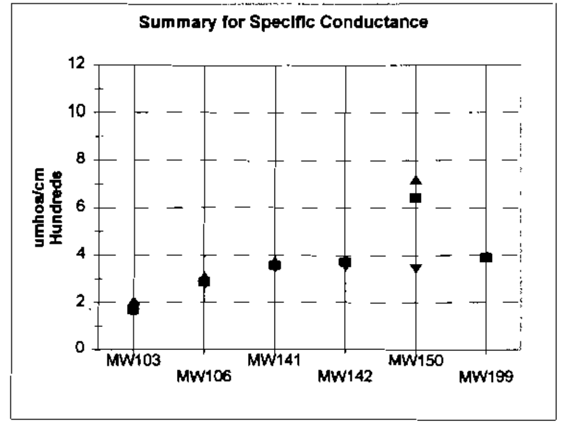
Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS	CORRECTED DATA SET								
Specific conductance	155		YES	6027-94	MW103	umhos/cm		MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
Specific conductance	155		YES	6028-94	MW103	umhos/cm		Specific conductance							
Specific conductance	155		YES	6029-94	MW103	umhos/cm		155	278	346	352	344	379		
Specific conductance	156		YES	7302-93	MW103	umhos/cm		155	278	347	353	632	380		
Specific conductance	156		YES	6028-94	MW103	umhos/cm		155	278	347	366	633	380		
Specific conductance	157		YES	7301-93	MW103	umhos/cm		156	280	347	368	633	381		
Specific conductance	158		YES	7300-93	MW103	umhos/cm		156	280	347	369	633	384		
Specific conductance	159		YES	5287-96	MW103	umhos/cm		157	280	351	369	639	384		
Specific conductance	159		YES	6776-94	MW103	umhos/cm		158	280	351	369	639	384		
Specific conductance	160		YES	6777-94	MW103	umhos/cm		159	281	351	369	639	384		
Specific conductance	180		YES	6775-94	MW103	umhos/cm		159	282	351	369	640	388		
Specific conductance	160		YES	7299-93	MW103	umhos/cm		160	282	352	369	640	388		
Specific conductance	160		YES	5288-98	MW103	umhos/cm		160	283	352	370	640	389		
Specific conductance	160		YES	5288-98	MW103	umhos/cm		160	284	352	370	641	389		
Specific conductance	180		YES	5285-96	MW103	umhos/cm		160	284	352	370	641	390		
Specific conductance	161		YES	6774-94	MW103	umhos/cm		160	284	353	370	642	390		
Specific conductance	165		YES	4275-94	MW103	umhos/cm		180	284	354	371	642	390		
Specific conductance	168		YES	4274-94	MW103	umhos/cm		181	285	355	371	642	390		
Specific conductance	167		YES	5947-93	MW103	umhos/cm		165	285	357	371	643	390		
Specific conductance	187		YES	5946-93	MW103	umhos/cm		188	286	358	371	644	390		
Specific conductance	168		YES	4273-94	MW103	umhos/cm		187	286	360	372	645	390		
Specific conductance	168		YES	5945-93	MW103	umhos/cm		167	286	360	372	645	390		
Specific conductance	189		YES	4272-94	MW103	umhos/cm		188	287	361	372	845	390		
Specific conductance	170		YES	5190-94	MW103	umhos/cm		168	287	362	373	651	391		
Specific conductance	170		YES	5443-95	MW103	umhos/cm		189	288	363	373	652	391		
Specific conductance	170		YES	5944-93	MW103	umhos/cm		170	288	364	373	652	391		
Specific conductance	170		YES	5441-95	MW103	umhos/cm		170	290	364	373	653	394		
Specific conductance	172		YES	5440-95	MW103	umhos/cm		170	290	367	373	655	394		
Specific conductance	172		YES	5189-94	MW103	umhos/cm		170	290	369	374	657	395		
Specific conductance	172		YES	5442-95	MW103	umhos/cm		172	290	374	374	657	395		
Specific conductance	177		YES	5181-93	MW103	umhos/cm		172	290		374	657	402		
Specific conductance	179		YES	5179-93	MW103	umhos/cm		172	290		375	660			
Specific conductance	180		YES	5180-93	MW103	umhos/cm		177	291		377	661			
Specific conductance	183		YES	5178-93	MW103	umhos/cm		179	291		378	681			
Specific conductance	190		YES	5142-97	MW103	umhos/cm		180	292		378	662			
Specific conductance	209		YES	5372-97	MW103	umhos/cm		183	292		378	882			
Specific conductance	278		YES	5518-94	MW108	umhos/cm		190	292		381	682			
Specific conductance	278		YES	5514-94	MW108	umhos/cm		209	293		383	662			
Specific conductance	278		YES	5515-94	MW108	umhos/cm			294		383	683			
Specific conductance	280		YES	5513-94	MW106	umhos/cm			295		383	719			
Specific conductance	280		YES	5325-93	MW108	umhos/cm			295						
Specific conductance	280		YES	5324-93	MW108	umhos/cm			296						
Specific conductance	280		YES	5323-93	MW108	umhos/cm			310						
Specific conductance	281		YES	4898-94	MW106	umhos/cm			310						
Specific conductance	282		YES	4700-94	MW106	umhos/cm									
Specific conductance	282		YES	4899-94	MW108	umhos/cm	Min	155.00	278.00	348.00	352.00	344.00	379.00	155.00	
Specific conductance	283		YES	5322-93	MW108	umhos/cm	Max	209.00	310.00	374.00	383.00	719.00	402.00	719.00	
Specific conductance	284		YES	6582-93	MW108	umhos/cm	Average	167.08	287.79	355.96	372.00	841.79	388.72	369.03	368.89
Specific conductance	284		YES	4897-94	MW108	umhos/cm	Number	36	42	28	38	38	29	211	

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Specific conductance	284		YES	6580-93	MW106	umhos/cm
Specific conductance	284		YES	6581-93	MW106	umhos/cm
Specific conductance	285		YES	7865-93	MW106	umhos/cm
Specific conductance	285		YES	6579-93	MW106	umhos/cm
Specific conductance	286		YES	7862-93	MW106	umhos/cm
Specific conductance	286		YES	7864-93	MW106	umhos/cm
Specific conductance	286		YES	7863-93	MW106	umhos/cm
Specific conductance	287		YES	5291-96	MW106	umhos/cm
Specific conductance	287		YES	5292-96	MW106	umhos/cm
Specific conductance	288		YES	5290-96	MW106	umhos/cm
Specific conductance	288		YES	5269-96	MW106	umhos/cm
Specific conductance	290		YES	5447-95	MW106	umhos/cm
Specific conductance	290		YES	6640-94	MW106	umhos/cm
Specific conductance	290		YES	5444-95	MW106	umhos/cm
Specific conductance	290		YES	6643-94	MW106	umhos/cm
Specific conductance	290		YES	5446-95	MW106	umhos/cm
Specific conductance	290		YES	5445-95	MW106	umhos/cm
Specific conductance	291		YES	6641-94	MW106	umhos/cm
Specific conductance	291		YES	6642-94	MW106	umhos/cm
Specific conductance	292		YES	7275-94	MW106	umhos/cm
Specific conductance	292		YES	7274-94	MW106	umhos/cm
Specific conductance	292		YES	7273-94	MW106	umhos/cm
Specific conductance	293		YES	7272-94	MW106	umhos/cm
Specific conductance	294		YES	6785-94	MW106	umhos/cm
Specific conductance	295		YES	6784-94	MW106	umhos/cm
Specific conductance	295		YES	6783-94	MW106	umhos/cm
Specific conductance	296		YES	6782-94	MW106	umhos/cm
Specific conductance	310		YES	5788-97	MW106	umhos/cm
Specific conductance	310		YES	5138-97	MW106	umhos/cm
Specific conductance	346		YES	7087-93	MW141	umhos/cm
Specific conductance	347		YES	6054-94	MW141	umhos/cm
Specific conductance	347		YES	6057-94	MW141	umhos/cm
Specific conductance	347		YES	6055-94	MW141	umhos/cm
Specific conductance	347		YES	6058-94	MW141	umhos/cm
Specific conductance	351		YES	7088-93	MW141	umhos/cm
Specific conductance	351		YES	5202-94	MW141	umhos/cm
Specific conductance	351		YES	7086-93	MW141	umhos/cm
Specific conductance	351		YES	6093-93	MW141	umhos/cm
Specific conductance	352		YES	5199-94	MW141	umhos/cm
Specific conductance	352		YES	5200-94	MW141	umhos/cm
Specific conductance	352		YES	7085-93	MW141	umhos/cm
Specific conductance	352		YES	5201-94	MW141	umhos/cm
Specific conductance	353		YES	6094-93	MW141	umhos/cm
Specific conductance	354		YES	6092-93	MW141	umhos/cm
Specific conductance	355		YES	6095-93	MW141	umhos/cm
Specific conductance	357		YES	4230-94	MW141	umhos/cm
Specific conductance	358		YES	4231-94	MW141	umhos/cm
Specific conductance	360		YES	4229-94	MW141	umhos/cm
Specific conductance	360		YES	4232-94	MW141	umhos/cm
Specific conductance	361		YES	6870-94	MW141	umhos/cm
Specific conductance	362		YES	6671-94	MW141	umhos/cm
Specific conductance	363		YES	6869-94	MW141	umhos/cm
Specific conductance	364		YES	8083-93	MW141	umhos/cm
Specific conductance	364		YES	6868-94	MW141	umhos/cm

CORRECTED DATA SET



Data for Specific Conductance were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Specific conductance	367		YES	6082-93	MW141	umhos/cm
Specific conductance	369		YES	6081-93	MW141	umhos/cm
Specific conductance	374		YES	6080-93	MW141	umhos/cm
Specific conductance	352		YES	5797-97	MW142	umhos/cm
Specific conductance	353		YES	5147-97	MW142	umhos/cm
Specific conductance	366		YES	6058-94	MW142	umhos/cm
Specific conductance	368		YES	5205-94	MW142	umhos/cm
Specific conductance	369		YES	6061-94	MW142	umhos/cm
Specific conductance	369		YES	6060-94	MW142	umhos/cm
Specific conductance	369		YES	6059-94	MW142	umhos/cm
Specific conductance	369		YES	5203-94	MW142	umhos/cm
Specific conductance	369		YES	5206-94	MW142	umhos/cm
Specific conductance	369		YES	5316-96	MW142	umhos/cm
Specific conductance	370		YES	5317-96	MW142	umhos/cm
Specific conductance	370		YES	5320-96	MW142	umhos/cm
Specific conductance	370		YES	5204-94	MW142	umhos/cm
Specific conductance	370		YES	5319-96	MW142	umhos/cm
Specific conductance	371		YES	7092-93	MW142	umhos/cm
Specific conductance	371		YES	7090-93	MW142	umhos/cm
Specific conductance	371		YES	7091-93	MW142	umhos/cm
Specific conductance	371		YES	7089-93	MW142	umhos/cm
Specific conductance	372		YES	6085-93	MW142	umhos/cm
Specific conductance	372		YES	6086-93	MW142	umhos/cm
Specific conductance	372		YES	6087-93	MW142	umhos/cm
Specific conductance	373		YES	5464-95	MW142	umhos/cm
Specific conductance	373		YES	5467-95	MW142	umhos/cm
Specific conductance	373		YES	5466-95	MW142	umhos/cm
Specific conductance	373		YES	5465-95	MW142	umhos/cm
Specific conductance	373		YES	6084-93	MW142	umhos/cm
Specific conductance	374		YES	6098-93	MW142	umhos/cm
Specific conductance	374		YES	6096-93	MW142	umhos/cm
Specific conductance	374		YES	6097-93	MW142	umhos/cm
Specific conductance	375		YES	6099-93	MW142	umhos/cm
Specific conductance	377		YES	4234-94	MW142	umhos/cm
Specific conductance	378		YES	4235-94	MW142	umhos/cm
Specific conductance	378		YES	4236-94	MW142	umhos/cm
Specific conductance	378		YES	4233-94	MW142	umhos/cm
Specific conductance	381		YES	6874-94	MW142	umhos/cm
Specific conductance	383		YES	6873-94	MW142	umhos/cm
Specific conductance	383		YES	6872-94	MW142	umhos/cm
Specific conductance	383		YES	6875-94	MW142	umhos/cm
Specific conductance	344		YES	5649-93	MW150	umhos/cm
Specific conductance	632		YES	4789-94	MW150	umhos/cm
Specific conductance	633		YES	4791-94	MW150	umhos/cm
Specific conductance	633		YES	4792-94	MW150	umhos/cm
Specific conductance	633		YES	4790-94	MW150	umhos/cm
Specific conductance	639		YES	6766-93	MW150	umhos/cm
Specific conductance	639		YES	6765-93	MW150	umhos/cm
Specific conductance	639		YES	6764-93	MW150	umhos/cm
Specific conductance	640		YES	5652-93	MW150	umhos/cm
Specific conductance	640		YES	5653-93	MW150	umhos/cm
Specific conductance	640		YES	6767-93	MW150	umhos/cm
Specific conductance	641		YES	5651-93	MW150	umhos/cm
Specific conductance	641		YES	5650-93	MW150	umhos/cm

Summary of RGA Background Wells Physical Parameters

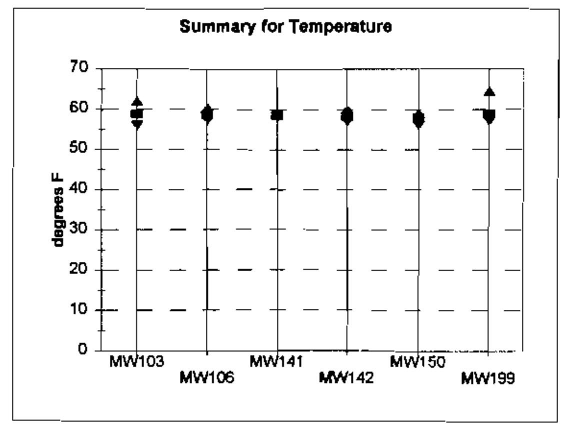
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Specific conductance	642		YES	7726-93	MW150	umhos/cm
Specific conductance	642		YES	7724-93	MW150	umhos/cm
Specific conductance	642		YES	7725-93	MW150	umhos/cm
Specific conductance	643		YES	7727-93	MW150	umhos/cm
Specific conductance	644		YES	5321-96	MW150	umhos/cm
Specific conductance	645		YES	5322-96	MW150	umhos/cm
Specific conductance	645		YES	5323-96	MW150	umhos/cm
Specific conductance	645		YES	5324-96	MW150	umhos/cm
Specific conductance	651		YES	5578-94	MW150	umhos/cm
Specific conductance	652		YES	5579-94	MW150	umhos/cm
Specific conductance	652		YES	5580-94	MW150	umhos/cm
Specific conductance	653		YES	5581-94	MW150	umhos/cm
Specific conductance	655		YES	7367-94	MW150	umhos/cm
Specific conductance	657		YES	7368-94	MW150	umhos/cm
Specific conductance	657		YES	7369-94	MW150	umhos/cm
Specific conductance	657		YES	7366-94	MW150	umhos/cm
Specific conductance	660		YES	6503-94	MW150	umhos/cm
Specific conductance	661		YES	6504-94	MW150	umhos/cm
Specific conductance	661		YES	5468-95	MW150	umhos/cm
Specific conductance	662		YES	6501-94	MW150	umhos/cm
Specific conductance	662		YES	5469-95	MW150	umhos/cm
Specific conductance	662		YES	5470-95	MW150	umhos/cm
Specific conductance	662		YES	6502-94	MW150	umhos/cm
Specific conductance	663		YES	5471-95	MW150	umhos/cm
Specific conductance	719		YES	5148-97	MW150	umhos/cm
Specific conductance	379		YES	6077-94	MW199	umhos/cm
Specific conductance	380		YES	6074-94	MW199	umhos/cm
Specific conductance	380		YES	6075-94	MW199	umhos/cm
Specific conductance	381		YES	6076-94	MW199	umhos/cm
Specific conductance	384		YES	7314-93	MW199	umhos/cm
Specific conductance	384		YES	7312-93	MW199	umhos/cm
Specific conductance	384		YES	7311-93	MW199	umhos/cm
Specific conductance	384		YES	7313-93	MW199	umhos/cm
Specific conductance	388		YES	5171-93	MW199	umhos/cm
Specific conductance	388		YES	5172-93	MW199	umhos/cm
Specific conductance	389		YES	5170-93	MW199	umhos/cm
Specific conductance	389		YES	5173-93	MW199	umhos/cm
Specific conductance	390		YES	6888-94	MW199	umhos/cm
Specific conductance	390		YES	5263-94	MW199	umhos/cm
Specific conductance	390		YES	5985-93	MW199	umhos/cm
Specific conductance	390		YES	5262-94	MW199	umhos/cm
Specific conductance	390		YES	5984-93	MW199	umhos/cm
Specific conductance	390		YES	5986-93	MW199	umhos/cm
Specific conductance	390		YES	6889-94	MW199	umhos/cm
Specific conductance	390		YES	5987-93	MW199	umhos/cm
Specific conductance	390		YES	6890-94	MW199	umhos/cm
Specific conductance	391		YES	5260-94	MW199	umhos/cm
Specific conductance	391		YES	5261-94	MW199	umhos/cm
Specific conductance	391		YES	6891-94	MW199	umhos/cm
Specific conductance	394		YES	4313-94	MW199	umhos/cm
Specific conductance	394		YES	4312-94	MW199	umhos/cm
Specific conductance	395		YES	4314-94	MW199	umhos/cm
Specific conductance	395		YES	4315-94	MW199	umhos/cm
Specific conductance	402		YES	5556-97	MW199	umhos/cm

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Temperature	56		YES	5142-97	MW103	F
Temperature	58		YES	5440-95	MW103	F
Temperature	58		YES	4272-94	MW103	F
Temperature	58		YES	5285-96	MW103	F
Temperature	59		YES	5178-93	MW103	F
Temperature	59		YES	5187-94	MW103	F
Temperature	59		YES	8774-94	MW103	F
Temperature	59		YES	6026-94	MW103	F
Temperature	59.3		YES	7299-93	MW103	F
Temperature	59.3		YES	5944-93	MW103	F
Temperature	62		YES	5372-97	MW103	F
Temperature	57.3		YES	5788-97	MW106	F
Temperature	58		YES	5138-97	MW106	F
Temperature	58		YES	7862-93	MW106	F
Temperature	58		YES	4697-94	MW106	F
Temperature	58		YES	7272-94	MW106	F
Temperature	58		YES	5444-95	MW106	F
Temperature	58		YES	5289-98	MW106	F
Temperature	59		YES	6640-94	MW106	F
Temperature	59		YES	5513-94	MW108	F
Temperature	59		YES	6782-94	MW108	F
Temperature	60		YES	5322-93	MW108	F
Temperature	60.4		YES	6579-93	MW108	F
Temperature	58		YES	4229-94	MW141	F
Temperature	58		YES	7085-93	MW141	F
Temperature	58		YES	6868-94	MW141	F
Temperature	59		YES	5199-94	MW141	F
Temperature	59		YES	8080-93	MW141	F
Temperature	59		YES	8092-93	MW141	F
Temperature	59		YES	6054-94	MW141	F
Temperature	57		YES	5464-95	MW142	F
Temperature	57		YES	5147-97	MW142	F
Temperature	58		YES	6672-94	MW142	F
Temperature	58		YES	4233-94	MW142	F
Temperature	58		YES	5797-97	MW142	F
Temperature	58		YES	5317-96	MW142	F
Temperature	58		YES	7089-93	MW142	F
Temperature	59		YES	6098-93	MW142	F
Temperature	59		YES	6058-94	MW142	F
Temperature	59		YES	6084-93	MW142	F
Temperature	60		YES	5203-94	MW142	F
Temperature	56		YES	5148-97	MW150	F
Temperature	57		YES	4789-94	MW150	F
Temperature	58		YES	5650-93	MW150	F
Temperature	58		YES	7724-93	MW150	F
Temperature	58		YES	5321-98	MW150	F
Temperature	58		YES	5468-95	MW150	F
Temperature	58		YES	7366-94	MW150	F
Temperature	58		YES	8501-94	MW150	F
Temperature	58.6		YES	8764-93	MW150	F
Temperature	59		YES	5578-94	MW150	F
Temperature	57		YES	6888-94	MW199	F
Temperature	57.9		YES	7311-93	MW199	F
Temperature	58		YES	5260-94	MW199	F

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Temperature							
	56	57.3	58	57	56	57		
	58	58	58	57	57	57.9		
	58	58	58	58	58	58		
	58	58	59	58	58	58		
	59	58	59	58	58	58		
	59	58	59	58	58	58		
	59	58	59	58	58	59.1		
	59	59		59	58	64.5		
	59.3	59		59	58.6			
	59.3	59		59	59			
	62	60		60				
		60.4						
Min	56.00	57.30	58.00	57.00	56.00	57.00	56.00	
Max	62.00	60.40	59.00	60.00	59.00	64.50	64.50	
Average	58.78	58.58	56.57	58.27	57.86	58.81	58.46	58.48
Number	11	12	7	11	10	8	59	



Data for Temperature were not modified

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Temperature	58		YES	5170-93	MW199	F
Temperature	58		YES	4312-94	MW199	F
Temperature	58		YES	6074-94	MW199	F
Temperature	59.1		YES	5984-93	MW199	F
Temperature	64.5		YES	5558-97	MW199	F

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Organic Carbon	1	<	NO	5180-93	MW103	mg/L
Total Organic Carbon	1	<	NO	6029-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5945-93	MW103	mg/L
Total Organic Carbon	1	<	NO	7299-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5946-93	MW103	mg/L
Total Organic Carbon	1	<	NO	6776-94	MW103	mg/L
Total Organic Carbon	1	<	NO	6777-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5288-96	MW103	mg/L
Total Organic Carbon	1	<	NO	5944-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5441-95	MW103	mg/L
Total Organic Carbon	1	<	NO	5181-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5179-93	MW103	mg/L
Total Organic Carbon	1	<	NO	7301-93	MW103	mg/L
Total Organic Carbon	1	<	NO	7302-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5286-96	MW103	mg/L
Total Organic Carbon	1	<	NO	6026-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5285-96	MW103	mg/L
Total Organic Carbon	1	<	NO	7300-93	MW103	mg/L
Total Organic Carbon	1	<	NO	6775-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5287-96	MW103	mg/L
Total Organic Carbon	1	<	NO	6774-94	MW103	mg/L
Total Organic Carbon	1	<	NO	6027-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5178-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5440-95	MW103	mg/L
Total Organic Carbon	1	<	NO	5947-93	MW103	mg/L
Total Organic Carbon	1	<	NO	5443-95	MW103	mg/L
Total Organic Carbon	1	<	NO	5442-95	MW103	mg/L
Total Organic Carbon	1	<	NO	4272-94	MW103	mg/L
Total Organic Carbon	1	<	NO	6028-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5187-94	MW103	mg/L
Total Organic Carbon	1	<	NO	5445-95	MW106	mg/L
Total Organic Carbon	1	<	NO	5446-95	MW106	mg/L
Total Organic Carbon	1	<	NO	5325-93	MW106	mg/L
Total Organic Carbon	1	<	NO	5324-93	MW106	mg/L
Total Organic Carbon	1	<	NO	5444-95	MW106	mg/L
Total Organic Carbon	1	<	NO	5323-93	MW106	mg/L
Total Organic Carbon	1	<	NO	5447-95	MW106	mg/L
Total Organic Carbon	1	<	NO	4700-94	MW106	mg/L
Total Organic Carbon	1	<	NO	5322-93	MW106	mg/L

CORRECTED DATA SET

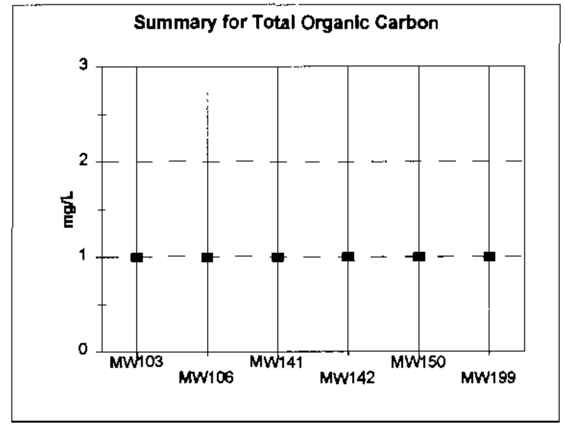
Total Organic Carbon

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1	1	1	1	1	1		
	1		1	1	1	1		
	1		1	1	1	1		
	1		1	1	1	1		
	1		1	1	1	1		
	1		1	1	1	1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1		1	1		1		
	1			1				
	1			1				
	1			1				
	1			1				
	1			1				
				1				
				1				
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Average	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number	30	12	25	32	17	25	141	

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Organic Carbon	1	<	NO	4698-94	MW106	mg/L
Total Organic Carbon	1	<	NO	4697-94	MW106	mg/L
Total Organic Carbon	1	<	NO	4699-94	MW106	mg/L
Total Organic Carbon	1	<	NO	5201-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6095-93	MW141	mg/L
Total Organic Carbon	1	<	NO	4229-94	MW141	mg/L
Total Organic Carbon	1	<	NO	5199-94	MW141	mg/L
Total Organic Carbon	1	<	NO	7088-93	MW141	mg/L
Total Organic Carbon	1	<	NO	8869-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6871-94	MW141	mg/L
Total Organic Carbon	1	<	NO	8870-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6057-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6056-94	MW141	mg/L
Total Organic Carbon	1	<	NO	5200-94	MW141	mg/L
Total Organic Carbon	1	<	NO	7085-93	MW141	mg/L
Total Organic Carbon	1	<	NO	6082-93	MW141	mg/L
Total Organic Carbon	1	<	NO	7086-93	MW141	mg/L
Total Organic Carbon	1	<	NO	6094-93	MW141	mg/L
Total Organic Carbon	1	<	NO	7087-93	MW141	mg/L
Total Organic Carbon	1	<	NO	5202-94	MW141	mg/L
Total Organic Carbon	1		YES	6092-93	MW141	mg/L
Total Organic Carbon	1		YES	6093-93	MW141	mg/L
Total Organic Carbon	1		YES	6080-93	MW141	mg/L
Total Organic Carbon	1	<	NO	6083-93	MW141	mg/L
Total Organic Carbon	1	<	NO	6054-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6688-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6055-94	MW141	mg/L
Total Organic Carbon	1	<	NO	6081-93	MW141	mg/L
Total Organic Carbon	1	<	NO	5485-95	MW142	mg/L
Total Organic Carbon	1	<	NO	7091-93	MW142	mg/L
Total Organic Carbon	1	<	NO	7092-93	MW142	mg/L
Total Organic Carbon	1	<	NO	7069-93	MW142	mg/L
Total Organic Carbon	1	<	NO	5205-94	MW142	mg/L
Total Organic Carbon	1	<	NO	5204-94	MW142	mg/L
Total Organic Carbon	1		YES	6099-93	MW142	mg/L
Total Organic Carbon	1	<	NO	5203-94	MW142	mg/L
Total Organic Carbon	1	<	NO	5208-94	MW142	mg/L
Total Organic Carbon	1	<	NO	7090-93	MW142	mg/L
Total Organic Carbon	1	<	NO	5467-95	MW142	mg/L
Total Organic Carbon	1		YES	6096-93	MW142	mg/L
Total Organic Carbon	1	<	NO	6061-94	MW142	mg/L
Total Organic Carbon	1	<	NO	6872-94	MW142	mg/L
Total Organic Carbon	1	<	NO	5468-95	MW142	mg/L
Total Organic Carbon	1	<	NO	6058-94	MW142	mg/L
Total Organic Carbon	1		YES	6085-93	MW142	mg/L
Total Organic Carbon	1	<	NO	6873-94	MW142	mg/L
Total Organic Carbon	1	<	NO	5318-96	MW142	mg/L
Total Organic Carbon	1		YES	4233-94	MW142	mg/L
Total Organic Carbon	1	<	NO	6087-93	MW142	mg/L
Total Organic Carbon	1	<	NO	5320-96	MW142	mg/L
Total Organic Carbon	1	<	NO	6875-94	MW142	mg/L
Total Organic Carbon	1	<	NO	6059-94	MW142	mg/L
Total Organic Carbon	1	<	NO	5317-96	MW142	mg/L
Total Organic Carbon	1	<	NO	5464-95	MW142	mg/L

CORRECTED DATA SET



Data for Total Organic Carbon were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Organic Carbon	1		YES	6098-93	MW142	mg/L
Total Organic Carbon	1	<	NO	5319-96	MW142	mg/L
Total Organic Carbon	1	<	NO	6084-93	MW142	mg/L
Total Organic Carbon	1	<	NO	6060-94	MW142	mg/L
Total Organic Carbon	1	<	NO	6097-93	MW142	mg/L
Total Organic Carbon	1		YES	6086-93	MW142	mg/L
Total Organic Carbon		Q	NO	6874-94	MW142	
Total Organic Carbon	1		YES	5651-93	MW150	mg/L
Total Organic Carbon	1		YES	5469-95	MW150	mg/L
Total Organic Carbon	1		YES	4789-94	MW150	mg/L
Total Organic Carbon	1	<	NO	5471-95	MW150	mg/L
Total Organic Carbon	1		YES	4792-94	MW150	mg/L
Total Organic Carbon	1		YES	5653-93	MW150	mg/L
Total Organic Carbon	1	<	NO	5649-93	MW150	mg/L
Total Organic Carbon	1	<	NO	5321-96	MW150	mg/L
Total Organic Carbon	1		YES	5323-96	MW150	mg/L
Total Organic Carbon	1	<	NO	5468-95	MW150	mg/L
Total Organic Carbon	1		YES	5650-93	MW150	mg/L
Total Organic Carbon	1		YES	4791-94	MW150	mg/L
Total Organic Carbon	1		YES	5324-96	MW150	mg/L
Total Organic Carbon	1		YES	4790-94	MW150	mg/L
Total Organic Carbon	1	<	NO	5322-96	MW150	mg/L
Total Organic Carbon	1		YES	5470-95	MW150	mg/L
Total Organic Carbon	1		YES	5652-93	MW150	mg/L
Total Organic Carbon	1	<	NO	6077-94	MW199	mg/L
Total Organic Carbon	1	<	NO	5171-93	MW199	mg/L
Total Organic Carbon	1	<	NO	5260-94	MW199	mg/L
Total Organic Carbon	1	<	NO	4312-94	MW199	mg/L
Total Organic Carbon	1		YES	5261-94	MW199	mg/L
Total Organic Carbon	1		YES	5170-93	MW199	mg/L
Total Organic Carbon	1	<	NO	7312-93	MW199	mg/L
Total Organic Carbon	1	<	NO	5262-94	MW199	mg/L
Total Organic Carbon	1	<	NO	6075-94	MW199	mg/L
Total Organic Carbon	1	<	NO	6076-94	MW199	mg/L
Total Organic Carbon	1	<	NO	7314-93	MW199	mg/L
Total Organic Carbon	1	<	NO	7311-93	MW199	mg/L
Total Organic Carbon	1		YES	5263-94	MW199	mg/L
Total Organic Carbon	1	<	NO	6868-94	MW199	mg/L
Total Organic Carbon	1		YES	6869-94	MW199	mg/L
Total Organic Carbon	1		YES	5173-93	MW199	mg/L
Total Organic Carbon	1	<	NO	6891-94	MW199	mg/L
Total Organic Carbon	1	<	NO	6890-94	MW199	mg/L
Total Organic Carbon	1	<	NO	5964-93	MW199	mg/L
Total Organic Carbon	1		YES	6074-94	MW199	mg/L
Total Organic Carbon	1	<	NO	5986-93	MW199	mg/L
Total Organic Carbon	1	<	NO	5987-93	MW199	mg/L
Total Organic Carbon	1	<	NO	5172-93	MW199	mg/L
Total Organic Carbon	1	<	NO	7313-93	MW199	mg/L
Total Organic Carbon	1	<	NO	5985-93	MW199	mg/L

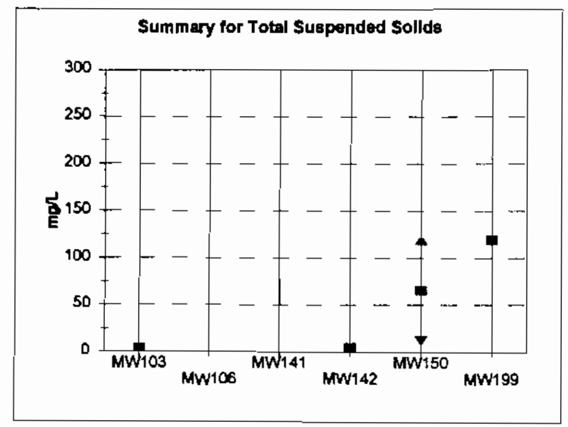
Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Total Suspended Solids	4	<	NO	5285-96	MW103	mg/L
Total Suspended Solids	4	<	NO	5142-97	MW103	mg/L
Total Suspended Solids	4	<	NO	5317-96	MW142	mg/L
Total Suspended Solids	5	*	YES	5147-97	MW142	mg/L
Total Suspended Solids	12		YES	5321-96	MW150	mg/L
Total Suspended Solids	119		YES	5148-97	MW150	mg/L
Total Suspended Solids	119		YES	5558-97	MW199	mg/L

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
Total Suspended Solids								
	4			4	12	119		
	4			5	119			

Min	4.00	ERR	ERR	4.00	12.00	119.00	4.00	
Max	4.00	ERR	ERR	5.00	119.00	119.00	119.00	
Average	4.00	ERR	ERR	4.50	65.50	119.00	38.14	48.25
Number	2	0	0	2	2	1	7	



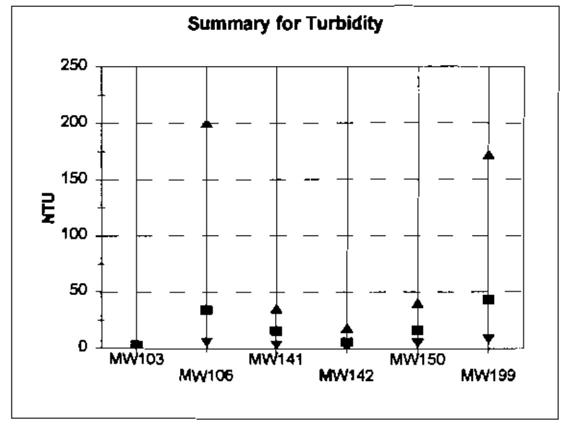
Data for Total Suspended Solids were not modified.

Summary of RGA Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION ID	UNITS
Turbidity	0.35		YES	6026-94	MW103	NTU
Turbidity	0.42		YES	6774-94	MW103	NTU
Turbidity	0.43		YES	5187-94	MW103	NTU
Turbidity	1.1		YES	5944-93	MW103	NTU
Turbidity	1.8		YES	7299-93	MW103	NTU
Turbidity	4		YES	5285-96	MW103	NTU
Turbidity	4.5		YES	5440-95	MW103	NTU
Turbidity	4.8		YES	4272-94	MW103	NTU
Turbidity	5		YES	5178-93	MW103	NTU
Turbidity	5.3		YES	4697-94	MW106	NTU
Turbidity	7		YES	6782-94	MW106	NTU
Turbidity	9		YES	7272-94	MW106	NTU
Turbidity	11		YES	6579-93	MW106	NTU
Turbidity	14		YES	8640-94	MW106	NTU
Turbidity	18		YES	7862-93	MW106	NTU
Turbidity	23		YES	5444-95	MW106	NTU
Turbidity	25		YES	5513-94	MW106	NTU
Turbidity	27		YES	5289-96	MW106	NTU
Turbidity	200		YES	5322-93	MW106	NTU
Turbidity	2.9		YES	8054-94	MW141	NTU
Turbidity	3		YES	6868-94	MW141	NTU
Turbidity	7.6		YES	5199-94	MW141	NTU
Turbidity	9.3		YES	7085-93	MW141	NTU
Turbidity	17		YES	4229-94	MW141	NTU
Turbidity	33		YES	6080-93	MW141	NTU
Turbidity	35		YES	6092-93	MW141	NTU
Turbidity	1.6		YES	4233-94	MW142	NTU
Turbidity	1.8		YES	6872-94	MW142	NTU
Turbidity	2.2		YES	6096-93	MW142	NTU
Turbidity	2.6		YES	5203-94	MW142	NTU
Turbidity	3.8		YES	5484-95	MW142	NTU
Turbidity	4		YES	5317-96	MW142	NTU
Turbidity	6.6		YES	7089-93	MW142	NTU
Turbidity	11		YES	6058-94	MW142	NTU
Turbidity	18		YES	6084-93	MW142	NTU
Turbidity	5		YES	5468-95	MW150	NTU
Turbidity	5.8		YES	6501-94	MW150	NTU
Turbidity	7		YES	7366-94	MW150	NTU
Turbidity	8.2		YES	5321-96	MW150	NTU
Turbidity	12		YES	5578-94	MW150	NTU
Turbidity	18		YES	6764-93	MW150	NTU
Turbidity	23		YES	4789-94	MW150	NTU
Turbidity	26		YES	7724-93	MW150	NTU
Turbidity	40		YES	5650-93	MW150	NTU
Turbidity	8.3		YES	4312-94	MW199	NTU
Turbidity	14		YES	6074-94	MW199	NTU
Turbidity	23		YES	5280-94	MW199	NTU
Turbidity	24		YES	6888-94	MW199	NTU
Turbidity	27		YES	5964-93	MW199	NTU
Turbidity	33		YES	7311-93	MW199	NTU
Turbidity	172		YES	5170-93	MW199	NTU

CORRECTED DATA SET

	MW103	MW106	MW141	MW142	MW150	MW199	Overall	Weighted
	Turbidity							
	0.35	5.3	2.9	1.8	5	8.3		
	0.42	7	3	1.8	5.8	14		
	0.43	9	7.6	2.2	7	23		
	1.1	11	9.3	2.6	8.2	24		
	1.8	14	17	3.6	12	27		
	4	18	33	4	18	33		
	4.5	23	35	6.6	23	172		
	4.8	25		11	26			
	5	27		18	40			
		200						
Min	0.350	5.300	2.900	1.600	5.000	8.300	0.350	
Max	5.000	200.000	35.000	18.000	40.000	172.000	200.000	
Average	2.489	33.930	15.400	5.733	16.111	43.043	18.989	19.451
Number	9	10	7	9	9	7	51	



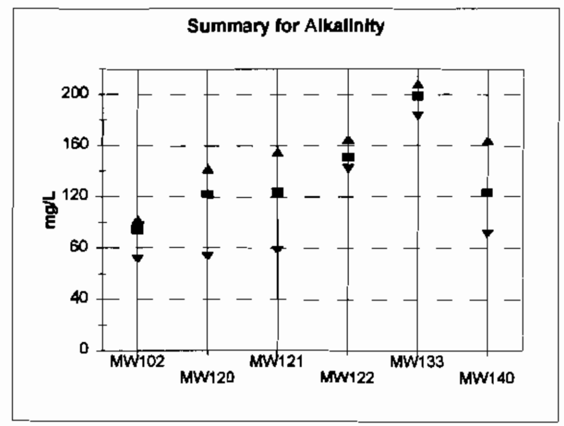
Data for Tubidity were not modified.

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Alkalinity	71		YES	5281-96	MW102	mg/L
Alkalinity	92		YES	7295-93	MW102	mg/L
Alkalinity	93		YES	5141-97	MW102	mg/L
Alkalinity	93		YES	4268-94	MW102	mg/L
Alkalinity	94		YES	7467-95	MW102	mg/L
Alkalinity	95		YES	6022-94	MW102	mg/L
Alkalinity	95		YES	5940-93	MW102	mg/L
Alkalinity	95		YES	5174-93	MW102	mg/L
Alkalinity	96		YES	5183-94	MW102	mg/L
Alkalinity	99		YES	5819-95	MW102	mg/L
Alkalinity	100		YES	6592-95	MW102	mg/L
Alkalinity	100		YES	8285-95	MW102	mg/L
Alkalinity	102		YES	6770-94	MW102	mg/L
Alkalinity	73		YES	5293-98	MW120	mg/L
Alkalinity	120		YES	5448-95	MW120	mg/L
Alkalinity	121		YES	7065-93	MW120	mg/L
Alkalinity	126		YES	4209-94	MW120	mg/L
Alkalinity	127		YES	5088-93	MW120	mg/L
Alkalinity	127		YES	6928-94	MW120	mg/L
Alkalinity	127		YES	4991-94	MW120	mg/L
Alkalinity	128		YES	5143-97	MW120	mg/L
Alkalinity	130		YES	6034-94	MW120	mg/L
Alkalinity	142		YES	5900-93	MW120	mg/L
Alkalinity	78		YES	5500-96	MW121	mg/L
Alkalinity	112		YES	4864-94	MW121	mg/L
Alkalinity	151		YES	5452-95	MW121	mg/L
Alkalinity	155		YES	5144-97	MW121	mg/L
Alkalinity	142		YES	5456-95	MW122	mg/L
Alkalinity	145		YES	5246-93	MW122	mg/L
Alkalinity	146		YES	6596-95	MW122	mg/L
Alkalinity	150		YES	4868-94	MW122	mg/L
Alkalinity	158		YES	5301-96	MW122	mg/L
Alkalinity	165		YES	5145-97	MW122	mg/L
Alkalinity	183		YES	5460-95	MW133	mg/L
Alkalinity	205		YES	5282-93	MW133	mg/L
Alkalinity	208		YES	4781-94	MW133	mg/L
Alkalinity	91		YES	5146-97	MW140	mg/L
Alkalinity	111		YES	6864-94	MW140	mg/L
Alkalinity	112		YES	6050-94	MW140	mg/L
Alkalinity	112		YES	5313-96	MW140	mg/L
Alkalinity	120		YES	5195-94	MW140	mg/L
Alkalinity	130		YES	6004-93	MW140	mg/L
Alkalinity	131		YES	4225-94	MW140	mg/L
Alkalinity	137		YES	7081-93	MW140	mg/L
Alkalinity	184		YES	6088-93	MW140	mg/L

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
	Alkalinity							
	71	73	76	142	183	91		
	92	120	112	145	205	111		
	93	121	151	146	208	112		
	93	126	155	150		112		
	94	127		158		120		
	95	127		165		130		
	95	127				131		
	95	128				137		
	96	130				164		
	99	142						
	100							
	100							
	102							
Min	71.00	73.00	78.00	142.00	163.00	91.00	71.00	
Max	102.00	142.00	155.00	165.00	208.00	164.00	208.00	
Average	94.23	122.10	124.00	151.00	198.67	123.11	123.38	135.52
Number	13	10	4	6	3	9	45	



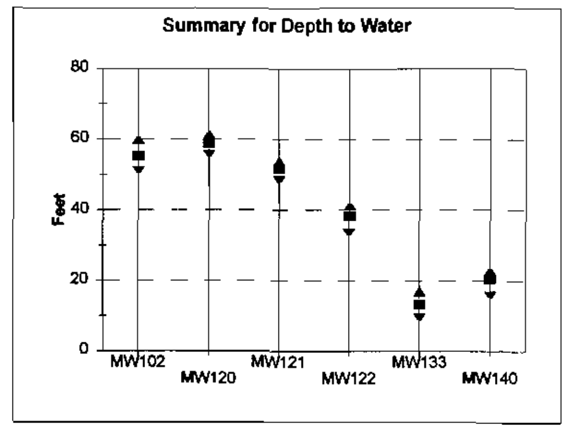
Data for Alkalinity were not modified.

