Department of Energy

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MAY 2 0 2015

Ms. Julie Corkran
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

PPPO-02-2926713-15C

Ms. April Webb
Interim Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

Dear Ms. Corkran and Ms. Webb:

TRANSMITTAL OF REPLACEMENT PAGES FOR THE SAMPLING AND ANALYSIS PLAN TO SUPPORT THE ADDITIONAL ACTION FOR THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) FIVE-YEAR REVIEW AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-2200&D2)

References: Letter from J. Woodard to J. Corkran, "Transmittal of the Sampling and Analysis Plan to Support the Additional Action for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-2200&D1)," (PPPO-02-2926713-15B), dated May 13, 2015

Please find enclosed for your review the replacement pages for the *Sampling and Analysis Plan to Support the Additional Action for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-2200&D2 (SAP). The SAP, which includes a Quality Assurance Project Plan (QAPP), is for additional fieldwork within the Water Policy Area. This additional fieldwork was scoped by the Federal Facility Agreement (FFA) parties on August 20, 2014; February 22, 2015; and April 22, 2015. The Kentucky Department for Environmental Protection (KDEP) and the U.S. Environmental Protection Agency (EPA) concurred with U.S. Department of Energy's approach on April 22, 2015.

Replacement pages for the SAP incorporate comments received via e-mail on May 15, 2015, from EPA. The comments were discussed with all parties on May 18, 2015 and the following resolutions were reached.

1. Comment: Page 1, Section 3. Investigation Boundary. Per the 4/22/15 scoping discussion, my notes indicated that the text should be revised to read generally as follows: Samples will be taken as close as possible to, but not more than 300 feet from, the residence for this study.

   Resolution: No change was needed in the document.

2. Comment: Appendix D: Water Policy Vapor Intrusion Scooping Meeting Presentation, April 22, 2015. Please replace the 4/15/15 draft powerpoint in Appendix D with the two (2) powerpoints that were used by the FAA parties during the VI Scoping meeting on 4/22/15. Powerpoint titled: Second Sampling and Analysis Plan Scoping Meeting – revision to 4/15/15 version – submitted on 4/21/15 (35 pages). Powerpoint titled: BACKUP to: Second Sampling and Analysis Plan Scoping Meeting – submitted 4/20/15 (16 pages).

   Resolution: Appendix D page changes have been made in this submittal.

3. Comment: Bailer vs discrete depth sampler – clarification requested. REF: Page 4, Item 2 "Lower a discrete depth sampler….."; QAPP WS#21 (Sampling SOPs), Ref 4 PAD-ENM-2100 Groundwater Sampling; and "Backup to…" powerpoint from 4/22/15 scoping call – slide 33 – reference to use of bailer. On 4/22/15, EPA stated a possible concern regarding use of a bailer to collect first water from the DPTs. My notes indicate that the SOP for sampling with a bailer with a gas pressurized system and bottom valve was in the programmatic QAPP. I have read through the PAD ENM 2100 (groundwater sampling) and PAD ENM 2203 (surface water sampling) procedures as the likely candidates where I might find the specific information to which DOE referred in response to EPA's question about sampling with a bailer, without success. Although QAPP WS#21 references 2100, it does not discuss collection of grab samples via bailer (or discrete depth sampler). 2203 (surface water) discusses collection of grab samples by peristaltic pump, but is not referenced in WS#21. It is not clear that the SAP/QAPP calls out an existing SOP, or creates an SOP, for collecting first water from the DPTs (but I recognize I may looking in the wrong place).

   Response: Appendix E has been added to this submittal which contains the sampling process that will be followed. Reference to Appendix E has been made on QAPP worksheet #21.

4. Verbal Comment: EPA relayed a comment from KDEP verbally during the phone conference on May 18, 2015. The comment that text needed to be added to the SAP noting that any unsuccessful attempts to gain access to residential property would be documented in the report.

   Resolution: Text has been added to Section 5 of the SAP.

To meet the expedited schedule for implementation of fieldwork and as agreed to among the FFA parties during the May 18, 2015, teleconference, please provide written comments or acceptance of the attached document no later than one week from the date of this transmittal.