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Depth to Water	50.95		YES	5183-94	MW102	Feet
Depth to Water	52.59		YES	5174-93	MW102	Feet
Depth to Water	52.95		YES	6022-94	MW102	Feet
Depth to Water	53.14		YES	5940-93	MW102	Feet
Depth to Water	54.64		YES	6592-95	MW102	Feet
Depth to Water	54.82		YES	5141-97	MW102	Feet
Depth to Water	54.95		YES	7467-95	MW102	Feet
Depth to Water	55.16		YES	4268-94	MW102	Feet
Depth to Water	55.46		YES	7295-93	MW102	Feet
Depth to Water	56.76		YES	5619-95	MW102	Feet
Depth to Water	57.93		YES	8285-95	MW102	Feet
Depth to Water	58.48		YES	5281-96	MW102	Feet
Depth to Water	59.95		YES	6770-94	MW102	Feet
Depth to Water	55.62		YES	6034-94	MW120	Feet
Depth to Water	55.7		YES	4991-94	MW120	Feet
Depth to Water	57.5		YES	5900-93	MW120	Feet
Depth to Water	57.87		YES	5088-93	MW120	Feet
Depth to Water	58.75		YES	4209-94	MW120	Feet
Depth to Water	58.85		YES	5143-97	MW120	Feet
Depth to Water	59.01		YES	7065-93	MW120	Feet
Depth to Water	59.42		YES	6928-94	MW120	Feet
Depth to Water	80.29		YES	5793-97	MW120	Feet
Depth to Water	60.93		YES	5448-95	MW120	Feet
Depth to Water	81.31		YES	5293-96	MW120	Feet
Depth to Water	48.39		YES	4864-94	MW121	Feet
Depth to Water	49.79		YES	5517-94	MW121	Feet
Depth to Water	50.35		YES	5144-97	MW121	Feet
Depth to Water	51.36		YES	7782-93	MW121	Feet
Depth to Water	52.4		YES	8656-93	MW121	Feet
Depth to Water	52.48		YES	5452-95	MW121	Feet
Depth to Water	52.76		YES	5500-96	MW121	Feet
Depth to Water	52.67		YES	6453-94	MW121	Feet
Depth to Water	53.75		YES	5794-97	MW121	Feet
Depth to Water	33.48		YES	5521-94	MW122	Feet
Depth to Water	38.31		YES	4868-94	MW122	Feet
Depth to Water	36.32		YES	5246-93	MW122	Feet
Depth to Water	37.88		YES	5145-97	MW122	Feet
Depth to Water	37.83		YES	6662-93	MW122	Feet
Depth to Water	36.27		YES	6457-94	MW122	Feet
Depth to Water	38.32		YES	6596-95	MW122	Feet
Depth to Water	39		YES	7786-93	MW122	Feet
Depth to Water	39.84		YES	5795-97	MW122	Feet
Depth to Water	40.43		YES	7200-94	MW122	Feet
Depth to Water	40.65		YES	5456-95	MW122	Feet
Depth to Water	41.18		YES	5301-96	MW122	Feet
Depth to Water	9.45		YES	4761-94	MW133	Feet
Depth to Water	9.5		YES	5611-94	MW133	Feet
Depth to Water	10.81		YES	5282-93	MW133	Feet
Depth to Water	11.52		YES	5139-97	MW133	Feet
Depth to Water	12.82		YES	7704-93	MW133	Feet
Depth to Water	13.5		YES	6740-93	MW133	Feet
Depth to Water	13.75		YES	5460-95	MW133	Feet
Depth to Water	15.01		YES	6648-94	MW133	Feet
Depth to Water	18.16		YES	5305-96	MW133	Feet

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
Depth to Water								
	50.95	55.62	48.39	33.46	9.45	15.63		
	52.59	55.7	49.79	36.31	9.5	16.45		
	52.95	57.5	50.35	36.32	10.61	19.7		
	53.14	57.87	51.36	37.68	11.52	19.81		
	54.64	58.75	52.4	37.83	12.82	20.21		
	54.82	58.85	52.48	38.27	13.5	20.95		
	54.95	59.01	52.76	38.32	13.75	21.11		
	55.16	59.42	52.67	39	15.01	21.98		
	55.46	60.29	53.75	39.64	16.16	22.43		
	56.78	60.93		40.43	16.88	22.67		
	57.93	61.31		40.65	16.89			
	58.46			41.18				
	59.95							
Min	50.950	55.620	46.390	33.460	9.450	15.630	9.450	
Max	59.950	61.310	53.750	41.180	16.890	22.670	61.310	
Average	55.214	58.659	51.572	38.274	13.281	20.294	39.932	39.549
Number	13	11	9	12	11	10	86	



Data for Depth to Water were not modified.

Summary of McNairy Background Wells Physical Parameters

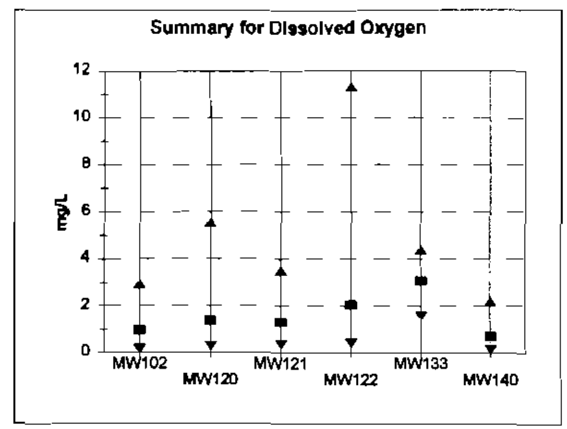
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Depth to Water	16.88		YES	7292-94	MW133	Feet
Depth to Water	16.89		YES	5789-97	MW133	Feet
Depth to Water	15.63		YES	5195-94	MW140	Feet
Depth to Water	18.45		YES	6004-93	MW140	Feet
Depth to Water	19.7		YES	6088-93	MW140	Feet
Depth to Water	19.81		YES	6050-94	MW140	Feet
Depth to Water	20.21		YES	4225-94	MW140	Feet
Depth to Water	20.95		YES	7081-93	MW140	Feet
Depth to Water	21.11		YES	5146-97	MW140	Feet
Depth to Water	21.98		YES	5313-96	MW140	Feet
Depth to Water	22.43		YES	6864-94	MW140	Feet
Depth to Water	22.67		YES	5796-97	MW140	Feet

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Dissolved Oxygen	0.17	J	YES	5940-93	MW102	mg/L
Dissolved Oxygen	0.19		YES	4268-94	MW102	mg/L
Dissolved Oxygen	0.27		YES	8285-95	MW102	mg/L
Dissolved Oxygen	0.31		YES	7487-95	MW102	mg/L
Dissolved Oxygen	0.38		YES	5281-96	MW102	mg/L
Dissolved Oxygen	0.73		YES	6022-94	MW102	mg/L
Dissolved Oxygen	0.83		YES	5619-95	MW102	mg/L
Dissolved Oxygen	0.9		YES	5174-93	MW102	mg/L
Dissolved Oxygen	0.95		YES	5183-94	MW102	mg/L
Dissolved Oxygen	1.02		YES	5141-97	MW102	mg/L
Dissolved Oxygen	1.48		YES	6592-95	MW102	mg/L
Dissolved Oxygen	2.4		YES	7295-93	MW102	mg/L
Dissolved Oxygen	2.94		YES	8770-94	MW102	mg/L
Dissolved Oxygen	0.29		YES	5088-93	MW120	mg/L
Dissolved Oxygen	0.33		YES	5293-96	MW120	mg/L
Dissolved Oxygen	0.33		YES	7065-93	MW120	mg/L
Dissolved Oxygen	0.45		YES	5793-97	MW120	mg/L
Dissolved Oxygen	0.52		YES	4991-94	MW120	mg/L
Dissolved Oxygen	0.71		YES	5143-97	MW120	mg/L
Dissolved Oxygen	0.83		YES	4209-94	MW120	mg/L
Dissolved Oxygen	1.8		YES	6928-94	MW120	mg/L
Dissolved Oxygen	2.04		YES	5448-95	MW120	mg/L
Dissolved Oxygen	2.39		YES	6034-94	MW120	mg/L
Dissolved Oxygen	5.53		YES	5900-93	MW120	mg/L
Dissolved Oxygen	0.35		YES	5794-97	MW121	mg/L
Dissolved Oxygen	0.38		YES	4864-94	MW121	mg/L
Dissolved Oxygen	0.43	J	YES	8658-93	MW121	mg/L
Dissolved Oxygen	0.6		YES	5517-94	MW121	mg/L
Dissolved Oxygen	0.62		YES	5144-97	MW121	mg/L
Dissolved Oxygen	1.21		YES	7782-93	MW121	mg/L
Dissolved Oxygen	1.94		YES	6453-94	MW121	mg/L
Dissolved Oxygen	2.73		YES	5452-95	MW121	mg/L
Dissolved Oxygen	3.5		YES	5500-96	MW121	mg/L
Dissolved Oxygen	0.4	J	YES	6862-93	MW122	mg/L
Dissolved Oxygen	0.48		YES	5145-97	MW122	mg/L
Dissolved Oxygen	0.48		YES	5795-97	MW122	mg/L
Dissolved Oxygen	0.51		YES	8457-94	MW122	mg/L
Dissolved Oxygen	0.79		YES	5301-96	MW122	mg/L
Dissolved Oxygen	0.83		YES	5521-94	MW122	mg/L
Dissolved Oxygen	1.15		YES	8596-95	MW122	mg/L
Dissolved Oxygen	1.37		YES	4868-94	MW122	mg/L
Dissolved Oxygen	1.97		YES	7200-94	MW122	mg/L
Dissolved Oxygen	2.08		YES	5246-93	MW122	mg/L
Dissolved Oxygen	3.08		YES	5456-95	MW122	mg/L
Dissolved Oxygen	11.31		YES	7786-93	MW122	mg/L
Dissolved Oxygen	1.57		YES	5139-97	MW133	mg/L
Dissolved Oxygen	2.06		YES	5789-97	MW133	mg/L
Dissolved Oxygen	2.81		YES	5480-95	MW133	mg/L
Dissolved Oxygen	2.93		YES	5305-98	MW133	mg/L
Dissolved Oxygen	2.97		YES	5282-93	MW133	mg/L
Dissolved Oxygen	3.41		YES	5611-94	MW133	mg/L
Dissolved Oxygen	3.48		YES	6648-94	MW133	mg/L
Dissolved Oxygen	3.91		YES	6740-93	MW133	mg/L
Dissolved Oxygen	4.39		YES	4761-94	MW133	mg/L

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
	Dissolved Oxygen							
	0.17	0.29	0.35	0.4	1.57	0.14		
	0.19	0.33	0.38	0.48	2.06	0.3		
	0.27	0.33	0.43	0.48	2.81	0.32		
	0.31	0.45	0.6	0.51	2.93	0.34		
	0.38	0.52	0.62	0.79	2.97	0.39		
	0.73	0.71	1.21	0.83	3.41	0.41		
	0.83	0.83	1.94	1.15	3.48	0.72		
	0.9	1.8	2.73	1.37	3.91	1.02		
	0.95	2.04	3.5	1.97	4.39	1.27		
	1.02	2.39		2.08		2.2		
	1.48	5.53		3.08				
	2.4			11.31				
	2.94							
Min	0.170	0.290	0.350	0.400	1.570	0.140	0.140	
Max	2.940	5.530	3.500	11.310	4.390	2.200	11.310	
Average	0.967	1.384	1.304	2.038	3.059	0.711	1.541	1.577
Number	13	11	9	12	9	10	64	



Data for Dissolved Oxygen were not modified.

Summary of McNairy Background Wells Physical Parameters

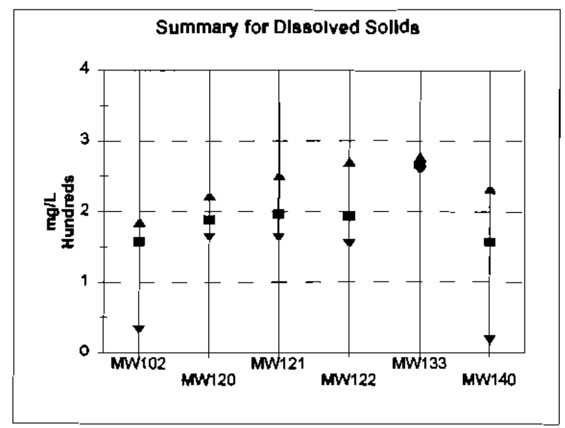
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Dissolved Oxygen	0.14		YES	6004-93	MW140	mg/L
Dissolved Oxygen	0.3		YES	5146-97	MW140	mg/L
Dissolved Oxygen	0.32		YES	5313-96	MW140	mg/L
Dissolved Oxygen	0.34		YES	5796-97	MW140	mg/L
Dissolved Oxygen	0.39		YES	6088-93	MW140	mg/L
Dissolved Oxygen	0.41		YES	7081-93	MW140	mg/L
Dissolved Oxygen	0.72		YES	6864-94	MW140	mg/L
Dissolved Oxygen	1.02		YES	4225-94	MW140	mg/L
Dissolved Oxygen	1.27		YES	6050-94	MW140	mg/L
Dissolved Oxygen	2.2		YES	5195-94	MW140	mg/L

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Dissolved Solids	32		YES	5183-94	MW102	mg/L
Dissolved Solids	141		YES	8592-95	MW102	mg/L
Dissolved Solids	157		YES	5281-96	MW102	mg/L
Dissolved Solids	184		YES	7295-93	MW102	mg/L
Dissolved Solids	188		YES	6022-94	MW102	mg/L
Dissolved Solids	166		YES	5940-93	MW102	mg/L
Dissolved Solids	167		YES	4266-94	MW102	mg/L
Dissolved Solids	167		YES	5619-95	MW102	mg/L
Dissolved Solids	170		YES	8265-95	MW102	mg/L
Dissolved Solids	173		YES	5174-93	MW102	mg/L
Dissolved Solids	176		YES	6770-94	MW102	mg/L
Dissolved Solids	176		YES	5141-97	MW102	mg/L
Dissolved Solids	185		YES	7487-95	MW102	mg/L
Dissolved Solids	163		YES	5293-96	MW120	mg/L
Dissolved Solids	173		YES	5143-97	MW120	mg/L
Dissolved Solids	180		YES	4209-94	MW120	mg/L
Dissolved Solids	185		YES	6926-94	MW120	mg/L
Dissolved Solids	165		YES	4991-94	MW120	mg/L
Dissolved Solids	189		YES	5900-93	MW120	mg/L
Dissolved Solids	169		YES	6034-94	MW120	mg/L
Dissolved Solids	193		YES	7065-93	MW120	mg/L
Dissolved Solids	200		YES	5446-95	MW120	mg/L
Dissolved Solids	222		YES	5086-93	MW120	mg/L
Dissolved Solids	163		YES	5500-96	MW121	mg/L
Dissolved Solids	176		YES	4664-94	MW121	mg/L
Dissolved Solids	195		YES	5452-95	MW121	mg/L
Dissolved Solids	251		YES	5144-97	MW121	mg/L
Dissolved Solids	154		YES	5456-95	MW122	mg/L
Dissolved Solids	172		YES	5301-96	MW122	mg/L
Dissolved Solids	179		YES	4668-94	MW122	mg/L
Dissolved Solids	182		YES	6596-95	MW122	mg/L
Dissolved Solids	200		YES	5145-97	MW122	mg/L
Dissolved Solids	270		YES	5246-93	MW122	mg/L
Dissolved Solids	258		YES	4761-94	MW133	mg/L
Dissolved Solids	263		YES	5460-95	MW133	mg/L
Dissolved Solids	277		YES	5262-93	MW133	mg/L
Dissolved Solids	18		YES	7061-93	MW140	mg/L
Dissolved Solids	135		YES	5146-97	MW140	mg/L
Dissolved Solids	142		YES	5313-96	MW140	mg/L
Dissolved Solids	152		YES	6050-94	MW140	mg/L
Dissolved Solids	172		YES	5195-94	MW140	mg/L
Dissolved Solids	182		YES	6664-94	MW140	mg/L
Dissolved Solids	186		YES	4225-94	MW140	mg/L
Dissolved Solids	194		YES	6004-93	MW140	mg/L
Dissolved Solids	232		YES	6088-93	MW140	mg/L

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
	Dissolved Solids							
	32	183	163	154	258	16		
	141	173	176	172	263	135		
	157	180	195	179	277	142		
	164	165	251	182		152		
	166	165		200		172		
	166	169		270		182		
	167	189				188		
	167	193				194		
	170	200				232		
	173	222						
	178							
	176							
	165							
Min	32.000	183.000	163.000	154.000	258.000	18.000	18.000	
Max	185.000	222.000	251.000	270.000	277.000	232.000	277.000	
Average	157.077	187.900	196.250	192.833	268.000	157.222	179.467	192.880
Number	13	10	4	6	3	9	45	



Data for Dissolved Solids were not modified.

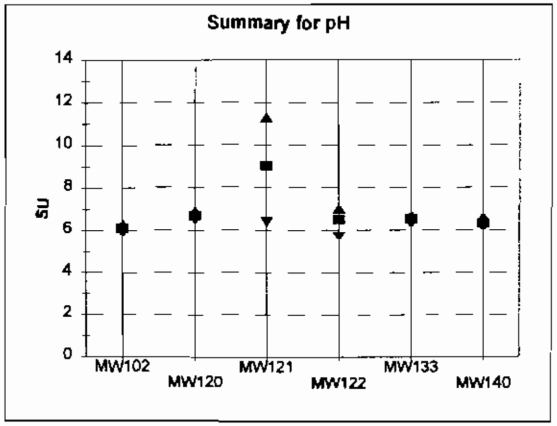
Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS	CORRECTED DATA SET								
pH	5.9		YES	6022-94	MW102	SU		MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
pH	5.9		YES	5261-96	MW102	SU		pH							
pH	5.9		YES	6023-94	MW102	SU		5.9	6.5	6.4	5.7	6.3	6.1		
pH	5.9		YES	5263-96	MW102	SU		5.9	6.5	6.4	5.7	6.3	6.1		
pH	5.9		YES	6024-94	MW102	SU		5.9	6.5	6.4	5.7	6.3	6.1		
pH	5.9		YES	6025-94	MW102	SU		5.9	6.55	6.4	5.7	6.3	6.1		
pH	5.9		YES	5284-96	MW102	SU		5.9	6.6	6.4	6.2	6.4	6.2		
pH	5.9		YES	5262-96	MW102	SU		5.9	6.6	6.4	6.2	6.4	6.2		
pH	6		YES	7297-93	MW102	SU		5.9	6.6	6.5	6.2	6.4	6.2		
pH	6		YES	7296-93	MW102	SU		5.9	6.6	6.5	6.2	6.4	6.2		
pH	6		YES	7295-93	MW102	SU		6	6.6	6.5	6.4	6.4	6.2		
pH	6		YES	7296-93	MW102	SU		6	6.6	6.5	6.4	6.49	6.2		
pH	6.1		YES	4271-94	MW102	SU		6	6.6	6.5	6.4	6.5	6.2		
pH	6.1		YES	6770-94	MW102	SU		6	6.6	6.5	6.4	6.5	6.2		
pH	6.1		YES	4269-94	MW102	SU		6.1	6.6	9.5	6.5	6.5	6.2		
pH	6.1		YES	4270-94	MW102	SU		6.1	6.7	9.9	6.5	6.5	6.2		
pH	6.1		YES	4266-94	MW102	SU		6.1	6.7	9.9	6.5	6.5	6.3		
pH	6.1		YES	6773-94	MW102	SU		6.1	6.7	9.9	6.5	6.5	6.3		
pH	6.1		YES	5164-94	MW102	SU		6.1	6.7	9.9	6.6	6.5	6.3		
pH	6.1		YES	5166-94	MW102	SU		6.1	6.7	10.6	6.6	6.5	6.3		
pH	6.1		YES	5165-94	MW102	SU		6.1	6.7	10.6	6.6	6.6	6.3		
pH	6.1		YES	5175-93	MW102	SU		6.1	6.7	10.6	6.6	6.7	6.3		
pH	6.1		YES	5163-94	MW102	SU		6.1	6.7	10.6	6.6	6.7	6.3		
pH	6.1		YES	6771-94	MW102	SU		6.1	6.7	10.6	6.6	6.7	6.3		
pH	6.1		YES	5174-93	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.4		
pH	6.1		YES	5177-93	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.4		
pH	6.1		YES	6772-94	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.4		
pH	6.1		YES	5176-93	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.4		
pH	6.2		YES	7470-95	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.5		
pH	6.2		YES	6593-95	MW102	SU		6.1	6.7	11.3	6.6	6.7	6.5		
pH	6.2		YES	6594-95	MW102	SU		6.2	6.7	11.3	6.6	6.7	6.5		
pH	6.2		YES	7467-95	MW102	SU		6.2	6.7	11.3	6.6	6.7	6.5		
pH	6.2		YES	5622-95	MW102	SU		6.2	6.6		6.7		6.6		
pH	6.2		YES	6595-95	MW102	SU		6.2	6.6		6.7		6.6		
pH	6.2		YES	7468-95	MW102	SU		6.2	6.6		6.7		6.6		
pH	6.2		YES	5940-93	MW102	SU		6.2	6.6		6.7		6.6		
pH	6.2		YES	5941-93	MW102	SU		6.2	6.9		6.7				
pH	6.2		YES	7469-95	MW102	SU		6.2	6.9		6.7				
pH	6.2		YES	5942-93	MW102	SU		6.2	6.9		6.6				
pH	6.2		YES	6592-95	MW102	SU		6.2	6.9		6.95				
pH	6.2		YES	5619-95	MW102	SU		6.2			7				
pH	6.2		YES	5141-97	MW102	SU		6.2			7				
pH	6.2		YES	5943-93	MW102	SU		6.2			7				
pH	6.2		YES	5621-95	MW102	SU		6.2			7				
pH	6.2		YES	5620-95	MW102	SU		6.2							
pH	6.3		YES	6267-95	MW102	SU		6.2							
pH	6.3		YES	6285-95	MW102	SU		6.2							
pH	6.3		YES	6286-95	MW102	SU		6.3							
pH	6.3		YES	6288-95	MW102	SU		6.3							
pH	6.5		YES	6931-94	MW120	SU		6.3							
pH	6.5		YES	6930-94	MW120	SU		6.3							
pH	6.5		YES	6926-94	MW120	SU	Min	5.900	6.500	6.400	5.700	6.300	6.100	5.700	
pH	6.55		YES	5793-97	MW120	SU	Max	6.300	6.900	11.300	7.000	6.700	6.600	11.300	
pH	6.6		YES	5295-96	MW120	SU	Average	6.110	6.688	9.030	6.513	6.533	6.318	6.766	6.865
pH	6.6		YES	5293-96	MW120	SU	Number	49	38	30	42	30	34	223	

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
pH	6.6		YES	5296-96	MW120	SU
pH	6.6		YES	5294-96	MW120	SU
pH	6.6		YES	6929-94	MW120	SU
pH	6.6		YES	5090-93	MW120	SU
pH	6.6		YES	5089-93	MW120	SU
pH	6.6		YES	5091-93	MW120	SU
pH	6.6		YES	5088-93	MW120	SU
pH	6.7		YES	5903-93	MW120	SU
pH	6.7		YES	5902-93	MW120	SU
pH	6.7		YES	5901-93	MW120	SU
pH	6.7		YES	5900-93	MW120	SU
pH	6.7		YES	5451-95	MW120	SU
pH	6.7		YES	4211-94	MW120	SU
pH	6.7		YES	4210-94	MW120	SU
pH	6.7		YES	5449-95	MW120	SU
pH	6.7		YES	5448-95	MW120	SU
pH	6.7		YES	5143-97	MW120	SU
pH	6.7		YES	5450-95	MW120	SU
pH	6.7		YES	4212-94	MW120	SU
pH	6.7		YES	4991-94	MW120	SU
pH	6.7		YES	4209-94	MW120	SU
pH	6.7		YES	4992-94	MW120	SU
pH	6.7		YES	4993-94	MW120	SU
pH	6.7		YES	4994-94	MW120	SU
pH	6.6		YES	7067-93	MW120	SU
pH	6.8		YES	7065-93	MW120	SU
pH	6.8		YES	7066-93	MW120	SU
pH	6.6		YES	7066-93	MW120	SU
pH	6.9		YES	6036-94	MW120	SU
pH	6.9		YES	6037-94	MW120	SU
pH	6.9		YES	6034-94	MW120	SU
pH	6.9		YES	6035-94	MW120	SU
pH	6.4		YES	5503-96	MW121	SU
pH	6.4		YES	4867-94	MW121	SU
pH	6.4		YES	5501-96	MW121	SU
pH	6.4		YES	5502-96	MW121	SU
pH	6.4		YES	4865-94	MW121	SU
pH	6.4		YES	4666-94	MW121	SU
pH	6.5		YES	5520-94	MW121	SU
pH	6.5		YES	5516-94	MW121	SU
pH	6.5		YES	5517-94	MW121	SU
pH	6.5		YES	5500-96	MW121	SU
pH	6.5		YES	4664-94	MW121	SU
pH	6.5		YES	5519-94	MW121	SU
pH	9.5		YES	5144-97	MW121	SU
pH	9.9		YES	5454-95	MW121	SU
pH	9.9		YES	5455-95	MW121	SU
pH	9.9		YES	5452-95	MW121	SU
pH	9.9		YES	5453-95	MW121	SU
pH	10.6		YES	7762-93	MW121	SU
pH	10.6		YES	5784-97	MW121	SU
pH	10.8		YES	7765-93	MW121	SU
pH	10.8		YES	7763-93	MW121	SU
pH	10.8		YES	7784-93	MW121	SU

CORRECTED DATA SET



Data for pH were not modified.

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
pH	11.3		YES	6455-94	MW121	SU
pH	11.3		YES	6660-93	MW121	SU
pH	11.3		YES	6453-94	MW121	SU
pH	11.3		YES	6456-94	MW121	SU
pH	11.3		YES	6661-93	MW121	SU
pH	11.3		YES	6454-94	MW121	SU
pH	11.3		YES	6658-93	MW121	SU
pH	11.3		YES	6659-93	MW121	SU
pH	5.7		YES	4870-94	MW122	SU
pH	5.7		YES	4871-94	MW122	SU
pH	5.7		YES	4869-94	MW122	SU
pH	5.7		YES	4868-94	MW122	SU
pH	6.2		YES	5521-94	MW122	SU
pH	6.2		YES	5524-94	MW122	SU
pH	6.2		YES	5522-94	MW122	SU
pH	6.2		YES	5523-94	MW122	SU
pH	6.4		YES	5246-93	MW122	SU
pH	6.4		YES	5248-93	MW122	SU
pH	6.4		YES	5247-93	MW122	SU
pH	6.4		YES	5249-93	MW122	SU
pH	6.5		YES	6459-94	MW122	SU
pH	6.5		YES	6457-94	MW122	SU
pH	6.5		YES	6458-94	MW122	SU
pH	6.5		YES	6460-94	MW122	SU
pH	6.6		YES	5302-96	MW122	SU
pH	6.6		YES	7202-94	MW122	SU
pH	6.6		YES	6683-93	MW122	SU
pH	6.6		YES	5304-96	MW122	SU
pH	6.6		YES	5301-96	MW122	SU
pH	6.6		YES	5303-96	MW122	SU
pH	6.6		YES	7203-94	MW122	SU
pH	6.6		YES	6597-95	MW122	SU
pH	6.6		YES	6665-93	MW122	SU
pH	6.6		YES	6662-93	MW122	SU
pH	6.6		YES	6664-93	MW122	SU
pH	6.6		YES	6599-95	MW122	SU
pH	6.6		YES	6596-95	MW122	SU
pH	6.6		YES	6598-95	MW122	SU
pH	6.7		YES	5456-95	MW122	SU
pH	6.7		YES	5459-95	MW122	SU
pH	6.7		YES	5457-95	MW122	SU
pH	6.7		YES	7200-94	MW122	SU
pH	6.7		YES	5458-95	MW122	SU
pH	6.7		YES	7201-94	MW122	SU
pH	6.8		YES	5145-97	MW122	SU
pH	6.95		YES	5795-97	MW122	SU
pH	7		YES	7787-93	MW122	SU
pH	7		YES	7786-93	MW122	SU
pH	7		YES	7789-93	MW122	SU
pH	7		YES	7786-93	MW122	SU
pH	6.3		YES	4764-94	MW133	SU
pH	6.3		YES	4761-94	MW133	SU
pH	6.3		YES	4763-94	MW133	SU
pH	6.3		YES	4762-94	MW133	SU

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
pH	6.4		YES	5611-94	MW133	SU
pH	6.4		YES	5139-97	MW133	SU
pH	6.4		YES	5613-94	MW133	SU
pH	6.4		YES	5612-94	MW133	SU
pH	6.4		YES	5614-94	MW133	SU
pH	6.49		YES	5789-97	MW133	SU
pH	6.5		YES	5284-93	MW133	SU
pH	6.5		YES	5283-93	MW133	SU
pH	6.5		YES	5307-96	MW133	SU
pH	6.5		YES	5305-96	MW133	SU
pH	6.5		YES	5308-96	MW133	SU
pH	8.5		YES	5282-93	MW133	SU
pH	6.5		YES	5265-93	MW133	SU
pH	6.5		YES	5308-96	MW133	SU
pH	8.6		YES	5460-95	MW133	SU
pH	6.7		YES	6651-94	MW133	SU
pH	6.7		YES	6649-94	MW133	SU
pH	6.7		YES	6743-93	MW133	SU
pH	6.7		YES	6648-94	MW133	SU
pH	6.7		YES	6742-93	MW133	SU
pH	6.7		YES	6650-94	MW133	SU
pH	6.7		YES	5462-95	MW133	SU
pH	6.7		YES	5463-95	MW133	SU
pH	6.7		YES	6741-93	MW133	SU
pH	6.7		YES	6740-93	MW133	SU
pH	6.7		YES	5461-95	MW133	SU
pH	6.1		YES	6051-94	MW140	SU
pH	6.1		YES	5796-97	MW140	SU
pH	6.1		YES	6050-94	MW140	SU
pH	6.1		YES	6052-94	MW140	SU
pH	6.2		YES	5198-94	MW140	SU
pH	6.2		YES	5196-94	MW140	SU
pH	6.2		YES	5314-96	MW140	SU
pH	6.2		YES	5316-96	MW140	SU
pH	6.2		YES	5195-94	MW140	SU
pH	6.2		YES	5146-97	MW140	SU
pH	6.2		YES	6053-94	MW140	SU
pH	6.2		YES	5313-96	MW140	SU
pH	6.2		YES	5197-94	MW140	SU
pH	6.2		YES	5315-96	MW140	SU
pH	6.3		YES	6866-94	MW140	SU
pH	6.3		YES	6867-94	MW140	SU
pH	6.3		YES	4227-94	MW140	SU
pH	6.3		YES	4228-94	MW140	SU
pH	6.3		YES	4226-94	MW140	SU
pH	6.3		YES	8865-94	MW140	SU
pH	6.3		YES	6864-94	MW140	SU
pH	8.3		YES	4225-94	MW140	SU
pH	6.4		YES	7081-93	MW140	SU
pH	8.4		YES	7084-93	MW140	SU
pH	8.4		YES	7082-93	MW140	SU
pH	6.4		YES	7063-93	MW140	SU
pH	6.5		YES	6007-93	MW140	SU
pH	6.5		YES	6004-93	MW140	SU

Summary of McNairy Background Wells Physical Parameters

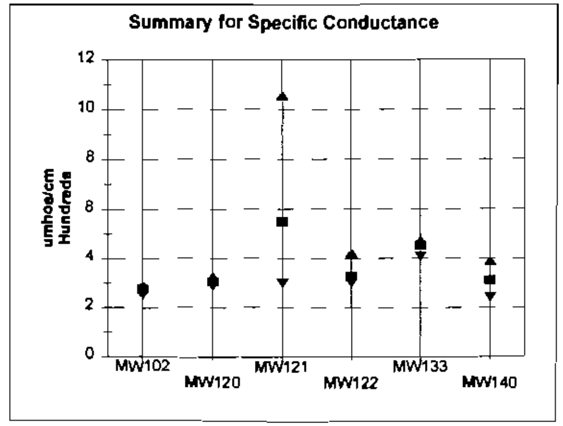
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
pH	6.5		YES	6006-93	MW140	SU
pH	6.5		YES	6005-93	MW140	SU
pH	6.6		YES	6089-93	MW140	SU
pH	6.6		YES	6091-93	MW140	SU
pH	6.6		YES	6088-93	MW140	SU
pH	6.6		YES	6090-93	MW140	SU

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS	CORRECTED DATA SET								
Specific conductance	251		YES	5185-94	MW102	umhos/cm		MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
Specific conductance	251		YES	5186-94	MW102	umhos/cm		Specific conductance							
Specific conductance	251		YES	5184-94	MW102	umhos/cm		251	290	301	301	408	242		
Specific conductance	253		YES	5183-94	MW102	umhos/cm		251	291	305	303	408	243		
Specific conductance	259		YES	5943-93	MW102	umhos/cm		251	291	305	303	409	265		
Specific conductance	259		YES	5942-93	MW102	umhos/cm		253	291	308	303	410	270		
Specific conductance	260		YES	5941-93	MW102	umhos/cm		259	292	308	304	414	273		
Specific conductance	261		YES	6023-94	MW102	umhos/cm		259	298	306	304	427	274		
Specific conductance	261		YES	6025-94	MW102	umhos/cm		260	298	308	305	451	274		
Specific conductance	261		YES	6024-94	MW102	umhos/cm		281	298	310	305	452	274		
Specific conductance	262		YES	6022-94	MW102	umhos/cm		261	299	346	308	453	275		
Specific conductance	263		YES	5940-93	MW102	umhos/cm		261	304	348	308	454	276		
Specific conductance	264		YES	7298-93	MW102	umhos/cm		262	305	350	309	455	284		
Specific conductance	265		YES	7297-93	MW102	umhos/cm		263	305	353	310	455	286		
Specific conductance	266		YES	7295-93	MW102	umhos/cm		264	305	383	310	455	287		
Specific conductance	266		YES	7296-93	MW102	umhos/cm		285	306	384	311	458	286		
Specific conductance	272		YES	7467-95	MW102	umhos/cm		266	306	388	312	459	289		
Specific conductance	273		YES	7468-95	MW102	umhos/cm		266	306	390	312	460	289		
Specific conductance	273		YES	5175-93	MW102	umhos/cm		272	306	415	317	480	290		
Specific conductance	273		YES	5177-93	MW102	umhos/cm		273	306	427	318	461	291		
Specific conductance	273		YES	7470-95	MW102	umhos/cm		273	306	436	320	482	324		
Specific conductance	273		YES	7469-95	MW102	umhos/cm		273	307	456	320	462	324		
Specific conductance	274		YES	5174-93	MW102	umhos/cm		273	307	458	321	463	325		
Specific conductance	275		YES	5176-93	MW102	umhos/cm		273	307	535	322	467	328		
Specific conductance	278		YES	5141-97	MW102	umhos/cm		274	307	584	322	467	332		
Specific conductance	280		YES	6595-95	MW102	umhos/cm		275	307	641	326	488	334		
Specific conductance	281		YES	5284-96	MW102	umhos/cm		278	308	748	327	488	334		
Specific conductance	281		YES	6594-95	MW102	umhos/cm		280	308	781	328	489	337		
Specific conductance	282		YES	8593-95	MW102	umhos/cm		281	308	847	328	470	358		
Specific conductance	282		YES	5282-96	MW102	umhos/cm		281	309	884	329	471	359		
Specific conductance	282		YES	5283-96	MW102	umhos/cm		262	309	941	329	471	359		
Specific conductance	283		YES	5281-96	MW102	umhos/cm		282	309	979	331	472	380		
Specific conductance	283		YES	6592-95	MW102	umhos/cm		282	318	990	331		378		
Specific conductance	288		YES	8286-95	MW102	umhos/cm		283	317	1042	339		379		
Specific conductance	288		YES	8288-95	MW102	umhos/cm		283	317	1058	339		379		
Specific conductance	288		YES	8287-95	MW102	umhos/cm		288	317	1058	341		390		
Specific conductance	289		YES	8285-95	MW102	umhos/cm		288	324		343				
Specific conductance	290		YES	5822-95	MW102	umhos/cm		288	328		344				
Specific conductance	290		YES	8773-94	MW102	umhos/cm		289	327		353				
Specific conductance	290		YES	8772-94	MW102	umhos/cm		290	327		356				
Specific conductance	292		YES	4270-94	MW102	umhos/cm		290			380				
Specific conductance	292		YES	5820-95	MW102	umhos/cm		290			371				
Specific conductance	292		YES	8771-94	MW102	umhos/cm		292			383				
Specific conductance	292		YES	5821-95	MW102	umhos/cm		292			422				
Specific conductance	292		YES	8770-94	MW102	umhos/cm		292							
Specific conductance	292		YES	4271-94	MW102	umhos/cm		292							
Specific conductance	294		YES	4269-94	MW102	umhos/cm		292							
Specific conductance	294		YES	5619-95	MW102	umhos/cm		292							
Specific conductance	295		YES	4268-94	MW102	umhos/cm		294							
Specific conductance	290		YES	5296-96	MW120	umhos/cm		294							
Specific conductance	291		YES	5295-98	MW120	umhos/cm		295							
Specific conductance	291		YES	5294-98	MW120	umhos/cm	Min	251.00	290.00	301.00	301.00	408.00	242.00	242.00	
Specific conductance	291		YES	5293-98	MW120	umhos/cm	Max	295.00	327.00	1058.00	422.00	472.00	390.00	1058.00	
Specific conductance	292		YES	5793-97	MW120	umhos/cm	Average	276.08	308.64	548.44	328.78	451.97	310.78	359.84	370.14
Specific conductance	298		YES	5451-95	MW120	umhos/cm	Number	49	38	34	42	30	34	227	

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS	CORRECTED DATA SET
Specific conductance	298		YES	5449-95	MW120	umhos/cm	
Specific conductance	298		YES	5450-95	MW120	umhos/cm	
Specific conductance	299		YES	5448-95	MW120	umhos/cm	
Specific conductance	304		YES	5143-97	MW120	umhos/cm	
Specific conductance	305		YES	6930-94	MW120	umhos/cm	
Specific conductance	305		YES	6929-94	MW120	umhos/cm	
Specific conductance	305		YES	6931-94	MW120	umhos/cm	
Specific conductance	306		YES	6928-94	MW120	umhos/cm	
Specific conductance	306		YES	4210-94	MW120	umhos/cm	
Specific conductance	306		YES	4209-94	MW120	umhos/cm	
Specific conductance	306		YES	4212-94	MW120	umhos/cm	
Specific conductance	306		YES	4211-94	MW120	umhos/cm	
Specific conductance	306		YES	7066-93	MW120	umhos/cm	
Specific conductance	307		YES	5090-93	MW120	umhos/cm	
Specific conductance	307		YES	5066-93	MW120	umhos/cm	
Specific conductance	307		YES	7068-93	MW120	umhos/cm	
Specific conductance	307		YES	7067-93	MW120	umhos/cm	
Specific conductance	307		YES	7065-93	MW120	umhos/cm	
Specific conductance	308		YES	5089-93	MW120	umhos/cm	
Specific conductance	308		YES	5091-93	MW120	umhos/cm	
Specific conductance	308		YES	4993-94	MW120	umhos/cm	
Specific conductance	309		YES	4992-94	MW120	umhos/cm	
Specific conductance	309		YES	4994-94	MW120	umhos/cm	Data for Specific Conductance were not modified.
Specific conductance	309		YES	4991-94	MW120	umhos/cm	
Specific conductance	316		YES	6036-94	MW120	umhos/cm	
Specific conductance	317		YES	6034-94	MW120	umhos/cm	
Specific conductance	317		YES	6035-94	MW120	umhos/cm	
Specific conductance	317		YES	6037-94	MW120	umhos/cm	
Specific conductance	324		YES	5901-93	MW120	umhos/cm	
Specific conductance	326		YES	5902-93	MW120	umhos/cm	
Specific conductance	327		YES	5900-93	MW120	umhos/cm	
Specific conductance	327		YES	5903-93	MW120	umhos/cm	
Specific conductance	301		YES	4867-94	MW121	umhos/cm	
Specific conductance	305		YES	5500-96	MW121	umhos/cm	
Specific conductance	305		YES	5502-96	MW121	umhos/cm	
Specific conductance	306		YES	5501-96	MW121	umhos/cm	
Specific conductance	306		YES	4865-94	MW121	umhos/cm	
Specific conductance	308		YES	5503-96	MW121	umhos/cm	
Specific conductance	308		YES	4866-94	MW121	umhos/cm	
Specific conductance	310		YES	4864-94	MW121	umhos/cm	
Specific conductance	346		YES	5517-94	MW121	umhos/cm	
Specific conductance	348		YES	5518-94	MW121	umhos/cm	
Specific conductance	350		YES	5519-94	MW121	umhos/cm	
Specific conductance	353		YES	5520-94	MW121	umhos/cm	
Specific conductance	383		YES	5453-95	MW121	umhos/cm	
Specific conductance	384		YES	5454-95	MW121	umhos/cm	
Specific conductance	386		YES	5455-95	MW121	umhos/cm	
Specific conductance	390		YES	5452-95	MW121	umhos/cm	
Specific conductance	415		YES	7279-94	MW121	umhos/cm	
Specific conductance	427		YES	7276-94	MW121	umhos/cm	
Specific conductance	436		YES	7277-94	MW121	umhos/cm	
Specific conductance	456		YES	5144-97	MW121	umhos/cm	
Specific conductance	458		YES	7278-94	MW121	umhos/cm	
Specific conductance	535		YES	6681-93	MW121	umhos/cm	



Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Specific conductance	564		YES	6660-93	MW121	umhos/cm
Specific conductance	641		YES	6659-93	MW121	umhos/cm
Specific conductance	746		YES	6658-93	MW121	umhos/cm
Specific conductance	781		YES	5794-97	MW121	umhos/cm
Specific conductance	847		YES	6456-94	MW121	umhos/cm
Specific conductance	864		YES	6455-94	MW121	umhos/cm
Specific conductance	941		YES	6454-94	MW121	umhos/cm
Specific conductance	979		YES	6453-94	MW121	umhos/cm
Specific conductance	990		YES	7785-93	MW121	umhos/cm
Specific conductance	1042		YES	7784-93	MW121	umhos/cm
Specific conductance	1058		YES	7782-93	MW121	umhos/cm
Specific conductance	1058		YES	7783-93	MW121	umhos/cm
Specific conductance	301		YES	5524-94	MW122	umhos/cm
Specific conductance	303		YES	5522-94	MW122	umhos/cm
Specific conductance	303		YES	5521-94	MW122	umhos/cm
Specific conductance	303		YES	5523-94	MW122	umhos/cm
Specific conductance	304		YES	5249-93	MW122	umhos/cm
Specific conductance	304		YES	6597-95	MW122	umhos/cm
Specific conductance	305		YES	6596-95	MW122	umhos/cm
Specific conductance	305		YES	5248-93	MW122	umhos/cm
Specific conductance	308		YES	5247-93	MW122	umhos/cm
Specific conductance	306		YES	6598-95	MW122	umhos/cm
Specific conductance	309		YES	6599-95	MW122	umhos/cm
Specific conductance	310		YES	4871-94	MW122	umhos/cm
Specific conductance	310		YES	5246-93	MW122	umhos/cm
Specific conductance	311		YES	4869-94	MW122	umhos/cm
Specific conductance	312		YES	4870-94	MW122	umhos/cm
Specific conductance	312		YES	4868-94	MW122	umhos/cm
Specific conductance	317		YES	5304-96	MW122	umhos/cm
Specific conductance	316		YES	5456-95	MW122	umhos/cm
Specific conductance	320		YES	5457-95	MW122	umhos/cm
Specific conductance	320		YES	5303-96	MW122	umhos/cm
Specific conductance	321		YES	5301-96	MW122	umhos/cm
Specific conductance	322		YES	5458-95	MW122	umhos/cm
Specific conductance	322		YES	5302-96	MW122	umhos/cm
Specific conductance	326		YES	6665-93	MW122	umhos/cm
Specific conductance	327		YES	7203-94	MW122	umhos/cm
Specific conductance	328		YES	5459-95	MW122	umhos/cm
Specific conductance	328		YES	7202-94	MW122	umhos/cm
Specific conductance	329		YES	6664-93	MW122	umhos/cm
Specific conductance	329		YES	6663-93	MW122	umhos/cm
Specific conductance	331		YES	7201-94	MW122	umhos/cm
Specific conductance	331		YES	6662-93	MW122	umhos/cm
Specific conductance	339		YES	6460-94	MW122	umhos/cm
Specific conductance	339		YES	6459-94	MW122	umhos/cm
Specific conductance	341		YES	6458-94	MW122	umhos/cm
Specific conductance	343		YES	6457-94	MW122	umhos/cm
Specific conductance	344		YES	7200-94	MW122	umhos/cm
Specific conductance	353		YES	7789-93	MW122	umhos/cm
Specific conductance	356		YES	7788-93	MW122	umhos/cm
Specific conductance	360		YES	7787-93	MW122	umhos/cm
Specific conductance	371		YES	7786-93	MW122	umhos/cm
Specific conductance	383		YES	5145-97	MW122	umhos/cm
Specific conductance	422		YES	5795-97	MW122	umhos/cm
Specific conductance	408		YES	5308-96	MW133	umhos/cm

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Specific conductance	408		YES	5305-96	MW133	umhos/cm
Specific conductance	409		YES	5307-96	MW133	umhos/cm
Specific conductance	410		YES	5306-96	MW133	umhos/cm
Specific conductance	414		YES	5789-97	MW133	umhos/cm
Specific conductance	427		YES	5139-97	MW133	umhos/cm
Specific conductance	451		YES	5463-95	MW133	umhos/cm
Specific conductance	452		YES	5462-95	MW133	umhos/cm
Specific conductance	453		YES	5614-94	MW133	umhos/cm
Specific conductance	454		YES	5461-95	MW133	umhos/cm
Specific conductance	455		YES	5613-94	MW133	umhos/cm
Specific conductance	455		YES	5460-95	MW133	umhos/cm
Specific conductance	455		YES	5285-93	MW133	umhos/cm
Specific conductance	458		YES	5284-93	MW133	umhos/cm
Specific conductance	459		YES	5611-94	MW133	umhos/cm
Specific conductance	460		YES	5283-93	MW133	umhos/cm
Specific conductance	460		YES	5612-94	MW133	umhos/cm
Specific conductance	461		YES	4784-94	MW133	umhos/cm
Specific conductance	462		YES	4762-94	MW133	umhos/cm
Specific conductance	462		YES	4763-94	MW133	umhos/cm
Specific conductance	463		YES	4761-94	MW133	umhos/cm
Specific conductance	467		YES	5282-93	MW133	umhos/cm
Specific conductance	467		YES	6743-93	MW133	umhos/cm
Specific conductance	468		YES	6651-94	MW133	umhos/cm
Specific conductance	468		YES	6742-93	MW133	umhos/cm
Specific conductance	469		YES	6741-93	MW133	umhos/cm
Specific conductance	470		YES	6650-94	MW133	umhos/cm
Specific conductance	471		YES	6740-93	MW133	umhos/cm
Specific conductance	471		YES	6649-94	MW133	umhos/cm
Specific conductance	472		YES	6648-94	MW133	umhos/cm
Specific conductance	242		YES	5146-97	MW140	umhos/cm
Specific conductance	243		YES	5796-97	MW140	umhos/cm
Specific conductance	265		YES	5316-96	MW140	umhos/cm
Specific conductance	270		YES	5315-96	MW140	umhos/cm
Specific conductance	273		YES	5314-96	MW140	umhos/cm
Specific conductance	274		YES	5313-96	MW140	umhos/cm
Specific conductance	274		YES	6052-94	MW140	umhos/cm
Specific conductance	274		YES	6053-94	MW140	umhos/cm
Specific conductance	275		YES	6051-94	MW140	umhos/cm
Specific conductance	276		YES	6050-94	MW140	umhos/cm
Specific conductance	284		YES	5198-94	MW140	umhos/cm
Specific conductance	286		YES	5196-94	MW140	umhos/cm
Specific conductance	287		YES	6867-94	MW140	umhos/cm
Specific conductance	288		YES	5195-94	MW140	umhos/cm
Specific conductance	289		YES	6866-94	MW140	umhos/cm
Specific conductance	289		YES	5197-94	MW140	umhos/cm
Specific conductance	290		YES	6865-94	MW140	umhos/cm
Specific conductance	291		YES	6864-94	MW140	umhos/cm
Specific conductance	324		YES	4226-94	MW140	umhos/cm
Specific conductance	324		YES	4228-94	MW140	umhos/cm
Specific conductance	325		YES	4227-94	MW140	umhos/cm
Specific conductance	328		YES	4225-94	MW140	umhos/cm
Specific conductance	332		YES	6005-93	MW140	umhos/cm
Specific conductance	334		YES	6007-93	MW140	umhos/cm
Specific conductance	334		YES	6006-93	MW140	umhos/cm

Summary of McNairy Background Wells Physical Parameters

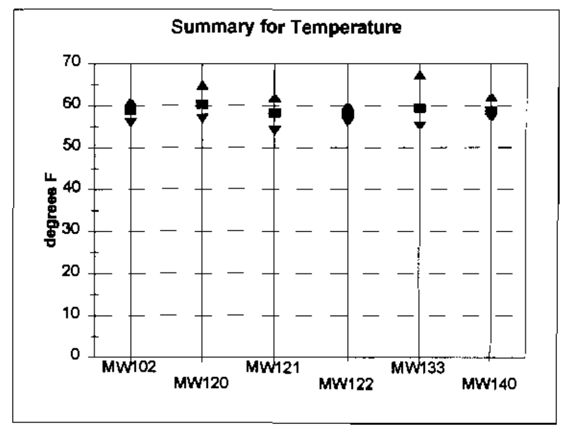
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Specific conductance	337		YES	6004-93	MW140	umhos/cm
Specific conductance	356		YES	7081-93	MW140	umhos/cm
Specific conductance	359		YES	7063-93	MW140	umhos/cm
Specific conductance	359		YES	7084-93	MW140	umhos/cm
Specific conductance	360		YES	7082-93	MW140	umhos/cm
Specific conductance	378		YES	6089-93	MW140	umhos/cm
Specific conductance	379		YES	6091-93	MW140	umhos/cm
Specific conductance	379		YES	6090-93	MW140	umhos/cm
Specific conductance	390		YES	6088-93	MW140	umhos/cm

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Temperature	56		YES	5141-97	MW102	F
Temperature	56		YES	5281-96	MW102	F
Temperature	58		YES	4266-94	MW102	F
Temperature	56		YES	6265-95	MW102	F
Temperature	59		YES	5174-93	MW102	F
Temperature	59		YES	5619-95	MW102	F
Temperature	59		YES	6022-94	MW102	F
Temperature	59		YES	7467-95	MW102	F
Temperature	59.7		YES	7295-93	MW102	F
Temperature	60		YES	5183-94	MW102	F
Temperature	60		YES	6770-94	MW102	F
Temperature	60		YES	6592-95	MW102	F
Temperature	61		YES	5940-93	MW102	F
Temperature	57		YES	5446-95	MW120	F
Temperature	58		YES	5143-97	MW120	F
Temperature	59		YES	4209-94	MW120	F
Temperature	60		YES	5293-96	MW120	F
Temperature	60		YES	6926-94	MW120	F
Temperature	60		YES	4991-94	MW120	F
Temperature	60.5		YES	5793-97	MW120	F
Temperature	61		YES	5086-93	MW120	F
Temperature	61.1		YES	7065-93	MW120	F
Temperature	62		YES	6034-94	MW120	F
Temperature	65		YES	5900-93	MW120	F
Temperature	54		YES	7782-93	MW121	F
Temperature	57		YES	5452-95	MW121	F
Temperature	57		YES	5144-97	MW121	F
Temperature	58		YES	5500-96	MW121	F
Temperature	58.1		YES	5794-97	MW121	F
Temperature	59		YES	4664-94	MW121	F
Temperature	59.6		YES	6656-93	MW121	F
Temperature	60		YES	6453-94	MW121	F
Temperature	62		YES	5517-94	MW121	F
Temperature	5.72		YES	5795-97	MW122	F
Temperature	56		YES	5145-97	MW122	F
Temperature	56		YES	7766-93	MW122	F
Temperature	57		YES	5456-95	MW122	F
Temperature	56		YES	5301-96	MW122	F
Temperature	56		YES	4666-94	MW122	F
Temperature	56		YES	7200-94	MW122	F
Temperature	59		YES	5246-93	MW122	F
Temperature	59.7		YES	6662-93	MW122	F
Temperature	60		YES	6457-94	MW122	F
Temperature	60		YES	5521-94	MW122	F
Temperature	60		YES	6596-95	MW122	F
Temperature	55		YES	5139-97	MW133	F
Temperature	55		YES	4761-94	MW133	F
Temperature	56		YES	5305-96	MW133	F
Temperature	56		YES	5769-97	MW133	F
Temperature	57		YES	5460-95	MW133	F
Temperature	61		YES	5262-93	MW133	F
Temperature	63		YES	5611-94	MW133	F
Temperature	64		YES	6646-94	MW133	F
Temperature	67.3		YES	6740-93	MW133	F
Temperature	57		YES	5313-96	MW140	F

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
	Temperature							
	56	57	54	56	55	57		
	56	56	57	56	55	57		
	56	59	57	56	58	57.1		
	56	60	56	57	56	56		
	59	60	56.1	58	57	56		
	59	60	59	58	61	58		
	59	60.5	59.6	58	63	59		
	59	61	60	59	64	60		
	59.7	61.1	62	59.7	67.3	61		
	60	62		60		62		
	60	65		60				
	60			60				
	61							
Min	56.00	57.00	54.00	56.00	55.00	57.00	54.00	
Max	61.00	65.00	62.00	60.00	67.30	62.00	67.30	
Average	58.96	60.33	58.30	58.14	59.37	58.71	58.97	58.97
Number	13	11	9	12	9	10	64	



MW 102 - Data were not modified.

MW 120 - Data were not modified.

MW 121 - Data were not modified.

MW 122 - Smallest detected value is anamolous and increased to next smallest detected value.

MW 133 - Data were not modified.

MW 140 - Data were not modified.

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Temperature	57		YES	5146-97	MW140	F
Temperature	57.1		YES	5796-97	MW140	F
Temperature	58		YES	7081-93	MW140	F
Temperature	58		YES	4225-94	MW140	F
Temperature	58		YES	6864-94	MW140	F
Temperature	59		YES	8004-93	MW140	F
Temperature	60		YES	8050-94	MW140	F
Temperature	61		YES	6088-93	MW140	F
Temperature	62		YES	5195-94	MW140	F

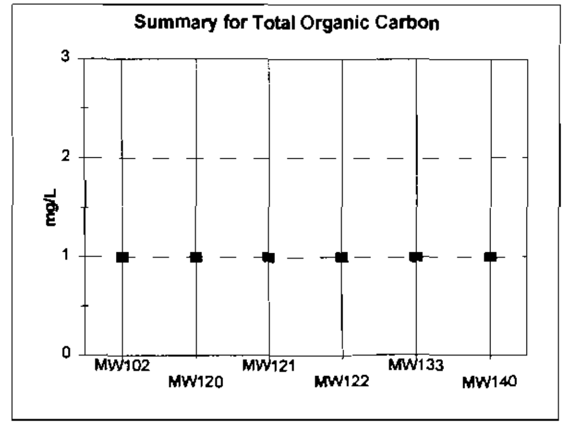
Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS	CORRECTED DATA SET								
Total Organic Carbon	1	<	NO	8286-95	MW102	mg/L		MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
Total Organic Carbon	1	<	NO	7469-95	MW102	mg/L		Total Organic Carbon							
Total Organic Carbon	1	<	NO	5941-93	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	6772-94	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	7297-93	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	5620-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	7470-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	5943-93	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	6593-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	4268-94	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	8288-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	5622-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	5619-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	7468-95	MW102	mg/L		1	1	1	1	1	1		
Total Organic Carbon	1	<	NO	6594-95	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	5281-96	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	5942-93	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	5282-96	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	5177-93	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	6592-95	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	8287-95	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	5940-93	MW102	mg/L		1	1		1		1		
Total Organic Carbon	1	<	NO	6595-95	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	5283-96	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	5176-93	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	5621-95	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	7467-95	MW102	mg/L		1	1				1		
Total Organic Carbon	1		YES	8285-95	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	6773-94	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	6025-94	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	5175-93	MW102	mg/L		1	1				1		
Total Organic Carbon	1	<	NO	7295-93	MW102	mg/L		1	1						
Total Organic Carbon	1	<	NO	6024-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5284-96	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5183-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5185-94	MW102	mg/L		1							
Total Organic Carbon	1		YES	5174-93	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5184-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	7296-93	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	6022-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	6771-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5188-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	7298-93	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	6770-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	6023-94	MW102	mg/L		1							
Total Organic Carbon	1	<	NO	5088-93	MW120	mg/L		1							
Total Organic Carbon	1	<	NO	7067-93	MW120	mg/L		1							
Total Organic Carbon	1	<	NO	5091-93	MW120	mg/L									
Total Organic Carbon	1	<	NO	5293-96	MW120	mg/L									
Total Organic Carbon	1	<	NO	7068-93	MW120	mg/L									
Total Organic Carbon	1	<	NO	4209-94	MW120	mg/L									
Total Organic Carbon	1	<	NO	5089-93	MW120	mg/L	Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Total Organic Carbon	1	<	NO	5090-93	MW120	mg/L	Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Total Organic Carbon	1	<	NO	6931-94	MW120	mg/L	Average	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Organic Carbon	1	<	NO	8038-94	MW120	mg/L	Number	45	30	12	20	12	29	148	

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Total Organic Carbon	1	<	NO	5901-93	MW120	mg/L
Total Organic Carbon	1	<	NO	5450-95	MW120	mg/L
Total Organic Carbon	1	<	NO	5295-96	MW120	mg/L
Total Organic Carbon	1	<	NO	6930-94	MW120	mg/L
Total Organic Carbon	1	<	NO	6037-94	MW120	mg/L
Total Organic Carbon	1	<	NO	6035-94	MW120	mg/L
Total Organic Carbon	1	<	NO	5296-96	MW120	mg/L
Total Organic Carbon	1	<	NO	5294-96	MW120	mg/L
Total Organic Carbon	1	<	NO	6034-94	MW120	mg/L
Total Organic Carbon	1	<	NO	5449-95	MW120	mg/L
Total Organic Carbon	1	<	NO	4991-94	MW120	mg/L
Total Organic Carbon	1	<	NO	5448-95	MW120	mg/L
Total Organic Carbon	1	<	NO	6929-94	MW120	mg/L
Total Organic Carbon	1	<	NO	5900-93	MW120	mg/L
Total Organic Carbon	1	<	NO	5902-93	MW120	mg/L
Total Organic Carbon	1	<	NO	7066-93	MW120	mg/L
Total Organic Carbon	1	<	NO	5903-93	MW120	mg/L
Total Organic Carbon	1	<	NO	5451-95	MW120	mg/L
Total Organic Carbon	1		YES	6928-94	MW120	mg/L
Total Organic Carbon	1	<	NO	7065-93	MW120	mg/L
Total Organic Carbon	1	<	NO	5454-95	MW121	mg/L
Total Organic Carbon	1	<	NO	5500-96	MW121	mg/L
Total Organic Carbon	1	<	NO	4666-94	MW121	mg/L
Total Organic Carbon	1	<	NO	4865-94	MW121	mg/L
Total Organic Carbon	1		YES	5453-95	MW121	mg/L
Total Organic Carbon	1	<	NO	4664-94	MW121	mg/L
Total Organic Carbon	1	<	NO	4867-94	MW121	mg/L
Total Organic Carbon	1		YES	5455-95	MW121	mg/L
Total Organic Carbon	1		YES	5452-95	MW121	mg/L
Total Organic Carbon	1	<	NO	5501-96	MW121	mg/L
Total Organic Carbon	1	<	NO	5503-96	MW121	mg/L
Total Organic Carbon	1	<	NO	5502-96	MW121	mg/L
Total Organic Carbon	1	<	NO	5304-96	MW122	mg/L
Total Organic Carbon	1	<	NO	5303-96	MW122	mg/L
Total Organic Carbon	1	<	NO	4869-94	MW122	mg/L
Total Organic Carbon	1	<	NO	6599-95	MW122	mg/L
Total Organic Carbon	1	<	NO	5248-93	MW122	mg/L
Total Organic Carbon	1	<	NO	5302-96	MW122	mg/L
Total Organic Carbon	1	<	NO	4866-94	MW122	mg/L
Total Organic Carbon	1	<	NO	6597-95	MW122	mg/L
Total Organic Carbon	1	<	NO	6598-95	MW122	mg/L
Total Organic Carbon	1	<	NO	6596-95	MW122	mg/L
Total Organic Carbon	1	<	NO	5456-95	MW122	mg/L
Total Organic Carbon	1	<	NO	4671-94	MW122	mg/L
Total Organic Carbon	1	<	NO	5457-95	MW122	mg/L
Total Organic Carbon	1		YES	5246-93	MW122	mg/L
Total Organic Carbon	1	<	NO	5249-93	MW122	mg/L
Total Organic Carbon	1	<	NO	4870-94	MW122	mg/L
Total Organic Carbon	1	<	NO	5459-95	MW122	mg/L
Total Organic Carbon	1	<	NO	5247-93	MW122	mg/L
Total Organic Carbon	1	<	NO	5301-96	MW122	mg/L
Total Organic Carbon	1	<	NO	5458-95	MW122	mg/L
Total Organic Carbon	1	<	NO	4764-94	MW133	mg/L
Total Organic Carbon	1	<	NO	4761-94	MW133	mg/L

CORRECTED DATA SET



Data for Total Organic Carbon were not modified.

Summary of McNairy Background Wells Physical Parameters

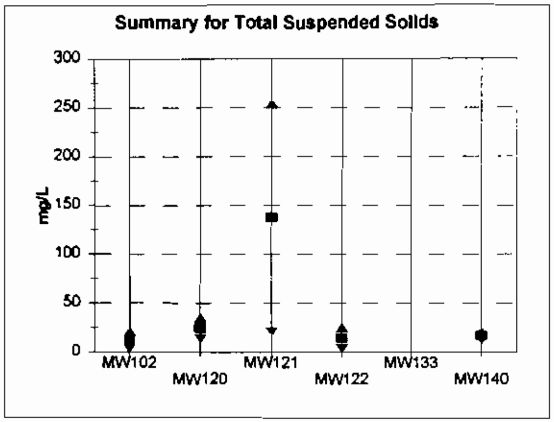
ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Total Organic Carbon	1	<	NO	4763-94	MW133	mg/L
Total Organic Carbon	1	<	NO	5283-93	MW133	mg/L
Total Organic Carbon	1	<	NO	5284-93	MW133	mg/L
Total Organic Carbon	1	<	NO	5462-95	MW133	mg/L
Total Organic Carbon	1	<	NO	5282-93	MW133	mg/L
Total Organic Carbon	1	<	NO	4762-94	MW133	mg/L
Total Organic Carbon	1	<	NO	5461-95	MW133	mg/L
Total Organic Carbon	1	<	NO	5285-93	MW133	mg/L
Total Organic Carbon	1	<	NO	5460-95	MW133	mg/L
Total Organic Carbon	1	<	NO	5463-95	MW133	mg/L
Total Organic Carbon	1	<	NO	6004-93	MW140	mg/L
Total Organic Carbon	1	<	NO	5198-94	MW140	mg/L
Total Organic Carbon	1	<	NO	5195-94	MW140	mg/L
Total Organic Carbon	1	<	NO	6864-94	MW140	mg/L
Total Organic Carbon	1	<	NO	5197-94	MW140	mg/L
Total Organic Carbon	1	<	NO	5316-96	MW140	mg/L
Total Organic Carbon	1	<	NO	6089-93	MW140	mg/L
Total Organic Carbon	1	<	NO	6007-93	MW140	mg/L
Total Organic Carbon	1	<	NO	6052-94	MW140	mg/L
Total Organic Carbon	1	<	NO	5314-96	MW140	mg/L
Total Organic Carbon	1	<	NO	6665-94	MW140	mg/L
Total Organic Carbon	1	<	NO	6006-93	MW140	mg/L
Total Organic Carbon	1	<	NO	8867-94	MW140	mg/L
Total Organic Carbon	1	<	NO	8866-94	MW140	mg/L
Total Organic Carbon	1	<	NO	4225-94	MW140	mg/L
Total Organic Carbon	1	<	NO	7084-93	MW140	mg/L
Total Organic Carbon	1	<	NO	5315-96	MW140	mg/L
Total Organic Carbon	1	<	NO	6005-93	MW140	mg/L
Total Organic Carbon	1	<	NO	7082-93	MW140	mg/L
Total Organic Carbon	1	<	NO	5196-94	MW140	mg/L
Total Organic Carbon	1	<	NO	6053-94	MW140	mg/L
Total Organic Carbon	1	<	NO	7083-93	MW140	mg/L
Total Organic Carbon	1		YES	6090-93	MW140	mg/L
Total Organic Carbon	1	<	NO	6091-93	MW140	mg/L
Total Organic Carbon	1	<	NO	5313-96	MW140	mg/L
Total Organic Carbon	1	<	NO	7081-93	MW140	mg/L
Total Organic Carbon	1	<	NO	6050-94	MW140	mg/L
Total Organic Carbon	1	<	NO	6088-93	MW140	mg/L
Total Organic Carbon	1	<	NO	6051-94	MW140	mg/L

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Total Suspended Solids	4	<	NO	5281-96	MW102	mg/L
Total Suspended Solids	21		YES	5141-97	MW102	mg/L
Total Suspended Solids	14		YES	5293-96	MW120	mg/L
Total Suspended Solids	35		YES	5143-97	MW120	mg/L
Total Suspended Solids	21		YES	5144-97	MW121	mg/L
Total Suspended Solids	254		YES	5500-96	MW121	mg/L
Total Suspended Solids	4	<	NO	5301-96	MW122	mg/L
Total Suspended Solids	25		YES	5145-97	MW122	mg/L
Total Suspended Solids	13		YES	5146-97	MW140	mg/L
Total Suspended Solids	21		YES	5313-96	MW140	mg/L

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
Total Suspended Solids								
	4	14	21	4		13		
	21	35	254	25		21		
Min	4.00	14.00	21.00	4.00	ERR	13.00	4.00	
Max	21.00	35.00	254.00	25.00	ERR	21.00	254.00	
Average	12.50	24.50	137.50	14.50	ERR	17.00	41.20	41.20
Number	2	2	2	2	0	2	10	



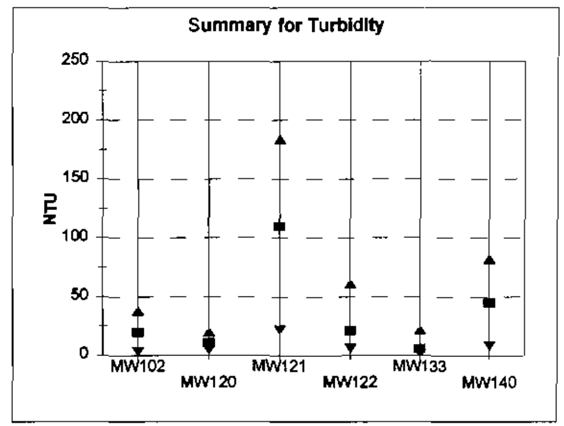
Data for Total Suspended Solids were not modified.

Summary of McNairy Background Wells Physical Parameters

ANALYSIS	RESULT	QUALIFIER	DETECT?	SAMPLE ID	STATION	UNITS
Turbidity	3.4		YES	4268-94	MW102	NTU
Turbidity	6.6		YES	5174-93	MW102	NTU
Turbidity	11		YES	5281-96	MW102	NTU
Turbidity	12		YES	8285-95	MW102	NTU
Turbidity	15		YES	5819-95	MW102	NTU
Turbidity	16		YES	7467-95	MW102	NTU
Turbidity	17		YES	5940-93	MW102	NTU
Turbidity	22		YES	6592-95	MW102	NTU
Turbidity	24		YES	5183-94	MW102	NTU
Turbidity	35.1		YES	6770-94	MW102	NTU
Turbidity	36		YES	6022-94	MW102	NTU
Turbidity	38		YES	7295-93	MW102	NTU
Turbidity	5		YES	8034-94	MW120	NTU
Turbidity	8		YES	5900-93	MW120	NTU
Turbidity	8		YES	4209-94	MW120	NTU
Turbidity	9.3		YES	6928-94	MW120	NTU
Turbidity	10		YES	5293-98	MW120	NTU
Turbidity	11		YES	4991-94	MW120	NTU
Turbidity	18		YES	5448-95	MW120	NTU
Turbidity	20		YES	7065-93	MW120	NTU
Turbidity	22		YES	7782-93	MW121	NTU
Turbidity	29		YES	6453-94	MW121	NTU
Turbidity	67		YES	5517-94	MW121	NTU
Turbidity	120		YES	6858-93	MW121	NTU
Turbidity	140		YES	4864-94	MW121	NTU
Turbidity	155		YES	5500-96	MW121	NTU
Turbidity	160		YES	5452-95	MW121	NTU
Turbidity	184		YES	7276-94	MW121	NTU
Turbidity	6.5		YES	6457-94	MW122	NTU
Turbidity	9.7		YES	5521-94	MW122	NTU
Turbidity	12		YES	6662-93	MW122	NTU
Turbidity	13		YES	5458-95	MW122	NTU
Turbidity	13		YES	4868-94	MW122	NTU
Turbidity	18		YES	7786-93	MW122	NTU
Turbidity	23		YES	7200-94	MW122	NTU
Turbidity	35		YES	8596-95	MW122	NTU
Turbidity	61		YES	5301-96	MW122	NTU
Turbidity	1.5		YES	5611-94	MW133	NTU
Turbidity	1.5		YES	5305-96	MW133	NTU
Turbidity	1.5		YES	6648-94	MW133	NTU
Turbidity	1.9		YES	4761-94	MW133	NTU
Turbidity	2.8		YES	5480-95	MW133	NTU
Turbidity	10		YES	5282-93	MW133	NTU
Turbidity	22		YES	6740-93	MW133	NTU
Turbidity	8.4		YES	8050-94	MW140	NTU
Turbidity	22		YES	4225-94	MW140	NTU
Turbidity	29		YES	5313-96	MW140	NTU
Turbidity	33		YES	8664-94	MW140	NTU
Turbidity	48		YES	5195-94	MW140	NTU
Turbidity	68		YES	7061-93	MW140	NTU
Turbidity	70		YES	6004-93	MW140	NTU
Turbidity	82		YES	6088-93	MW140	NTU

CORRECTED DATA SET

	MW102	MW120	MW121	MW122	MW133	MW140	Overall	Weighted
	Turbidity							
	3.4	5	22	6.5	1.5	8.4		
	6.6	8	29	9.7	1.5	22		
	11	8	67	12	1.5	29		
	12	9.3	120	13	1.9	33		
	15	10	140	13	2.8	48		
	16	11	155	18	10	68		
	17	18	160	23	22	70		
	22	20	184	35		82		
	24			61				
	35.1							
	36							
	38							
Min	3.40	5.00	22.00	6.50	1.50	8.40	3.40	
Max	38.00	20.00	184.00	61.00	22.00	82.00	184.00	
Average	19.66	10.91	109.63	21.24	5.89	45.05	34.48	41.30
Number	12	8	8	9	7	8	52	



Data for Turbidity were not modified.

APPENDIX C

RESULTS OF REGRESSION AND CORRELATION ANALYSES FOR TURBIDITY AND DISSOLVED SOLIDS

THIS PAGE INTENTIONALLY LEFT BLANK

Regression and Correlation Analyses

As noted earlier in this document, sample turbidity can significantly affect the concentrations of constituents in groundwater. To further investigate this phenomenon, simple regression analyses were performed in which the concentrations of inorganic chemicals in samples were regressed upon sample turbidity. This appendix presents the results of these analyses. In addition, this appendix presents the results of simple regression analyses of inorganic chemical concentrations upon sample dissolved solids estimates. This additional analyses was performed after it was noted that sample dissolved solids seems to be more highly related to inorganic chemical concentrations than turbidity.

It should be noted that sample turbidity is generally induced by the sampling process. Thus, a strong correlation between an analyte concentration and a measure of turbidity indicates a bias caused by sampling. Similarly, the lack of a strong correlation suggests that the original sample quality was good. However, total dissolved solids are a measure of dissolved metals. Total dissolved solids occur naturally, but its value may be biased (i.e., increased) by the sample preservative. Therefore, positive correlations between total dissolved solids and the major anions and cations in groundwater are expected. In a sense, the strong correlations found here validates the lab analyses used in this background groundwater report.

A summary of the information in this appendix is presented in Table C-1. As noted in this table, the analyses for groundwater samples from the McNairy Formation are limited to the development of a correlation matrix for total samples. Other results for the McNairy Formation are not presented because results for the RGA are sufficient to demonstrate that sample results for turbidity and total dissolved solids should be considered when applying the background concentrations developed in this report to results from site samples.

Table C-1. Table of Contents for Appendix B

THIS PAGE INTENTIONALLY LEFT BLANK

Summary of Results of Regression and Correlation Analyses - RGA Samples

Results of Regression of Background Concentrations on Turbidity and Dissolved Solids - Total Samples

		Regression on Turbidity				Regression on Dissolved Solids			
Chemical	Freq	R2	Intercept	Slope	Significance	R2	Intercept	Slope	Significance
Aluminum	29/40	0.263	0.2765	0.0277	0.002	0.015	0.3551	0.0034	0.484
Barium	41/44	0.088	0.1004	0.0013	0.070	0.520	0.0254	0.0005	0.000
Iron	37/44	0.394	0.0218	0.1076	0.000	0.012	0.8874	0.0049	0.515
Magnesium	44/44	0.222	6.4854	0.1518	0.003	0.821	-0.1998	0.0426	0.000
Calcium	44/44	0.284	16.8778	0.3798	0.001	0.767	3.2867	0.0909	0.000
Manganese	30/44	0.548	0.0085	0.0021	0.000	0.040	0.0089	0.0002	0.223
Sodium	44/44	0.120	24.1574	0.4182	0.033	0.809	-2.6587	0.1597	0.000
Sulfate	32/32	0.098	2.8265	0.8953	0.119	0.614	2.3583	0.0371	0.000
Vanadium	22/33	0.344	0.0533	0.0014	0.001	0.556	0.0100	0.0003	0.000
Chloride	43/43	0.073	29.9286	0.5728	0.107	0.791	-17.4928	0.2742	0.000
Nitrate as Nitrogen	33/43	0.009	3.1623	0.0498	0.586	0.370	-5.5670	0.0474	0.000
Silica	43/43	0.091	20.2192	-0.0973	0.070	0.091	21.9484	-0.0141	0.062

Results of Regression of Background Concentrations on Turbidity and Dissolved Solids - Dissolved Samples

		Regression on Turbidity				Regression on Dissolved Solids			
Chemical	Freq	R2	Intercept	Slope	Significance	R2	Intercept	Slope	Significance
Barium, Dissolved	39/44	0.069	0.1037	0.0011	0.116	0.515	0.0247	0.00046	0.000
Calcium, Dissolved	40/40	0.268	17.2791	0.3890	0.001	0.729	3.1551	0.09371	0.000
Magnesium, Dissolved	39/39	0.202	6.8341	0.1510	0.005	0.793	-0.1011	0.04375	0.000
Sodium, Dissolved	40/40	0.115	24.9454	0.4446	0.037	0.805	-4.0165	0.17221	0.000

Notes:

An analyte must be detected in more than two-thirds of all samples to be presented here.

Significance" reports the p-value of the simple regression of the inorganic chemical upon either turbidity or dissolved solids. This value should be considered an estimate only because results were not corrected for temporal or spatial correlation.

Correlations for Total Concentrations and Turbidity/Dissolved Solids - RGA Samples

	Al	Ba	Ca	Cl-	Fe	Mg	Mn	Nitrate as Nitrogen	Si	Na	Sulfate	Va	Turbidity	Dissolved Solids
Aluminum	1.00													
Barium	0.38	1.00												
Calcium	**0.64**	**0.79**	1.00											
Chloride	0.31	**0.83**	**0.81**	1.00										
Iron	0.39	0.17	0.34	0.18	1.00									
Magnesium	0.44	**0.85**	**0.93**	**0.91**	0.33	1.00								
Manganese	**0.62**	0.27	**0.54**	0.36	**0.57**	0.48	1.00							
Nitrate as Nitrogen	0.16	0.40	**0.55**	**0.55**	0.02	**0.53**	0.14	1.00						
Silica	-0.17	-0.32	-0.25	-0.30	-0.14	-0.35	-0.14	-0.02	1.00					
Sodium	0.37	**0.84**	**0.84**	**0.90**	0.13	**0.91**	0.42	**0.63**	-0.34	1.00				
Sulfate	0.38	0.43	**0.68**	**0.71**	0.10	**0.66**	0.47	**0.80**	-0.03	**0.76**	1.00			
Vanadium	**0.61**	**0.56**	**0.80**	**0.66**	0.47	**0.73**	**0.73**	**0.76**	-0.22	**0.70**	**0.64**	1.00		
[redacted]														
Dissolved Solids	0.45	**0.78**	**0.90**	**0.90**	0.23	**0.93**	**0.51**	**0.61**	-0.32	**0.93**	**0.80**	**0.78**	[redacted]	1.00
Frequncy	29/40	41/44	44/44	43/43	37/44	44/44	30/44	33/43	43/43	44/44	32/32	22/33	NA	NA

Notes: When calculating these values, only samples that had a result for turbidity were used; however the frequncies presented are for all samples.
Only correlations that involve inorganic chemicals that were detected in more than two-thirds of all samples are shown.
Correlations between turbidity and inorganic chemicals are shaded. Correlations that exceed |0.50| are in bold font. Correlations that exceed |0.90| are in bold font and outlined.

Correlations for Total Concentrations and Turbidity/Dissolved Solids - McNairy Samples

	Ba	Ca	Cl-	Fluoride	Fe	Mg	Mn	K	Si	Na	Sulfate	Turbidity	Dissolved Solids
Barium	1.00												
Calcium	0.10	1.00											
Chloride	-0.29	**0.57**	1.00										
Fluoride	0.10	**0.50**	0.01	1.00									
Iron	-0.38	**-0.80**	-0.17	-0.48	1.00								
Magnesium	-0.07	**0.90**	**0.71**	0.32	**-0.58**	1.00							
Manganese	-0.22	-0.06	**0.54**	**-0.61**	0.39	0.21	1.00						
Potassium	0.24	-0.13	**-0.52**	0.24	-0.13	-0.25	-0.42	1.00					
Silica	0.11	0.33	0.06	0.07	-0.48	0.24	-0.39	0.02	1.00				
Sodium	-0.16	-0.10	0.14	-0.36	0.35	0.06	**0.58**	0.17	**-0.52**	1.00			
[redacted]													
Dissolved Solids	0.00	**0.70**	**0.56**	0.31	**-0.55**	**0.72**	0.12	-0.06	0.11	0.24	-0.19	[redacted]	1.00
Frequancy	44/46	46/46	45/45	38/38	45/46	46/46	46/46	39/46	45/45	46/46	37/37		

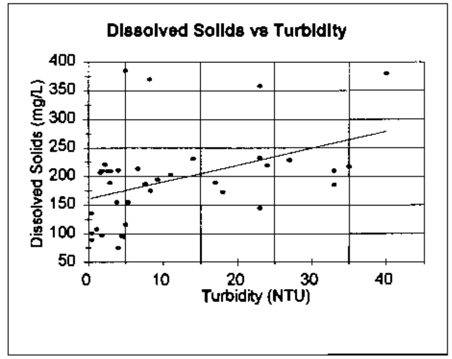
When calculating these values, only samples which had a result for turbidity were used; however, the frequncies presented are for all samples.
Only correlations that involve inorganic chemicals that were detected in more than two-thirds of all samples are shown.
Correlations between turbidity and inorganic chemicals are shaded. Correlations that exceed |0.50| are in bold font. Correlations that exceed |0.90| are in bold font and outlined.

Summary of Results of Regression and Correlation Analyses - RGA Samples

Turbidity	Dissolved	Y-Hat
0.35	136	161.982
0.42	89	162.189
0.43	101	162.218
1 1	108	164.193
1 6	207	165.666
1.8	210	166.256
1.8	97	166.256
2.2	221	167.435
2.6	210	168.613
2.9	189	169.498
3	210	169.792
3.8	155	172.15
4	211	172.739
4	75	172.739
4.5	98	174.213
4.8	94	175.097
5	385	175.686
5	118	175.686
5.3	155	176.57
6.6	214	180.402
7.6	187	183.349
8.2	370	185 117
8.3	175	185.412
9.3	195	188.359
11	203	193.369
14	231	202.21
17	189	211.051
18	173	213.998
23	358	228.734
23	145	228.734
23	233	228.734
24	220	231.681
27	229	240.522
33	186	258.204
33	210	258.204
35	217	264.098
40	380	278.834

ith turbidity of 200 NTU and 172 NTU

172	233
200	171



Regression Statistics

Multiple R	0.427253
R Square	0.182545
Adjusted R Square	0.159189
Standard Error	72.17895
Observations	37

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	40718.86342	40719	7.81581882135372	0.0083528
Residual	35	182343.0265	5209.8		
Total	36	223061.8919			

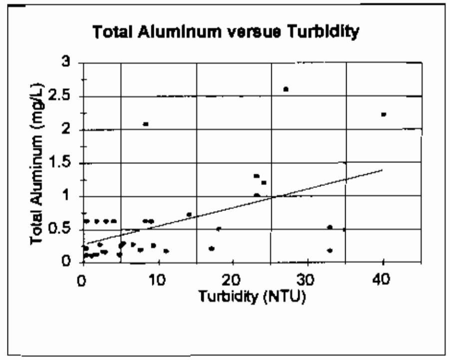
	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	160.9513	16.78326356	9.6014	1.62063768838E-11	126.9201	194.9826
x1	2.947066	1.054150542	2 7957	0.00825548514869	0 8070269	5.087106

Summary of Results of Regression and Correlation Analyses - RGA Samples

Aluminum	Turbidity	Y-Hat
0.208	0.35	0.2862
0.625	0.42	0.28813
0.112	0.43	0.28841
0.1	1.1	0.30697
0.123	1.6	0.32082
0.62	1.8	0.32636
0.125	1.8	0.32636
0.267	2.2	0.33744
0.169	2.6	0.34852
0.157	2.9	0.35683
0.62	3	0.3596
0.625	4	0.3873
0.625	4	0.3873
0.115	4.8	0.40946
0.243	5	0.415
0.288	5.3	0.42331
0.267	6.6	0.45932
0.188	7.6	0.48702
0.625	8.2	0.50364
2.06	8.3	0.50641
0.62	9	0.5258
0.254	9.3	0.53411
0.166	11	0.5812
0.721	14	0.6643
0.204	17	0.7474
0.501	18	0.7751
1.01	23	0.9136
1.3	23	0.9136
1.2	24	0.9413
2.6	27	1.0244
0.172	33	1.1906
0.524	33	1.1906
0.486	36	1.246
2.22	40	1.3545

ith turbidity of 200 NTU and 172 NTU

11	200	171
4.77	172	233



Regression Statistics

Multiple R	0.513313
R Square	0.26349
Adjusted R Square	0.240474
Standard Error	0.543953
Observations	34

Analysis of Variance

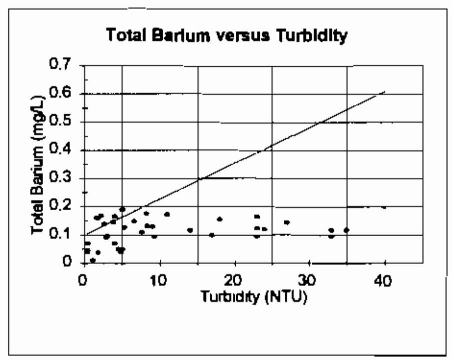
	df	Sum of Squar	Mean S	F	Significance F
Regression	1	3.387336627	3.3873	11.448174215982	0.0019051
Residual	32	9.468302108	0.2959		
Total	33	12.85563874			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.276544	0.132080335	2.0938	0.0440440507228	0.0075056	0.545583
x1	0.027701	0.008187194	3.3835	0.00185893203831	0.0110247	0.044378

Barium	Turbidity	Y-Hat
0.038	0.35	0.10487
0.07	0.42	0.10575
0.046	0.43	0.10588
0.01	1.1	0.11439
0.16	1.6	0.12074
0.038	1.8	0.12328
0.16	1.8	0.12328
0.168	2.2	0.12836
0.139	2.8	0.13344
0.091	2.9	0.13725
0.096	3	0.13852
0.145	3.8	0.14868
0.165	4	0.15122
0.07	4	0.15122
0.05	4.5	0.15757
0.04	4.8	0.16138
0.046	5	0.16392
0.19	5	0.16392
0.127	5.3	0.16773
0.149	6.6	0.18424
0.11	7.6	0.19694
0.176	8.2	0.20456
0.132	8.3	0.20583
0.13	9	0.21472
0.094	9.3	0.21853
0.172	11	0.24012
0.118	14	0.27822
0.098	17	0.31632
0.156	18	0.32902
0.163	23	0.39252
0.122	23	0.39252
0.094	23	0.39252
0.12	24	0.40522
0.144	27	0.44332
0.094	33	0.51952
0.117	33	0.51952
0.118	35	0.54492
0.199	40	0.60842

ith turbidity of 200 NTU and 172 NTU

0.088	172
0.2	200



Regression Statistics

Multiple R	0.297132
R Square	0.088287
Adjusted R Square	0.062962
Standard Error	0.048586
Observations	38

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0.007559247	0.0076	3.4861199257536	0.0700454
Residual	36	0.076061832	0.0022		
Total	37	0.085621079			

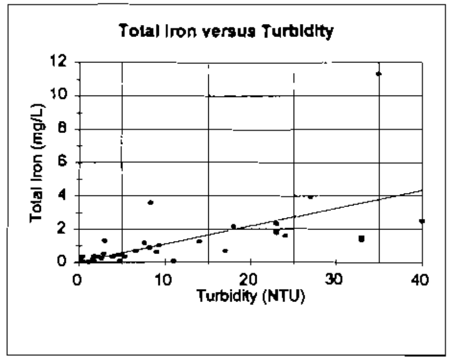
	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.100424	0.010712043	9.3749	2.5662516664E-11	0.0756984	0.122149
x1	0.001269	0.000679729	1.8671	0.06962400503276	-0.0001094	0.002648

Summary of Results of Regression and Correlation Analyses - RGA Samples

Iron	Turbidity	Y-Hat
0 069	0.35	0.05951
0.355	0.42	0.06704
0.053	0.43	0.06812
0.01	1.1	0.14021
0.172	1.6	0.19401
0.043	1.8	0.21553
0 38	1.8	0.21553
0.354	2.2	0.25857
0.28	2.6	0.30161
0.515	2.9	0.33389
1.3	3	0.34465
0.355	3.6	0.43073
0.355	4	0.45225
0 355	4	0.45225
0.438	4.5	0.50605
0 064	4 8	0 53833
0 484	5	0 55985
0 48	5	0 55985
0 354	5 3	0 59213
0 881	6 8	0 73201
1 18	7 8	0 83961
0.872	8.2	0 90417
3 58	8 3	0 91483
0 82	9	0 99075
1 02	9 3	1 02253
0.087	11	1 20645
1 24	14	1 52825
0.681	17	1 85106
2 13	18	1 95865
2.31	23	2.49865
1 84	23	2.49865
1 75	23	2.49865
1.6	24	2 60425
3.94	27	2.92705
1.35	33	3.57265
1.52	33	3.57265
11.3	35	3.78785
2.49	40	4.32585

ith turbidity of 206 NTU and 172 NTU

8.91	172
18.8	200



Regression Statistics

Multiple R	0.627573
R Square	0.393848
Adjusted R Square	0.37701
Standard Error	1.524118
Observations	38

Analysis of Variance

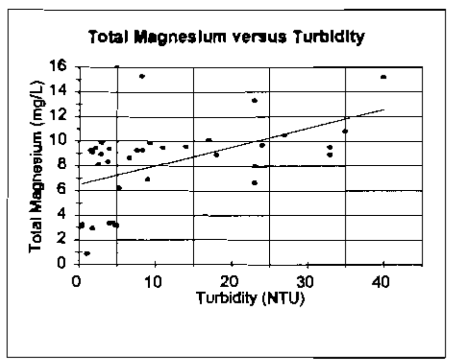
	df	Sum of Squar	Mean S	F	Significance F
Regression	1	54 33587581	54 336	23.3910067166121	2.474E-05
Residual	36	83 62548873	2 3229		
Total	37	137 9611623			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.02185	0 350608375	0.0623	0.9506443267831	-0.6892172	0 732816
x1	0.107598	0 02224772	4 8364	2 3357852353E-05	0.062478	0.15272