If you have any questions or require additional information, please contact Jennifer Woodard at (270) 441-6820.

Sincerely,

Jennifer Woodard
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:
1. Replacement Pages for the SAP-Clean
2. Replacement Pages for the SAP-Redline

e-copy w/enclosures:
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DOE/LX/07-2200&D2
Secondary Document

Sampling and Analysis Plan to Support the Additional Action for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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DOE/LX/07-2200&D2
Secondary Document

Sampling and Analysis Plan to Support the Additional Action for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—May 2015

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Revised by
LATA Environmental Services of Kentucky, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-10CC40020

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1. INTRODUCTION

This Sampling and Analysis Plan (SAP) documents how groundwater samples will be collected and analyzed in a screening study to determine whether volatile organic compound (VOC) [primarily trichloroethene (TCE)] concentrations warrant a vapor intrusion study at certain locations within the Water Policy Area outside the Paducah Gaseous Diffusion Plant (PGDP).

The *Five-Year Review for Remedial Actions at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1289&D2/R1, (Five-Year Review) (DOE 2014a) presents the results of a 2012 review of the Water Policy Removal Action. In a letter dated September 30, 2014, (EPA 2014a) the U.S. Environmental Protection Agency (EPA) noted the following project-related uncertainty:

> The protectiveness determination of the removal action for the Water Policy cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions: DOE demonstrates that all residents located above the contaminated groundwater plume are not using groundwater from their wells, and a vapor intrusion study is conducted if current groundwater data indicate a study is warranted.

Three meetings were held to scope this concern raised by EPA. The meetings were held on August 8, 2014, February 24, 2015, and April 22, 2015. The meeting presentations are located in Appendices B, C, and D, respectively. As a result of these meetings, the Federal Facility Agreement (FFA) parties agreed to undertake this screening study to determine whether a vapor intrusion study is warranted. This study is being accomplished under the provisions of Section XXX, Five-Year Review, of the PGDP FFA, as documented in the Record of Conversation letter dated August 1, 2014 (DOE 2014b).

2. PURPOSE

Collect first-available water samples from four locations within the Water Policy Area near the residences located above the TCE Plume. The FFA parties have agreed that this sampling approach will provide a sufficient basis on which to determine whether a vapor intrusion study is warranted, as follows:

- Advance Direct Push Technology (DPT) rods into the Upper Continental Recharge System (UCRS) to allow collection of water from the first-available depth.
- Sample groundwater from the first available depth and analyze for VOCs.
- Compare groundwater analytical results to the respective Vapor Intrusion Screening Level (VISL) for groundwater calculated using the VISL Calculator (EPA 2014b).

3. INVESTIGATION BOUNDARY

The screening study boundaries are first available UCRS water from DPT rods installed near six residences (4 locations) within the TCE plume, as detailed in this plan. Samples will be taken within 100 ft laterally, where possible, from the residence but no further than 300 ft for this study.

4. NUMBER OF BORINGS

In order to determine the first available water at each of the 4 locations shown in Figure 1, 3 DPT borings at each of the 4 locations will be advanced to targeted depths, for a total of 12 borings. Table 1 provides the approximate coordinates for the four DPT sample boring groups.

Table 1. Five-Year Review Screening Study DPT Sample Borings Locations

Sample Boring Group	Approximate Location of Boring from Residence	DPT Depths (bgs) Paired RGA well	Approximate Plant Coordinates	
			East	North
NW1	~ 80 ft North (Figure 2)	12 ft, 22 ft, 32 ft MW451	-7123	4924
NW2	~ 100 ft West (Figure 3)	12 ft, 22 ft, 32 ft MW236	-5010	7417
NE1 (3 residences—1 boring location)	Left Residence ~ 110 ft Northeast Middle Residence ~ 40 ft North Right Residence ~ 235 ft West (Figure 4)	12 ft, 22 ft, 32 ft MW148	3190	5820
NE2	~ 65 ft South (Figure 5)	12 ft, 22 ft, 32 ft MW253	4716	3708

5. DRILLING METHOD

For this field characterization effort, the investigation will use a DPT rig and dual tube sampling system. The drill crew will advance the sample system with a center rod and drive point assembly to 5 ft short of the target depth (See Section 6) and withdraw the drive point for the bottom 5 ft, allowing the sampler to fill with soil over the bottom 5 ft. This will minimize the compaction of soils over the bottom 5 ft. Compaction by the DPT rods in the overlying soils will result in an effective temporary seal for the DPT rods.