Magnesiu	Turbidity	Y-Hat
3.1	0.35	6.53851
3 12	0.42	6.54914
3.28	0 43	6.55066
0.879	1.1	6 6524
9.25	1.6	6.72832
2.96	1.8	6.75869
8.1	1.8	6.75869
9.45	2.2	6.81943
8.13	2.6	6.88017
8.95	2.9	6.92573
8.9	3	6.94091
8.34	3.8	7.06239
9.38	4	7 09276
3.37	4	7.09276
3.4	4.5	7.16868
3.14	4.8	7.21424
3 15	5	7.24461
16	5	7 24461
6.2	5 3	7.29017
8.63	6 6	7 48757
9 25	7.6	7 63942
15.3	8.2	7.73053
9.29	8 3	7.74572
8 9	9	7 85201
9.84	9 3	7.89757
9.51	11	8.15571
9 58	14	8 61126
10 1	17	9.06681
8 88	18	9.21866
13.3	23	9.97791
6 65	23	9.97791
7 99	23	9.97791
8 7	24	10.1298
10 5	27	10 5853
9 51	33	11.4964
8.9	33	11 4964
10.8	35	11.8001
15.2	40	12.5594

ith turbidity of 200 NTU and 172 NTU

4.81	172
8 73	200



Regression Statistics

Multiple R	0 471575
R Square	0 222383
Adjusted R Square	0 200783
Standard Error	3 242109
Observations	38

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	108.216508	108.22	10 2952637049897	0.0028014
Residual	36	378 4057278	10.511		
Total	37	486.6222368			

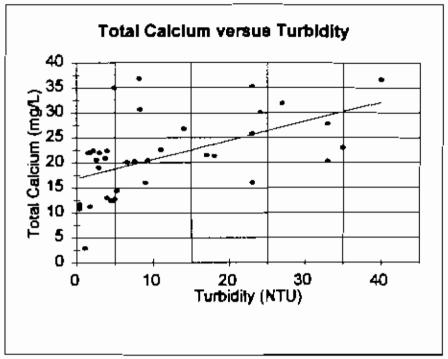
	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	6 485357	0.7456816192	8.6957	1.7920557552E-10	4.972772	7.997943
x1	0.15185	0.047325481	3.2088	0 0027537687328	0 0556693	0.24783

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Calcium	Turbidity	Y-Hat
MW103	6026-94	10 6	0 35	17 0107
MW103	6774-94	11.2	0 42	17 0373
MW103	5187-94	11.7	0 43	17 0411
MW103	5944-93	2.88	1 1	17 2956
MW142	4233-94	22	1 6	17 4855
MW103	7299-93	11 3	1 8	17.5614
MW142	6872-94	22	1 8	17.5614
MW142	6098-93	22 4	2 2	17.7134
MW142	5203-94	20.6	2 6	17.8653
MW141	6054-94	18.03	2 9	17 9792
MW141	6868-94	22	3	18 0172
MW142	5464-95	20.9	3 8	18.321
MW142	5317-96	22.4	4	18.367
MW103	5285-96	13	4	18.397
MW103	5440-95	12.4	4 5	18 5868
MW103	4272-94	12.5	4.8	18.7008
MW103	5178-93	12 75	5	18.7768
MW150	5466-95	35	5	18.7768
MW106	4697-94	14 4	5.3	18.8907
MW142	7069-93	20.1	6.6	19.3845
MW141	5199-94	20 3	7.6	19 7643
MW150	5321-96	36 8	8.2	19.9922
MW199	4312-94	30.7	8.3	20 0301
MW106	7272-94	16	9	20.296
MW141	7085-93	20.5	9.3	20.4099
MW142	6056-94	22 62	11	21.0556
MW199	6074-94	26.8	14	22.195
MW141	4229-94	21.5	17	23.3344
MW142	6084-93	21 38	18	23.7142
MW150	4769-94	35.2	23	25.6132
MW106	5444-95	16	23	25.6132
MW199	5260-94	25 6	23	25.6132
MW199	6888-94	30	24	25.993
MW199	5984-93	31 8	27	27.1324
MW141	6080-93	20.35	33	28.4112
MW199	7311-93	27.8	33	29.4112
MW141	6092-93	23	35	30.1708
MW150	5650-93	36.6	40	32 0698

Delete value with turbidity of 200 NTU and 172 NTU

MW199	5170-93	15.31	172
MW106	5322-93	15.6	200



Regression Statistics

Multiple R	0.532476
R Square	0.28353
Adjusted R Square	0.263628
Standard Error	6.893458
Observations	38

Analysis of Variance

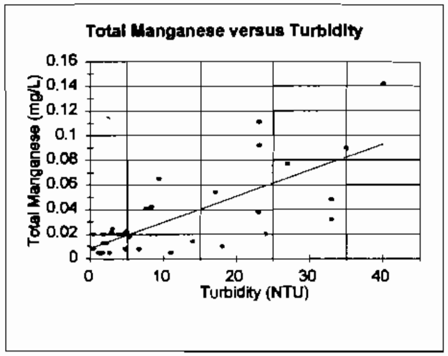
	df	Sum of Squar	Mean S	F	Significance F
Regression	1	676.9836045	676.98	14 2463587516294	0 000579
Residual	36	1710.711501	47.52		
Total	37	2387.695105			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	16.8778	1.585774169	10.643	9 1626643379E-13	13 661699	20 0939
x1	0.379801	0.100624684	3.7744	0 000562963869676	0 175725	0.583878

STATION ID	SAMPLE ID	Manganese	Turbidity	Y-Hat
MW103	6026-94	0.008	0 35	0 00926
MW103	6774-94	0.02	0 42	0.00941
MW103	5187-94	0.008	0 43	0 00943
MW103	5944-93	0.005	1 1	0 01084
MW142	4233-94	0.005	1.6	0.0119
MW103	7299-93	0.013	1.8	0 01232
MW142	6872-94	0.02	1.8	0.01232
MW142	6098-93	0.013	2.2	0.01316
MW142	5203-94	0 005	2.6	0.01401
MW141	6054-94	0.021	2.9	0.01464
MW141	6868-94	0.024	3	0.01485
MW142	5464-95	0.02	3.8	0.01654
MW142	5317-96	0.02	4	0.01696
MW103	5285-96	0.02	4	0.01696
MW103	5440-95	0.02	4.5	0.01802
MW103	4272-94	0.008	4.8	0.01865
MW103	5178-93	0.022	5	0.01907
MW150	5466-95	0.02	5	0 01907
MW106	4697-94	0.018	5.3	0.0197
MW142	7069-93	0.008	6.6	0.02245
MW141	5199-94	0.041	7.6	0.02456
MW150	5321-96	0.02	8.2	0.02582
MW199	4312-94	0.042	8.3	0.02603
MW106	7272-94	0.02	9	0.02751
MW141	7085-93	0.065	9 3	0.02814
MW142	6056-94	0.005	11	0.03173
MW199	6074-94	0.014	14	0.03808
MW141	4229-94	0 054	17	0.04439
MW142	6084-93	0 01	18	0 0465
MW150	4769-94	0.111	23	0.05705
MW106	5444-95	0.038	23	0.05705
MW199	5260-94	0.092	23	0.05705
MW199	6888-94	0.02	24	0 05916
MW199	5984-93	0.077	27	0 06549
MW141	6080-93	0.032	33	0 07815
MW199	7311-93	0.048	33	0 07815
MW141	6092-93	0.09	35	0 08237
MW150	5650-93	0.142	40	0 09292

Delete value with turbidity of 200 NTU and 172 NTU

MW199	5170-93	0.066	172
MW106	5322-93	0.409	200



Regression Statistics

Multiple R	0.740395
R Square	0 548185
Adjusted R Square	0 535635
Standard Error	0.021852
Observations	38

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0.020858883	0 0209	43.6767115849972	1.076E-07
Residual	36	0.017190081	0 0005		
Total	37	0.038048763			

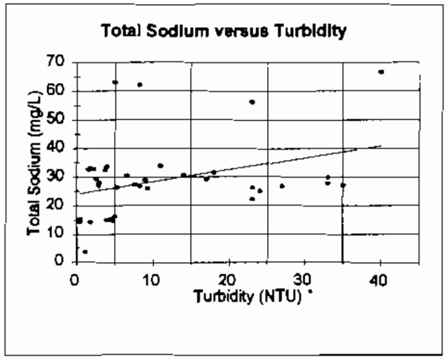
	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0 008524	0 005028804	1.6957	0.0983501633959	-0.0016711	0.018719
x1	0 002108	0.000318974	6 609	9.4580845081E-08	0 0014612	0 002755

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Sodium	Turbidity	Y-Hat
MW103	6026-94	14.8	0.35	24 3038
MW103	6774-94	14.3	0 42	24 333
MW103	5187-94	15.2	0 43	24.3372
MW103	5944-93	3.71	1.1	24 6174
MW142	4233-94	32.8	1.6	24.8264
MW103	7299-93	14.2	1.8	24.9101
MW142	6872-94	33	1.8	24.9101
MW142	6096-93	32.7	2.2	25.0773
MW142	5203-94	29 3	2.6	25.2446
MW141	6054-94	27 1	2.9	25.37
MW141	6868-94	28	3	25.4119
MW142	5464-95	32 4	3.8	25.7484
MW142	5317-96	33 6	4	25.83
MW103	5285-96	15	4	25.83
MW103	5440-95	15.2	4.5	26.0381
MW103	4272-94	14.68	4.8	26.1645
MW103	5178-93	16.12	5	26.2482
MW150	5466-95	63	5	26.2482
MW106	4697-94	26.4	5.3	26 3736
MW142	7069-93	30.4	6.6	26.9172
MW141	5199-94	27.4	7 6	27 3353
MW150	5321-96	62.2	8.2	27.5862
MW199	4312-94	26.8	8.3	27.628
MW106	7272-94	29	9	27 9206
MW141	7065-93	26	9 3	28.0462
MW142	6058-94	33.85	11	28.7571
MW199	6074-94	30.4	14	30.0115
MW141	4229-94	29.2	17	31.266
MW142	6084-93	31 54	18	31.6841
MW150	4769-94	56 3	23	33.7749
MW106	5444-95	26 1	23	33.7749
MW199	5260-94	22 1	23	33.7749
MW199	6888-94	25	24	34.193
MW199	5984-93	26 6	27	35.4475
MW141	6080-93	29.93	33	37.9564
MW199	7311-93	27.8	33	37 9564
MW141	6092-93	27	35	38.7927
MW150	5650-93	68.8	40	40 8834

Delete value with turbidity of 200 NTU and 172 NTU

MW199	5170-93	13.31	172
MW106	5322-93	27.5	200



Regression Statistics

Multiple R	0.345822
R Square	0 119593
Adjusted R Square	0.095137
Standard Error	12.95401
Observations	38

Analysis of Variance

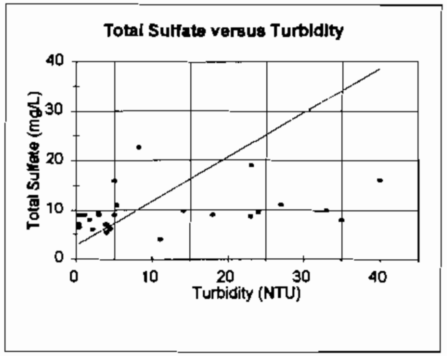
	df	Sum of Squar	Mean S	F	Significance F
Regression	1	620.6016754	620.6	4.89017217828602	0 0334463
Residual	36	6941 026622	167.81		
Total	37	6861 626297			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	24.15744	2.979945573	8.1067	1 0047919869E-09	18 113835	30.20105
x1	0.418151	0.189081306	2.2114	0.03326801624876	0 0346565	0 801648

STATION ID	SAMPLE ID	Sulfate	Turbidity	Y-Hat
MW103	6026-94	7.2	0 35	3 13666
MW103	6774-94	6.5	0.42	3.20258
MW103	5187-94	9	0.43	3.21151
MW103	5944-93	8	1 1	3.81136
MW142	6872-94	6	1.8	4.43807
MW142	6096-93	6	2.2	4.79619
MW141	6054-94	9 3	2.9	5.4229
MW141	6868-94	9	3	5.51243
MW142	5464-95	7 1	3.8	6.22867
MW103	5285-96	5.4	4	6.40773
MW142	5317-96	7.1	4	6.40773
MW103	5446-95	6.1	4.5	6.85538
MW150	5466-95	15.9	5	7.30303
MW103	5178-93	9	5	7.30303
MW106	4697-94	11	5 3	7.57162
MW150	5321-96	22.6	8 2	10 166
MW142	6058-94	4	11	12.6746
MW199	6074-94	9.8	14	15 3607
MW142	6084-93	9	18	16.9419
MW106	5444-95	8.6	23	23.4164
MW150	4769-94	19	23	23 4164
MW199	6888-94	9.4	24	24.3137
MW199	5984-93	11	27	26.9996
MW141	6080-93	10	33	32.3714
MW141	6092-93	8	35	34.162
MW150	5650-93	16	40	38.5385

Delete value with turbidity of 200 NTU and 172 NTU

MW199	5170-93	9	172
MW106	5322-93	11	200



Regression Statistics

Multiple R	0 313041
R Square	0 097995
Adjusted R Square	0 060411
Standard Error	11 78542
Observations	26

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	362.1561446	362.16	2.60738668045193	0.1194388
Residual	24	3333.509164	138 9		
Total	25	3695.665338			

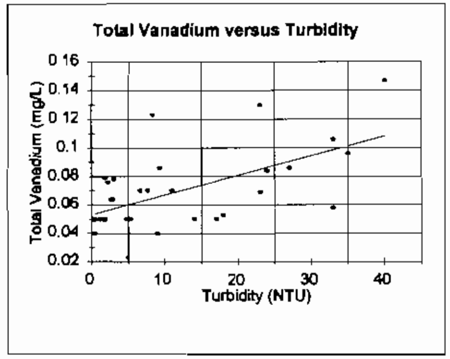
	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	2.826527	5.869481031	0 4816	0.63430535394857	-9.2875069	14.94056
x1	0.895298	0.554452952	1 6147	0.11891904106706	-0.249037	2.039532

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Vanadium	Turbidity	Y-Hat
MW103	6026-94	0 05	0.35	0.0538
MW103	6774-94	0.04	0.42	0.0539
MW103	5187-94	0.05	0.43	0.05391
MW103	5944-93	0.05	1.1	0.05483
MW142	4233-94	0.05	1.6	0.05551
MW103	7299-93	0.05	1.8	0.05579
MW142	6872-94	0 079	1.8	0.05579
MW142	6096-93	0.076	2.2	0 05633
MW142	5203-94	0.064	2.6	0.05688
MW141	6054-94	0 064	2.9	0.05729
MW141	6868-94	0.076	3	0.05743
MW103	4272-94	0.05	4 6	0.0599
MW103	5178-93	0.023	5	0.06017
MW105	4697-94	0.05	5.3	0.06058
MW142	7089-93	0 07	6.6	0.06236
MW141	5199-94	0.07	7.6	0.06373
MW199	4312-94	0.123	8.3	0.06469
MW106	7272-94	0.04	9	0.06565
MW141	7085-93	0.086	9.3	0.06606
MW142	6058-94	0.07	11	0.06839
MW199	6074-94	0 05	14	0.0725
MW141	4229-94	0.05	17	0.07661
MW142	6084-93	0 053	18	0.07798
MW150	4788-94	0.13	23	0.08483
MW199	5280-94	0 059	23	0.08483
MW199	6680-94	0.084	24	0.0862
MW199	5984-93	0.086	27	0 09031
MW141	6080-93	0.058	33	0.09853
MW199	7311-93	0.106	33	0 09853
MW141	6092-93	0 096	35	0 10127
MW150	5850-93	0.147	40	0.10812

Delete value with turbidity of 200 NTU and 172 NTU

MW198	5170-93	0 05	172
MW106	5322-93	0 074	200



Regression Statistics

Multiple R	0.586535
R Square	0.344024
Adjusted R Square	0.321404
Standard Error	0.022963
Observations	31

Analysis of Variance

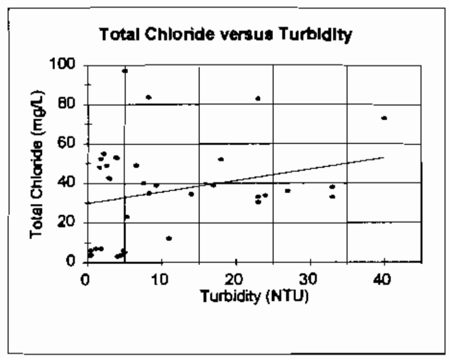
	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0 00801986	0.008	15.2089189448776	0.0005247
Residual	29	0.015292076	0 0005		
Total	30	0 023311935			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0 053317	0.005894731	9.0449	4.4911185144E-10	0.0412611	0.065373
x1	0 001366	0.000350874	3 8999	0.00050244019536	0.0006507	0.002086

STATION ID	SAMPLE ID	Chloride	Turbidity	Y-Hat
MW103	6026-94	3 4	0.35	30.1291
MW103	6774-94	3 9	0.42	30.1692
MW103	5187-94	5	0.43	30.1749
MW103	5944-93	7	1.1	30.5586
MW142	4233-94	48	1.6	30 845
MW103	7299-93	7	1.8	30.9596
MW142	6872-94	52.4	1 8	30 9596
MW142	0096-93	55	2 2	31 1887
MW142	5203-94	49	2 5	31 4178
MW141	6054-94	42.8	2 9	31 5898
MW141	6868-94	42.4	3	31 6469
MW142	5464-95	53.2	3 8	32 1051
MW142	5317-96	52.9	4	32.2196
MW103	5285-96	3.1	4	32.2196
MW103	5440-95	3.5	4.5	32.506
MW103	4272-94	6	4 8	32.6778
MW103	5178-93	5	5	32 7924
MW150	5468-95	97.1	5	32.7924
MW105	4697-94	23	5 3	32 9642
MW142	7089-93	49	6.6	33.7088
MW141	5199-94	40	7.6	34.2816
MW150	5321-96	83.6	8.2	34.6252
MW199	4312-94	35	8 3	34.6825
MW141	7085-93	39	9.3	35.2553
MW142	6058-94	12	11	36 229
MW199	6074-94	34.5	14	37 9472
MW141	4229-94	39	17	39.6655
MW142	6084-93	52	18	40.2383
MW150	4789-94	83	23	43.1021
MW106	5444-95	30.5	23	43 1021
MW199	5280-94	33	23	43.1021
MW199	6688-94	33.8	24	43.6745
MW199	5984-93	36	27	45.3931
MW141	6080-93	35	33	48.8297
MW199	7311-93	33	33	48.8297
MW141	6092-93	40	35	49.9752
MW150	5850-93	73	40	52.839

Delete value with turbidity of 200 NTU and 172 NTU

MW199	5170-93	30	172
MW106	5322-93	22	200



Regression Statistics

Multiple R	0.259608
R Square	0.072688
Adjusted R Square	0.046194
Standard Error	23.67718
Observations	37

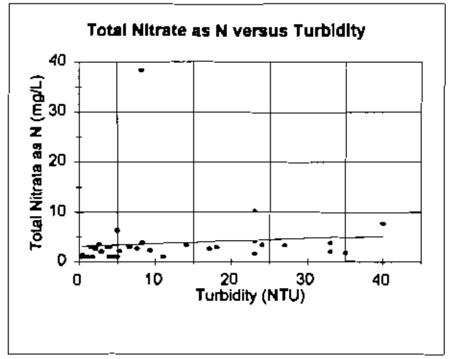
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	1538.04005	1538	2.74351763662844	0 1065692
Residual	35	19621.30698	560 61		
Total	36	21159.34703			

	Coefficien	Standard Error	t Statist	P-value	Lower 95 0	Upper 95 00
Intercept	29 92863	5.498927047	5.4426	3.8641000478E-06	18.765211	41.09204
x1	0 572764	0.345797837	1.6564	0.10834164351728	-0.1292423	1.274771

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Nitrate as	Turbidity	Y-Hat
MW103	6026-94	1	0.35	3.17968
MW103	6774-94	1	0.42	3.18317
MW103	5167-94	1.4	0.43	3.18366
MW103	5944-93	1	1.1	3.21703
MW142	4233-94	3	1.6	3.24193
MW103	7289-93	1	1.8	3.25189
MW142	6672-94	3	1.8	3.25189
MW142	6096-93	2.8	2.2	3.27181
MW142	5203-94	3.5	2.6	3.29173
MW141	6054-94	2	2.9	3.30667
MW141	6868-94	2.1	3	3.31165
MW142	5484-95	2.9	3.8	3.35149
MW142	5317-96	3	4	3.36145
MW103	5285-96	1	4	3.36145
MW103	5440-95	1	4.5	3.38635
MW103	4272-94	1	4.8	3.40129
MW103	5178-93	1	5	3.41125
MW150	5468-95	6.3	5	3.41125
MW106	4697-94	2.2	5.3	3.42619
MW142	7069-93	3	6.6	3.49093
MW141	5199-94	2.7	7.6	3.54073
MW150	5321-96	38.3	8.2	3.57061
MW199	4312-94	3.6	8.3	3.57559
MW141	7085-93	2.3	9.3	3.62539
MW142	6059-94	1	11	3.71005
MW199	6074-94	3.4	14	3.85945
MW141	4229-94	2.6	17	4.00885
MW142	6084-93	2.9	18	4.05865
MW150	4769-94	10.2	23	4.30785
MW100	5444-95	1.6	23	4.30765
MW199	5260-94	4.1	23	4.30785
MW199	6888-94	3.4	24	4.35745
MW199	5984-93	3.3	27	4.50685
MW141	5060-93	2	33	4.80585
MW199	7311-93	3.7	33	4.80565
MW141	6092-93	1.7	35	4.90525
MW150	5650-93	7.7	40	5.15425
	Delete value with turbidity of 200 NTU and 172 NTU			
MW199	5170-93	2.7	172	
MW106	5322-93	1.8	200	



Regression Statistics

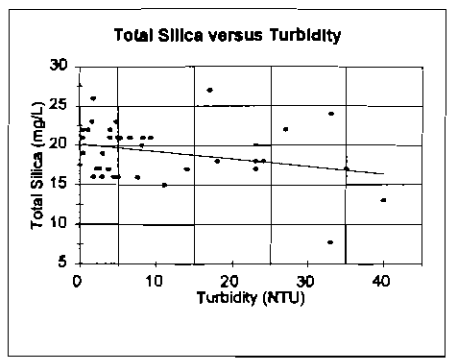
Multiple R	0.092421
R Square	0.008542
Adjusted R Square	-0.01979
Standard Error	6.20968
Observations	37

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	11.62703135	11.627	0.30153186304786	0.5864102
Residual	35	1349.585871	38.56		
Total	36	1361.222703			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	3.16225	1.442187918	2.1927	0.03487444744809	0.2344936	6.090007
x1	0.0496	0.090690103	0.5481	0.58631384959335	-0.134311	0.23391

STATION ID	SAMPLE ID	Silica	Turbidity	Y-Hat
MW103	6026-94	21	0.35	20.1852
MW103	6774-94	22	0.42	20.1783
MW103	5167-94	19	0.43	20.1774
MW103	5944-93	22	1.1	20.1122
MW142	4233-94	23	1.6	20.0636
MW142	6672-94	16	1.8	20.0441
MW103	7289-93	26	1.8	20.0441
MW142	6096-93	17	2.2	20.0052
MW142	5203-94	17	2.6	19.9663
MW141	6054-94	16	2.9	19.9371
MW141	6868-94	19	3	19.9274
MW142	5484-95	17	3.8	19.8495
MW142	5317-96	21	4	19.8301
MW103	5285-96	22	4	19.8307
MW103	5440-95	16	4.5	19.7814
MW103	4272-94	23	4.8	19.7523
MW150	5468-95	18	5	19.7328
MW103	5178-93	21	5	19.7328
MW106	4697-94	21	5.3	19.7036
MW142	7069-93	21	6.6	19.5772
MW141	5199-94	16	7.6	19.4799
MW150	5321-96	20	8.2	19.4215
MW199	4312-94	21	8.3	19.4118
MW141	7085-93	21	9.3	19.3145
MW142	6059-94	15	11	19.1491
MW199	6074-94	17	14	18.8573
MW141	4229-94	27	17	18.5654
MW142	6084-93	18	18	18.4682
MW150	4769-94	20	23	17.9818
MW106	5444-95	18	23	17.9818
MW199	5269-94	17	23	17.9818
MW199	6868-94	18	24	17.8845
MW199	5984-93	22	27	17.5926
MW141	6080-93	7.86	33	17.009
MW199	7311-93	24	33	17.009
MW141	6092-93	17	35	16.8144
MW150	5650-93	13	40	16.328
	Delete value with turbidity of 200 NTU and 172 NTU			
MW199	5170-93	22	172	
MW106	5322-93	19	200	



Regression Statistics

Multiple R	0.301656
R Square	0.090996
Adjusted R Square	0.065025
Standard Error	3.558431
Observations	37

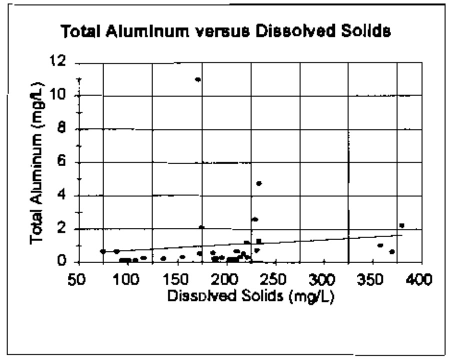
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	44.36525113	44.365	3.50369059489662	0.0696083
Residual	35	443.1851921	12.662		
Total	36	487.5504432			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	20.21915	0.826431025	24.466	0	18.541406	21.8969
x1	-0.09728	0.051969756	-1.872	0.06937468858619	-0.202782	0.008226

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Aluminum	Dissolved	Y-Hat
MW103	5285-96	0.625	75	0.60714
MW103	6774-94	0.625	89	0.65418
MW103	4272-94	0.115	94	0.67098
MW103	7299-93	0.125	97	0.68106
MW103	5187-94	0.112	101	0.6945
MW103	5944-93	0 1	108	0.71802
MW103	5178-93	0 243	116	0.7449
MW103	6026-94	0.208	136	0.8121
MW108	4697-94	0 289	155	0.87594
MW108	5322-93	11	171	0.9297
MW142	6084-93	0.501	173	0.93642
MW199	4312-94	2.08	175	0.94314
MW141	6080-93	0.524	186	0.9801
MW141	5199-94	0.188	187	0.98346
MW141	6054-94	0.157	189	0.99018
MW141	4229-94	0.204	189	0.99018
MW141	7085-93	0.254	195	1 01034
MW142	8059-94	0 169	203	1.03722
MW142	4233-94	0.123	207	1 05066
MW141	6868-94	0 62	210	1.06074
MW142	5203-94	0.169	210	1.06074
MW199	7311-93	0 172	210	1.06074
MW142	6872-94	0.62	210	1.06074
MW142	5317-96	0 625	211	1.0641
MW142	7069-93	0.267	214	1.07418
MW141	6092-93	0 466	217	1.08426
MW199	6888-94	1 2	220	1 09434
MW142	6098-93	0 267	221	1.0977
MW199	5984-93	2 6	229	1.12458
MW199	6074-94	0 721	231	1.1313
MW199	5170-93	4 77	233	1.13802
MW199	5260-94	1 3	233	1.13802
MW150	4769-94	1.01	355	1 55802
MW150	5321-96	0 525	370	1.59834
MW150	5650-93	2.22	380	1 63194



Regression Statistics

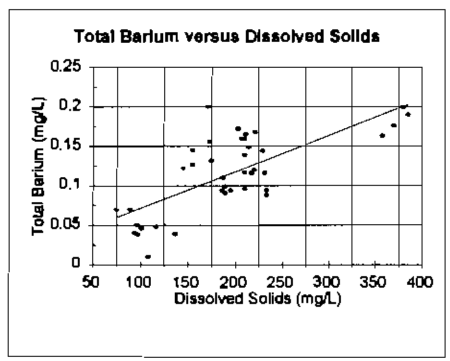
Multiple R	0 122232
R Square	0 014941
Adjusted R Square	-0 01491
Standard Error	1 989179
Observations	35

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	1 980459202	1 9805	0 50051635884656	0.4842401
Residual	33	130 5754586	3 9566		
Total	34	132 555819			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.355138	0.983256268	0.3612	0.72019530953947	-1 6453117	2.355588
x1	0.003363	0 004753686	0.7075	0.48409482520871	-0.0063083	0.013035

STATION ID	SAMPLE ID	Barium	Dissolved	Y-Hat
MW103	5285-96	0.07	75	0 05892
MW103	6774-94	0.07	89	0 06636
MW103	4272-94	0.04	94	0.06866
MW103	5440-95	0 05	96	0.06955
MW103	7299-93	0.038	97	0 07004
MW103	5187-94	0.046	101	0.07165
MW103	5944-93	0.01	108	0.0751
MW103	5178-93	0.048	115	0.07878
MW103	5026-94	0.039	136	0.08798
MW108	5444-95	0.122	145	0.09212
MW108	4697-94	0.127	155	0.09672
MW142	5464-95	0.145	155	0.09672
MW108	5322-93	0.2	171	0.10408
MW142	6084-93	0 156	173	0.105
MW199	4312-94	0.132	175	0.10592
MW141	6080-93	0.094	166	0.11098
MW141	5199-94	0.11	157	0.11144
MW141	6054-94	0 081	189	0.11236
MW141	4229-94	0 089	189	0.11236
MW141	7085-93	0.094	195	0.11512
MW142	6058-94	0.172	203	0.1188
MW142	4233-94	0.16	207	0.12064
MW142	5203-94	0 139	210	0.12202
MW141	6868-94	0.096	210	0.12202
MW142	6872-94	0.16	210	0.12202
MW199	7311-93	0.117	210	0.12202
MW142	5317-96	0.165	211	0.12248
MW142	7069-93	0.149	214	0.12386
MW141	6092-93	0.116	217	0.12524
MW199	6869-94	0 12	220	0.12662
MW142	6098-93	0 188	221	0.12708
MW199	5994-93	0.144	229	0.13076
MW199	6074-94	0 118	231	0.13168
MW199	5260-94	0.094	233	0.1326
MW199	5170-93	0 066	233	0.1326
MW150	4769-94	0.163	356	0.1901
MW150	5321-95	0.176	370	0.19562
MW150	5650-93	0 199	380	0.20022
MW150	5488-95	0 19	385	0.20252



Regression Statistics

Multiple R	0.72115
R Square	0.520057
Adjusted R Square	0.507086
Standard Error	0.034795
Observations	39

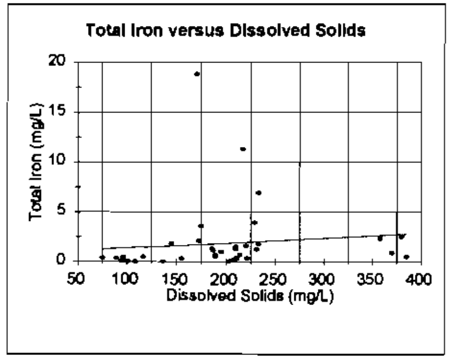
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0 048540017	0 0485	40.092539483707	2.234E-07
Residual	37	0 044795881	0 0012		
Total	38	0 093335897			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.025417	0 015311095	1 66	0 10513835685896	-0 0058062	0.05644
x1	0.000464	7 33378E-05	6.3319	1 9975721929E-07	0.0003158	0 000613

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Iron	Dissolved	Y-Hat
MW103	5285-96	0.356	75	1.2534
MW103	6774-94	0.355	89	1.32172
MW103	4272-94	0.064	94	1.34612
MW103	5440-95	0.438	96	1.35588
MW103	7299-93	0.043	97	1.36076
MW103	5187-94	0.053	101	1.38028
MW103	5944-93	0.01	106	1.41444
MW103	5178-93	0.464	116	1.45348
MW103	6026-94	0.069	136	1.55108
MW106	5444-95	1.84	145	1 595
MW142	5464-95	0.355	155	1 6438
MW106	4697-94	0.354	155	1 6438
MW106	5322-93	18.8	171	1 72188
MW142	6084-93	2.13	173	1.73164
MW199	4312-94	3.59	175	1 7414
MW141	6080-93	1.35	186	1.79506
MW141	5199-94	1.16	187	1 79996
MW141	6054-94	0.515	189	1.80972
MW141	4229-94	0.681	189	1.80972
MW141	7085-93	1 02	195	1.839
MW142	6056-94	0 087	203	1.87804
MW142	4233-94	0 172	207	1.89756
MW142	5203-94	0.26	210	1.9122
MW141	6888-94	1 3	210	1.9122
MW199	7311-93	1 52	210	1.9122
MW142	6872-94	0.36	210	1.9122
MW142	5317-96	0 356	211	1.91708
MW142	7089-93	0 661	214	1.93172
MW141	6092-93	11 3	217	1.94636
MW199	6680-94	1.6	220	1.961
MW142	6096-93	0.354	221	1.96588
MW199	5984-93	3 84	228	2.00492
MW199	6074-94	1 24	231	2.01468
MW199	5170-93	6 61	233	2.02444
MW199	5260-94	1 75	233	2.02444
MW150	4789-94	2.31	358	2.63444
MW150	5321-96	0 872	370	2.693
MW150	5650-93	2 49	380	2.7418
MW150	5466-95	0 48	385	2.7662



Regression Statistics

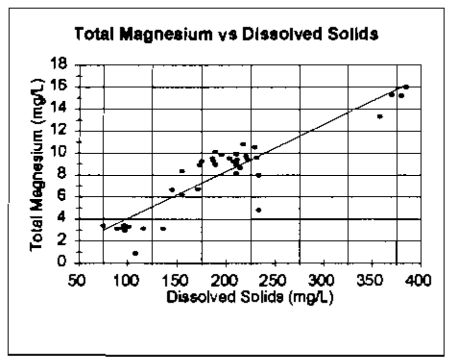
Multiple R	0 107428
R Square	0 01154
Adjusted R Square	-0.01517
Standard Error	3 521649
Observations	39

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	5 357387551	5 3574	0.4319772920873	0.5150883
Residual	37	458 8744432	12 402		
Total	38	464.2318308			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.887399	1 54965168	0 5726	0.57025879528396	-2.2524943	4.027292
x1	0 004876	0 007422578	0 6572	0.51498178300206	-0.0101611	0.019918

STATION ID	SAMPLE ID	Magnesiu	Dissolved	Y-Hat
MW103	5285-96	3.37	75	2.99816
MW103	6774-94	3.12	89	3.59512
MW103	4272-94	3 14	94	3.80832
MW103	5440-95	3.4	96	3 8936
MW103	7299-93	2.96	97	3.93624
MW103	5187-94	3.28	101	4.1068
MW103	5944-93	0.879	106	4 40528
MW103	5178-93	3.15	116	4.7464
MW103	6026-94	3.1	136	5 5992
MW106	5444-95	6.65	145	5.98296
MW106	4697-94	6.2	155	6.40936
MW142	5464-95	8.34	155	6 40936
MW106	5322-93	6.73	171	7 0916
MW142	6084-93	8.89	173	7.17688
MW199	4312-94	8.26	175	7.26216
MW141	6080-93	9.51	186	7 7312
MW141	5199-94	8.25	187	7.77384
MW141	6054-94	8.95	189	7 85912
MW141	4229-94	10.1	189	7 85912
MW141	7085-93	9.94	195	8.11496
MW142	5056-94	8.51	203	8.45608
MW142	4233-94	9.25	207	8.62664
MW142	5203-94	8.13	210	8 75456
MW141	6888-94	9.8	210	8.75456
MW142	6872-94	9.1	210	8.75456
MW199	7311-93	8.9	210	8.75456
MW142	5317-96	8.38	211	8 7972
MW142	7089-93	8.83	214	8.92512
MW141	6092-93	10 8	217	9.05304
MW199	6680-94	9 7	220	9.18096
MW142	6096-93	8 45	221	9.2236
MW199	5984-93	10 5	228	9.52472
MW199	6074-94	9.59	231	9.65
MW199	5260-94	7 96	233	9.73528
MW199	5170-93	4.81	233	9.73528
MW150	4789-94	13 3	358	15.0853
MW150	5321-96	15 3	370	15 577
MW150	5650-93	15 2	380	16.0034
MW150	5466-95	16	385	16 2166



Regression Statistics

Multiple R	0 906349
R Square	0.821469
Adjusted R Square	0.816644
Standard Error	1.550351
Observations	39

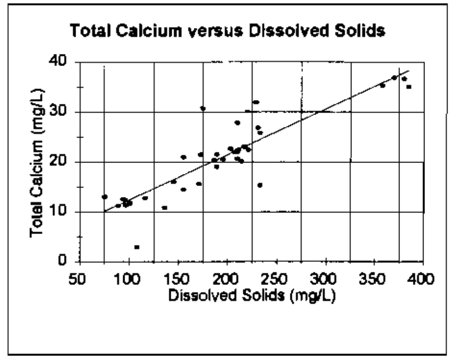
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	409.2035165	409.2	170.246975715171	2.051E-15
Residual	37	88 93274093	2.4036		
Total	38	498 1362584			

	Coefficien	Standard Error	t Statist	P-value	Lower 95 0	Upper 95.00
Intercept	-0 19894	0 682209952	-0.293	0.7711665005984	-1.552131	1.182446
x1	0.042636	0 003267674	13 048	1 2854947319E-15	0.0360153	0.049257

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Calcium	Dissolved	Y-Hat
MW103	5285-96	13	75	10.1042
MW103	6774-94	11.2	89	11.3768
MW103	4272-94	12.5	94	11.8313
MW103	5440-95	12 4	96	12.0131
MW103	7299-93	11.3	97	12 104
MW103	5187-94	11.7	101	12.4676
MW103	5944-93	2 68	108	13.1039
MW103	5178-93	12.75	116	13.8311
MW103	6026-94	10.8	136	15.6491
MW106	5444-95	16	145	16.4672
MW106	4697-94	14.4	155	17.3782
MW142	5464-95	20.9	155	17.3762
MW106	5322-93	15.6	171	18.8306
MW142	6084-93	21.39	173	19.0124
MW199	4312-94	30.7	175	19.1942
MW141	6080-93	20.35	186	20.1941
MW141	5199-94	20.3	187	20.285
MW141	6054-94	19.03	189	20.4668
MW141	4229-94	21.5	189	20.4668
MW141	7085-93	20.5	195	21.0122
MW142	6058-94	22.62	203	21.7394
MW142	4233-94	22	207	22.103
MW142	5203-94	20.6	210	22.3757
MW141	6868-94	22	210	22.3757
MW142	6672-94	22	210	22.3757
MW199	7311-93	27.8	210	22.3757
MW142	5317-96	22.4	211	22.4666
MW142	7089-93	20.1	214	22.7393
MW141	6092-93	23	217	23.012
MW199	6888-94	30	220	23.2847
MW142	6096-93	22.4	221	23.3756
MW199	5984-93	31 9	229	24.1028
MW199	6074-94	26.8	231	24.2846
MW199	5260-94	25.8	233	24.4664
MW199	5170-93	15.31	233	24.4664
MW150	4789-94	36.2	358	35.8289
MW150	5321-96	36.8	370	36.9187
MW150	5650-93	36.6	380	37.8287
MW150	5468-95	35	385	38.2832



Regression Statistics

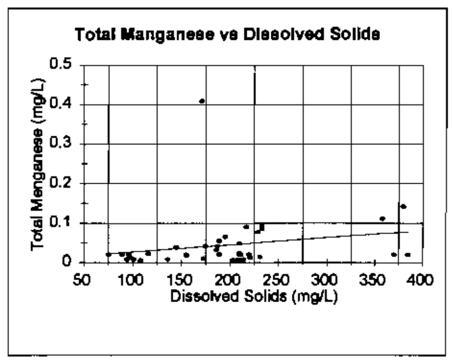
Multiple R	0 875769
R Square	0.767007
Adjusted R Square	0.760709
Standard Error	3 907539
Observations	39

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	1859.78958	1859.8	121 802759036819	2.918E-13
Residual	37	564.9479125	15 269		
Total	38	2424.737492			

	Coefficien	Standard Error	t Statist	P-value	Lower 95 0	Upper 95.00
Intercept	3.286702	1.719457383	1.9115	0.06350698859912	-0.1972499	6.770653
x1	0.090895	0.008235918	11.036	2.0540692628E-13	0.0742076	0.107583

STATION ID	SAMPLE ID	Manganes	Dissolved	Y-Hat
MW103	5285-96	0.02	75	0.02241
MW103	6774-94	0 02	89	0.02493
MW103	4272-94	0.006	94	0.02583
MW103	5440-95	0.02	96	0.02619
MW103	7299-93	0.013	97	0.02637
MW103	5187-94	0.008	101	0.02709
MW103	5944-93	0.005	108	0.02835
MW103	5178-93	0.022	116	0.02979
MW103	6026-94	0.008	136	0.03339
MW106	5444-95	0.036	145	0.03501
MW106	4697-94	0.018	155	0.03681
MW142	5464-95	0.02	155	0.03681
MW106	5322-93	0.409	171	0.03969
MW142	6084-93	0.01	173	0.04005
MW199	4312-94	0.042	175	0.04041
MW141	6080-93	0.032	186	0.04239
MW141	5199-94	0.041	187	0.04257
MW141	6054-04	0.021	189	0.04293
MW141	4229-94	0.054	189	0.04293
MW141	7085-93	0.065	195	0.04401
MW142	6058-94	0.005	203	0.04545
MW142	4233-94	0.005	207	0.04617
MW142	5203-94	0.005	210	0.04671
MW141	6868-94	0.024	210	0.04671
MW142	6672-94	0.02	210	0.04671
MW199	7311-93	0.048	210	0.04671
MW142	5317-96	0.02	211	0.04689
MW142	7089-93	0.008	214	0.04743
MW141	6092-93	0.09	217	0.04797
MW199	6888-94	0.02	220	0.04851
MW142	6096-93	0.013	221	0.04869
MW196	5984-93	0.077	229	0.05013
MW199	6074-94	0.014	231	0.05049
MW199	5260-94	0 092	233	0.05085
MW199	5170-93	0.086	233	0 05085
MW150	4789-94	0 111	358	0.07335
MW150	5321-96	0.02	370	0.07551
MW150	5650-93	0.142	380	0 07731
MW150	5468-95	0.02	385	0.07821



Regression Statistics

Multiple R	0.199741
R Square	0.039896
Adjusted R Square	0.013946
Standard Error	0.067933
Observations	39

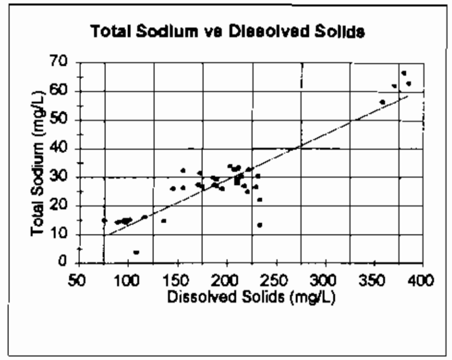
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0.007095457	0.0071	1.53750290946946	0.2227964
Residual	37	0.170752133	0 0046		
Total	38	0.17784759			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0.008911	0.029893054	0.2981	0.76725414684904	-0.0516561	0 06946
x1	0.000176	0.000143183	1.24	0.22259246785761	-0 0001126	0.000468

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Sodium	Dissolved	Y-Hat
MW103	5265-96	15	75	9.31728
MW103	6774-94	14.3	89	11.5526
MW103	4272-94	14.68	94	12.3512
MW103	5440-95	15.2	96	12.6706
MW103	7299-93	14.2	97	12.8302
MW103	5187-94	15.2	101	13.469
MW103	5944-93	3.71	108	14.5867
MW103	5178-93	16.12	116	15.8642
MW103	6026-94	14.8	136	19.0578
MW106	5444-95	26.1	145	20.4949
MW106	4697-94	26.4	155	22.0917
MW142	5464-95	32.4	155	22.0917
MW106	5322-93	27.5	171	24.6466
MW142	6084-93	31.54	173	24.9659
MW199	4512-94	26.8	175	25.2853
MW141	6080-93	26.93	186	27.0418
MW141	5199-94	27.4	187	27.2014
MW141	6054-94	27 1	189	27.5208
MW141	4229-94	29.2	189	27.5208
MW141	7085-93	26	195	28 4789
MW142	6058-94	33 85	203	29 7563
MW142	4233-94	32 6	207	30 395
MW142	5203-94	29.3	710	30 8741
MW141	6868-94	26	210	30 8741
MW142	6872-94	33	210	30.8741
MW199	7311-93	27 8	210	30.8741
MW142	5317-96	33 6	211	31 0339
MW142	7069-93	30 4	214	31 5128
MW141	6092-93	27	217	31 9918
MW199	6868-94	25	220	32 4706
MW142	6098-93	32 7	221	32 6306
MW199	5984-93	26 8	229	33.906
MW199	6074-94	30 4	231	34 2274
MW199	5260-94	22.1	233	34 5467
MW199	5170-93	13.31	233	34 5467
MW150	4769-94	56 3	356	54.5067
MW150	5321-96	62 2	370	56 4229
MW150	5650-93	66.6	380	58 0197
MW150	5468-95	63	386	58.6181



Regression Statistics

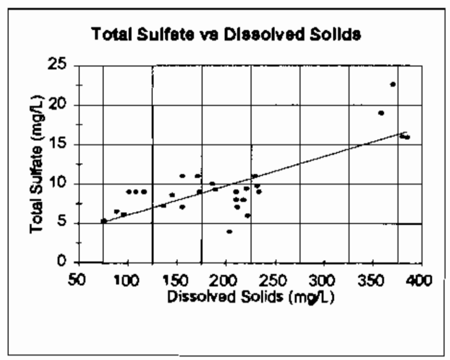
Multiple R	0.899325
R Square	0.808765
Adjusted R Square	0.803617
Standard Error	6.056078
Observations	39

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	5739.787407	5739 8	156.499490458139	7.354E-15
Residual	37	1357 01466	36.676		
Total	38	7096.802267			

	Coefficien	Standard Error	t Statist	P-value	Lower 95 0	Upper 95.00
Intercept	-2.65572	2.66489139	-0.998	0.32474364964446	-8.058302	2.740864
x1	0.159682	0.012764392	12.51	4 7888667855E-15	0.1338191	0.165545

STATION ID	SAMPLE ID	Sulfate	Omsolved	Y-Hat
MW103	5265-96	5 4	75	5 14376
MW103	6774-94	6.5	69	5 86372
MW103	5440-95	6 1	96	5.9237
MW103	5187-94	9	101	6 1094
MW103	5944-93	9	108	6.36936
MW103	5178-93	9	116	6 6665
MW103	6026-94	7.2	136	7.4093
MW106	5444-95	8.6	145	7.74356
MW106	4697-94	11	156	8.11496
MW142	5464-95	7.1	155	8.11496
MW106	5322-93	11	171	8.7092
MW142	6084-93	9	173	8.78348
MW141	6080-93	10	186	9.2663
MW141	6054-94	9.3	189	9.37772
MW142	6058-94	4	203	9.89768
MW141	6868-94	9	210	10.1577
MW142	6872-94	8	210	10.1577
MW142	5317-96	7.1	211	10.1948
MW141	6092-93	8	217	10.4176
MW199	6868-94	9.4	220	10.5291
MW142	6098-93	6	221	10.5662
MW199	5984-93	11	229	10.8633
MW199	6074-94	9.6	231	10.9376
MW199	5170-93	9	233	11.0119
MW150	4769-94	19	356	15.6544
MW150	5321-96	22.6	370	16.1001
MW150	5650-93	16	380	16.4715
MW150	5468-95	15.9	385	16.6572



Regression Statistics

Multiple R	0.783319
R Square	0.613589
Adjusted R Square	0.598727
Standard Error	2.59742
Observations	28

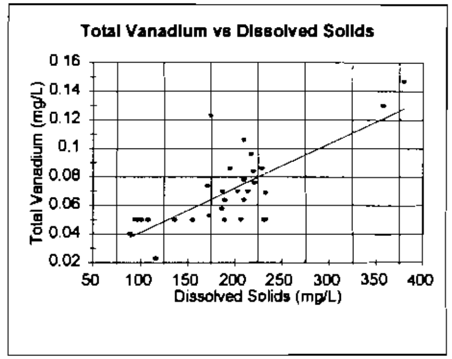
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	278 5365852	278.54	41 2858149636649	8 292E-07
Residual	26	175 4114148	6 7466		
Total	27	453.95			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	2.358264	1.250740731	1 8855	0 07018852567078	-0.2126701	4.929199
x1	0.037138	0.005779829	6.4254	8.9522267125E-07	0 0252571	0 049018

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Vanadium	Dissolved	Y-Hat
MW103	6774-94	0.04	89	0.03763
MW103	4272-94	0 05	94	0 03918
MW103	7299-93	0 05	97	0.04011
MW103	5187-94	0.05	101	0 04135
MW103	5944-93	0 05	108	0.04352
MW103	5178-93	0.023	116	0.046
MW103	6026-94	0.05	136	0.0522
MW108	4697-94	0.05	155	0.05809
MW108	5322-93	0.074	171	0.06305
MW142	6084-93	0.053	173	0 06367
MW199	4312-94	0.123	175	0 06429
MW141	6080-93	0 058	186	0 0677
MW141	5199-94	0 07	187	0 06801
MW141	4228-94	0 05	189	0.06863
MW141	6054-94	0 064	189	0 06863
MW141	7085-93	0 066	195	0 07049
MW142	6056-94	0 07	203	0 07287
MW142	4233-94	0 05	207	0.07421
MW142	5203-94	0 064	210	0 07514
MW141	6886-94	0.078	210	0.07514
MW199	7311-93	0 108	210	0 07514
MW142	6872-94	0 079	210	0.07514
MW142	7089-93	0 07	214	0 07638
MW141	6082-93	0 098	217	0 07731
MW199	6888-94	0.084	220	0 07824
MW142	6096-93	0 076	221	0.07855
MW199	5984-93	0.088	229	0 08103
MW199	6074-94	0 05	231	0 08165
MW199	5280-94	0 089	233	0.08227
MW199	5170-93	0 05	233	0 08227
MW150	4780-94	0.13	358	0.12102
MW150	6650-93	0.147	380	0.12784



Regression Statistics

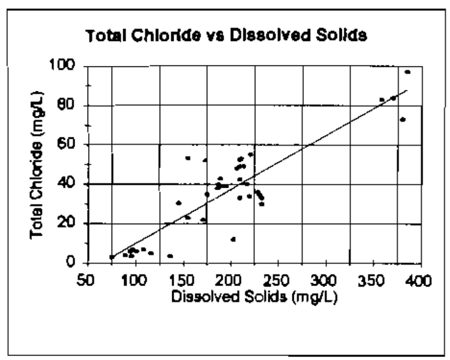
Multiple R	0 745907
R Square	0.556377
Adjusted R Square	0 54159
Standard Error	0.018373
Observations	32

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	0.012701461	0.0127	37 6249896306894	9 595E-07
Residual	30	0.010127414	0.0003		
Total	31	0.022828875			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95 00
Intercept	0.010042	0.010329266	0.9722	0.33846135887401	-0 0110527	0 031138
x1	0 000313	5.10445E-05	6.1339	8.3872320043E-07	0 0002089	0 000417

STATION ID	SAMPLE ID	Chloride	Dissolved	Y-Hat
MW103	5285-98	3.1	75	3.07295
MW103	6774-94	3.9	89	6.91189
MW103	4272-94	6	94	8.28294
MW103	5440-95	3.5	96	8.83136
MW103	7299-93	7	97	9.10557
MW103	5187-94	8	101	10.2024
MW103	5944-93	7	108	12.1219
MW103	5179-93	5	116	14.3156
MW103	6026-94	3.4	136	19.7996
MW108	5444-95	30.5	145	22.2677
MW108	4697-94	23	155	25.0098
MW142	5484-95	53.2	155	25.0098
MW108	5322-93	22	171	29.3971
MW142	6084-93	52	173	29.9455
MW199	4312-94	35	175	30.494
MW141	6080-93	38	186	33.5103
MW141	5199-94	40	187	33.7845
MW141	6054-94	42.9	189	34.3329
MW141	4229-94	39	189	34 3329
MW141	7089-93	39	195	35.9782
MW142	6059-94	12	203	38 1718
MW142	4233-94	48	207	39.2687
MW142	5203-94	49	210	40 0813
MW141	6889-94	42.4	210	40 0813
MW142	6872-94	52 4	210	40 0813
MW199	T311-93	33	210	40 0813
MW142	5317-98	52.9	211	40 3555
MW142	T089-93	49	214	41 1681
MW141	6082-93	40	217	42.0108
MW199	6888-94	33 6	220	42 8334
MW142	6096-93	55	221	43.1076
MW199	5984-93	36	229	45 3013
MW199	6074-94	34 5	231	45.8497
MW199	5280-94	33	223	46 3981
MW199	5170-93	30	233	46.3981
MW150	4789-94	83	358	80 6744
MW150	5321-98	83 8	370	83.9649
MW150	5650-93	73	380	86 707
MW150	5468-95	97 1	385	88.0781



Regression Statistics

Multiple R	0 889446
R Square	0 791114
Adjusted R Square	0 785469
Standard Error	10 99034
Observations	39

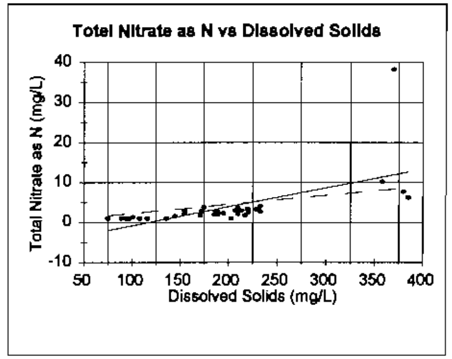
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	16925 94373	16926	140 129870371986	3.813E-14
Residual	37	4469 139351	120.79		
Total	38	21395 08308			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95 00
Intercept	-17.4928	4.836143292	-3.617	0.00088335759874	-27 291713	-7 6938
x1	0.274211	0.023164332	11.838	2.57209076809E-14	0 2272738	0 321147

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Nitrate as	Dissolved	Y-Hat	Y-Hat 2
MW103	5285-96	1	75	-2.0135	1.6905
MW103	6774-94	1	89	-1.3501	2.00606
MW103	4272-94	1	94	-1.1132	2.11876
MW103	5440-95	1	96	-1.0185	2.16384
MW103	7299-93	1	97	-0.9711	2.18638
MW103	5187-94	1.4	101	-0.7816	2.27684
MW103	5944-93	1	108	-0.4499	2.43432
MW103	5178-93	1	116	-0.0709	2.61464
MW103	6026-94	1	136	0.87672	3.06544
MW106	5444-95	1.6	145	1.30314	3.2683
MW142	5464-95	2.9	155	1.77694	3.4937
MW106	4697-94	2.2	155	1.77694	3.4937
MW106	5322-93	1.8	171	2.53502	3.85434
MW142	6084-93	2.9	173	2.62978	3.89942
MW199	4312-94	3.8	175	2.72454	3.9445
MW141	6080-93	2	186	3.24572	4.19244
MW141	5199-94	2.7	187	3.2931	4.21498
MW141	6054-94	2	189	3.38786	4.26006
MW141	4229-94	2.6	189	3.38786	4.26006
MW141	7065-93	2.3	195	3.67214	4.3953
MW142	6058-94	1	203	4.05118	4.57562
MW142	4233-94	3	207	4.2407	4.66578
MW142	5203-94	3.5	210	4.38284	4.7334
MW141	6868-94	2.1	210	4.38284	4.7334
MW199	7311-93	3.7	210	4.38284	4.7334
MW142	6872-94	3	210	4.38284	4.7334
MW142	5317-96	3	211	4.43022	4.75594
MW142	7069-93	3	214	4.57236	4.82356
MW141	6092-93	1.7	217	4.7145	4.89118
MW199	6888-94	3.4	220	4.85664	4.9588
MW142	6096-93	2.6	221	4.90402	4.98134
MW199	5984-93	3.3	229	5.28306	5.16168
MW199	5074-94	3.4	231	5.37782	5.20674
MW199	5170-93	2.7	233	5.47258	5.25182
MW199	5260-94	4.1	233	5.47258	5.25182
MW150	4789-94	10.2	358	11.3951	8.06932
MW150	5321-96	38.3	370	11.9636	8.3398
MW150	5650-93	7.7	380	12.4374	8.5652
MW150	5468-95	6.3	385	12.6743	8.6779



Regression Statistics

Multiple R	0.608248
R Square	0.369966
Adjusted R Square	0.352938
Standard Error	4.822417
Observations	39

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	505.2757445	505.28	21.7269564380873	3.997E-05
Residual	37	860.4611786	23.256		
Total	38	1365.736923			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	-5.56696	2.122036514	-2.623	0.01246269449679	-9.8666165	-1.26731
x1	0.047378	0.010164206	4.6612	3.8027148148E-05	0.0267829	0.067972

Regression Statistics

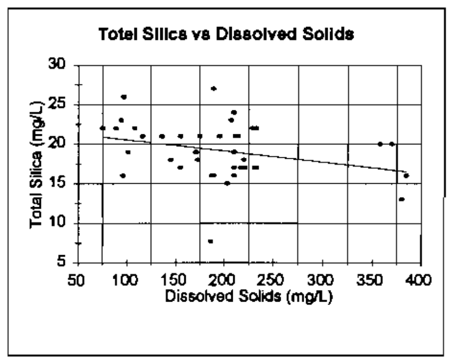
Multiple R	0.502767
R Square	0.252775
Adjusted R Square	0.233111
Standard Error	5.182239
Observations	39

Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	345.2238937	345.22	12.8548167253195	0.0009454
Residual	38	1020.513029	26.856		
Total	39	1365.736923			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	0	0	0	0	0	0
x1	0.022541	0.003974713	5.6711	1.4627037182E-06	0.0144945	0.030587

STATION ID	SAMPLE ID	Silica	Dissolved	Y-Hat
MW103	5285-96	22	75	20.8872
MW103	6774-94	22	89	20.6891
MW103	4272-94	23	94	20.6183
MW103	5440-95	16	96	20.59
MW103	7299-93	26	97	20.5759
MW103	5187-94	19	101	20.5193
MW103	5944-93	22	108	20.4202
MW103	5178-93	21	116	20.307
MW103	6026-94	21	136	20.024
MW106	5444-95	18	145	19.8967
MW142	5464-95	17	155	19.7552
MW106	4697-94	21	155	19.7552
MW106	5322-93	19	171	19.5288
MW142	6084-93	18	173	19.5005
MW199	4312-94	21	175	19.4722
MW141	6080-93	7.68	186	19.3165
MW141	5199-94	16	187	19.3024
MW141	6054-94	16	189	19.2741
MW141	4229-94	27	189	19.2741
MW141	7065-93	21	195	19.1892
MW142	6058-94	15	203	19.076
MW142	4233-94	23	207	19.0194
MW142	5203-94	17	210	18.9769
MW141	6868-94	19	210	18.9769
MW199	7311-93	24	210	18.9769
MW142	6672-94	16	210	18.9769
MW142	5317-96	21	211	18.9628
MW142	7069-93	21	214	18.9203
MW141	6092-93	17	217	18.8779
MW199	6868-94	16	220	18.8354
MW142	6096-93	17	221	18.8213
MW199	5984-93	22	229	18.7081
MW199	5074-94	17	231	18.6798
MW199	5170-93	22	233	18.6515
MW199	5260-94	17	233	18.6515
MW150	4789-94	20	358	16.8827
MW150	5321-96	20	370	16.7129
MW150	5650-93	13	380	16.5714
MW150	5468-95	16	385	16.5007



Regression Statistics

Multiple R	0.301535
R Square	0.090923
Adjusted R Square	0.066353
Standard Error	3.489621
Observations	39

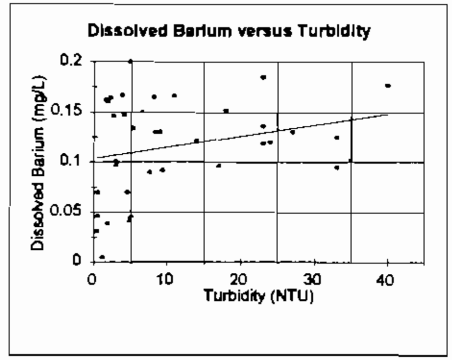
Analysis of Variance

	df	Sum of Squar	Mean S	F	Significance F
Regression	1	45.06424082	45.064	3.7006291614531	0.0621113
Residual	37	450.5657899	12.177		
Total	38	495.6300308			

	Coefficien	Standard Error	t Statist	P-value	Lower 95.0	Upper 95.00
Intercept	21.94835	1.535558333	14.293	7.1991024253E-17	18.837016	25.05969
x1	-0.01415	0.007355072	-1.924	0.06190691658534	-0.0290516	0.000754

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Barium, Dissolved	Turbidity	Y-Hat
MW103	6026-94	0.031	0.35	0.1040885
MW103	6774-94	0.07	0.42	0.1041662
MW103	5187-94	0.046	0.43	0.1041773
MW103	5944-93	0.005	1.1	0.104821
MW142	4233-94	0.162	1.6	0.105476
MW142	6872-94	0.16	1.8	0.105696
MW103	7299-93	0.039	1.8	0.105698
MW142	6098-93	0.164	2.2	0.106142
MW142	5203-94	0.148	2.6	0.106586
MW141	6054-94	0.101	2.8	0.106919
MW141	6868-94	0.097	3	0.10703
MW142	5464-95	0.167	3.8	0.107916
MW142	5317-96	0 147	4	0.10814
MW103	5440-95	0.07	4.5	0.108695
MW103	4272-94	0.041	4.8	0.109028
MW103	5178-93	0.045	5	0.10925
MW150	5468-95	0.2	5	0.10925
MW106	4697-94	0 134	5.3	0.109583
MW142	7089-93	0.15	6 6	0.111026
MW141	5199-94	0.09	7.8	0.112136
MW150	5321-96	0 165	8 2	0 112802
MW199	4312-94	0 13	8 3	0 112913
MW106	7272-94	0 13	9	0.11369
MW141	7085-93	0.062	9 3	0 114023
MW142	6058-94	0.166	11	0 11591
MW199	6074-94	0 121	14	0 11924
MW141	4229-94	0.098	17	0 12257
MW142	6084-93	0.152	18	0.12368
MW106	5444-95	0 136	23	0.12923
MW150	4789-94	0.185	23	0.12923
MW199	5260-94	0 119	23	0.12923
MW199	6888-94	0 12	24	0.13034
MW199	5984-93	0.13	27	0.13367
MW199	7311-93	0 125	33	0.14033
MW141	6080-93	0.095	33	0.14033
MW141	6092-93	0.102	35	0.14255
MW150	5650-93	0.177	40	0.1481
	Delete value with turbidity of 200 NTU and 172 NTU			
MW199	5170-93	0 087	172	
MW106	5322-93	0 143	200	



Regression Statistics

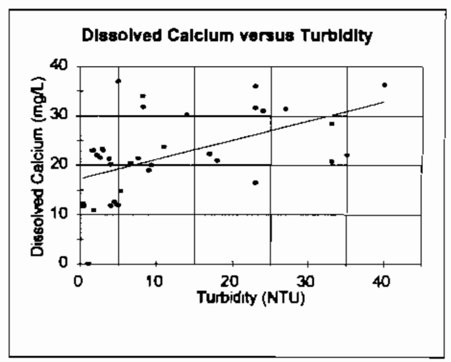
Multiple R	0.26285
R Square	0.06909
Adjusted R Square	0.04249
Standard Error	0.04707
Observations	37

Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	0.005755	0 005755	2.597702	0.1160013
Residual	35	0.07754	0 002215		
Total	36	0.083295			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95.
Intercept	0.10372	0.011028	9.406839	3.1E-11	0.0813351	0 126103
x1	0.00111	0.000691	1.611739	0 115753	-0.0002691	0.002516

STATION ID	SAMPLE ID	Calcium, Dissolved	Turbidity	Y-Hat
MW103	6026-94	12 2	0 35	17.415136
MW103	6774-94	11 7	0.42	17.4423632
MW103	5187-94	11 6	0 43	17.4462528
MW103	5944-93	0.026	1.1	17.706856
MW142	4233-94	22.9	1 6	17.901336
MW103	7299-93	10.6	1.8	17.979128
MW142	6872-94	23	1 8	17.979128
MW142	6096-93	22	2 2	18.134712
MW142	5203-94	21.5	2.6	18.290296
MW141	6054-94	23.27	2.9	18.406984
MW141	6868-94	23	3	18.44568
MW142	5464-95	21.3	3.8	18 757046
MW142	5317-96	20.2	4	18.83464
MW103	5285-96	11.8	4	18.83464
MW103	5440-95	12.6	4.5	19.02932
MW103	4272-94	12	4 8	19.146008
MW103	5178-93	11.91	5	19.2238
MW150	5468-95	37	5	19.2238
MW106	4697-94	14.8	5 3	19.340488
MW142	7089-93	20.4	6.6	19.846136
MW141	5199-94	21.4	7 6	20.235096
MW150	5321-96	34	8.2	20.469472
MW199	4312-94	31.8	8.3	20.507368
MW106	7272-94	19	9	20 77984
MW141	7085-93	20	9 3	20 896328
MW142	6058-94	23.72	11	21 55756
MW199	6074-94	30 2	14	22 72444
MW141	4229-94	22.3	17	23 89132
MW142	6084-93	20.93	18	24 28028
MW150	4789-94	36	23	26 22508
MW106	5444-95	16.5	23	26 22508
MW199	5260-94	31.6	23	26 22508
MW199	6888-94	31	24	26 61404
MW199	5984-93	31 4	27	27 78092
MW141	6080-93	20.7	33	30 11468
MW199	7311-93	26.4	33	30 11468
MW141	6092-93	22.1	35	30 8926
MW150	5650-93	36.3	40	32.8374
	Delete value with turbidity of 200 NTU and 172 NTU			
MW199	5170-93	15.96	172	
MW106	5322-93	15.1	200	



Regression Statistics

Multiple R	0.51795
R Square	0 26827
Adjusted R Square	0 24795
Standard Error	7 33448
Observations	38

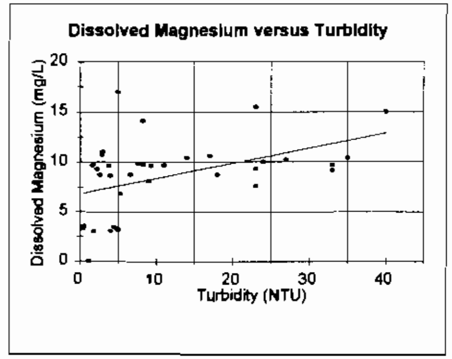
Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	710.0195	710 0195	13 19867	0.0008663
Residual	36	1936.612	53 79478		
Total	37	2646.632			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95.
Intercept	17 2791	1 68723	10 24106	2.39E-12	13.857204	20.70093
x1	0.38896	0 107063	3 632997	0.000845	0.171825	0.606091

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Magnesium, Dissolve	Turbidity	Y-Hat
MW103	6026-94	3.46	0.35	6.8868925
MW103	6774-94	3.34	0.42	6.897459
MW103	5187-94	3.51	0.43	6.8989885
MW103	5944-93	0.008	1.1	7.000105
MW142	4233-94	8.63	1.6	7.07558
MW142	6872-94	8.8	1.8	7.10577
MW103	7299-93	3.01	1.8	7.10577
MW142	6096-93	8.29	2.2	7.16815
MW142	5203-94	8.69	2.6	7.22853
MW141	6054-94	10.73	2.9	7.271815
MW141	6868-94	11	3	7.28881
MW142	5464-95	9.59	3.8	7.40767
MW142	5317-96	8.6	4	7.43788
MW103	5285-98	3.07	4	7.43788
MW103	5440-95	3.48	4.5	7.513335
MW103	4272-94	3.33	4.8	7.55862
MW150	5488-95	17	5	7.58881
MW103	5178-93	3.22	5	7.58881
MW106	4697-94	8.82	5.3	7.634095
MW142	7088-93	8.72	6.6	7.83033
MW141	5199-94	9.8	7.6	7.98128
MW160	5321-98	14.1	8.2	8.07185
MW199	4312-94	9.74	8.3	8.086945
MW106	7272-94	8.08	9	8.19261
MW141	7085-93	9.6	9.3	8.237895
MW142	6058-94	9.66	11	8.49451
MW199	6074-94	10.4	14	8.94736
MW141	4229-94	10.6	17	9.40021
MW142	6084-93	8.7	18	9.55118
MW199	5260-94	8.31	23	10.30591
MW150	4789-94	15.5	23	10.30591
MW106	5444-95	7.56	23	10.30591
MW199	6868-94	10	24	10.45686
MW198	5964-93	10.2	27	10.90971
MW141	6080-93	9.67	33	11.81541
MW199	7311-93	9.15	33	11.81541
MW141	6092-93	10.4	35	12.11731
MW150	5650-93	15	40	12.87206
	Delete value with turbidity of 172 NTU			
MW199	5170-93	4.78	172	



Regression Statistics

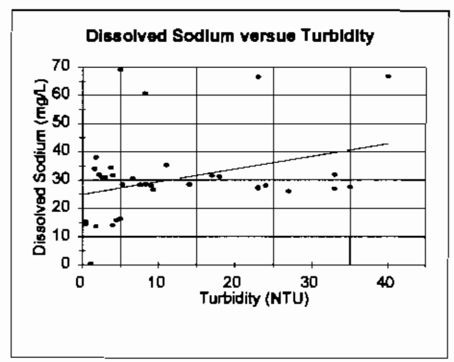
Multiple R	0.44991
R Square	0.20242
Adjusted R Square	0.18027
Standard Error	3.42118
Observations	38

Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	106.9396	106.9396	9.136856	0.0045954
Residual	36	421.3605	11.70446		
Total	37	528.3001			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95.
Intercept	6.83406	0.787008	8.683578	1.98E-10	5.2378283	8.430184
x1	0.15095	0.049939	3.02269	0.00453	0.0498695	0.252233

STATION ID	SAMPLE ID	Sodium, Dissolved	Turbidity	Y-Hat
MW103	6026-94	14.7	0.35	25.101705
MW103	6774-94	14.4	0.42	25.132446
MW103	5187-94	15.2	0.43	25.136909
MW103	5944-93	0.317	1.1	25.43593
MW142	4233-94	34	1.6	25.65908
MW103	7299-93	13.7	1.8	25.74834
MW142	6872-94	38	1.8	25.74834
MW142	6096-93	32	2.2	25.92686
MW142	5203-94	30.9	2.6	26.10538
MW141	6054-94	30.56	2.9	26.23927
MW141	6868-94	31	3	26.2839
MW142	5464-95	34.3	3.8	26.64094
MW142	5317-96	31.6	4	26.7302
MW103	5285-98	14	4	26.7302
MW103	5440-95	15.7	4.5	26.95335
MW103	4272-94	16.2	4.8	27.08724
MW103	5178-93	16.2	5	27.1765
MW150	5488-95	69	5	27.1765
MW106	4697-94	28.4	5.3	27.31039
MW142	7088-93	30.4	6.6	27.89058
MW141	5199-94	28.3	7.6	28.33688
MW150	5321-98	60.8	8.2	28.60466
MW199	4312-94	28.5	8.3	28.64929
MW106	7272-94	28	9	28.9817
MW141	7085-93	28.6	9.3	29.09559
MW142	6058-94	35.36	11	29.8543
MW199	6074-94	28.4	14	31.1932
MW141	4229-94	31.5	17	32.5321
MW142	6084-93	31.14	18	32.9784
MW160	4789-94	66.4	23	36.2099
MW106	5444-95	27.4	23	35.2099
MW199	5260-94	27	23	35.2099
MW199	6868-94	28	24	35.6562
MW199	5964-93	28	27	36.9951
MW141	6080-93	31.64	33	39.6729
MW198	7311-93	28.6	33	39.6729
MW141	6092-93	27.5	35	40.5655
MW150	5650-93	66.7	40	42.797
	Delete value with turbidity of 172 NTU			
MW199	5170-93	13.9	172	
MW106	5322-93	26.8	200	



Regression Statistics

Multiple R	0.33983
R Square	0.11549
Adjusted R Square	0.09092
Standard Error	14.0497
Observations	38

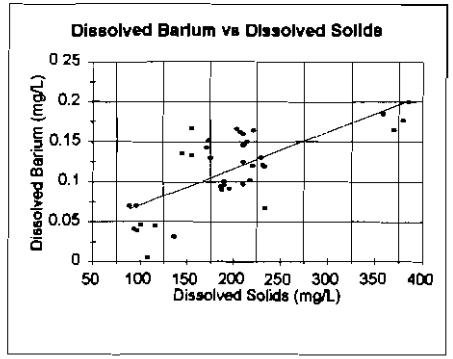
Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	927.8233	927.8233	4.70037	0.0368451
Residual	36	7106.172	197.3937		
Total	37	8033.995			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95.
Intercept	24.9454	3.231996	7.718275	3.2E-09	18.390843	31.50023
x1	0.44463	0.205085	2.168034	0.03666	0.0288995	0.860563

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Barium, Dissolved	Dissolved Solids	Y-Hat
MW103	6774-94	0.07	89	0 065511
MW103	4272-94	0.041	94	0 067806
MW103	5440-95	0 07	96	0.068724
MW100	7299-93	0.039	97	0.069183
MW103	5187-94	0.046	101	0.071018
MW103	5944-93	0.005	108	0.074232
MW103	5178-93	0.045	116	0 077904
MW103	6028-94	0.031	136	0.087084
MW108	5444-95	0.136	145	0.091215
MW142	5464-95	0 187	155	0 095805
MW108	4697-94	0 134	155	0.095805
MW106	5322-93	0.143	171	0 103149
MW142	6084-93	0.152	173	0 104067
MW199	4312-94	0.13	175	0.104985
MW141	6080-93	0 095	186	0.110034
MW141	5199-94	0.09	187	0.110493
MW141	6054-94	0.101	189	0.111411
MW141	4229-94	0.098	189	0.111411
MW141	7085-93	0.092	195	0.114165
MW142	6058-94	0.156	203	0.117837
MW142	4233-94	0.162	207	0.119673
MW142	6203-94	0.148	210	0 12105
MW141	6868-94	0.097	210	0 12105
MW199	7311-93	0.125	210	0 12106
MW142	6872-94	0.16	210	0 12106
MW142	5317-96	0.147	211	0 121509
MW142	7069-93	0.15	214	0.122886
MW141	6092-93	0.102	217	0.124263
MW199	6886-94	0.12	220	0.12564
MW142	6098-93	0.184	221	0.126099
MW199	5984-93	0.13	229	0.129771
MW199	6074-94	0 121	231	0.130689
MW199	5170-93	0 087	233	0.131607
MW199	5260-94	0.119	233	0.131607
MW150	4769-94	0.185	358	0 188962
MW150	5321-96	0.165	370	0.19449
MW150	5650-93	0.177	380	0 19908
MW150	5488-95	0.2	385	0 201375



Regression Statistics

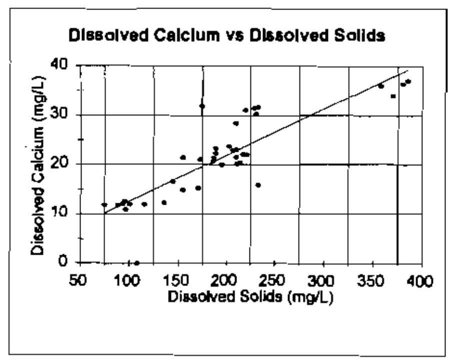
Multiple R	0.7176
R Square	0 51495
Adjusted R Square	0 50147
Standard Error	0 03408
Observations	38

Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	0.044399	0 044399	38.21886	3.971E-07
Residual	36	0.041822	0 001162		
Total	37	0.086221			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95.
Intercept	0.02466	0.015688	1 571817	0.124508	-0.0071581	0 058476
x1	0.00046	7.43E-05	6 16214	3.56E-07	0.0003086	0 00061

STATION ID	SAMPLE ID	Calcium, Dissolved	Dissolved Solids	Y-Hat
MW103	5285-96	11.6	75	10.16295
MW103	6774-94	11.7	89	11.494834
MW103	4272-94	12	94	11.963364
MW103	5440-95	12 6	96	12.150776
MW103	7299-93	10.9	97	12.244482
MW103	5187-94	11.8	101	12.619306
MW103	5944-93	0.028	106	13.275248
MW103	5178-93	11.91	116	14.024896
MW103	6028-94	12 2	136	15.899016
MW108	5444-95	18.5	145	16 74237
MW142	5464-95	21.3	155	17.67943
MW106	4697-94	14 6	155	17 67943
MW106	5322-93	15.1	171	19.178728
MW142	6084-93	20.93	173	19.366138
MW199	4312-94	31.8	175	19 55355
MW141	6080-93	20 7	186	20.584318
MW141	5199-94	21.4	187	20.678022
MW141	6054-94	23.27	189	20.865434
MW141	4229-94	22.3	189	20.865434
MW141	7085-93	20	195	21.42767
MW142	6058-94	23.72	203	22.177318
MW142	4233-94	22.9	207	22.552142
MW142	5203-94	21 5	210	22.83326
MW141	6886-94	23	210	22.83326
MW199	7311-93	28 4	210	22.83326
MW142	6872-94	23	210	22.83326
MW142	5317-96	20 7	211	22.926966
MW142	7069-93	20 4	214	23.208084
MW141	6092-93	22 1	217	23 489202
MW199	6886-94	31	220	23.77032
MW142	6098-93	22	221	23.864026
MW199	5984-93	31 4	229	24.613674
MW199	6074-94	30.2	231	24.801086
MW199	5170-93	15.89	233	24.988498
MW199	5260-94	31.6	233	24.988498
MW150	4788-94	36	358	36.701748
MW150	5321-96	34	370	37.82622
MW150	5650-93	38.3	380	38.76328
MW150	5468-95	37	385	39.23181



Regression Statistics

Multiple R	0.85354
R Square	0 72853
Adjusted R Square	0.72119
Standard Error	4 46171
Observations	39

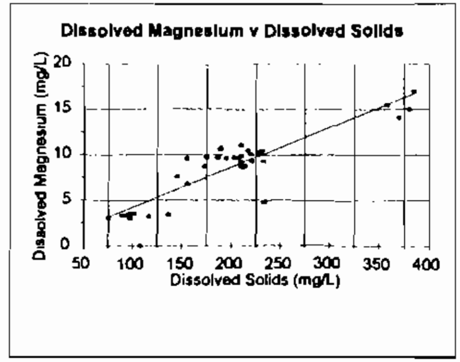
Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	1976.606	1976.606	99 29272	5.054E-12
Residual	37	736.5537	19.90686		
Total	38	2713.16			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95
Intercept	3.15506	1.963312	1 607011	0.116331	-0.822985	7.133113
x1	0.09371	0 009404	9.964573	3 77E-12	0.0746521	0.11276

Summary of Results of Regression and Correlation Analyses - RGA Samples

STATION ID	SAMPLE ID	Magnesium, Dissolve	Disolved Solids	Y-Hat
MW103	5265-98	3 07	75	3 18012
MW103	6774-94	3 34	89	3 79262
MW103	4272-94	3 33	94	4 01137
MW103	5440-95	3 48	96	4 09887
MW103	7299-93	3 01	97	4.14262
MW103	5187-94	3 51	101	4 31762
MW103	5944-93	0 008	108	4 62387
MW103	5176-93	3 22	118	4 97387
MW103	6026-94	3 46	138	5 84887
MW106	5444-95	7 58	145	6.24262
MW106	4697-94	6.82	155	6 68012
MW142	5464-95	8.58	155	6 68012
MW142	6084-93	8.7	173	7 46762
MW199	4312-94	8.74	175	7.55512
MW141	6080-93	8.67	186	8 03637
MW141	5199-94	9 8	187	8.08012
MW141	6054-94	10 73	189	8 16762
MW141	4229-94	10 6	189	8 16762
MW141	7085-93	9 8	195	8 43012
MW142	6058-94	9 88	203	8 78012
MW142	4233-94	9 63	207	8 95517
MW142	5203-94	8 89	210	9 08637
MW141	6868-94	11	210	9 08637
MW199	7311-93	9 15	210	9 08637
MW142	6872-94	9 8	210	9 08637
MW142	5317-98	8 6	211	9 13012
MW142	7089-93	8 72	214	9 26137
MW141	6092-93	10 4	217	9 39262
MW199	6868-94	10	220	9 52387
MW142	6096-93	9 29	221	9 56762
MW199	5984-93	10 2	229	9 91762
MW199	6074-94	10 4	231	10 00512
MW199	5170-93	4 78	233	10 09262
MW199	5260-94	9 31	233	10 09262
MW150	4789-94	15 5	358	15 56137
MW150	5321-98	14 1	370	16 08637
MW150	5650-93	15	380	16.52387
MW150	5468-95	17	385	16 74262



Regression Statistics

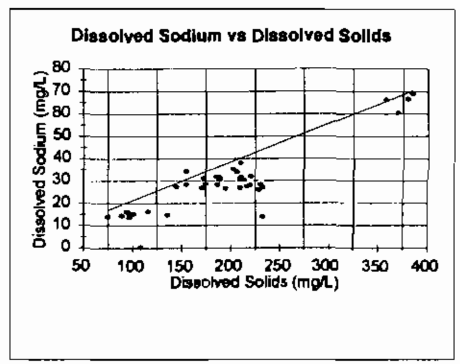
Multiple R	0 89067
R Square	0.79328
Adjusted R Square	0.78755
Standard Error	1 76382
Observations	38

Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	429.8137	429.8137	138.156	6.993E-14
Residual	36	111 9987	3.111074		
Total	37	541.8124			

	Coefficie	Standard	t Statistic	P-value	Lower 95.00	Upper 95
Intercept	-0.1011	0.78048	-0.12958	0.897603	-1 6840182	1 481754
x1	0 04375	0.003722	11 75398	4 7E-14	0 0362025	0 051301

STATION ID	SAMPLE ID	Sodium, Dissolved	Dissolved Solids	Y-Hat
MW103	5265-98	14	75	16 9315
MW103	6774-94	14 4	89	19.5423
MW103	4272-94	16 2	94	20.2033
MW103	5440-95	15 7	96	20 5477
MW103	7299-93	13 7	97	20 7199
MW103	5187-94	15 2	101	21.4087
MW103	5944-93	0 317	108	22 6141
MW103	5176-93	16 2	116	23 9917
MW103	6026-94	14 7	136	27 4357
MW106	5444-95	27.4	145	28 9655
MW142	5464-95	34 3	156	30 7075
MW106	4697-94	28 4	155	30 7075
MW106	5322-93	26 8	171	33 4627
MW142	6084-93	31.14	173	33 8071
MW199	4312-94	26.5	175	34.1515
MW141	6080-93	31.84	186	36 0457
MW141	5199-94	28.3	187	36.2179
MW141	6054-94	30.56	189	36.8623
MW141	4229-94	31.5	189	36 5623
MW141	7085-93	26.6	195	37 5955
MW142	6058-94	35.36	203	38.9731
MW142	4233-94	34	207	39.6619
MW142	5203-94	30 9	210	40 1785
MW141	6868-94	31	210	40.1785
MW199	7311-93	26.9	210	40 1785
MW142	6872-94	36	210	40 1785
MW142	5317-98	31 6	211	40 3507
MW142	7089-93	30.4	214	40 8673
MW141	6092-93	27.5	217	41.3839
MW199	6868-94	28	220	41 9005
MW142	6096-93	32	221	42 0727
MW199	5984-93	26	229	43 4503
MW199	6074-94	28.4	231	43 7947
MW199	5170-93	13 8	233	44 1391
MW199	5260-94	27	233	44 1391
MW150	4789-94	66.4	358	65 6841
MW150	5321-98	60 6	370	67 7305
MW150	5650-93	66 7	380	69 4525
MW150	5468-95	69	385	70 3135



Regression Statistics

Multiple R	0 89745
R Square	0 80541
Adjusted R Square	0 80015
Standard Error	6 60245
Observations	39

Analysis of Variance

	df	Sum of S	Mean Squ	F	Significance F
Regression	1	6675 949	6675 949	153 145	1.018E-14
Residual	37	1612 916	43.59233		
Total	38	8288 866			

	Coefficien	Standard	t Statistic	P-value	Lower 95 00	Upper 95.
Intercept	-4.0165	2.905314	-1.38247	0.174898	-9 9032446	1 870207
x1	0 17221	0 013916	12.37516	6.88E-15	0.1440163	0 200409

GWOUFSD1

Comment Response Summary

for the

Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1857&D1 issued July 2000)

Prepared for
U.S. Department of Energy
Office of Environmental Management

I-04611-0119

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
1.	General	United States Environmental Protection Agency (USEPA): "This Feasibility Study (FS) for the Groundwater Operable Unit (GWOU) is intended to serve as the sole source document for ALL future remedial actions that will address groundwater across the area. This document should be a combination strategic implementation plan and remedial technology list designed to address the contamination found across the complex. At present, it is neither. There is no indication provided as to how the DOE can effectively manage the funding and energies necessary to implement any of the action alternatives. It is also unclear how the DOE will address the groundwater contamination from the outside in, from the fence line in, or from the fence line out, etc. While it could be argued that this strategic approach should be saved for decision documents like the Proposed Plan, it does play a tremendous part in the selection of remedies and the means by which the DOE secures the necessary funding and level of effort necessary to remediate the contaminated groundwater leaving the site. Clearly, some strategy should be presented to the public (in this FS document) which would benefit in making a choice (at the Proposed Plan) in which direction the DOE is headed. DOE should present their ideas about how groundwater should be cleaned up at the site and then present the alternative remedial technologies which will be necessary to accomplish this task. This document is too confusing to help the public make any choice or to allow the public to choose between the many technologies."	Agree. The feasibility study was revised to present an analysis of 11 separate remedial technologies that could be utilized at PGDP. Three of these technologies are analyzed for remediation of Primary Source Areas, three are analyzed for remediation of Secondary Source Areas, and the remaining five are analyzed for remediation of the Dissolved Phase Plume. To allow for a comparative analysis among technologies, the analysis and associated cost estimate for each technology considered for a particular source area assume implementation at the same location. All technologies analyzed for remediation of Primary and Secondary Source Areas assume implementation at the southeast corner of the C-400 Building. All technologies analyzed for remediation of the Dissolved Phase Plume assume implementation for a 600 ft wide plume. It is true the FS does not supply a single strategy. The FS, however, does provide a means to allow the site and the stakeholders to focus their attention on what they think should or should not be done. The proposed remedial action plan, as the commentor recognizes, will more succinctly lay out the work to be completed based on the DOE preferred alternative. At that time, the public will have a clear picture as to what the DOE plans to do and in what sequence the actions will take place. Additional language was included in the Executive Summary to more clearly describe how the alternatives can be considered remedial strategies.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
1. (continued)			The Lifecycle Baseline is used by BJC and DOE to plan a budget request to support the necessary action to be taken once the Record of Decision is signed. The information contained in the FS is used by the site to develop a likely scenario of potential costs for upcoming actions. However, since the site has not pre-selected what the alternative is, assumptions must be made as to what will be acceptable to all stakeholders.
2.	General	EPA: "As part of a strategic planning document, this FS should include some schedule per each alternative which would show when the technology would be implemented and for how long the monitoring period would last. The public might be more willing to accept limited action (and longer term remediation) if a schedule of remedial activities were presented. To simply state that an alternative will take 7,000 years to remediate the groundwater fails to show the activities implemented to achieve this goal."	Disagree. As a result of the realignment of alternatives, the usefulness of the bar chart is no longer applicable. The new alternatives do not indicate the areas to be remediated and how many times they may be applied. To that end, the timelines could not be completed.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
3.	General	EPA: "Although identified early on as a part of the GWOU investigation, no alternative appears to address the upwelling of contamination into Little Bayou Creek. Please identify which technologies will address this problem and prove a map showing the area of the creek and contaminate levels discharge into it. How long will it take to eliminate this ecological problem and is there a simple solution? What about a horizontal PTZ over the area of upwelling?"	Disagree. As a result of the realignment of alternatives in this D2 GWOU FS, areas are not selected for implementation of the individual alternatives. However, it should be noted the alternatives for the Dissolved Phase Plume Area can be protective of the Little Bayou Creek area if the alternative is repeatedly performed to provide continous protection. Each of the alternative evaluations includes analysis of timeframes for returning the groundwater back to use under the "time until remediation is complete" section. We do not believe a horizontal PTZ is appropriate. A vertical PTZ will cut across the formation and will minimize the size of the zone. The time for complete remediation is dependent on which alternative is implemented. This is discussed further in the alternative section Time Until Action is Complete.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
4.	General	EPA: "It appears that a thorough review of technologies potentially applicable to remediation of groundwater contaminants at PGDP has been conducted by the Paducah Project Technical advisory Group (TAG). Details of the technology review efforts are provided in Appendix C 2 of the FS. At least 29 technologies were identified and evaluated for applicability under the existing conditions at PGDP. The TAG review process narrowed the field of technologies to the leading four to five technology candidates. The review process continues with some of these technology candidates in the form of treatability studies to be conducted in the near future. The list of technologies initially evaluated appears quite comprehensive. Furthermore, 'the TAG agreed that the complexity of hydrogeologic and infrastructure issues at the site made it imperative that well understood and readily available technologies would be needed for application at the site, and that varying combinations of technologies would be required to address all remediation issues'(page C2-9). "It seems only natural that some of the technologies would take on predominant roles while others would be only supplementary in nature. However, in narrowing the field to only the leading four to five technology candidates for additional evaluation, there is danger that other technologies not making the initial cut will soon be forgotten and left out of future iterations of the feasibility study process. For instance, it is noted on page C2-21 that 'aquifer leveling may be an appropriate technique to include in an overall site remediation strategy' and that it would continue to	Agree. The Feasibility Study focuses on selected technologies as examples of process options to (1) simplify the discussion of the remediation approach and (2) to establish a basis for a cost estimate to allow comparison. The other technologies remain viable candidates for selection as THE process option, once a remediation strategy is selected. The DOE intends to evaluate all relevant technologies in the selection of remedial measures at the PGDP.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
4. (continued)		be evaluated as a potential cost-effective enhancement to the site remediation strategy. It is clear that aquifer leveling would play at most only a small role in any final remediation plan. What is not clear is whether the evaluation of this potential technology has now been completed because there is no further mention of aquifer leveling anywhere in the main text of the FS document. It is important that aquifer leveling and any other promising technologies initially evaluated by the TAG will not be forgotten simply because they were not included in any of the eight remedial alternatives formally proposed in the FS document."	
5.	General	EPA: "The present worth cost estimates developed for each remedial alternative presented in the FS were prepared for a base maintenance/monitoring period of 30 years. Although the FS states in numerous places that many of the options would have to be carried out for much longer periods of time, the cost estimates were prepared for only a 30-year period to be consistent with EPA guidance according to page 4-7 of the FS. Comparing present worth cost estimates for a standard time period such as 30 years is often performed so that cost of alternative actions can be fairly evaluated on equivalent terms. However, a 30-year time period may not be considered adequate for comparison of alternatives that could potentially be active for hundreds or thousands of years.	As described in the guidance documents for CERCLA Feasibility Studies, 30 yr. Present Worth analysis is used to compare alternatives. However, it is widely known that such comparisons of present worth are not appropriate for large costs over extended periods of time, such as would be implied for some of the alternatives estimated here. Discounting costs over 30 years out diminishes the impact in the PW analysis. Since the federal government does not normally use industrial discounted cash flow analysis or estimate out year expenditures for cost analysis comparisons, they have not been used here aside from those shown.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
5. (continued)		"A good description of present-worth analysis can be found on page 4-7 of the FS. The method can be further utilized to compare a hypothetical alternative, similar in this case to Alternative 8 of the FS, which will be fully completed at the end of 30 years and a second 'worst case' hypothetical alternative that would have to be repeated in it's entirety every 30 years forever. In the case of an action that is complete within 30 years, a present worth estimate prepared for a 30-year period should fully capture all cost for that alternative, discounting all actual costs incurred over the full active period back to present worth at the beginning of the project. In the case of Alternative 8 of the FS, this value is $917,847,000. For the sake of the present comparison, the value of the second 'worst case' hypothetical alternative will be chosen as $172,935,000 (the present worth of the second highest alternative presented in the FS alternative 6). For this alternative, a present worth $172,935,000 at the beginning of the project would be spent over the initial 30-year period. But at the completion of the initial 30-year period in this 'worst case' scenario, the entire $172,935,000 would be needed again to repeat the entire action over again for a second 30-year period. Funding for the second 30-year period could be provided simply by investing an amount in the base year of the project that would generate the second $172,935,000 needed at the completion of the first 30-year period. From present-worth tables, the required amount for investing in the base year of the project is found to be 13.14% of the amount required at the end of the 30-year period (at the assumed 7% discount factor as used in the FS according to EPA protocol, page 4-7 of FS). In other words,	

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
5. (continued)		the alternative with a $172,935,000 present worth price tag could be repeated as second time in its entirety for an additional present worth of only 13.14% or approximately $22,700,000. Of course, this still only provides for the first 60 years of action. Additional money must be set aside similarly at the start of the project to provide funding for the third 30-year period and the fourth period, etc. However, the amounts required to fulfill this funding obligation become discounted to much greater degrees in proportion to the amount of time available for the money to 'grow.' The third 30-year period can be funded with an amount of only 1.7% of the initial amount and the similar value for the fourth 30-year period is only 0.23%. "It can be seen that the amount required for periods even further into the future become trivial in comparison to the amount to fund the initial 30-year period. The total amount required to be invested at the beginning of the project to continue funding subsequent 30-year periods can be found by summing the series of amounts required for the first several periods (i.e. 13.14% + 1.7% + 0.23% + ...). It can be seen that this sum approaches something in the range of 15% to 16% of the original 30-year present worth. For safe measure, the amount could be rounded up to 20% and it can be safely assumed that if an additional 20% of the initial 30-year period present worth were provided at the beginning of the project to be set aside to grow as an investment at a rate equivalent tot the discount rate of 7%, it would provide adequate funding to keep repeating the action every 30 years over and over again indefinitely into the future.	