The drill crew will extract the soil core from the bottom of the hole and pull the outer rods up 0.5 ft to expose the soils and allow shallow groundwater to flow into the interior of the DPT rods. Because the shallow groundwater samples will be collected the next day, no additional measures will be required to maintain the DPT borings prior to sampling. Upon completion of sampling, the DPT boreholes will be abandoned by pulling the DPT rods from the ground and filling the boreholes with 3/8-inch particle size bentonite to within 2 ft of ground surface, hydrating the bentonite in 3-ft lifts. The top 2 ft of the borehole will be filled with materials consistent with the surrounding ground surface.

If DPT cannot advance to the targeted depth, up to three ten-ft step-out attempts will be made, or if the resident requests a different location, then this will be documented in the report.

Residents will be contacted to access their property and to obtain agreement on the location of sampling; these interactions will be documented in the report. DOE will keep within the designated boundary conditions (see Section 3 above).

QAPP Worksheet #1
Title Page

Document Title: *Sampling and Analysis Plan to Support the Additional Action for the CERCLA Five-Year Review at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

Lead Organization: U.S. Department of Energy

Preparer's Name and Organizational Affiliation: LATA Environmental Services of Kentucky, LLC (LATA Kentucky)

Preparer's Address, Telephone Number, and E-mail Address: 761 Veterans Avenue, Kevil, KY, 42053, Phone (270) 441-5000

Preparation Date (Month/Year): 5/2015

Document Control Number: DOE/LX/07-2200&D2

LATA Kentucky Environmental Remediation Project Manager	Signature Mark J. Duff	Date 5/20/15
LATA Kentucky Regulatory Manager	Signature Myrna Espinosa Redfield	Date 5/20/15
LATA Kentucky Sample/Data Management Manager	Signature Jaime Morrow	Date 5/20/15

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Paducah Gaseous Diffusion Plant
Site Location: Paducah, Kentucky
Site Number/Code: KY8890008982
Contractor Name: LATA Environmental Services of Kentucky, LLC
Contractor Number: DE-AC30-10CC40020
Contract Title: Paducah Gaseous Diffusion Plant Paducah Environmental Remediation Project
Work Assignment Number: N/A

1. Identify guidance used to prepare QAPP:

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Implementing Environmental Quality Systems, Version 2.0, 126 pages.

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 1 UFP QAPP Manual, Version 1.0, 177 pages (DTIC ADA 427785 or EPA-505-B-04-900A).

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 2A UFP QAPP Worksheets, Version 1.0, 44 pages.

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 2B Quality Assurance/Quality Control Compendium: Minimum QA/QC activities, Version 1.0, 76 pages.

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant*, DOE/OR/07-1707 (FFA)

3. Identify approval entity: DOE, EPA Region 4, and Kentucky Division of Waste Management (KDWM)

4. Indicate whether the QAPP is a generic or a project-specific QAPP (circle one).

5. List dates of scoping sessions that were held:

   August 2014 Conference Call: Vapor Intrusion for the Water Policy Area
   February 2015 DQO Scoping: Vapor Intrusion for the Water Policy Area
   April 2015 DQO Scoping: Vapor Intrusion for the Water Policy Area

QAPP Worksheet #21
Project Sampling SOP References Table

Site-specific standard operating procedures (SOPs) have been developed for site sampling activities. Below is a list of site sampling procedures that projects will select from for implementing sampling activities. Appendix E contains the project-specific sampling process for the discrete depth sampler.