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
5. (continued)		"To complete our comparison, the value of the $917,847,000 alternative fully completed in the first 30-year period must be compared to the worst case scenario of repeating the $172,935,000 alternative over and over again. The worst case full present worth of the second alternative is $172,935,000 plus 20% or $207,522,000. It is clear that an alternative costing $917 million and completed within a 30-year time frame is much larger than any of the other alternatives presented in this FS even if those other alternatives had to be carried on much longer than the base 30-year period. It should be noted that the cost estimates have an expected accuracy of –30% to +50% consistent with EPA guidance according to page 4-6 of the FS. The additional 20% required to fund any of the alternatives indefinitely into the future falls within the expected accuracy range of the initial cost estimate. It can be concluded that with the expected accuracy of cost estimates in an FS, the cost of any anticipated actions required greater than 30 years in the future are likely to be negligibly small due to the discounting of future cost in a present worth analysis."	

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
6.	General	EPA: "Considering the broad range of general response actions, technology types and process options evaluated in the FS, a large number of permutations of combinations of technologies is possible. The eight remedial alternatives reviewed in the FS appear to provide a reasonable range of the possible combinations and associated costs. Table 2.3 provides a useful summary table for comparing the overall remediation strategies for each of the eight proposed alternatives. The table places components of the remedial alternatives into three main categories. Those categories are: 1) Source reduction; 2) Fence line actions; and 3) Treatment of the dissolved-phase plumes. It seems that a remedial strategy comprehensive enough to deal aggressively with the full range of groundwater problems in a reasonable time period would necessarily include a component within each of these three main categories. Yet, only two of the proposed alternatives, alternatives 6 and 8, include all three of these component types. Although there is nothing wrong with having evaluated alternatives that did not include each of the three component types, it would be prudent to develop additional alternatives that do include each of these components. The present worth cost estimates for Alternatives 6 and 8 are approximately $173 million and $917 million, respectively. It is not difficult to imagine alternatives more aggressive than Alternative 6 and yet less aggressive than Alternative 8 that would include all three types of components and would have present worth values falling somewhere in between."	 Agree. The FS was revised to present an analysis of 11 separate remedial technologies that could be utilized at PGDP. The FS allows for a comparison of these individual technologies so that the most appropriate combination of technologies can be chosen to provide for groundwater remediation at PGDP.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit

at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1857&D1 issued July 2000) (continued)

<table>
<tr><th>Comment Number</th><th>Sect. Page/Para.</th><th>Reviewer and Comment</th><th>Draft Response</th></tr>
<tr><td>7.</td><td>General</td><td>EPA:

"Also, it is apparent throughout the document text that certain technologies are felt to be more promising than others under the conditions at PGDP. Some of the proposed technologies have severe limitations that will be pointed out in following specific comments. It is not apparent that the most promising of the various process options have been combined into a single alternative for evaluation at this time.

"For these reasons, it would be prudent to propose and evaluate additional alternatives that would recombine the most promising of the process options for accomplishing: 1) source reduction; 2) fence line actions; and 3) treatment of dissolved phase plumes. One such alternative might look something like:

<table>
<tr><th>Component</th><th>Specific Process Option</th></tr>
<tr><td>Source Reduction
1. UCRS
2. RGA</td><td>
Excavation/Six-phase heating
Six-phase heating/DUS/HPO</td></tr>
<tr><td>Fence line Action
1. Treatment at Fence</td><td>
PTZ Treatment at fence (similar in scale to Alternative 6)</td></tr>
<tr><td>Dissolved Phase Plumes
1. Areas >100 ppb* TCE</td><td>
Ozonation</td></tr>
</table>
</td><td>See response to Comment #6.</td></tr>
</table>

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
7. (continued)		Other combinations of technologies could also be developed that would strike an overall compromise between current Alternatives 6 and 8. Results of treatability studies would obviously play a major role in final selection of the specific process options. What is most important to emphasize is that a wide range of compromises exists between the currently proposed alternatives that could be accomplished at budgets and within time frames falling somewhere in between those currently proposed. "	
8.	General	EPA: "The document states that not all groundwater issues are being addressed in this FS. These unaddressed issues appear to deal with source areas. Hopefully, an overall strategy for dealing with all groundwater issues is available so that no issues go unresolved or cause additional problems after a remedial activity has taken place. A definition of the GWOU, that lists what is and is not being addressed, would be helpful. It is not clear if the UCRS is included in the GWOU. If it is not, please explain why."	There are areas of groundwater contamination that are being deferred to other operable units. An example of these deferrals is the inclusion of SWMU 4 (which is a major source area for the Southwest Plume) in the Burial Grounds Operable Unit. This is consistent with the ongoing Core Team SWMU binning process. Table ES-1 provides the reader with a summary of the SWMUs with groundwater contamination and provides a crosswalk to the operable unit in which they are being addressed. The UCRS is included in the GWOU. Additional verbiage was included in the Executive Summary to help explain that the UCRS is considered in the GWOU and is being addressed in the technologies analyzed to address the Primary Source Areas.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
9.	ES Remedial Action Objectives; Page ES-11	EPA: "This is where the issue of dissolved phase TCE upwelling into Little Bayou Creek is raised as an issue which needs to be addressed in this FS. However, it is not addressed clearly anywhere within this report. How will the upwelling of contamination be addressed?"	Disagree. The D2 FS has been revised to include 11 technology based alternatives. The Dissolved Phase Plume Area alternatives provide technologies for protecting the Little Bayou Creek area referenced. However, no technology in the FS was chosen to be the alternative to be implemented. The selection will be made as part of the proposed remedial action plan and documented in a record of decision.
10.	ES Alternatives; Page ES-11 – ES-15	EPA: "The focus of all of the technologies is on TCE. The plumes leaving the DOE-PGDP also contains ^{99}Tc and other contaminants. It would appear by reading this section that TCE was the ONLY contaminant of concern for the entire facility. Please add additional contaminants to this section and show how the alternatives address these additional issues."	Disagree. The D2 FS was revised to include trichloroethene, trichloroethene degradation products and technetium 99 as the contaminants of concern. This approach was developed and agreed to by representatives of the DOE, USEPA, and Commonwealth of Kentucky.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
11.	ES Alternative 8; Page ES-15	EPA: "As this FS is designed to be a complete document addressing all of the groundwater issues across the complex it is not appropriate to defer other possible groundwater issues or actions to other 'future' groundwater documents. "Either this document needs to be a comprehensive FS OR it needs to be clearly stated that this FS addresses a portion of the groundwater operable unit and that other documents will be provided for public review and comment when we reach a point in time when the additional documentation is necessary. It should also be clearly pointed out what role these other documents will play in addressing the groundwater operable unit. Groundwater deed restrictions and/or Technical Impractability Waivers place serious restrictions on the use of groundwater by either the DOE or the public surrounding the site. These are very serious issues that need to be better presented within this document especially if they are being deferred to later decisional documents."	The FS identifies in the Executive Summary and the Introduction the SWMUs/areas that the FS is directed toward. The FS is not intended to be completely comprehensive for all groundwater contaminants. Section 1.2.6.3 and the Scope section of the Executive Summary provides a description of the process that was used to identify the major contaminants that are driving the risk. In addition , the Groundwater Core Team binning has modified the SWMUs that will be encompassed by the GWOU. Following completion of this binning process, it will be necessary to either develop additional documentation or modify the FS to be consistent with the determinations made by the Groundwater Core Team. Institutional Controls for groundwater will be addressed in a separate action with its own supporting decision documents.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
12.	Contaminant Fate and Transport Analyses; Page 1-45; Sect. 1.2.5.2	EPA: "The statement is made in the last sentence of the section that 'it may be concluded that there is no potential problem due to volatilization of TCE or vinyl chloride from the PGDP sites.' Clarification is needed for this conclusion because the text leading up to that conclusion does not seem to justify it."	Agree. The passage will be clarified and additional information will be provided as follows. Change from: "Therefore, it may be concluded that there is no potential problem due to volatilization of TCE or vinyl chloride from the PGDP sites." Change to: "Because these results indicated that risks could be present, sampling activities were performed in spring 2000. The results of these studies indicated that exposure to TCE or vinyl chloride volatilizing from source areas or from the contaminant plumes at the PGDP does not present significant risk." (Information concerning this study was added to the uncertainty section of the risk assessment presented in the FS report.) Text was changed in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
13.	Treatment of Dissolved-phase Plumes; Page 2-11; Sect. 2.4.1.3	EPA: "This section makes the erroneous statement that 'Two strategies exist for treatment of dissolved-phase plumes.' The text goes on to explain that the strategies are 1) treating the high concentration plume cores (above 1000 ppb TCE), and 2) treatment of all the plumes above 5 ppb TCE. Concern is expressed in the text regarding the second strategy being cost intensive and requiring access to private property. The FS presents it as if the only options are treating the core above 1000 ppb TCE or the entire plume along with the conclusion that the second option would not be practical. As presented, this section is misleading and almost draws the reader to the conclusion that the only reasonable action regarding plume treatment is to treat the plume cores above 1000 ppb. Certainly other options exist. The size of the plume cores to be treated could be expanded to perhaps 500 or 100 ppb TCE. Any such compromise concentration would be more aggressive than treating only the cores above 1000 ppb but less aggressive and less expensive than treating the entire plume. The options must not be narrowed to only include the two presented levels."	Agree. The D2 FS has been revised to include the evaluation of five technology based alternatives that could be implemented in the Dissolved Phase Plume Area.
14.	Balancing Criteria; Cost; Pages 4-6 & 7; Sect. 4.1.1.2	EPA: "Page 4-6 states that present-worth values are included using a discount factor of 5% while on the following page the discount rate is reported as 7%. Clarification is needed as to which of these values is correct."	Agree. The discount factor used for the cost estimates was 5%. This text was corrected.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
15.	Socioeconomic Impacts; Pages 4-13 and 4-26; Assessment of Alternative 1; Sect. 4.1.1.2 and; Assessment of Alternative 2; Sect. 4.2.2.2	EPA: "A socioeconomic impact for Alternative 2 is described as follows: 'The presence of contaminants in the groundwater will prevent its use and may limit economic development opportunities until the groundwater is brought back to beneficial use.' Although this statement would also be true for Alternative 1, no such statement is made for Alternative 1. Similar statements regarding socioeconomic impacts related to groundwater are also missing from other Alternatives that will not restore groundwater to beneficial use in the near future."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
16.	Assessment of Alternative 4; Page 4-53; Sect 4.2.4.2	EPA: "A sentence reads: 'Modeling indicates that in approximately 60 years, after the RGA DNAPL is removed, the TCE contaminant concentrations in the off-site plumes will decrease to require MCLs.' However, Alternative 4 includes no provisions for removing RGA DNAPL in 60 years. The sentence may simply be poorly structured but needs clarification. It may have been intended to read more like: 'Modeling indicates that approximately 60 years after RGA DNAPL is removed....'"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
17.	Assessment of Alternative 4; Page 4-64; Sect. 4.2.4.2	EPA: "A sentence reads: 'Long-term maintenance of the PTZ will be infrequent and limited in scope.' It is not clear how this can be known before completion of the feasibility study. The topic of PTZ maintenance and expected lifetime is addressed in several places in the FS and is addressed in following specific comments as well."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate. The implementation of the PTZ TS will assist in providing the information concerning the maintenance of a permeable treatment zone.
18.	Assessment of Alternative 6; Page 4-104; Sect. 4.2.6.2	EPA: "A concern is expressed in the text for the viability of the bioremediation process option in the highly aerobic RGA. The aerobic condition of the RGA presents a serious problem for successful implementation of bioremediation of TCE through anaerobic biodegradative processes. This process option must be carefully evaluated before a realistic budget for its implementation can be estimated and before predictions as to its potential successfulness can be made."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
19.	Assessment of Alternative 6; Page 4-105; Sect. 4.2.6.2	EPA: "Concern is expressed for the failure of the sitewide treatment system (PTZ) to completely remove TCE from migrating groundwater. In addition, it is stated that if the PTZ should fail to match or exceed the RGA hydraulic conductivity, the plume migration route could be irreversibly altered. Questions regarding these potential failures of the PTZ will hopefully be answered in the treatability study scheduled for FY 2000. They are simply pointed out now so that their answers can be anticipated in findings of the treatability study."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
20.	Assessment of Alternative 6; Page 4-107; Sect. 4.2.6.2	EPA: "Referring to DNAPL source recovery in the main C-400 area, the final sentence of the first paragraph of page 4-107 reads: '...Approximately 12% of the RGA DNAPL volume will be recovered (65,000 of 550,000 gal).' However, the estimated volume of the source according to page 1-27 of the text is expressed as approximately 550,000 liters, not gallons. Please review the FS to standardize the units of measurement used. As this is a public document it is recommended that the DOE use English units as the metric system is not widely used outside of academia."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
21.	Assessment of Alternative 6; Page 4-112; Sect. 4.2.6.2	EPA: "Dissolved oxygen concentrations in the RGA are reported in the range of 8 mg/l. This represents a highly aerobic condition for site groundwater. Under these conditions, anaerobic biodegradation of the TCE would be difficult to achieve. As stated in this section, it might be technically possible to deplete the oxygen in the groundwater through injection of artificial substrates that would stimulate oxygen uptake. However, the cost of such an alternative could be cost prohibitive over the required large area. Under the conditions of the RGA, a more promising bioremediation scenario is likely to be found through aerobic cometabolism of TCE. This is described briefly in Appendix C2, page C2-18."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
22.	Assessment of Alternative 6; Page 4-120; Sect. 4.2.7.2	EPA: "According to the text, Six-Phase Heating can be expected to increase emissions of radionuclides and toxic materials. The section goes on to state that 'in the event emissions are identified that require emission controls, these controls shall be incorporated into the design of the treatment system as necessary to ensure compliance with the identified standards.' It is not clear whether current cost estimating has included a contingency for this possibility or whether any expected associated cost would be small enough to be negligible in the context of the current cost estimate. Please clarify."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY
Feasibility Study for the Groundwater Operable Unit
at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
23.	Description of Alternative 8; Page 4-132; Section 4.2.8.2	EPA: "The description says that should zones of contamination reappear (following source reduction activities in the UCRS and RGA) direct heating technology and chemical oxidation would be implemented to re-treat the AOC. It is not clear whether current cost estimating has accounted for the possibility of having to re-apply these activities after the initial application. Please clarify."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
24.	Assessment of Alternative 8; Page 4-141; Sect. 4.2.8.2	EPA: "The time-period for cleanup by Alternative 8 could be greater than expected if *in-situ* conditions limit the effectiveness of DNAPL source removal through ozonation. Pockets of DNAPL could be missed by the initial ozonation treatment and would be a continuing source of TCE to groundwater. It is possible that even repeated ozonation treatments would never reach some portion of the DNAPL pools resulting in a cleanup that would take considerably longer than the predicted 14 years under this alternative. This needs to be developed and explained within this section."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
25.	Assessment of Alternative 8; Page 4-146; Sect. 4.2.8.2	EPA: "Another limitation of the PTZ treatment is noted. The toxicity of the contaminated groundwater could actually increase while passing through the PTZ treatment if sufficient retention time in the treatment area is not provided. Incomplete dechlorination of TCE could result in the formation of the daughter product vinyl chloride with a higher toxicity than the TCE itself. "In addition, it is pointed out that ^{99}Tc will only be adsorbed in PTZ treatment. Only the mobility of 99Tc will be decreased for an undetermined period of time. "Greater understanding of these limitations will hopefully be provided in the results of the treatability study."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
26.	Assessment of Alternative 8; Page 4-151; Sect. 4.2.8.2	EPA: "The effectiveness of 6-phase heating may be limited in UCRS soils if soil conductivity does not permit sufficient air flow for removal of COCs. This could result in an increased period of time for treatment or alternatively, a means of inducing secondary conductivity in the soil may be required."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit
at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
27.	Appendix C2; Page C2-16	EPA: "Under the heading of Multi-Phase Extraction, it is stated that 'For our application, this technology (dual-phase extraction) would not significantly improve remediation schedules or costs over a standard pump-and-treat system.' If this is true, why is dual-phase extraction included as the representative process option in several of the remedial alternatives? It is not clear why a standard pump-and-treat system is not proposed instead. Please clarify."	In the Multi-Phase Extraction section of the Appendix C2, the ITRD report describes Dual Phase Extraction and Two Phase Extraction. The description of Dual Phase Extraction includes a suggestion that the RGA would be dewatered, thus lowering the water table. This is not practical when considering the RGA and its high specific capacity. For this reason the ITRD team concluded that Dual Phase would work no better than pump-and-treat. The ITRD later in the section discusses Two Phase Extraction and variants of that technology and indicated that it seemed appropriate for the PGDP setting. The GWOU FS includes in Alternatives 3 & 6 source reduction in the UCRS using Dual Phase Technology. In this instance Dual Phase Extraction is very much like Two Phase Extraction. In this case Dual Phase Extraction would not include any treatment or dewatering of the RGA. In fact, care would have to taken in completing the extraction wells so as to not produce large quantities of RGA water and make the treatment not economical. The FS team chose to use the term Dual Phase Extraction due to issues that may be associated with patents issued for Two Phase Extraction. The ITRD report was independently developed by a team of individuals with special expertise in areas of remediation or site knowledge. The ITRD report was developed independently of the GWOU FS. However,

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
27. (continued)			due to the large amount of expertise contained in the ITRD team, the FS team, to the extent practical, adapted the information contained in the report. Revisions of the ITRD Report are expected. The draft final ITRD report has been included in Volume 4, Appendix C2.
28.	Appendix C2; Page C2-18	EPA: "Under the topic of Biological Treatment, a good case is made for bioremediation of TCE via aerobic cometabolism. This technique may also prove to be very costly as any attempt at anaerobic bioremediation is likely to be. However, promoting aerobic cometabolism of TCE appears to be a more promising possibility because it is more in tune with the natural aerobic state of the groundwater. This technology deserves a closer look than is apparent in the FS."	The use of a cometabolic system of bioremediation for the off-site plumes is a possibility. In the development of the FS, the project team needed to use representative process options for evaluation of the alternatives. In the case of the bioremediation, anaerobic was selected as the representative process option. Should bioremediation technology be selected for implementation, the design team that will be implementing the bioremediation phase of the alternative may select to implement aerobic bioremediation based on further analysis and testing of the aquifer. However, for the purposes of this FS, the project team selected as the representative option, anaerobic. One should keep in mind that, although the RGA is highly oxygenated, use of a cometabolic system may not be feasible as a result of the development of an epoxide that, in some instances, has led to the destruction of the implementing bacteria.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
29.	Appendix C2; Page C2-21	EPA: "A statement reads: 'the expected life of an iron filing wall can exceed 10 years.' Ten years seems very short for a treatment wall that would be required for a minimum of many decades. This potentially severe limitation should be addressed in the PTZ treatability study. Are other PTZ walls planned to compensate for this short life? Please explain."	Useful life of the media is a critical concern for the PTZ and is part of the Treatability Assessment. See response to Comment #27 above.
30.	Appendix C7; Basis of Cost Estimate; Alternative 2; Sect. WBS 2.01.03 P&A Wells	EPA: "Clarification is needed for the $40,833 figure for plugging and abandoning existing monitoring wells."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
31.	Appendix C7; Basis of Cost Estimate; Alternative 2; Sect. WBS 2.03.01.02 Sample Collection	EPA: "Cost of collecting water samples from monitoring wells seems excessive at $1059 per sample. This cost figure is used throughout the cost estimates for the various remedial alternatives for monitoring well sample collection as part of ongoing O & M activities. The cost is in sharp contrast with the cost assumptions provided for collecting samples from newly installed monitoring wells (see page 1, Basis of Estimate, Alternative 2, section WBS 2.01.02 Monitoring Wells). In this section, sampling of water 'assumes 1 (sample) per well and includes $25 (materials) and 2 hours (labor) each with modified level D PPE.' It is not clear why sample collection cost would be so different shortly after installing the wells compared to the cost during ongoing O & M activities. Justification for the $1059 figure is needed."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
32.	Appendix C7; Basis of Cost Estimate; Alternative 5; Sect. WBS 5.01.04; New Regional Treatment Systems; AND Appendix C7; Basis of Cost Estimate; Alternative 6; Sect. WBS 6.01.02.01; (Spreadsheet Page 5)	EPA: "Cost for installation of extraction wells seems excessive at $52,000. "Cost of bioremediation injection wells seems excessive at $52,000 for a well described as '6-inch PVC casing w/ 10-inch open hole, 120' dp.' In contrast to the $52,000 quotes for extraction wells and bioremediation wells above, the cost for an extraction well on page 8 of the spreadsheet for Alternative 6 (Section 6.01.02.01) is provided as $25,400 for a well of the following description: 'Extraction well w/8' HDPE pipe riser, 14" open hole, 8"X30' SS scream (sic), 100' dp.' Although the spreadsheet abbreviations are difficult to follow, it appears that this extraction well is to be 100' deep, constructed of 8" materials in a 14" borehole. The earlier description of a bioremediation well appears to be a well 120' deep, constructed of 6" materials in a 10" borehole. It is unclear why the bioremediation well will cost $52,000 while the extraction well of almost the same depth in a much larger borehole will cost less than half as much. "Well capital cost have an additional impact on the overall cost of various remedial alternatives because well O & M cost are calculated based on 2% annually of the original well capital cost. The total cost of any remedial alternative that includes extensive well drilling and maintenance will be especially sensitive to the accuracy of well cost estimates."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
33.	Appendix C7; Basis of Cost Estimate; Alternative 6; Sect. WBS 6.01.03 Maintenance	EPA: "In comparison to the basis of O&M cost for the other alternatives, the basis for Alternative 6 maintenance does not seem complete. For other alternatives, O&M costs are figured based on 2% of the system capital cost annually. For example, alternative 5 (Section WBS 5.03.03.01 O&M) annual maintenance is provided as 2% of capital costs of monitoring wells and 2% of the new regional treatment facility, extraction wells, piezometers, and lift stations. The maintenance cost for Alternative 6 appears to include only an annual provision equal to 2% of capital cost for monitoring wells but nothing for the bioremediation wells, extraction wells and other capital items. This discrepancy needs to be corrected or justified."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
34.	Volume 4; Appendix C; General	EPA: "Some of the costing elements were difficult to follow as far as what was being charged and on what basis. A number of abbreviations used were not clear. Drilling mobilization and cost per well seemed high. An explanation of what all is included in the drilling costs might help justify these costs."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
35.	Alternative 2; WBS 2.01.01.01	EPA: "Port-O-Let lists as 1 @ $80 for 2 months but is carried forward as 9 months @ $80 per month. Please explain."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
36.	Alternative 2; WBS 2.01.01.02	EPA: "Mob/Demob Support Labor appears for construction trailer and change trailer. The trailers should be set up at the same time which should save one support labor charge. Also, trailer mob/demob normally includes set up and break down. What is the set up labor charge for?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
37.	Alternative 2; WBS 2.01.01.02	EPA: "The total cost for H&S plans is $7,000. This cost appears high. General H&S plans for the PGDP must already exist."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
38.	Alternative 2; WBS 2.01.02.01	EPA: "What is included in the mobilization charge? $150,000 seems very high for mobilizing to put in 32 wells. Why is a new decontamination pad being built when one already exists at the PGDP? Was more than one vendor quote obtained?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
39.	Alternative 2; WBS 2.01.02.01	EPA: "There is a grader rental charge for 5 days and then an hourly charge for 40 hrs for materials. What is the material charge for? Same question for 5,000 gallon tanker, fork truck, and flatbed truck."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
40.	Alternative 2; WBS 2.01.02.01	EPA: "The tanker truck rental for development water for the 27 wells inside the fence is shown for 143 days. Does this mean that well development of these 27 wells will take 143 days? Same question for the 38 days shown for the 7 wells outside the fence. Please explain."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
41.	Alternative 2; WBS 2.01.02.01	EPA: "What well is being sampled as part of disposal of solids?"	Actual samples of the waste solids produced from the well cuttings are sampled to provide actual analytical data for interpretation. These results are then used to classify the waste produced. Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
42.	Alternative 2; WBS 2.01.02.01	EPA: "What does the 0.95 acres, $1,975 cost for site prep: clear and grub light trees represent?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
43.	Alternative 2; WBS 2.04.02.02	EPA: "Why is the material cost for 0.28 acre the same as 0.95 acre and what does this represent?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
44.	Alternative 2; WBS 2.01.03	EPA: "Why is a 5,000 gallon tanker truck for development water included in the cost for P&A wells?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
45.	Alternative 2; WBS 2.01.3	EPA: 'For the P&A wells, it is assumed that P&A Cement-fill and squeeze means that the wells will be filled with cement and pressure used to squeeze cement into the formation. If this is not the case, please explain how wells will be P&A. If this assumption is correct, then $40,833/well seems excessive. Also, it doesn't seem that nay water or solids will be generated during P&A. What do water and sampling consist and disposal costs represent?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
46.	Alternative 2; WBS .01.04	EPA: "There is no discussion in the Basis of Estimate for this WBS element. Please explain. The costs seem to indicate that it will take one month to break up the concrete pad and three months to excavate the soils, This time estimate seems high. The cost given indicate that the dump truck(s) will only be needed for 3 weeks. Please explain."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
47.	Alternative 2; 2.01.04.01	EPA: "What is General Conditions (7 yrs)? Same comment as before on H&S plans. Same comment as before on Port-O-Let."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
48.	Sect. 2; Page 2-4 (Bullet 6) and 2-6; Para. 3	EPA: "These paragraphs state that the 4th SAS® program compares maximum detected concentrations of each compound to their RBCs. The source of these RBCs is not mentioned in this section. It should be stated whether the RBCs are EPA Region 3 values or if they come from other sources. Currently, EPA Region 9 values are the suggested values for screening, but Region 3 values are accepted for projects near completion before the policy change."	Disagree. The source of the RBCs is clearly defined within this section. Neither the EPA Region 3 nor the EPA Region 9 values were used because their use would be inconsistent with guidance in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE/OR/07-1506&D1). The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
49.	Sect. 3.3.5	EPA: "Region 4 makes an exception to the use of the upper confidence limit as the exposure point concentration in groundwater. Groundwater exposure point concentrations should be the arithmetic average of the wells in the highly concentrated area of the plume. If the use of upper confidence limits as exposure point concentrations in groundwater has been approved and is documented in the Methods Document, then it should be referenced in this section."	Agree. The use of the lesser of the max and the 95% UCL as the exposure point concentration will be referenced to the Risk Methods Document. The document was modified in response to this comment.
50.	Sect. 5.4.3.1	EPA: "In this section only the rural resident considered for exposure was 'child.' Although children are one of the most sensitive sub-populations and have lower default value for body weight, the intake and exposure defaults are different. Adult residents should be considered for exposure or a rationale for evaluating only the child resident should be included in this section."	Agree. Results for the adult resident are available in the risk assessment. These results are not highlighted in this section because the child results are always used for decision-making. A statement noting why the child results are highlighted will be added to the introduction of the risk characterization section. The document was modified in response to this comment.
51.	Volume 2; Appendix A; General	EPA: "Overall content of the Data Summary Report was well written and clearly presented."	Thank you.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
52.	Volume 2; Appendix A; Sect. 3.2.3.1; Para. 2	EPA: Overview of WAG 6; "Within this paragraph a reference is made to Figure 3.7; however, this figure is not presented in the document. Please ensure that Figure 3.7 is included in next revision of the document."	Agree. Figure 3.7 wase revised to present the intended data.
53.	Volume 2; Appendix A; Sect. 3.2.3.7; Para. 2	EPA: The C-400 Building, Fate and Transport "It is stated in this paragraph that "It is anticipated that TCE concentrations in the Northwest Plume....are at steady state." Evidence for this assumption, in the form of additional text or references, should be added to the document since the Northwest Plume is a major focus of the feasibility study."	Section 3.2 is intended to be a summary of previous remedial action reports. The text was revised to clarify that the assumption that TCE concentrations in the Northwest Plume are at steady state is an inference of the WAG 6 RI report.
54.	Volume2; Appendix A; Sect. 3.2.6.2; Para. 1	EPA: Low-level Radioactive/Hazardous Waste Burial Ground—SWMU 3. Summary of Previous Remedial Actions. "Near the end of this paragraph it is stated that "The most recent semiannual report, dated November 21,1994, did not indicate...." If there is a semiannual report issued for this SWMU, then is a report from 1994 really the most recent data available? If the November 1994 report is the most recent data, then a brief explanation within the document text as to why no additional data was collected after 1994 would be helpful."	Agree. The text was updated to reflect the most recent semiannual report at the time writing for the D1 Groundwater Feasibility Study was concluded.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
55.	Volume 2; Appendix A; Sect. 3.2.8.3; SWMU 56 and 80; Para. 2	EPA: C-540-A PCB Waste Staging Area and Spill Site, Fate and Transport of Contamination "The last sentence if this paragraph states "This pathway must be further investigated during the GWOU." If this document is the feasibility study for the GWOUS, how can remedial alternatives be explored if investigation of SWMUs 56 and 80 is not complete? Also, does this statement indicate that additional sampling will be conducted in the future at SWMUs 56 and 80—if so when is this sampling scheduled to be completed?"	Agree to revise the text to reflect the intent of the section, a summary of the conclusions of previous investigations. No further investigation of the C-540 area is currently scheduled. The Feasibility Study draws upon the site-wide groundwater database to identify contaminant source zones requiring remediation. Although this assessment did not identify the C-540 area as a suspected source zone, the area remains a potential contributing source to the Northeast Plume. The selection of a groundwater remedial strategy must address this uncertainty.
56.	Volume 2; Appendix A; Sect. 3.2.10.1; C-747-B Burial Yard (SWMU 4); Para. 7	EPA: Summary of Previous Investigations "The last two sentences of this paragraph indicate that field activities were scheduled to be completed in August 1999 and analytical results available in December 1999. Given that it is now September 2000, these two sentences should be updated to indicate the current status of field activities and availability of analytical data."	The text was updated as requested.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
57.	Volume 2; Appendix A; Sect. 3.2.10.2 C-746-F Classified Burial Yard (SWMU 5); Para. 4	EPA: Summary of Previous Investigations "The last two sentences of this paragraph indicate that field activities were scheduled to be completed in August 1999 and analytical results available in December 1999. Given that it is now September 2000, these two sentences should be updated to indicate the current status of the field activities and availability of analytical data."	Agree. Text was updated.
58.	Volume 2; Appendix A; Sect. 3.2.10.3; C-747-B Burial Grounds (SWMU 6); Para. 2	EPA: Summary of Previous Investigations "The last two sentences of this paragraph indicate that field activities were scheduled to be completed in August 1999 and analytical results available in December 1999. Given that it is now September 2000, these two sentences should be updated to indicate the current status of the field activities and availability of analytical data."	Agree. Text was updated.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
59.	Volume2; Appendix A; Sect. 3.2.11.1; SWMU 58— NSDD/Off-site; Last sent. of sect.	EPA: Nature and Extent of Contamination "It is stated within the document that Phase II investigation at the PGDP is a primary source of information used for the data summary and many detailed results for the various SWMUs are presented in the various sections of Chapter 3. Therefore, the last statements in this section of the documents "No risk data are available....may have been addressed in the Phase II SIs" are somewhat confusing and contradictory. The Phase II investigation documents must have been reviewed for the preparation of this document, so a more definitive statement as to whether or not there is risk data for SWMU 58 should be possible."	Agree. The text was revised by excluding the final sentence/paragraph of the "Nature and Extent" subsection. The risk data are unavailable.
60.	Volume 2; Appendix A; Sect. 3.2.11.2; C-616 Lagoon Complex; Last sent. of sect.	EPA: Nature and Extent of Contamination "It is stated within the document that Phase II investigation at the PGDP is a primary source of information used for the data summary and many detailed results for the various SWMUs are presented in the various sections of Chapter 3. Therefore, the last statements in this section of the document 'No risk data are available...may have been addressed in the Phase II SIs' are somewhat confusing and contradictory. The Phase II investigation documents must have been reviewed for the preparation of this document, so a more definitive statement as to whether or not there is risk data for the C-616 Lagoons should be possible."	Agree. The text was revised by excluding the final sentence/paragraph of the "Nature and Extent" subsection. The risk data are unavailable.

COMMENT RESPONSE SUMMARY
Feasibility Study for the Groundwater Operable Unit
at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
61.	Typographical; Entire Document	EPA: "There is an inconsistent manner in which figures are called out in the text of the document. In some cases the text references 'Fig. X.X' and in others 'Figure X.X.' The same inconsistency occurs within the title blocks of the actual figures. Recommended that the entire document be revised to correct this inconsistency."	Agree. Figures for the six volumes were prepared by and accessed from multiple sources. These will be made consistent in the next iteration of the FS.
62.	Fig. 3.4	EPA: "The word 'Figure' does not appear before the figure number."	Agree. The figure title was revised.
63.	Sect. 3.2.2.3; Investigation Methods; Radiation dose Assessment; Sent. 3	EPA: "This sentence states that the TLDs were left in place over a 3.2.2-month period. The time period '3.2.2' must be a typographical error, please change to the correct time period."	Agree. The text was corrected to read, "…3-month period…."
64.	Sect. 3.2.3.6; SWMU 203 – C-400 Waste Discard Sump; Surface Water Hydrology, Wetlands, and Floodplains; Sent. 4	EPA: "There is a closing bracket missing within this sentence after '001 Outfall system.'"	Agree. A closing bracket was added.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
65.	Sect. 3.2.4.1; SWMU 1; Setting; Sent. 1	EPA: "The word 'surface' in this sentence should not be capitalized."	Agree.
66.	Sect. 3.2.4.1; SWMU 1; Nature and Extent of Contamination; Sent. 1	EPA: "The SWMU reference use in the sentence 'SWMU 001' should be changed to 'SWMU 1' to be consistent with the other references in this section."	Agree.
67.	Sect. 3.2.4.4; C-720 Complex, Location and Physical Description; C-720 Building; Sent. 2	EPA: "The word 'ships' in this sentence should be changed to 'shops.'"	Agree.
68.	Sect. 3.2.5.1 Overview of WAG 28; Solid Waste Management Unit 99 – Kellogg Building Site; Summary of Investigation; Sent. 1	EPA: "The SWMU reference used in the sentence 'Solid Waste Management Unit 99' should be changed to 'SWMU 99' to be consistent with the other references in this section."	Disagree. "Solid Waste Management Unit" is an appropriate use for the beginning of a sentence.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
69.	Sect. 3.2.6.1 C-749 Uranium Burial Ground – SWMU 2; Surface Features and Surface Water Hydrology; Sent. 2	EPA: "The word 'unite' in this sentence should be changed to 'unit.'"	Agree.
70.	Fig. 3.42	EPA: "The numeral '8' is missing from the figure title."	Agree. The title was revised to reference SWMUs 8 and 100.
71.	Sect. 3.2.7.1 SWMU 8 – C-746-K Sanitary Landfill; Radionuclides Sent. 1	EPA: "There appears to be one or more words missing from this sentence, or possibly the second 'levels' in the sentence should be deleted to read 'were detected in soils.'"	Agree. The text was corrected to read, "…were detected in soils."
72.	Sect. 3.2.7.1 SWMU 8 – C-746-K Sanitary Landfill; Summary of Previous Remedial Actions; Para. 2; Sent. 2	EPA: "The word 'tributary' is missing after the word 'unnamed' in this sentence."	Agree. The text was corrected by inserting the word "tributary."

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
73.	Sect. 3.2.7.3 SWMU 136 – TCE Spill Site; Geology/ Hydrogeology; Para. 3; Sent. 1	EPA: "It appears that the reference to 'SWMU 3b' in this sentence is a typographical error and should be 'SWMU 136.'"	Agree. "SWMU 3b" was replaced with "SWMU 136."
74.	Fig. 3.63	EPA: "The word 'the' is spelled incorrectly in the figure title."	Agree. The figure title was corrected.
75.	Sect. 3.2.8.5 SWMU 74 – C-340 PCB Spill Site; Location; Sent. 1	EPA: "The reference to Fig. 3.54 in this sentence is incorrect, the reference should be for Fig. 3.64."	Agree. The reference "Fig. 3.54" was corrected to "Fig. 3.64."
76.	Sect. 3.2.10.1 C-747-B Burial Yard (SWMU 4); Location; Sent. 4	EPA: "The word 'the' after the comma in the sentence should be deleted.'	Agree. The word "the" after the comma was deleted.
77.	Fig. 3.73	EPA: "The word 'site' in the figure title is spelled with a capital 'I' rather than a lower case 'i' and should be corrected."	Agree. The spelling of the word was corrected.
78.	Sect. 3.2.10.3 C-747-B Burial Grounds (SWMU 6)	EPA: "There is a dash missing from the title of this section 'C747-B.'"	Agree. The title was corrected.

COMMENT RESPONSE SUMMARY
Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
79.	Sect. 3.2.11.3 Outfalls 010, 011, and 012; Method of Investigation Para 3; Sent. 2	EPA: "The depth indication '(one ft)' should be changed to '(1 ft)' to be consistent with other depth references in the text of the document."	Agree. Use of numerals was corrected.
80.	Sect. 3.2.11.3 Outfalls 010, 011, and 012; Nature and Extent of Contamination; Sediments; Sent. 3	EPA: "There appears to be one or more words missing between the words 'contaminated' and 'indicated' within this sentence."	Agree. The text was corrected to read, "The lack of TCE in sediments located upstream of the contaminated area indicated TCE is not migrating from upstream sources…."
81.	Fig. 3.86	EPA: "The figure title is incorrect, 'PGA' should be 'RGA.'"	Agree. The title was corrected.
82.	Figs. 4.3, 4.12, 4.13, and 4.14	EPA: "The titles of these figures do not match the titles presented in the Table of Contents."	Agree. The Table of Contents was corrected to reflect the correct titles of the figures.
83.	Fig. 4.46	EPA: "The word 'in' is missing from figure title, should be 'iron in RGA.'"	Agree. The figure title was corrected.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
84.	Table 5.17	EPA: "The footnote indicator associated with the acronym 'COPCs' in the figure title is not superscript."	Agree. The footnote indicator font was changed to superscript.
85.	Tables 5.43, 5.44, 5.45, and 5.46	EPA: "The word 'term' is spelled incorrectly in both the titles for these figures and in the Table of Contents."	Agree. The spelling of "term" was corrected.
86.	Sect. 6.1.1 Hydrogeology; Para. 3 Sent. 3	EPA: "PGDP is spelled incorrectly at the end of this sentence."	Agree. The spelling error was corrected.
87.	Fig. 6.3	EPA: "The title for this figure does not match the title presented in the Table of Contents."	Agree. The Table of Contents was corrected to reflect the title of the figure.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
88.	General	U.S. Dept. of the Interior Fish and Wildlife Service: "There does not appear to have been a thorough characterization of the nature and extent of metals contamination in the Upper Continental recharge System (UCRS) or a complete delineation of where the UCRS emerges on the West Kentucky Management Area (WKWMA). The remedial investigation and feasibility study for the Groundwater Operable Unit (GWOU) provided an opportunity to remove data gaps associated with metals contamination in the UCRS and the interaction of groundwater with surface hydrologic features present on the WKWLA. We believe this information is necessary to effectively conduct an ecological risk assessment for the Surface Water Operable Unit (SWOU)."	Agree that additional information regarding surface discharges will be required as part of the Surface Water Operable Unit. However, Groundwater flow in the UCRS at the PGDP is primarily vertically downward – to recharge the RGA. Thus, lateral groundwater flow distances in the on-site UCRS are very limited. UCRS groundwater contamination from onsite does not flow into the WKWMA, except through the RGA (specifically on Little Bayou Creek north of Anderson Road) and except through an intermediate surface-water pathway.
89.	General	Fish and Wildlife Service: "In previous forums, we have also expressed the need for other biota receptors to be considered in human health risk assessments. Primarily, these additional receptors would include amphibians (frogs) and reptiles (turtles) which may be harvested for consumption by sportsmen utilizing the WKWMA. The GWOU baseline risk assessment and previous risk assessments for a variety of Waste Area Groupings and Solid Waste Management Units have not evaluated these receptors and potential human health risks associated with their consumption."	Agree, however, please note that the forums to which you are referring were held after the time during which the scope of the GWOU BRA was determined. To address this issue, a discussion recognizing the existence of alternative biota receptors consumed by sportsman will be added to the uncertainty section of the baseline risk assessment. This document was modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
90.	General	Fish and Wildlife Service: "Due to the complexity of the various contaminant plumes originating at the PGDP and the interface between groundwater in the UCRS, the Regional Gravel Aquifer (RGA), and various surface water features on the WKWMA, it is important to consider what aquatic habitats are present that ecological receptors utilize. These habitats include ponded water areas on the WKWMA which have maintained their hydrology even during periods of low precipitation. We believe these ponded water areas may be surficial emergences of the UCRS. These habitats are ideally suited for amphibians, reptiles, and migratory birds. They also may provide foraging habitats for the Federally endangered Indiana bat (*Myotis sodalis*)."	Agree. If a hydrological connection can be determined, then it would be appropriate to include an evaluation of receptors in the ponds as part of the GWOU input into the SWOU investigation. However, Groundwater flow in the UCRS at the PGDP is primarily vertically downward – to recharge the RGA. Thus, lateral groundwater flow distances in the on-site UCRS are very limited. UCRS groundwater contamination from onsite does not flow into the WKWMA, except through the RGA (specifically on Little Bayou Creek north of Anderson Road) and except through an intermediate surface-water pathway. The document was not modified in response to this comment.
91.	General	Fish and Wildlife Service: "The UCRS also emerges in Big Bayou Creek to the west of the PGDP and the lower reaches of Little Bayou Creek. These areas provide suitable roosting and foraging habitat for the Indiana bat. The RGA emerges in the Ohio River where the Federally endangered pink mucket (*Lampsilis abrupta*), orange-foot pimpleback (*Plethobaasus cooperianus*), and fat pocketbook (*Potamilus capax*) are known to occur."	Noted. This information will be further considered in the SWOU investigation. Also, see response to Comment #92. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
92.	General	Fish and Wildlife Service: "We recommend that the DOE consider this information and recognize that the Endangered Species Act and Migratory Bird Treaty Act are applicable or relevant and appropriate requirements (ARAR) for consideration in developing remedial options and record of decision for the GWOU. Since the GWOU feasibility study did not include an ecological risk assessment, consideration must also be given to removing the data gaps and uncertainty that contaminant migration from the UCRS and RGA to the SWOU poses."	At this time, the only defined surface discharge from the contaminated portion of the RGA is at Little Bayou Creek. The impact that this discharge has upon ecological receptors will be further investigated in the SWOU. For the purposes of the GWOU, the identification of the discharge leads to a need to examine remedies either to prevent future discharges of contaminated groundwater or to reduce the impact of discharged materials to *de minimis* levels. The revised GWOU FS addresses this issue. Text was modified to include appropriate language concerning the Endangered Species Act and Migratory Bird Treaty Act. Modifications to the document were made in response to this comment.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
93.	General	Kentucky Department for Environmental Protection (KDEP): "The Division would like to see an additional alternative added to the current list of eight alternatives. This alternative should include aggressive source reduction in the UCRS and RGA using the Six-Phase and DUS technologies respectively. This would include reduction of the AOC 211 source zone as well as each of the zones identified in Alternative 8. In addition, chemical oxidation (e.g., potassium permanganate) should be included as a polishing treatment for each of the RGA Source zones. This alternative should also include the installation of Permeable Treatment Zones at the fence line – across the entire width of each of the three plumes – and at the terminal edges of the Northeast and Northwest plume centroids as well as at the Little Bayou Creek discharge point."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY
Feasibility Study for the Groundwater Operable Unit
at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
94.	General	KDEP: "The primary focus of this Feasibility Study's source remediation strategy is the remediation of DNAPL sources and dissolved phase organics. The study is not comprehensive in that it fails to address other known and potential sources of groundwater contamination. These sources include but are not necessarily limited to the C-746-S&T Landfill Complex, SWMU 145 Borrow Area, the abandoned section of the NSDD, and the C-746 Landfill. It is not the Division's intention to change the focus of this particular document in order to address these areas. Nevertheless, these areas must be addressed. The GWOU binning process will identify any additional contaminant sources that must be addressed (by an action or further investigation) and will identify the OUs under which they will be addressed. The D2 revision of this document must clearly state that this FS is not comprehensive and therefore will be followed by additional documentation required to address those areas ignored in the FS. It must also clearly state the regulatory mechanism (e.g., RI/FS, PASI, etc...) through which these areas will be addressed."	The FS identifies in the Executive Summary and the Introduction the SWMUs/areas that the FS is directed toward. The FS is not intended to be completely comprehensive for all groundwater contaminants. As agreed to by representatives of the DOE, Commonwealth of Kentucky and USEPA, this D2 FS will address TCE, TCE degradation products, and technetium 99. Section 1.2.6.3 and the Scope section of the Executive Summary provides a description of the process that was used to identify the major contaminants that are driving the risk. In addition, the Groundwater Core Team binning has modified the SWMUs that will encompass the GWOU. Following completion of this binning process, it will be necessary either to develop additional documentation or to modify the FS to be consistent with the Core Team actions.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
95.	General	KDEP: "If it is the DOE's intention to address SWMUs 7 and 30 under the BGOU then additional sampling will be required to confirm the possible extent of RGA and UCRS (Drum Mountain subsurface soils only) DNAPL contamination. This is necessary in order to determine whether source reduction is required in these areas. It is highly likely, given the high dissolved phase concentrations present at the MW230, that DNAPL exists in the RGA or at the UCRS/RGA boundary beneath SWMU 30. In addition, the soils beneath the old Drum Mountain site are an unknown and must be characterized. It is premature to assume that these sites can simply be capped and then forgotten."	Agree. This approach is consistent with the approach mutually agreed upon by the PGDP Core Team, recently. A description of this approach was added to Section 1.1.1, Purpose and Scope, of the FS Report.
96.	General	KDEP: "All of the alternatives presented in this Feasibility Study appear to require the installation of 32 monitoring wells and the abandonment of 15 wells. The locations of these old and new wells should be depicted in the Alternative Snapshots presented in Volume 1. Also, the DOE should consider using materials other than stainless steel when constructing any new monitoring wells."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate. Agree; however, monitoring well materials will require careful selection.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
97.	General	KDEP: "The Feasibility Study was composed of five volumes, one of which was the 'Groundwater Background Document' for the Paducah Gaseous Diffusion Plant. This document was used in support of the COPC screening process in the Feasibility Study. The Groundwater Background Document (HBD) presents concentrations of inorganics and radionuclides that are considered to be independent of influence from the facility. The data were obtained from a total of 12 wells; six were screened in the Regional Gravel Aquifer (RGA), with the remaining six screened in the McNairy Formation. We have several concerns with this approach, which are outlined in the specific comments below. Our primary concerns are with the identification and selection of background wells, data correction, radionuclide 'background,' and the data summary process. "An additional concern is the presentation of data deemed 'background' in the Executive Summary and used in the Feasibility Study for the Groundwater Operable Unit to screen chemicals of potential concern. Some of these values are identified in the text of the document as having 'considerable uncertainity', based on their method of derivation (qualitative). For example, the 'Group 1' list of analytes is composed of chemicals that were not detected or infrequently detected and whose background levels were set equal to the detection limit. In some cases, the detection limit exceeded the maximum contaminant level (MCL), although routine analytical techniques and equipment are capable of producing data that are more meaningful. For those readers (e.g., general public) not familiar with the methodology used to determine the Group 1 analytes, the data is potentially misleading."	We recognize the issue concerning the background data. The issue is being elevated to the appropriate Core Team to be resolved. The document was not modified in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
98.	General	KDEP: "While we agree with the general approach outlined in the Groundwater Operable Unit Feasibility Study, we consider the uncertainity in the modeling results sufficient to cast doubt on the quantitative estimate of future concentrations/risk at specific locations. As indicated in the following comments, we feel the primary risk drivers (volatiles are likely identified, and it is appropriate that the main focus of the feasibility study is on these contaminants. It should be noted that is possible that unacceptable residual risk will be present if risk drivers within other classes of chemicals are not considered when selecting the appropriate remedial strategy. "Our primary concern is source reduction in conjunction with prevention and remediation of off-site contamination. Although the Regional Gravel Aquifer (RGA) is described as the primary source of off-site contamination, only two of the eight remedial alternatives effectively address the RGA. These alternatives (Alternatives 3 and 8) also address source removal, although Alternative 3 would allow continuing impacts to Little Bayou Creek from the Northwest plume. It may be appropriate to evaluate an alternative equivalent to Alternative 3 with the addition of a permeable treatment zone to address the migration of contaminants into Little Bayou Creek."	Agree. Source actions to address nonvolatile contaminants may be needed. Please note that the main intent in presenting the modeling results is to demonstrate that over both the long-and short-term (from the present to over 1000 years from present), the primary problem at the PGDP is chlorinated VOCs. In fact, as demonstrated, it is likely that the problems posed by other contaminants will approach *de minimis* levels by the time the VOC problem is solved. However, it is agreed that if the VOC problem is resolved in a shorter period, then the other contaminants will need to be considered in more detail and be addressed more aggressively. Additionally, it is agreed that source action to address other contaminant may be appropriate as determined at the recent GWOU Project Team meetings. Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
99.	Volume 1; Executive Summary; Page ES-2; Bullet 2	KDEP: "It is stated in this bullet that '…levels of TCE contamination at the C-720 Building… suggest the presence of free-product TCE in the UCRS soils only.' Several months ago when this area was being considered as a possible Six-Phase Treatability Study site there was some discussion of using this technology to treat DNAPL in the RGA. How certain is the DOE that DNAPL does not exist within the RGA at this location?"	The data are sufficient as the basis for an UCRS action. The presence of an RGA DNAPL remains a reasonable deviation.
100.	Volume 1; Executive Summary; Page ES-5; Table ES.2	KDEP: "The C-404 Burial Ground as listed under the Northwest Plume UCRS sources is listed as '(SWMUs 7 & 30)'. SWMUs 7 & 30 should be listed beneath 'C-747-A Burial ground.' Modify this table to correct the error. Also, please explain how the free product volume estimates for SWMU 4 and the suspected source near the northeast corner of the C-333 Building were determined."	- Agree to correct the cross-reference of C-404 and SWMUs 7 and 30. The C-747-A reference will remain as presented because SWMU 30 no longer is a suspected DNAPL source zone. - Agree that the entry 'No Basis for Estimate' for SWMU 4 and the NE corner of C-333 begs an explanation. The text in Table ES.2 was changed to read "Small" for Source Zone Volume. The same material was revisited in Table 1.3 of Volume 1. Text was revised to present "Professional judgement and site experience" as the basis for the estimates, where applicable.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
101.	Volume 1; Executive Summary; Page ES-5; Table ES.2	KDEP: "Several additional source zones must be added to this table before the listing will be comprehensive. Areas that must be added are the C-746-S&T Landfill comples, SWMU 145 Borrow Area, the abandoned portion of the NSDD, the AOC 211 TCE Spill Site, the C-533 Switchyard, and the suspected source zone located to the southeast of the C-616 Reduction Facility. The table must indicate that all but the C-533 Switchyard are assigned to the GWOU. In addition, remove the words 'No Further Action' from the operable unit assignment column for SWMU 136. The GWOU Project Core Team has not yet made this determination."	Table ES.2 will be re-titled, "Representative known and suspected TCE source zones at the PGDP." The SWMU 136 operable unit assignment will be corrected.
102.	Volume 1; Executive Summary; Page ES-6; Para. 5	KDEP: "This paragraph states that contaminant concentrations near the Northeast Plume's source area are decreasing. Include evidence in the text to substantiate this assertion."	Agree to cite Northeast Plume source area wells exhibiting declining TCE levels in Section 1.2.5.1.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
103.	Volume 1; Executive Summary; Page ES-6; Para. 7	KDEP: "The first bullet under this paragraph indicates that the C-400 Building, C-720 Building, and SWMU 1 are the three 'main' areas containing subsurface DNAPL. This statement is somewhat misleading. A significant volume of free product TCE also exists or likely exists at several other locations. These include SWMU 4 and SWMUs 7 & 30. In addition, significant volumes of DNAPL may exist at three other areas that are as yet not well defined – the northeast corner of C-333, the C-533 Switchyard, and an area located to the southeast of the C-616 Reduction Facility. Delete the word 'main' from this paragraph. Modify the text to indicate that relatively large volumes of free product exist at three highly characterized areas (C-400 Building, C-720 Building, and SWMU 1) and that significant volumes exist as at several other SWMUs. Also indicate that at least three other areas (the C-161 area, C-533, and the northeast corner of C-333) may contain significant volumes of free phase TCE. The second bullet can be modified to indicate that the C-533 Switchyard is not within the scope of GWOU."	Agree that the first bullet is misleading and agree to revise the text such that "main" is replaced with "highly characterized." The second bullet addresses SWMUs 4 and 7 and 30. Also agree to add a bullet to acknowledge that other DNAPL source zones (e.g. source area of Northeast Plume) appear to exist. In addition, agree to state that the potential remains for additional unknown DNAPL source zones to exist at the PGDP and that the remedial strategy to be selected should address this uncertainty.
104.	Volume1; Executive Summary; Page ES-11; Para. 3; Bullet 3	KDEP: "The third bullet lists the northeast and southeast corners of C-720 as primary source areas. However, not one of the 8 remedial alternatives listed in this FS address the northeast source. At least one of the alternatives must include source reduction in this area."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit
at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
105.	Volume 1; Sect. 1.1.1; Page 1-5; Fig. 1.1	KDEP: "Figure 1.1 depicts the eastern edge of Northwest Plume ^{99}Tc contamination as extending as far east as the NSDD. This is referred to in the figure's legend as the 'probable' extent of ^{99}Tc contamination. Change the word probable to possible or move the eastern edge of contamination back to its originally accepted location."	Agree to update Figure 1.1 with concepts depicted on the latest plume maps (maps for Calendar Year 2000).
106.	Volume 1; Sect. 1.2.2.1; Page 1-10; Fig. 1.4	KDEP: "This figure is titled 'Land use surrounding PGDP.' Change the title to read 'Current land use surrounding PGDP.'"	Agree.
107.	Volume 1; Sect. 1.2.2.4; Page 1-13; Para. 5	KDEP: "It is stated here that potential habitat for the Indiana bat exists near the PGDP. In fact, the Indiana bat has been observed in this area. This paragraph must state that the Indiana bat has been identified at the PGDP."	Agree.
108.	Volume 1; Sect. 1.2.2.6; Page 1-19; Para. 8	KDEP: "This paragraph describes a 'linear discharge area associated with a ditch in the northwest quadrant of the PGDP.' The Division is unaware of any such feature. Please elaborate."	Agree. Text was added to identify the area as the "East/ West Ditch."

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
109.	Volume 1; Sect. 1.2.2.6; Page 1-23; Para. 3	KDEP: "It is unclear how the volume of suspected water leakage from the underground water utility system impacts the direction of the major contaminated groundwater plumes at PGDP, as described in this section. If the modeled amount of leakage (~44,000 gal/day) is considered to be a significant contributor to recharge and direction of flow, it may also contribute to rate of the migration of contaminants of potential concern (COPC's) into RGA. Consideration should be directed toward repairing the water utility system."	The leakage provides discrete areas of recharge/higher hydraulic potential that directs groundwater flow away from the leakage areas. The DOE will further evaluate the PGDP water balance to aid in the selection of a proper course of action.
110.	Volume 1; Sect. 1.2.2.6; Page 1-23; Para. 3	KDEP: "Estimates are given here on the recharge that may be associated with several of the plant's cooling towers. Unless the DOE plans to use the most aggressive means possible to treat dissolved phase contamination currently migrating offsite (e.g., a continuous PTZ installed along the western, northern, and eastern fence line) it must complete a new water budget study. This study must rely primarily on actual flow measurements and to a much lessor degree on assumptions."	The DOE currently is developing a scope of work for further analysis of the water budget.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
111.	Volume 1; Sect. 1.2.5.1; Page 1-24; Para. 3	KDEP: "The table that accompanies this paragraph fails to include AOC 211 (TCE Spill Site) and the northeast corner of C-333 as source areas. In addition, it refers to C-720 east as a source area instead of specifying the northeast and southeast corners as the actual source areas. AOC 211 and the C-333 DNAPL site must be added to the table. In the interest of maintaining consistency with Table ES.2, 'C-720 Northeast' and 'C-720 Southeast' should replace 'C-720 East' in this table."	Agree to revise the embedded table to include references to AOC 211, the southeast corner of C-720, and the northeast corner of C-333.
112.	Volume 1; Sect. 1.2.5.1; Page 1-27; Table 1.3	KDEP: "The C-404 Burial Ground as listed under the Northwest Plume UCRS sources is listed as '(SWMUs 7 & 30)'. SWMUs 7 & 30 should be listed beneath 'C-747-A Burial Ground.' Modify this table to correct the error."	Agree. The cross-reference of C-404 and SWMUs 7 and 30 wase corrected. The C-747-A reference will remain as presented because SWMU 30 no longer is a suspected DNAPL source zone.
113.	Volume 1; Sect. 1.2.5.1; Page 1-27; Table 1.3	KDEP: "See specific Comment # 3 [#101]."	The FS identifies in the Executive Summary and in the Introduction the SWMUs/areas that the FS is directed toward. The Groundwater Core Team binning has modified the SWMUs that will be encompassed by the GWOU. Following completion of this binning process, it will be necessary to either develop additional documentation or modify the FS to make it consistent with the Core Team actions.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
114.	Volume 1; Sect. 1.2.5.1; Page 1-27; Table 1.3	KDEP: "The C-404 Burial Ground as listed under the Northwest Plume UCRS sources is listed as '(SWMUs 7 & 30)'.SWMUs 7 & 30 should be listed beneath 'C-747-A Burial Ground.' Modify this table to correct the error."	See response to Comment #112.
115.	Volume 1; Sect. 1.2.5.1; Page 1-29; Table 1.11	KDEP: "The figure must identify the southeast corner of the C-616 Facility, the northeast corner of the C-333 Building, and the C-533 Switchyard as known as suspected DNAPL source zones. DNAPL is thought to exist at the C-333 site and is suspected at the two other locations."	Disagree. The northeast corner of C-333 and C-533 are speculative DNAPL source zones and will not be labeled on the figure. Latest plume mapping suggests the C-616 area may not be a DNAPL source zone.
116.	Volume 1; Sect. 1.2.5.1; Page 1-30; Para. 4	KDEP: "See Comment # 10 [#108]."	Agree. Text was added to identify the area as the "East/ West Ditch."
117.	Volume 1; Sect. 1.2.5.1; Page 1-30; Para. 6	KDEP: "See Comment # 11 [#109]."	The leakage provides discrete areas of recharge/higher hydraulic potential that directs groundwater flow away from the leakage areas. The DOE will further evaluate the PGDP water balance to aid in the selection of a proper course of action.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
118.	Volume 1; Sect. 1.2.5.2; Page 1-32; Para. 2; Bullet 1	KDEP: "Waste Burial Pit G: Currently Burial Pit G underlying the former Drum Mountain is not identified as a source of contaminants to groundwater. However, the text describes 'process knowledge' as the sole justification for the assumption that the nature and extent of contamination is Waste Burial Pit G is equivalent to Waste Burial Pit D. This assumption appears incorrect as it is inconsistent with Appendix A (page 3-153: Table 3.35) which describes the wastes in Burial Pit G as 'non-combustible, contaminated and uncontaminated trash and equipment' yet describes Burial Pit D wastes as 'contaminated concrete.' Appendix A (page 3-154; paragraph 3) also describes Burial Pit G wastes as similar to those in Burial Pit B and C which were identified as contaminant sources to groundwater at the four receptor locations. Furthermore, Burial Pit G has likely received additional contamination from the overlying Drum Mountain that is not associated with wastes characterized in any of the other Burial Pits. Since this pit has not been characterized due to the interference of Drum Mountain, it appears appropriate to assume, at a minimum, that contaminant levels at Pit G are equivalent to the levels found in the most contaminated of the Burial Pits located in SWMU 7. Alternatively, now that Drum Mountain has been shredded and removed, characterization of the underlying contamination should be performed."	Agree to correct the comparison. The text was revised to compare contamination in Pit G with that of Pits B and C. A note was added to the text stating that additional contamination may be present that is related to Drum Mountain. Future assessments/actions must address this uncertainty.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
119.	Volume 1; Sect. 1.2.5.2; Page 1-33; Para. 4	KDEP: "One of the steps used to identify the chemicals requiring fate and transport analysis was a frequency screen. The selection of the COPC was determined by best professional judgement by considering the frequency of detection, the magnitude of the detection relative to the screening level and the magnitude of the screening level relative to the sample quantitation level (SQL). The approach may ultimately select the appropriate chemicals for further analysis, but the decision criteria should be more clearly defined. In other words, it is not clear what minimum frequency of detection was required or what magnitude of difference between the detected chemical level and the screening level would result in the decision to retain the constituent for further analysis."	Disagree. While it is agreed that clearly defined decision criteria are desirable, in many cases, insufficient data are available to support rigorous screening rules. Thus, professional judgement, based on site experience, remains the preferred option to screen the data.
120.	Volume 1; Sect. 1.2.5.2; Page 1-37; Para. 2	KDEP: "A portion of the fourth sentence of this paragraph should be modified to '. . .no site-specific data were available . . . .'"	Agree. The text was revised as requested.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
121.	Volume 1; Sect. 1.2.5.2; Page 1-41; Bullet 4	KDEP: "Little attenuation is expected in radionuclides, such as technetium-99. The biodegradation of TCE is also a very slow process in groundwater with degradation to vinyl chloride, a more toxic compound. A large portion of the TCE present at PGDP occurs as a DNAPL (denser-than-water nonaqueous-phase liquid), which tends to resist dilution/attenuation. Thus, ignoring attenuation when modeling the migration of the risk drivers (technetium-99, TCE, and breakdown products) is not a highly conservative assumption as is stated in the document."	Agree with your comment that, vinyl chloride, a degradation product of TCE, is more toxic than TCE; and therefore, by not accounting for degradation of TCE, a very conservative assumption is not used. However, this has been overcome by modeling vinyl chloride separately and without using degradation of vinyl chloride. For the radionuclides, MEPAS model does account for the daughter products. Therefore, the statement for ^{99}Tc is not true.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
122.	Volume 1; Sect. 1.2.5.2; Page 1-41; Bullet 5	KDEP: "The soil-water partition coefficients (K_d) used in the groundwater modeling are described as literature values intended to produce conservative results. Our comparison of the selected K_d used in the model (as presented in Appendix A, Tables 5-2 through 5-10) for WAGs 1 & 7 with literature values presented in the USEPA *Soil Screening Guidance: Technical Background Document* (1998) show partial agreement. Some of the values presented do not appear to be as conservative as those in the EPA guidance. Additionally, we could not find a comprehensive list of all the COPCs modeled in past investigations of the various WAGs at PGDP. As this information is integral to the understanding of the study and is widely scattered in numerous documents, it is suggested that the corrected version of the Groundwater Operable Unit Feasibility Study (GWOU FS) provide a comprehensive list of the chemical, soil, and groundwater parameters used to develop the model, including the sources of the parameters selected."	Agree to add an appendix to the Feasibility Study that will document model parameters used at the PGDP. The text bullet will be revised with a reference to the appendix.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
123.	Volume 1; Sect. 1.2.5.2; Page 1-42; Fig. 1.16	KDEP: "Figure 1.16 indicates that the modeled ^{99}Tc concentration attributed to WAG 28 exceeds the total modeled concentration for all source areas combined. Explain how this is possible."	MEPAS modeling does not allow the modeler to define a specific time interval. Therefore, modeling results for different SWMUs/WAGs had different time intervals. However, in order to add the concentrations from the different sources, uniform time intervals were necessary and were generated using Microsoft Access. For example, the peak concentration for ^{99}TC from WAG 28 was 1.06E6 pCi/L at 92.85 years; however, the total concentration was generated at 90 years, thereby missing the WAG 28 peak at 92.85 years. The figure was corrected to portray the correct relationship: total concentration slightly exceeds that attributed to WAG 28.
124.	Volume 1; Sect. 1.2.5.2; Page 1-43; Para. 2	KDEP: "This paragraph refers to a 250-year estimate for removal of DNAPL at the site. This figure is contradicted in the subsequent paragraph. Is this a hypothetical example? This paragraph is somewhat confusing."	The purpose of the subsequent paragraph with estimated time of DNAPL removal of greater than 1,000 years is to provide the uncertainty with respect to DNAPL modeling using MEPAS. The goal is to clarify to the reader that, although MEPAS modeling predicts all the DNAPL will be released to the environment within 250 years thereby producing a very high concentration of TCE, in reality, the DNAPL will be released to the environment with a much slower rate than predicted by the MEPAS model.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
125.	Volume 1; Sect. 1.2.6.2; Page 1-47; Para. 6 Bullet 2	KDEP: "Although 'Area b' is described in the text, it does not appear in Figure 1.18 (Area used in BHHRA). However, two areas labeled 'Area c' are found in the figure. 'Area j' is also not found in the figure. Please make the necessary corrections."	Agree. The figure was corrected. Modifications to the document were made in response to this comment.
126.	Volume 1; Sect. 1.2.6.2; Page 1-47; Para. 4	KDEP: "An explanation should be provided within this paragraph as to hov BHHRA data was screened. Was additional screening performed ov above what was performed during the individual RI/FS risk assessm Was the same screening criteria consistently used for each of the component BHHRA data sets?"	Agree, a statement will be added to this section that indicates that the data screening used in the GWOU BHHRA was similar to that used in the individual RI risk assessments. The methods used in data evaluation are completely described in the BHHRA contained in the appendix to the FS. This appendix is referenced. Including a more extensive data evaluation description in this section would not be appropriate and would take away from the important discussion concerning the COCs. Note that screening criteria have indeed changed over time due to the accumulation of better information. This is noted in the summaries of individual RI risk assessments presented in the BHHRA. Modifications to the document were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
127.	Volume 1; Sect. 1.2.6.2; Page 1-50; Bullet 2	KDEP: "The wording in the last sentence is incorrect. It should begin with, with HIs and ELCRs . . . .'"	Agree. The bullet will be modified as follows. "To determine POCs, the exposure route HI and ELCR over all COPCs within the land-use scenarios of concern were compared to benchmarks of 0.1 and 1×10^{-6} for exposure route HI and ELCR, respectively. Exposure routes with HIs and ELCRs that exceed these benchmarks were deemed POCs for that land-use scenario of concern." Modifications to the document were made in response to this comment.
128.	Volume 1; Sect. 1.2.6.2; Page 1-58; Table 1.8	KDEP: "The 'notes' section of this table does not explain what the 'Xs' in the table indicate. Please modify the notes appropriately."	Agree. The footnote will be modified as follows. "Notes: A solid cell indicates that the analyte was identified as a priority COC because its chemical-specific HI exceeded 1 or its chemical-specific ELCR exceeded 1×10^{-4} for one or more areas. An "X" indicates that the analyte was identified as a COC with a chemical-specific HI between 0.1 and 1 or a chemical-specific ELCR between 1×10^{-6} and 1×10^{-4}." Modifications to the document were made in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
129.	Volume 1; Sect. 1.2.6.3; Pages 1-67 through 1-78	KDEP: "In this section, each potential COC was evaluated with respect to their contribution to the total risk and/or hazard and their frequency of detection in the total samples taken from each of three water bearing units [Upper Continental Recharge Unit(UCRS); Regional Gravel Aquifer (RGA); and the McNairy Formation]. Frequently detected chemicals considered to make significant contributions to total risk and/or hazard were retained and used to screen remedies in the feasibility study. However, the net result of this evaluation was the elimination of 59 of the 65 COCs that exceeded the initial toxicity screening [assuming residential use of groundwater at 1×10^{-6} and a hazard index (HI) of 0.1], culminating in a feasibility study based on only six volatile organic compounds (four are TCE and breakdown products). "This approach does focus the assessment of remedial strategy on those chemicals that are the most significant risk drivers, but there are two major shortcomings that should be addressed. "First, although volatiles appear to be the major risk drivers, other chemicals (radionuclides and other inorganics and semi-volatiles) are present that contribute to unacceptable risk and/or hazard. Basing the feasibility study (FS) entirely on volatiles does not address the different fate and transport characteristics and potential residual risks/hazards posed by these chemicals. Our recommendation is that the study should identify and retain risk drivers from each class of chemicals for use in determining the appropriate remedial strategy.	Agree. The material summarizing how the screening was performed is correct. Agree. The GWOU binning process will result in our addressing the two shortcomings raised in the comment. Therefore, the modified GWOU strategy will include these recommendations. Additionally, note that the COC discussion contained in the FS focuses the FS on TCE, TCE degradation products and technetium as agreed to by representatives of the DOE, USEPA, and Commonwealth of Kentucky. The earlier WAG specific discussions focused on the source-specific issues. Both the WAG-specific issues and the regional issues were used in decision-making, although the regional issues tend to dominate the FS because of the time required to remediate the regional problems identified. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
129. (continued)		KDEP: "Second, the frequency screening should focus on the data from specific exposure areas. It is inappropriate to calculate the detection frequency over the entire sampling area (complete data set sorted by groundwater unit). Some plume areas are contaminated with different chemicals than others. Evaluating the entire data set tends to reduce the frequency of the localized contaminants to levels considered insignificant and not worthy of further consideration in the FS. This approach is consistent with the analysis of the groundwater by water-bearing unit."	

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
130.	Volume 1; Sect. 2.2.2; Page 2-3; Table 2.1	KDEP: "It is stated in the table under the general response action for SWMU 99 that 10% of the soil located beneath the SWMU 16 concrete pad will be excavated to a depth of 5 feet. Explain how the figure of 10% was derived given that very little sampling has taken place near or under the pad. Also, modify the table to include an action for the DNAPL present at SWMUs 7 and 30 and add AOC 211 to the areas associated with C-720 East that will require extraction."	Agree. Minimal information exists to develop volume estimates for SWMU 99. During the WAG 28 RI, samples were not collected from inside/below SWMU 99, which is considered to be an active part of the facility. Additional future sampling will be required to determine the appropriate extent of remediation necessary at SWMU 99. The text was revised to indicate that the 10% value was developed assuming that soil contamination is present near cracks in the concrete pad but not under the entire pad. Disagree. As a result of the GWOU Core Team activities, SWMU 4, 7 and 30 remedial actions will be implemented asa part of the Burial Grounds Operable Unit. Table 2.1 was modified to indicate the transfer of the SWMUs to other operable units. AOC 211 was already included in Table 2.1 (i.e., it was identified in the "C-720 East" column in the "Extraction" row as "UCRS DNAPL Area - NE C-720"). The table will be modified to clarify that this area is AOC 211.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
131.	Volume l; Sect. 2.3.3; Page 2-8; Table 2.2	KDEP: "Table 2.2 indicates that a 'full-scale demonstration' of the VORTEC™ is scheduled to occur at PGDP. This is doubtful given the court challenges that have hampered this project. Perhaps this statement should be modified to better reflect reality. In addition, the direct heating (Six-Phase) process is listed as being applicable in the UCRS. This technology may also be applicable in the RGA. Indicate in the 'Comments' section that Six-Phase heating may be applicable as an RGA process."	Agree. The text regarding the Vortec™ demonstration was revised as appropriate. Agree. The text was revised to indicate that the Six-Phase Heating process option is potentially applicable in the RGA.
132.	Volume 1; Sect. 4.2.1.2; Page 4-9; Table 4.1	KDEP: "Several of the MCLs listed under the heading 'KAR Domestic Water Supply 401 KAR 8:250' can not be attributed to this regulation. In one instance an MCL of 0.4 ug/L is given for beryllium. This should be 4 ug/L. Several other inorganic MCLs listed in this column are secondary standards taken from 401 KAR 8:600. Several of the volatile organics could not be located in any state regulation. State regulation 401 KAR 8:250 does not list MCLs for organic compounds. This column must be revised to correct the errors present."	Agree. The table was corrected.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
133.	Volume 1; Sect. 4.2.2.1; Page 4-18; Para. 2	KDEP: "There is no mention within the paragraph of the pumping rate that would be required to contain this plume. Indicate the average pumping rate required to contain the Southwest Plume."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
134.	Volume 1; Sect. 4.2.2.2; Page 4-27; Para. 8	KDEP: "This paragraph states that the expected period of operation for the Alternative 2 groundwater extraction system would be 30 years. It should be made clear that any pump and treat system installed would actually be required to operate for a period in excess of 30 years. In fact, a system such as this would likely need to remain operational as long as DNAPL source zones existed inside the plant. Modify the paragraph to indicate that while only a 30-year operational time frame was considered for this alternative, it is understood that this time frame would exceed 30 years."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
135.	Volume 1; Sect. 4.2.2.3; Page 4-31; Para. 6	KDEP: "This sentence refers to Alternative 2, one of the alternatives that does not address any of the plant's DNAPL sources. The sentence at the bottom of the page states that '…residual risk in the source areas would not be unacceptable under future industrial land use.' Is it assumed that the future industrial worker would have no contact with groundwater or soils located in these areas? What about a future excavation worker?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
136.	Volume 1; Sect. 4.2.3.2; Page 4-47; Para. 6	KDEP: "The first sentence of this paragraph refers to the upwelling of TCE and ^{99}Tc from the Northwest Plume into Little Bayou Creek as 'suspected discharges.' There is little doubt given the evidence gathered by Dr. Alan Fryar of the University of Kentucky that these contaminants are discharging from groundwater to Little Bayou Creek. Delete the word suspected from this paragraph."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
137.	Volume 1; Sect. 4.2.4.2; Page 4-56; Para. 2	KDEP: "The last sentence in this paragraph seems to indicate that the dehalogenation of organic compounds passing through a PTZ is somehow dependent upon the chemical precipitation of ^{99}Tc. It is the Division's understanding that these two processes are more or less independent of one another. Please explain."	The commentor is correct. The destruction of the TCE and the absorbtion of the technetium-99 are independent of one another. Both contaminants need not be present for the zone to work. Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
138.	Volume 1; Sect. 4.2.4.2; Page 4-64; Para. 5	KDEP: "The last sentence of the paragraph states that 'long-term maintenance of the PTZ will be infrequent and limited in scope.' Although it is understood that this as well as the other alternatives presented in this document are based on a 30-year operational time frame, this statement remains somewhat misleading. In reality, PTZ maintenance will be required for as long as on-site sources remain in place. For this alternative (Alternative 4, sources are estimated to remain in place for as long as 7,000 years (UCRS source zones). It has been estimated that a PTZ's operational life span is likely no longer than 10 years. It should be made clear to the reader within this paragraph that the word 'long-term' refers to a 30- year time frame."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
139.	Volume 1; Sect. 4.2.4.2; Page 4-65; Para. 6	KDEP: "This paragraph explains the use of PTZs under Alternative 4 to treat groundwater migrating offsite. In the interest of consistency and full disclosure, modify the paragraph so that it is similar to the text used on page 4-105 under the heading *groundwater*. This paragraph should briefly describe the possible pitfalls associated with PTZ implementation. These include the possibility that TCE or its degradation byproducts may not be completely degraded, that byproducts such as vinyl chloride might be formed due to incomplete dehalogenation, that ^{99}Tc may desorb from the iron medium at some time in the future, and that the PTZ could become fouled and thereby become an impenetrable barrier to groundwater flow."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
140.	Volume 1; Sect. 4.2.4.2; Page 4-65; Para. 7	KDEP: "This paragraph implies that a groundwater to surface water connection may exist within Little Bayou Creek northeast of the plant. The study cited found that a connection does exist. Delete the word 'potential' from the second sentence of this paragraph. Also, it is suggested that the following more recent citation be used in place of the given citation: "Fryar, A. E., Wallin, E. J., and Brown, D. L., 2000, Spatial and temporal variability in seepage between a contaminated aquifer and tributaries to the Ohio River: Ground Water Monitoring & Remediation, v. 20, no. 3, p. 129-146."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
141.	Volume 1; Sect. 4.2.4.2; Page 4-68; Para. 8	KDEP: "The treatment times listed here as being required to reach acceptable contamination levels outside the security fence are inconsistent with the times listed elsewhere in the document. Other portions of the document (page 4-53, paragraph 7) indicate that at least 1,000 years will be required to dissolve the RGA DNAPL sources that, in part, fuel off-site TCE migration. This would be followed by a period of at least 60 years before off-site contamination levels would reach MCLs. Modify the text as appropriate."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
142.	Volume 1; Sect. 4.2.5.1; Page 4-70; Para. 7	KDEP: "The third sentence in this paragraph states that a '…series of extraction wells number fifty will produce 3.6 million gallons per day….' Does this mean that fifty extraction wells would be required to contain off-site migration of contaminants at the fence line?"	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
143.	Volume 1; Sect. 4.2.5.2; Page 4-80; Para. 3	KDEP: "This paragraph does not appear to be relevant to Alternative 5. If material injection is being considered as a part of Alternative 5, then the material must be identified in the text."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
144.	Volume 1; Sect. 4.2.5.2; Page 4-80 Para. 7	KDEP: "This paragraph refers to <u>suspected</u> non-aqueous phase TCE (DNAPL) being present in source areas. The presence of DNAPL was confirmed in at least one of these areas (SWMU 11) using downhole reactive membrane tests. These tests clearly identified the presence of DNAPL globules in the subsurface. Modify the text to indicate that DNAPL has been positively identified at the PGDP."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
145.	Volume 1; Sect. 4.2.5.2; Page 4-87; Para. 4	KDEP: "The second sentence states that '...groundwater...may be discharging to Little Bayou Creek....' Modify this sentence to state that groundwater is discharging to Little Bayou."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
146.	Volume 1; Sect. 4.2.6.1; Page 4-89; Para. 4	KDEP: "This figure is misleading. The entire plume is colored yellow indicating that all dissolved phase contamination will be treated using bioremediation. The text indicates that only the off-site portions of the dissolved phase contamination will be treated. Modify the figure."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
147.	Volume 1; Sect. 4.2.6.2; Page 4-109; Para. 3	KDEP: "This paragraph should briefly describe several of the possible pitfalls associated with PTZ implementation. These include the possibility that compounds such as vinyl chloride might be formed due to incomplete dehalogenation, that ^{99}Tc may desorb from the iron medium at some time in the future, and that the PTZ could become fouled and, thereby, become an impenetrable barrier to groundwater flow."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
148.	Volume 1; Sect. 4.2.7.1; Page 4-114; Para. 6	KDEP: "The last sentence of this paragraph states that Alternative 7 has the possibility of reducing dissolved phase TCE concentrations to the 5 µg/L within a 100-year time frame for groundwater located downgradient of the treatment systems. In addition to a pump and treat system, Alternative 7 includes UCRS source remediation. In contrast, Alternative 2 includes only the pump and treat system, and yet it is reported to be capable of obtaining the same results within a 60-year time frame, 40 years sooner than Alternative 7. This doesn't appear to make sense. Please explain the discrepancy in treatment time frames."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
149.	Volume 1; Sect. 4.2.7.1; Page 4-116; Para. 4	KDEP: "This paragraph indicates that an extraction well would be use to capture the core of the Southwest Plume under Alternative 7. Indicate within this paragraph the pumping rate that would be required in order to capture this contamination."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
150.	Volume 1; Sect. 4.2.8.1; Page 4-130; Para. 2	KDEP: "It is stated here that up to 547 monitoring wells would be installed as a part of Alternative 8. This seems to be overkill. It may be that the costs associated with this alternative could be substantially reduced if the number of monitoring wells planned were reduced. In the comment response, list the percentage of the total cost for Alternative 8 that is associated solely with monitoring well installation, maintenance, and sampling."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
151.	Volume 1; Sect. 4.2.8.1; Page 4-130; Para. 3	KDEP: "The last sentence of this paragraph seems to contradict what is depicted in Figure 4.14 on page 4-162. The figure indicates that groundwater at Little Bayou Creek will contain in excess of 20 ppb TCE following a 10-year treatment time, not less than 5 ppb as stated in the text. Please explain or modify the text as necessary."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
152.	Volume 1; Sect. 4.2.8.2; Page 4-136; Para. 6	KDEP: "Alternative 8 appears to be capable of reducing dissolved TCE levels to below the 5 ppb MCL within 15 years. Indicate in the comment response the degree to which this time frame would change if chemical oxidation was not used inside the security fence."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
153.	Volume 1; Sect. 4.2.8.2; Page 4-144; Para. 2	KDEP: "Modify this paragraph to more candidly state the possible pitfalls associated with the PTZ technology. Specifically, indicate that there is a risk of vinyl chloride production and ^{99}Tc desorption."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
154.	Volume 1; Sect. 4.2.8.2; Page 4-145; Para. 6	KDEP: "This paragraph states that the Six-Phase Heating system is capable of removing approximately 95% of UCRS DNAPL. The text associated with Alternative 7 stated that only 90% removal could be achieved. While it is realized that these percentages are simply estimates, an effort should nevertheless be made to be consistent when citing removal efficiencies. Please revise the text as necessary so that the same percentage is used throughout the text."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
155.	Volume1; Sect. 4.2.8.2; Page 4-148; Para. 5	KDEP: "See Comment #46 [#144]."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
156.	Volume 1; Sect. 4.2.8.2; Page 4-151; Para. 3	KDEP: "See Comment #46 [#144]."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.
157.	Volume 1; Sect. 4.3; Page 4-154; Table 4.19	KDEP: "Under the table row labeled 'Environmental Protection' discharges from the Northwest Plume into Little Bayou Creek are referred to as 'suspected discharges.' Discharges to Little Bayou Creek from the Northwest Plume are occurring. Delete the word 'suspected' from the table."	Agree. Text was revised accordingly.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
158.	Volume 1; Sect. 4.3; Page 4-156; Table 4.19	KDEP: "Under the table row labeled 'Type/quantity of residuals remaining after treatment' there are several instances where the text state '^{99}Tc will remain in the PTZ matrix within the aquifer.' This statement should be altered to read '^{99}Tc will remain in the PTZ matrix within the aquifer for a period of time yet to be determined.'"	Agree. Text was revised accordingly.
159.	Volume 2 Sect. 1.2.3; Page 1-7; Fig. 1.1	KDEP: "This figure is misleading. The ^{99}Tc plume is depicted as having migrated much further eastward than can be confirmed with available groundwater data. This area is listed in the figure legend as being the 'probable extent' of the ^{99}Tc plume. There is little data to support this assertion. Modify the legend so that it indicates that this is the 'possible extent' of contamination."	Agree to update Figure 1.1 with concepts depicted on the latest plume maps (maps for Calendar Year 2000).
160.	Volume 2; Sect. 2.2; Page 2-3; Fig. 2.2	KDEP: "The title of this figure is 'Land Use Surrounding PGDP.' Change the title to 'Current Land Use Surrounding PGDP.'"	Agree. The figure was retitled "Current Land Use Surrounding PGDP."