Reference Number	Title, Revision Date, and/or Number[a]	Originating Organization[b]	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	PAD-ENM-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System (OREIS)*	Contractor	N/A	N	None
2	PAD-ENM-1003, *Developing, Implementing, and Maintaining Data Management Implement. Plans*	Contractor	N/A	N	None
3	PAD-ENM-2100, *Groundwater Level Measurement*	Contractor	Sampling	N	None
4	PAD-ENM-2101, *Groundwater Sampling*	Contractor	Sampling	Y	None
5	PAD-ENM-2700, *Logbooks and Data Forms*	Contractor	N/A	N	None
6	PAD-ENM-2702, *Decontamination of Sampling Equipment and Devices*	Contractor	Sampling	N	None
7	PAD-ENM-2704, *Trip, Equipment, and Field Blank*	Contractor	Sampling	N	None
8	PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*	Contractor	Sampling	N	None
9	PAD-ENM-5003, *Quality Assured Data*	Contractor	N/A	N	None
10	PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*	Contractor	N/A	N	None
11	PAD-ENM-5007, *Data Management Coordination*	Contractor	N/A	N	None
12	PAD-ENR-0020, *Collection of Soil Samples with Direct Push Technology Sampling*	Contractor	Sampling	N	None
13	PAD-ENM-5105, *Volatile and Semivolatile Data Verification and Validation*	Contractor	N/A	N	None

[a] SOPs are posted to the LATA Kentucky intranet Web site. External FFA parties can access this site using remote access with privileges upon approval.
[b] The work will be conducted by LATA Kentucky staff or a subcontractor. In either case, SOPs listed will be followed.

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment*	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Water Quality Meter	Calibrate at the beginning of the day	Performed monthly and as needed	Measure solutions with known values [National Institute for Standards and Technology (NIST) traceable buffers and conductivity calibration solutions]	Upon receipt, successful operation	Daily before each use	Temp.: ± 0.3ºC	Recalibrate or service as necessary	Field Team Leader	Manufacturers specifications

*Additional equipment may be needed: additional equipment will follow manufacturer's specifications for calibration, maintenance, inspection, and testing. Calibration data will be documented in logbooks consistent with PAD-ENM-2700, Logbooks and Data Forms.

APPENDIX D

WATER POLICY VAPOR INTRUSION SCOPING MEETING PRESENTATION

APRIL 22, 2015

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Second Sampling and Analysis Plan Scoping Meeting: Evaluation of Vapor Intrusion (VI) at the Paducah Gaseous Diffusion Plant (PGDP) Water Policy Area

Recap of VI Guidance as Adapted to PGDP Site
Summary of Sampling and Analysis Plan Outline from Scoping Meeting 1
Additional Discussion/Backup/Evaluation
Evaluation of Proposed Changes to Plan
Monitoring Program Details

4/22/2015

VI Scoping Meeting 2 Agenda

- Recap VI guidance, VI Conceptual Site Model (CSM), and evaluation against PGDP conditions
- Summarize results from 1st Scoping Meeting including sampling plan outline
- Address issues raised during 1st scoping meeting
- Address comments on plan outline (notes/subsequent comments)
- Detail sampling, including planned methodology and form of deliverable(s)
- Summarize agreement: next step prepare Sampling and Analysis Plan (SAP)?

Recap: EPA Draft 2013 VI Guidance[2]

CSM Development: Features needed for VI

Three features must exist for hazardous vapors to reach the interior of buildings from the subsurface environment underneath or near a building:

1. A source of hazardous vapors must be present in the soil or in groundwater underneath or near a building

2. Vapors must form and have a pathway along which to migrate toward the building

3. Entry routes must exist for the vapors to enter the building and driving forces must exist to draw the vapors into the building

- *Guidance supplemented with VI Screening Level (VISL) calculator providing default screening levels for default site conditions*

[2]EPA 2013, OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air (External Review Draft)

Recap: VI Conceptual Site Model
from 2013 Draft EPA VI Guidance[2]