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
161.	Volume 2; Sect. 2.5.3; Page 2-7; Para. 6	KDEP: "Item number two states that the UCRS contains an 'overlying interval of fine-textured sediments.' The text goes on to state that this unit is present everywhere at the plant site. If this text is referring to the HU-3 confining unit, then this last statement is false. The HU-3 unit does not exist everywhere at the PGDP. A case in point is the C-400 building where the unit is believed to be non-existent. If the HU-3 unit is being referred to here, then modify the text to correct the error."	Agree. The text revised to state that the HU3 interval typically is present above the lower continental deposits beneath the plant site.
162.	Volume 2; Sect. 4.6.2.4; Page 2-11; Para. 1	KDEP: "The statement is made here that east-west heterogeneities within the RGA and water line leaks combine to produce the separation between the Northwest and Northeast plumes. Is this known with certainty or are there still other factors as yet unconsidered that could be producing this effect?"	These factors are certain to be significant controls on the separation between the Northwest and Northeast Plumes. Other factors are not apparent.
163.	Volume 2; Sect. 2.8.4; Page 2-15; Para. 2	KDEP: "The last sentence of this paragraph could be interpreted to mean that although habitat exists for the Indiana bat near the PGDP, the bat has never been sited in the area. In fact, state wildlife officials have sited the Indiana bat. Modify this paragraph to indicate that the Indiana bat is present near the PGDP."	Agree. A sentence was added to state that the Indiana bat is known to be present.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
164.	Volume 2; Sect. 3.2.2.4; Page 3-30; Para. 2	KDEP: "This paragraph states that during the Phase II site investigation the 'Lower Continental Deposits were determined to be underlain by the Porters Creek Clay, the McNairy Formation, and Eocene Sands across the site.' This statement is false. It is true that, south of the Porters Creek Clay Terrace, deposits similar to the Lower Continental Deposits overlie Eocene Sands, the Porters Creek Clay, and the McNairy Formation. Modify this text accordingly."	Disagree. This section reports the conclusions of previous investigations which, in this case, have proven to be incorrect. The conceptual model for the Feasibility Study is based on the correct geologic relationships.
165.	Volume 2; Sect. 4.3; Page 4-156; Table 4.19	KDEP: "Under the table row labeled 'Type/quantity of residuals remaining after treatment,' there are several instances where the text states, '^{99}Tc will remain in the PTZ matrix within the aquifer.' This statement should be altered to read, '^{99}Tc will remain in the PTZ matrix within the aquifer for a period of time yet to be determined.'"	This is a duplicate comment. Please see Comment #158 for a response.
166.	Volume 2; Sect. 3.2.6.1; Page 3-140; Para. 4	KDEP: "This paragraph indicates that levels of TCE in groundwater at SWMU 2 do not indicate that DNAPL is present there. This statement is contradicted by another statement made on page 3-138. The second paragraph on page 3-138 indicates that TCE was detected at 140 mg/kg in SWMU 2 UCRS soils. This level of TCE in soil could be interpreted as an indication of DNALP. Explain this discrepancy."	The detection of TCE at 140 mg/kg (and cis-1,2-DCE at 130 mg/L) from boring SWMU2-2 at 12 ft depth was an isolated occurrence from within the burial ground. These levels, alone, do not define DNAPL occurrence. Given the nature of the buried waste (TCE-contaminated sludges within a capped burial cell), it is likely that the released volatile organics are present only as dissolved phase. If DNAPL were present in any significant volume, much higher dissolved concentrations would be expected to occur.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
167.	Volume 2; Sect. 3.2.6.3; Page 3-158; Para. 4	KDEP: "The last sentence of this paragraph states that the property boundary is in the nearest point of exposure associated with SWMUs 7 and 30. This is incorrect. The nearest point of exposure is the PGDP security fence. Modify the text to indicate that the fence line, and not the property boundary, is the nearest point of exposure."	The text revised to read, "as the modeling indicates uranium never will reach the DOE property boundary at unacceptable levels." Section 3 summarizes previous reports. The PRAP and ROD will evaluate both scenarios (security fence and DOE property boundary as the point of exposure) with a decision being reached in the ROD.
168.	Volume 2; Sect. 3.2.8.1; Page 3-232; Para. 1	KDEP: "The last sentence of this paragraph indicates that Figure 3.57 identifies the area where dioxins were excavated. The figure does not depict the excavated area. Modify the text or the figure."	Agree. The figure was corrected.
169.	Volume 2; Sect. 3.2.8.3; Page 3-243; Para. 3	KDEP: "Borehole 'H,' where TCE is reported to have been detected, is not listed on Figure 3.61. Modify the figure to include this sampling point. Also, indicate why there are no provisions within this GWOU FS to address the high level of TCA (i.e., 168,000 µg/kg) detected in soil samples at SWMUs 56 and 80."	Agree. Borehole "H" will be labeled on Figure 3.61. Representatives of the Commonwealth of Kentucky and the EPA, along with the DOE, will review the site data and determine if an action is warranted under the GWOU.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
170.	Volume 2; Sect. 3.2.9.2; Page 3.261; Final Para.	KDEP: "The last sentence of this paragraph states that the '...C-720 area is not a significant source of TCE to the RGA.' While it is true that the C-720 source areas are much less of a problem then say the C-400 area, this area is nonetheless a problem area. Delete this sentence from the paragraph."	Agree. The text revised to better present the relative importance of C-720 as a TCE source to the RGA.
171.	Volume 2; Sect. 3.3.7; Age 3-333; Last Para.	KDEP: "Apparently, it was determined during the Data Gaps investigation that a TCE/^{99}Tc source area may exist to the south of the C-616 lagoons. This area will require further investigation since it may need to be addressed under the GWOU. Provide a time frame and regulatory mechanism (e.g., RI/FS, PSAI, etc.) for further characterization of this area."	This request is beyond the scope of the Groundwater Feasibility Study. Current analysis of the contaminant concentrations in the plumes does not indicate the presence of a source area.
172.	Volume 2; Sect. 4.3; Page 4-4; Table 4.2	KDEP: "Table 4.2 indicates that there are no contaminants present at SWMU 91 (UCRS) that present an ELCR to a human receptor. TCE is present at SWMU 91 at levels that present a risk to humans. Modify the table to indicate that TCE is a COC at SWMU 91."	Agree. Because Table 4.2 is intended to identify the potential COCs that may need to be addressed by the GWOU, the TCE contamination at SWMU 91 will be listed. However, a footnote was added that states that the TCE contamination currently is being remediated under the Lasagna project.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
173.	Volume 2; Sect. 4.3.1.2; Page 4-9; Figure 4.2	KDEP: "The figure does not indicate the full eastern and western extent of the on-site ^{99}Tc contamination. Modify the figure so that it depicts the off-site portion of the ^{99}Tc contamination associated with the Southwest Plume. Also, indicate that ^{99}Tc has extended east of MW255."	Agree that the figure does not reflect the current understanding of the extent of ^{99}Tc contamination. However, the figure was the latest update of the ^{99}Tc plumes map for the time when writing for the Feasibility Study was completed. The figure will not be revised.Text is present in Section 4.3.1.2 to qualify the time-related limitation of the map.
174.	Volume 2; Sect. 4.3.1.3; Page 4-10; Para. 5	KDEP: "This paragraph indicates that the primary source for the core of the Northeast Plume has yet to be identified. When does the DOE propose to locate and characterize the primary source?"	There are indications that the DNAPL source of the Northeast Plume is being rapidly depleted through un-assisted dissolution. This is supported by recent groundwater monitoring data that will be presented in the upcoming revision of the groundwater maps.
175.	Volume 2; Sect. 4.3.2.2; Page 4-30; Figure 4.19	KDEP: "The figure is not accompanied by a concentration map as are the other maps in this section. Add a 'maximum detected level' map to this section. In addition, provide an explanation in the response to comments as to why only a select few locations (i.e., Southwest Plume and the northern landfills) have been sampled for acrylonitrile."	Agree to label the single detection of acrylonitrile on the existing map. Acrylonitrile generally has not been recognized as a site-related groundwater contaminant and has not been a required analysis for most of the previous groundwater investigations.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
176.	Volume 2; Sect. 4.3.2.2; Page 4-35; Figure 4.24	KDEP: "See Comment #68 [#166]."	Agree to label the single detection of PCB-1254 on the existing map. PCB-1254 generally has not been recognized as a site-related groundwater contaminant and has not been a required analysis for most of the previous groundwater investigations.
177.	Volume2; Sect. 4.3.2.3; Page 4-36; Para. 1	KDEP: "This paragraph states that background values computed from filtered inorganic sample results were used as a basis for comparison when plotting the maps presented in this section. Since the samples represented on the maps were unfiltered, this comparison is invalid. The text states that this comparison was made to be conservative. Nevertheless, the comparison is inappropriate since it is basically comparing apples to oranges. The maps must be modified so that unfiltered background numbers, once corrected (see Volume 5 comments), are used as the basis for comparison. In addition, maps should be included in this section that indicate the location of all metals results that have exceeded MCLs."	Agree with logic. However, the more stringent filtered-sample comparison proves useful for highlighting potential pathways of migrating contaminants. The filtered sample background values have been retained as the standard for the maps. A comparison against unfiltered values and MCLs has merit for demonstrating the extent of PGDP-induced contamination and the severity of the contamination. A table has been added to the text, similar to and following Table 4.3, which provides the number of samples exceeding the unfiltered background levels (and factors thereof) and MCLs. Moreover, the extent of metals contamination will be evaluated (including maps that reference MCL standards) in a forthcoming White Paper. A reference to the White Paper will be added to the text.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
178.	Volume 2; Sect. 4.3.2.3; Page 4-44; Fig. 4.32	KDEP: "A scale was not included with this figure. Add a scale to the figure and modify the figure so that only those results that exceeded or were less than total barium background are plotted."	Agree to add a legend to the figure. The scale of the figure is indicated by markings of eastings and northings.
179.	Volume 2; Sect. 4.3.2.3; Page 4-52; Fig. 4.40	KDEP: "Do any of the samples plotted on this figure represent dissolved chromium hits?"	Agree. The text was modified as a result of this comment to research and discuss in text.
180.	Volume 2; Sect. 4.3.2.3; Page 4-75; Fig. 4.62	KDEP: "The legend at the bottom of this figure does not include any units. Add the appropriate units to the legend."	Agree. Units were added to the figure legend.
181.	Volume 2; Sect. 5.2.1; Page 5-3; Table 5.2	KDEP: "Are the source concentration units for the listed radionuclides mg/kg or pCi/g?"	It should be pCi/g. The units were corrected in the revised document.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
182.	Volume 2; Sect. 5.2.4; Page 5-29; Table 5.26	KDEP: "The table indicates that the source term for acenaphthylene (2,924 μg/kg) was derived by taking the 'average of 1 detect and ½ of 4 non-detects.' However, in the case of Np-237, the average of 1 detect and two non-detects was used. Explain why ½ of the NP-237 MDA wasn't applied to the two non-detects when computing the source term."	Agree. Table 5.26 was corrected. The Np^{237} value that was modeled was derived from the average of the one reported detection and ½ of the minimum detection limit that was reported for two other samples.
183.	Volume 2; Sect. 6.1.4; Page 6-7; Table 6.1	KDEP: "Suspected Northeast Plume sources SWMU 183 and SWMU 194 are listed as having no primary contaminants associated with them. In fact, several inorganic contaminants have been detected at high levels at the SWMU 194 (leach field). In addition, sampling at SWMU 183 has not been adequate to definitively determine the absence of contaminants there. Modify this table to indicate that it is unknown whether primary contaminants are present at SWMU 194."	Agree. SWMU 194 will be listed as a potential source of primary contaminants.
184.	Volume 3; Executive Summary; Page xiii; Para. 3	KDEP: "Area 'n' is incorrectly identified as composed of Areas m and n. It should be corrected to read 'composed of Areas 1 and m.' This error is also repeated in Section 2.2.1 (Data Evaluation: Consideration of Geographical Location of Sampling Location) and in Section 7.1 of the Baseline Risk Assessment."	Agree. This will be corrected in the revised document. Modifications to the document were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
185.	Volume 3; Executive Summary; Page xiv; Para 1	KDEP: "Ingestion of groundwater is listed under the Industrial Worker scenario as one of the assumed exposure routes. It is the Division's understanding that this exposure route is no longer to be considered under the future industrial worker scenario. Modify if necessary."	Agree. Ingestion of groundwater no longer is an exposure route considered for the worker; however, the decision to drop this exposure route was made after the completion of the GWOU FS BHHRA. Therefore, no modification to the FS is necessary. Note that the uncertainties associated with groundwater use by the worker are discussed in the BHHRA. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
186.	Volume 3; Executive Summary; Page xvi	KDEP: "We agree with the overall conclusions of the risk assessment, namely that risk from groundwater use both on and offsite is above acceptable levels. The primary risk drivers appear to be TCE and breakdown products, although other chemicals are present that contribute to unacceptable levels of risk. We also agree that aggressive action toward source removal and plume control/mitigation for the TCE contamination should be a priority. The conclusion presented here is that significant modeling uncertainty with regards to contaminant migration indicates that risk management decisions should be focused on addressing the TCE contamination in the short term. However, specific areas onsite appear to have little TCE contamination but are contaminated with other chemicals (inorganics/radionuclides). The expressed concern with the 'very uncertain' results of the modeling conducted to evaluate COC groundwater concentrations of these chemicals is a reason to elevate the priority of these other areas and COCs. In the selection of an appropriate remedial approach, these other chemicals (inorganics/radionuclides) should be considered."	Agree. The summaries of the WAG-specific risk assessments identify all COCs at source units, and it is agreed that these COCs should be addressed when action is taken at the source units. DOE's agreement with this approach was displayed in the GWOU "binning packages" prepared for use at the recently completed GWOU meetings. In those binning packages, all COCs at source units were presented. The document was not modified in response to this comment.
187.	Volume 3; Sect. 1.2.1.2; Page 1-23; Exhibit 1.16	KDEP: "This table indicates that a source of TCE exists within the RGA at the C-720 Building. The remainder of the FS would seem to reject this idea. Is there, in fact, a secondary DNAPL source (RGA source) present at the C-720 Building?"	The available data do not support the conclusion that a RGA DNAPL exists in the immediate C-720 Building area. However, the presence of DNAPL in the RGA at the C-720 Building area remains a reasonable deviation to the site conceptual model.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
188.	Volume 3; Sect. 1.2.1.3; Page 1-35; Exhibit 1.26	KDEP: "This table indicates that there is a TCE DNAPL source present within the UCRS at AOC. In previous comment responses submitted to the Division the DOE has denied that any DNAPL is present within the boundaries of AOC 204. Please explain."	This material is taken from the WAG 28 RI Report. This information will be checked and corrected as required. The status of past disagreements concerning AOC 204 is beyond the scope of this report; however, note that the information presented here indicates that AOC 204 may be a source of TCE and needs to be addressed as such. The document was not modified in response to this comment.
189.	Volume3; Attachment 2.3; Page 2-4; Para. 2	KDEP: "This paragraph states that groundwater background concentrations were used as a means of screening data prior to its consideration as a part of the BHHRA. The Division has some serious problems with the manner in which the background concentrations were calculated, especially for those calculated for inorganics. In their present form several of these background values are unacceptable and therefore can not be used to eliminate data from the BHHRA. It was inappropriate to utilize background values that have not yet received regulatory approval to screen data. If this screening tool was used extensively then it may be necessary for the DOE to amend the BHHRA."	Noted. Please be aware that the risk assessment contains a quantitative evaluation of the uncertainty inherent in a background screen. Therefore, no data were eliminated. All information is available for decision-making. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
190.	Volume 3; Sect. 2.4.1; Page 2-5; Bullet 2	KDEP: "It is stated here that only the 'volatile organic carbon' anatype was retained by the SAS program for samples collected form boreholes. Does this anatype refer to volatile organic compounds or total organic carbon? Explain the specific reasons for eliminating all other anatype for sample collected from boreholes."	Agree. An explanation will be added. This explanation will state that only results for VOCs were retained from boreholes. Additionally, the modified document will state that results for all other anatypes were not retained because these results were biased high due to the method used to collect samples from "naked" borings. Generally, samples collected from boreholes tend to have very high suspended solids leading to very high metals and radionuclide concentrations upon preservation. These results tend to be misleading. Modifications to the document were made in response to this comment.
191.	Volume 3; Sect. 3.2.7; Page 3-5; Para. 4	KDEP: "The last sentence of this paragraph states that '…no known sources of groundwater contamination exist in Area f.' This statement is inaccurate. A small DNAPL source exists at the KPDES 011 ditch. Modify this statement or delete it."	Agree. An UCRS DNAPL source is present on Outfall 011, within Area f, that does impact surface-water quality. Modifications to the document were made in response to this comment.

COMMENT RESPONSE SUMMARY ***Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
192.	Volume 3; Sect. 3.3.5; Page 3-14; Para. 4	KDEP: "USEPA Region 4 guidance (1995) specifies that the exposure concentrations of COPCs in groundwater should be calculated from the arithmetic average of the most contaminated wells in the highest impacted area of the plume. The approach used in the feasibility study to calculate the exposure concentrations consisted of the lesser of the upper 95% confidence of the arithmetic average or the detected maximum in eleven distinct areas (a-k), and three combined areas (l-n). The approach of breaking down the site into distinct areas (inside and outside specific plumes and inside/outside of the plant boundary) appears appropriate. However, using all data within all areas does not appear to be consistent with the USEPA guidance. Using data from the wells within each area considered to be most impacted (as seen by the well-by-well risk analysis included in the feasibility study) would appear to address the unique PGDP-specific issues (multiple plumes; presence of SNAPL and dissolved phase contaminants) and is consistent with the USEPA guidance."	Agree. The EPA approach makes sense if only major contaminants are important to the analysis and if source unit risks assessments are not available. However, the groundwater at the PGDP is contaminated with many chemicals and compounds and the source unit risk assessments are available. Additionally, because there are multiple chemicals and multiple sources at the PGDP, the rules that would allow the selection of "wells... most impacted" are not obvious. The document was not modified in response to this comment.

COMMENT RESPONSE SUMMARY

Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1857&D1 issued July 2000) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
193.	Volume3; Attachment 2; Figure 3.3	KDEP: "The 'DOE BOUNDARY' listed in the legend and depicted in the figure actually coincides with the Water Policy Boundary. This is confusing and may cause the reader to mistake this boundary for the DOE property boundary. In addition, the 'PGDP BOUNDARY' listed in the legend is represented by a solid line on the figure rather than by the dashed line shown in the legend. Modify the figure legend by changing the words 'PGDP BOUNDARY' to 'DOE PROPERTY BOUNDARY.' Also, change the solid line representing this boundary in the figure to the dashed line presented in the legend. Finally, change the words 'DOE BOUNDARY' listed in the legend to 'DOE WATER POLICY BOUNDARY.'"	Agree. The figure was corrected. Modifications to the document were made in response to this comment.
194.	Volume 4; Appendix C2; Sect. 4; Page C2-21; Para. 2	KDEP: "The fifth sentence of this paragraph indicates that PTZ technology has been used at depths up to 120 feet. Where has this been accomplished?"	Otis Air Force Base., Massachusetts Military Reservation, Cape Cod, MA (1999).
195.	Volume 4; Appendix C3; Figure C3.4	KDEP: "The vertical scale depicted in this figure is incorrect. Make the necessary corrections."	Agree. Necessary corrections were made in the revised document.
196.	Volume 4; Appendix C3, Figure 3.33	KDEP: "The vertical scale in this figure is incorrect. Make the necessary corrections."	Agree. Necessary corrections were made in the revised document.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
197.	Volume 4; Appendix C5; Page 8; Para 2	KDEP: "In the first sentence of this paragraph it is stated that, for the P4-H7 area, 'the mass of TCE is 190 1 (50 gal).' It is assumed that the word 'mass' was intended to be 'volume.' Make the appropriate changes. Also, briefly explain how this figure was derived."	Agree to add an errata sheet that revises the text. The previous paragraph presents lines of evidence to suggest that the DNAPL mass is small and states that the available data are insufficient to derive a mass or volume of the DNAPL zone. The 190 L (50 gal) volume is presented as an approximation of a small release.
198.	Volume 4; Appendix C5; Page 42; Para. 1	KDEP: "This paragraph states that 1% of the TCE solubility limit is 110 mg/L. This is incorrect. One percent of the TCE solubility limit is 11 mg/L. Correct the text."	Agree to correct the text with an errata sheet.
199.	Volume 4; Appendix C6; Page 17	KDEP: "SWMU 196 should be assigned to the SSOU. The Core Team made this decision several months ago. Modify this tale to include SWMU 196 under the SSAU and remove it from the GWOU."	Agree. This section was replaced with the most current information from the Core Team.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
200.	Volume 4; Appendix C6; Page 18	KDEP: "It is stated in the table that all soil contamination associated with SWMU 203-with the exception of the TCE and ^{99}TC contamination-will be addressed under the SSOU. This has yet to be determined. The binning process will determine how soils contaminated with substances other than TCE and ^{99}TC will be addressed. Remove the statement 'the remaining soil contamination will be addressed under the SSOU' from the comment box. In addition, SWMU 211 should be addressed under the SSOU as well as under the GWOU. Modify the table to include SWMU 211 under the SSOU."	This section was replaced with the most current information from the Core Team.
201.	Volume 4; "Basis of Estimate Feasibility Study for the GWOU Alternative 5 PGDP GWOU"; Section WBS 5.03.02.02	KDEP: "This section indicates that samples collected during the third year of operation would be obtained on a quarterly basis. Assuming Alternative 5 was selected, this level of sampling would be inadequate. If extracted groundwater were to be discharged continuously it would be necessary to implement a sampling program similar to that now being used at the C-612. Any such system would require an autosampler that would monitor TCE discharge levels."	Section 4 of the FS, "Detailed Analysis of Alternatives," and Appendix C7 were revised to provide analyses and cost estimates for 11 separate technologies that could be utilized for remediation at PGDP. These technologies include three for Primary Source Areas, three for Secondary Source Areas, and five for the Dissolved Phase Plume. Comments received on the original alternatives and their associated cost estimates were incorporated into these revisions as appropriate.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
202.	Volume 5; Executive Summary; Page xix; Para. 2	KDEP: "Two wells used in the background study were recently identified with plutonium concentrations above 'background' (DOE 2000) and the PGDP-derived risk-based concentration (RBC) of 0.12 pCi/L. Monitoring well MW-150, screened in the RGA, reportedly contained plutonium at 10 pCi/L. Plutonium was detected four times in the McNairy Formation well MW-122, ranging in concentration from 0.6 to 1.6 pCi/L. Plutonium data from these wells were not found in the data summary tables in Appendix B. The apparent contamination of these wells indicates that they are not suitable as background wells, at least for plutonium."	The results contained in this comment could not be verified. If the results are correct, then the selection of the wells as background wells for future work may be suspect. However, the use of historical data collected from these wells may not be incorrect unless it can be shown that Pu was in these wells at an earlier date. No text changes were made in response to this comment.
203.	Volume 2; Executive Summary; Page xxi; Table ES-1	KDEP: "The data presented for nickel in the RGA (0.305 mg/L) does not match that presented in Volume 2, Table 4-3 (page 4-36) in the Feasibility Study (0.288 mg/L)."	Table 4.3 will be corrected to reflect the correct nickel background level.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
204.	Volume 5; Sect. 2.0; Page 3	KDEP: "Most of the wells selected for background data apparently are affected by technetium-99 levels (some approaching *de minimus* risk levels). Since technetium-99 is clearly a site-related contaminant, we (KYDEP) strongly discourage using 'background' levels of this radionuclide for risk management decisions. Likewise, plutonium is predominately a man-made radionuclide. We are aware of the argument that atmospheric testing of nuclear weapons is responsible for low-level 'background' concentrations. This may be true, but we are not aware of any data showing widespread 'background' plutonium contamination in Kentucky, other than around PGDP. If such data exists, we would appreciate the opportunity to review it and reconsider our position. In the interim, it appears appropriate to assume that there is no 'background' level for plutonium, or any other man-made radionuclide in Kentucky."	Agree. ^{99}Tc was reported as detected in several wells; however, results for all wells are at or below *de minimis* levels (except well MW247, which was dropped). In fact, the highest ^{99}Tc levels from background wells were 29 and 27 pCi/l. (The values with their errors were 29±23 and 27±23 pCi/l, for the RGA and McNairy, respectively, indicating that these values are really not different from 0, if screened following methods proposed by the Commonwealth's Radiation Control Branch.) These concentrations translate to risk levels of 1.05×10^{-6} and 9.9×10^{-7}, respectively, using the No Action groundwater screening value in the Dec. 2000 revision of the Methods Document. Hence, they are at *de minimis* levels. In any case, because the background values presented in the report for Tc and Pu are essentially zero, it seems reasonable to report the calculated values in the report and then simply indicate that the selected value is 0, because these man-made radionuclides are not expected to be present in groundwater. This approach would be consistent with that used in the soils background report where the subsurface soil Pu background was set at 0 pCi/g. No text changes were made in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
205.	Volume 5; Sect. 2.1; Page 3	KDEP: "Two wells, MW-121 and MW-122, are located within the Northwest and Northeast plumes, respectively. Six organic compounds were detected in three samples from MW-121, including trichloroethene (2 µg/L) in 1994. Technetium-99 was detected eight times out of sixteen sampling events. Technetium-99 was also routinely found in MW-122. We are aware that these wells are screened in the McNairy Formation and the RGA is primary location of groundwater contamination, and may be hydraulically isolated at this location. However, the well cluster in Area 'f'(Northwest Plume) that includes MW-122, also includes wells screened in the overlying RGA that are among the most contaminated wells in the the Northeast Plume (MW-124, MW-126, MW-288, MW-291, MW-293, MW-294). "The routine occurrence of technetium-99 in virtually all wells selected for the background study indicates PGDP is surrounded by a large 'footprint' of site-related contaminants from historical releases. It is also doubtful that these detections are anomalous, as this constituent does not appear in samples taken at other facilities within the Commonwealth and is associated with uranium processing, the primary historical operation at PGDP. More meaningful background data could be obtained by sampling wells with the aquifer(s) at a much greater distance from the facility. As all wells appear to be impacted with low to moderate levels of technetium-99, it is possible that other site-related constituents may also be similarly affected."	Disagree. The information presented in the report provides sufficient evidence to declare the results anomalous. However, it is agreed that if additional wells are installed under a "background project," then siting these wells outside the "footprint" may be appropriate. No text changes were made in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
206.	Volume 5; Sect. 2.1.1.1; Page 4; Para. 1	KDEP: "It is stated that although *cis*-1,2-DCE was detected at MW 103, it was detected at a level that is below the method detection limit. In many cases, the method detection limit (MDL) does not take into account improvements in instrument technology that have occurred since the MDL was last published. In this instance, the instrument detection limit should have been used to validate the detect."	Noted. However, this information is not available. Additionally, it is never appropriate to use IDLs to validate analytical results from environmental samples because IDLs are set using standards that have characteristics that are very dissimilar to environmental samples. This is discussed at length in RAGs, Volume 1, Part A. No text changes were made in response to this comment.
207.	Volume5; Sect. 2.1; Page 5; Fig. 2.1	KDEP: "Dots indicating the locations of monitoring wells are shaded differently depending on whether a well is screened in the RGA or in the McNairy. A legend should be added to the figure that identifies what the shading signifies (RGA or McNairy)."	Agree. The figure was modified as suggested. Text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
208.	Volume 5; Sect. 2.1.2.2; Page 9; Entire section	KDEP: "This section indicates that bis(2-ethylhexyl)phthalate was detected at MW 120 at a concentration of 210 µg/L and that ^{99}Tc was detected in two instances where the error was less than or equal to the detected value. Was bis(2-ethylhexyl)phthalate detected in the method blank or trip blank associated with the sample in question and if so, at what level? Include in the text the second instance in which ^{99}Tc was detected at a level exceeding or equal to the error."	The information requested is not available; however, the lack of detection at a later date clearly supports the conclusion that the detection was anomalous – it is unlikely that such a high level of detection would not be repeated in later sampling. Additional information regarding samples with ^{99}Tc detections greater that their detection errors was added to the revised report. Text changes were made in response to this comment.
209.	Volume 5; Sect. 2.1.2.3; Page 9; Para. 5	KDEP: "This paragraph indicated that ^{99}Tc was detected in two instances where the error was less than or equal to the detected value. Include in the text the second instance in which ^{99}Tc was detected at a level exceeding or equal to the error."	Additional information regarding samples with ^{99}Tc detections greater than their detection errors was added to the revised report. Text changes were made in response to this comment.
210.	Volume 5; Sect. 2.1.2.4; Page 10; Para. 5	KDEP: "This paragraph states that bis(2-ethylhexyl)phthalate was detected in 'one or more of the associated blank samples.' Include in the text levels at which this compound was detected in the blanks."	As noted earlier, results from the blanks are not available for these historical samples. No text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
211.	Volume 5; Sect. 2.1.2.5; Page 11; Para. 5	KDEP: "It is stated here that ^{99}Tc was detected once at a level that exceeded the sample error. Indicate in the text the activity and error associated with that sample."	Additional information regarding samples with ^{99}Tc detections greater than their detections errors was added to the revised report. Text changes were made in response to this comment.
212.	Volume 5; Sect. 2.2.1; Page 13	KDEP: "While we appreciate and support the data analysis process which removed and/or corrected seemingly erroneous data that would bias the background concentrations high, we have a concern about the situation where a detected value was much greater ('generally more than 10x's greater') than the next greatest detected value from a sample from a particular well. In this case, the value was 'corrected' by reducing it to the next greatest value. As most of the wells are located very near the facility and in or near established plumes of contamination, the occasional high detections may indicate initial migration of contaminated groundwater into an area rather than erroneous 'background' data."	Although the alternative conclusion provided in the comment is impossible to refute, that conclusion would seem to have been made without considering why the "correction" was performed, if the corrected result was well outside what may be a "normal" result, and how many corrections were made. Actually, as shown in Table 2.2 and 2.3, the correction for large values was infrequent and was accounted for, in large part, by sample turbidity. No text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
213.	Volume 5; Sect. 2.2.1; Page 13; Bullet 4	KDEP: "This bullet indicates that, in some instances, sample results for a particular well that fell well below the next lowest sample result were 'increased to the next smallest value.' If the results in question could be deemed legitimate detects-that is, if there was no substantive reason (e.g., QA/QC problems) to disqualify the results-then these results should have been included in any calculations."	Disagree. The recommendation here does not consider the effect that including such results would have had on the standard error calculation. Generally, including the very small values actually would have led to larger standard errors and larger calculated upper bound values for background. No text changes were made in response to this comment.
214.	Volume 5; Sect. 2.2.2; Page 14; Bullet 3	KDEP: " See Comment 98 [#196]."	Please see response to Comment #213. No text changes were made in response to this comment.
215.	Volume 5; Sect. 2.2.3; Page 22; Table 2.4	KDEP: "All units presented at the top of this table are expressed in mg/liter. However, the analytes presented in the table are radionuclides. Are these units correct? If not, then correct the units."	Agree. The units were corrected. They should be pCi/l. Text changes were made in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
216.	Volume 5; Sect. 3.2; Page 26	KDEP: "Using the 95% upper tolerance limit (UTL) is not appropriate for characterizing background concentrations. The 95% UTL is the concentration for which one can be 95% confident that at least 95% of the concentrations in the distribution fall below the value. This approach, especially when used with data exhibiting a high degree of variation, can produce screening levels that far exceed health-based screening values, resulting in the elimination of chemicals of potential concern which pose significant risk. In some cases while using this approach, the selected background value actually exceeded the maximum detected value (e.g., Table 3.3; dissolved uranium). A more appropriate approach, and one that has been used by KYDEP and USEPA, is calculating the background based on the lesser of the 95% upper confidence limit (UCL) or the maximum detection."	Generally, any metric can be used for background screening. However, it is recommended that the metric chosen be one that is near the upper end of the background range to ensure that remediation is focused on contamination and not naturally occurring levels. The use of the UTL in the report is consistent with its use in the approved soil background document. Additionally, please note that dissolved uranium is not contained in the referenced table. Also, due to the rules used to select the background values (i.e. the lesser of the maximum detected value and the UTL), it is not possible for the selected value to exceed the maximum detected value. No text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
217.	Volume 5; Sect. 5.1.68; Page 74; Para. 2	KDEP: "The first sentence of this paragraph reads, 'If the method of derivation of the background concentration is considered (i.e., quantitatively versus qualitatively), then a marked proportion of the background concentrations that exceed one or more risk-based criteria are seen to fall within the group of background concentrations that were derived qualitatively.' This is not surprising given that elevated detection limits were not used to qualitatively derive these background concentrations. If this document is to be utilized further for decision making purposes it will be necessary to either run additional analyses using appropriate detection limits or substitute MCLs for background in those cases when the qualitatively determined background numbers exceed MCLs."	Agree. The decision about which path to follow will need to be discussed. No text changes were made in response to this comment.
218.	Volume 5; Sect. 5.2; Page 91; Para. 2	KDEP: "This section makes reference to other reports in which groundwater background concentrations were presented. Include in this section a short explanation of how background concentrations were calculated for the Moore Report, Tech Report, and Site Investigation. In what ways does DOE consider this most recent Groundwater Background Document more accurate than these prior studies?"	Agree. Short discussions of the metric used in the earlier reports will be added to the revised report. These metrics are density plots, twice the average concentration, and the maximum detected value, respectively. In addition, the source of the data (e.g., wells) used to derive the metrics also is now described. Text changes were made in response to this comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
219.	Volume 5; Sect. 5.2.68.2; Page 122; Para. 2	KDEP: "This section indicates that comparisons were made between background concentrations derived for this FS Report and open literature values. The open literature values are presented as ranges in this document. To what part of the range were the FS Report background concentrations compared?"	The proposed background values were compared to the range presented. No text changes were made in response to this comment.
220.	Volume 5; Sect. 5.3.1.1; Page 123; Para. 4	KDEP: "The last sentence of this paragraph states, '. . . there is little uncertainty in the adequacy of the initial list of wells that were selected as background wells.' The Division strongly disagrees with this statement. Many of the wells selected are located within the PGDP's contaminant plumes and show some evidence of contamination. In addition, none of the wells selected were first examined for signs of corrosion (e.g., pitting, etc.). If corrosion is present, concentrations of a select group of metals may be artificially elevated. As a consequence, any background values calculated using data from the corroded wells would be biased high. Amend this paragraph to indicate that there are uncertainties associated with these wells."	Agree. Uncertainties regarding well selection were changed to include concerns about the loss of well integrity. Additionally, the conclusion in the last sentence of the paragraph after that cited in the comment was deleted. Text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
221.	Volume 5; Sect. 5.3.1.3; Page 124	KDEP: "Although the laboratory methodology is consistent with EPA SW-846, the detection limits for some of the analyses are elevated above what is expected when using these methods. For example, lead was not detected in the McNairy Formation with a detection limit of 50 µg/L, although it is routinely characterized at 5 µg/L. In this case, the background value was set equal to the detection limit, although Maximum Contaminant Limit (MCL) is 15 µg/L. As the text points out, the background values for several chemicals that were non-detect or very infrequently detected were set equal to the detection limit. As seen in the above example, it is inappropriate to characterize background as equal to the detection limit when the detection limits exceed the MCL. We recommend that for these chemicals, the detections on-site relative to the MCLs should be used in remedial/management decision-making (essentially making the 'background' equal to the MCLs for those chemicals with high detection limits). We also stress that future work plan development at PGDP should take into account the magnitude of MCLs and health-based criteria with respect to analytical method detection limits before sample analyses in order to provide meaningful data. Data exhibiting high detection limits is essentially useless for risk-based or regulatory decision-making."	The discussion in the comment is essentially correct. However, please recognize that historical data were used in this report and issues such as those raised in the comment cannot be addressed using these data at this time. No text changes were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
222.	Volume 5; Appendix A; Page A-3; Table A-1	KDEP: "Table A-1 indicates that construction details and a boring log are unavailable for MW 102. This data should have been in hand before this well was considered for selection as a background well. What assurances can be given that this well was constructed properly/" .	Agree. This material was added to the revised document. Text changes were made in response to this comment.
223.	General	S. Hampson and J. Volpe, Radiation Health and Toxic Agents Branch (RHTAB): "The Radiation Health and Toxic Agents Branch (RHTAB) and the University of Kentucky have completed their initial review of the D1 GWOU Feasibility Study. Based on review of the material and data in the FS, the RHTAB identified numerous concerns with information provided in the document that must be addressed before the GWOU as a whole can move forward. Because of the volume of individual questions and comments the RHTAB noted in its GWOU FS review, comments are not provided on a page by page basis. The bullets below summarize the comments generated from the RHTAB's review of the GWOU FS document."	Comment continued on next page.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
223. (continued)		▪ ^{99}Tc must be considered as a primary COC for the actions proposed for the GWOU for several reasons, including: 1. ^{99}Tc does leave DOE property in upper, middle, and lower RGA NW Plume groundwater at activities that exceed the 900 pCi/l MCL. 2. Source areas for ^{99}Tc have not been identified; therefore, ^{99}Tc sources concentrations may prohibit the return of groundwater to its beneficial use long after implementation of technologies that will address TCE contamination. 3. Technologies required to remediate ^{99}Tc contamination may be significantly different than technologies that will remediate VOC contamination. Designation of ^{99}Tc as a primary PGDP groundwater contaminant will focus remedial efforts on ^{99}Tc in addition to TCE. ALARA must be incorporated into all DOE analyses, with the ALARA emphasis being placed on Reasonable. 4. Because of its half-life, ^{99}Tc poses a long-term threat to health, safety, and the environment. There are numerous uncertainties about the effectiveness of many of the proposed remedial technologies identified in the document. Several are unproven in any hydrogeological setting and nearly all are unproven in the unconsolidated material, depths, etc., that will be encountered at the PGDP. The effectiveness of several of the proposed technologies will be addressed by pilot studies conducted at the site. Until these pilot studies are concluded and the technologies are known to be effective for the subsurface conditions and contaminants at the PGDP, little emphasis should	Comment is continued on next page The D2 FS has been revised to indicate the contaminants of concern are trichloroethene and degradation products, and technetium-99. Also, the FS has been revised to include 11 technology-based alternatives. Some of these technologies remove the technetium and others capture the material in its structure. We further recognize that additional studies are needed to prove the effectiveness of these technologies at removing technetium. To that end, the DOE is working to implement the studies such as the PTZ Treatability Study and the testing of the Six-Phase Heating System. No change was made to the document in response to this section of the comment.

Comment Number	Sect. Page/Para.	Reviewer and Comment	Draft Response
223. (continued)		be placed on the possible combinations of technologies to address groundwater contamination. However, the development of alternatives from the various technologies is useful in determining the upper bounds of the budgetary requirements that might be necessary to address contamination at PGDP.	
		▪ Dose assessments must be provided for all radionuclides discussed in the GWOU FS. Presently, no dose assessment is provided for any of the radionuclides discussed in the FS.	Agree, dose calculations will be provided as an appendix to the revised risk assessment.
		▪ Source area reduction for groundwater contamination is focused on only a few major SWMUs. SWMUs with perceived but lesser contributions to groundwater contamination and secondary source areas that might exist in both the UCRS and RGA are not addressed in the GWOU FS. The RHTAB suggests that the DOE continue with the GWOU Project Team and the binning process for the GWOU in order to provide further information and a path forward for the GWOU SWMUs.	The FS identifies in the Executive Summary and the Introduction the SWMUs/areas that the FS is directed toward. The FS is not intended to be completely comprehensive for all groundwater contaminants. Section 1.2.6.3 and the Scope section of the Executive Summary provide a description of the process that was used to identify the major contaminants that are driving the risk. Also, some of the SWMUs that are providing contaminants to groundwater, such as some of the burial grounds, are being addressed in other operable units. In addition, the Groundwater Core Team binning has modified the SWMUs that will be encompassed by the GWOU. Following completion of this binning process, the document will be modified to make it consistent with the Core Team actions. It also should be recognized that the technologies used in the document are applicable to the other SWMUs should it be determined that additional action be needed.
		Finally, the RHTAB requests that the DOE provide thorough sets of radionuclide data for each sample collected in the investigation and that the radionuclide data is thoroughly evaluated and discussed in the text of the document so that reported results do not potentially confuse the public."	Agree. Uncertainty in dose calculations due to data will be addressed in the forthcoming appendix mentioned above.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1857&D1 issued July 2000) (continued)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
224.	Sect. 2.5.3	Kentucky Department of Fish and Wildlife (KDFWR): "Section 2.5.3 states that 'wildlife may also serve as an important exposure pathway to humans. To determine the ...importance of this pathway, requests were made for reports on harvest of deer, ducks, geese, and turkey....' Notably absent from the list of species used in Paducah Gaseous Diffusion Plant (PGDP) risk assessments are amphibians and turtles. KDFWR has repeatedly requested the DOE and its subcontractor, BJC, to look at these ecological receptors with respect to the potential human health risks associated with their consumption. These requests have been made in multiple forums ranging from the monthly Federal Facility Agreement Core Team meetings to the Quarterly Exchange meetings between KDFWR and DOE. KDFWR once again requests that amphibians and turtles be evaluated as receptors and potential pathways of human exposure in future PGDP risk assessments."	Agree. A discussion of the uncertainties due to limiting the biota to deer, rabbits, quail, and fish will be provided in the revised BHHRA. However, please note that the forums mentioned in the comment occurred after the completion of the BHHRA. Modifications to the document were made in response to this comment.

COMMENT RESPONSE SUMMARY *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1857&D1 issued July 2000) (continued)			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Draft Response**
225.	General	KDFWR: "Numerous ponded water areas on West Kentucky Wildlife Management Area (WKWMA) serve as valuable ecological habitat. These areas have remained ponded during the prolonged drought the region has experienced over the recent past, thus suggesting a connection to groundwater and, more specifically, the Upper Continental Recharge System (UCRS). These areas have not been adequately characterized, nor has a complete delineation of where the UCRS emerges on WKWMA been made. KDFWR requests DOE to make clear whether these data gaps will be filled in the scope of the GWOU or in the Surface Water Operable Unit (SWOU). Additionally, KDFWR requests DOE to coordinate identification of these ponded water areas on WKWMA with KDFWR staff."	Groundwater flow in the UCRS at the PGDP is primarily vertically downward – to recharge the RGA. Thus, lateral groundwater flow distances in the on-site UCRS near the source areas are very limited. UCRS groundwater contamination from onsite does not flow into the WKWMA, except through the RGA (specifically on Little Bayou Creek north of Anderson Road) and except through an intermediate surface-water pathway that will be investigated as part of the Surface Water Operable Unit.
226.	General	KDFWR: "The summary of potential applicable or relevant and appropriate requirements (ARARs) for all alternatives should include the Endangered Species Act and the Migratory Bird Treaty Act. The known areas of UCRS emergence in Big and Little Bayou Creeks provide excellent foraging habitat for the federally endangered Indiana bat (*Myotis sodalis*). Additionally, the federally endangered fat pocketbook (*Potamilus capax*), organge-foot pimpleback (*Plethobasus cooperianus*), and pink mucket (*Lampsilis abrupta*) are known to occur in the Ohio River immediately downstream of the confluence of Big Bayou Creek. Potential groundwater/surface water impacts on these species should be considered in any ecological risk assessments concerning the above media."	See response to Comment #92.