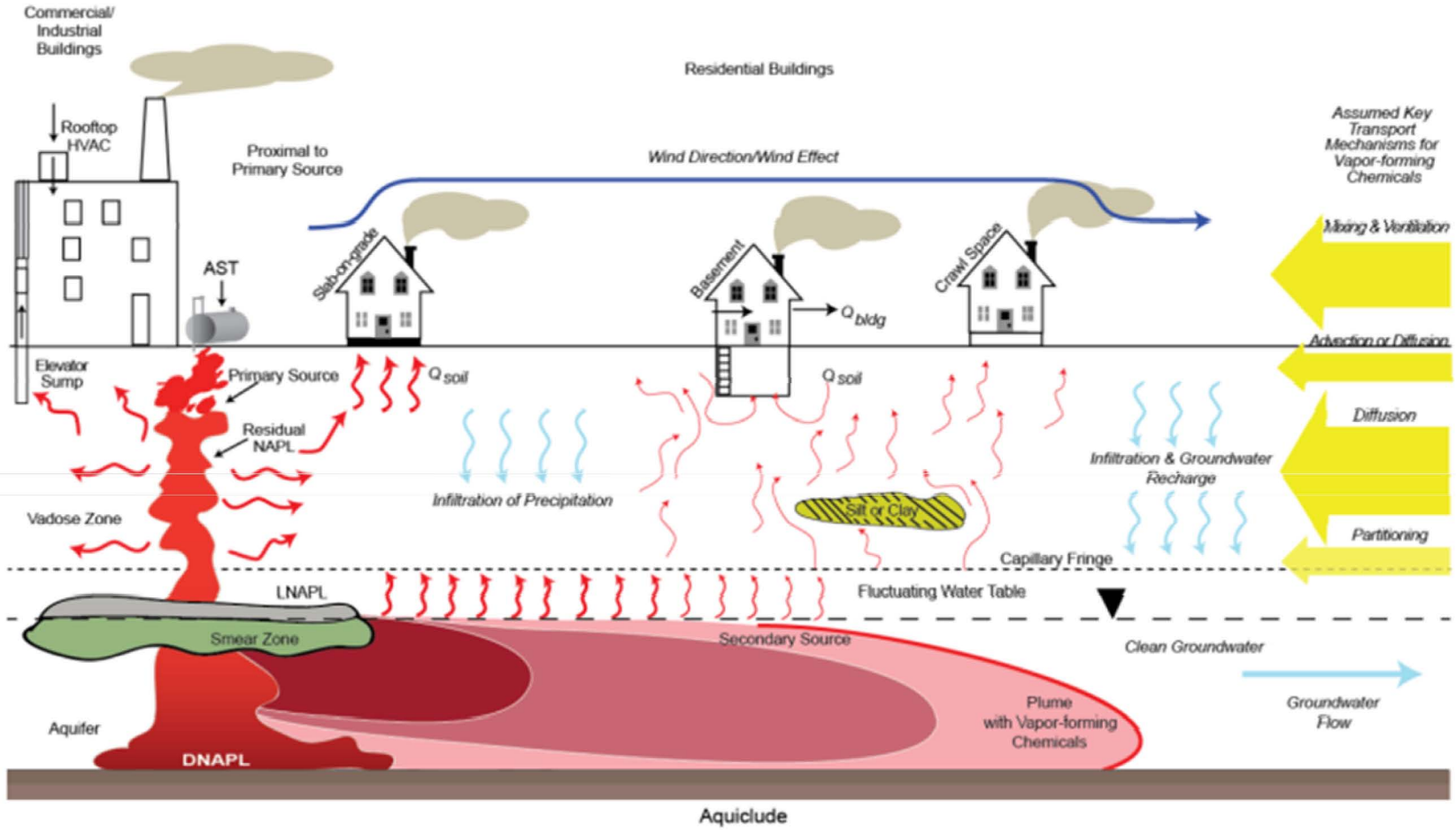

Figure 2-1 Illustration of Conceptual Model of Vapor Intrusion

Note: Q_{soil} represents soil gas entry; Q_{bldg} represents building ventilation.

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[2]EPA 2013, OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air (External Review Draft)

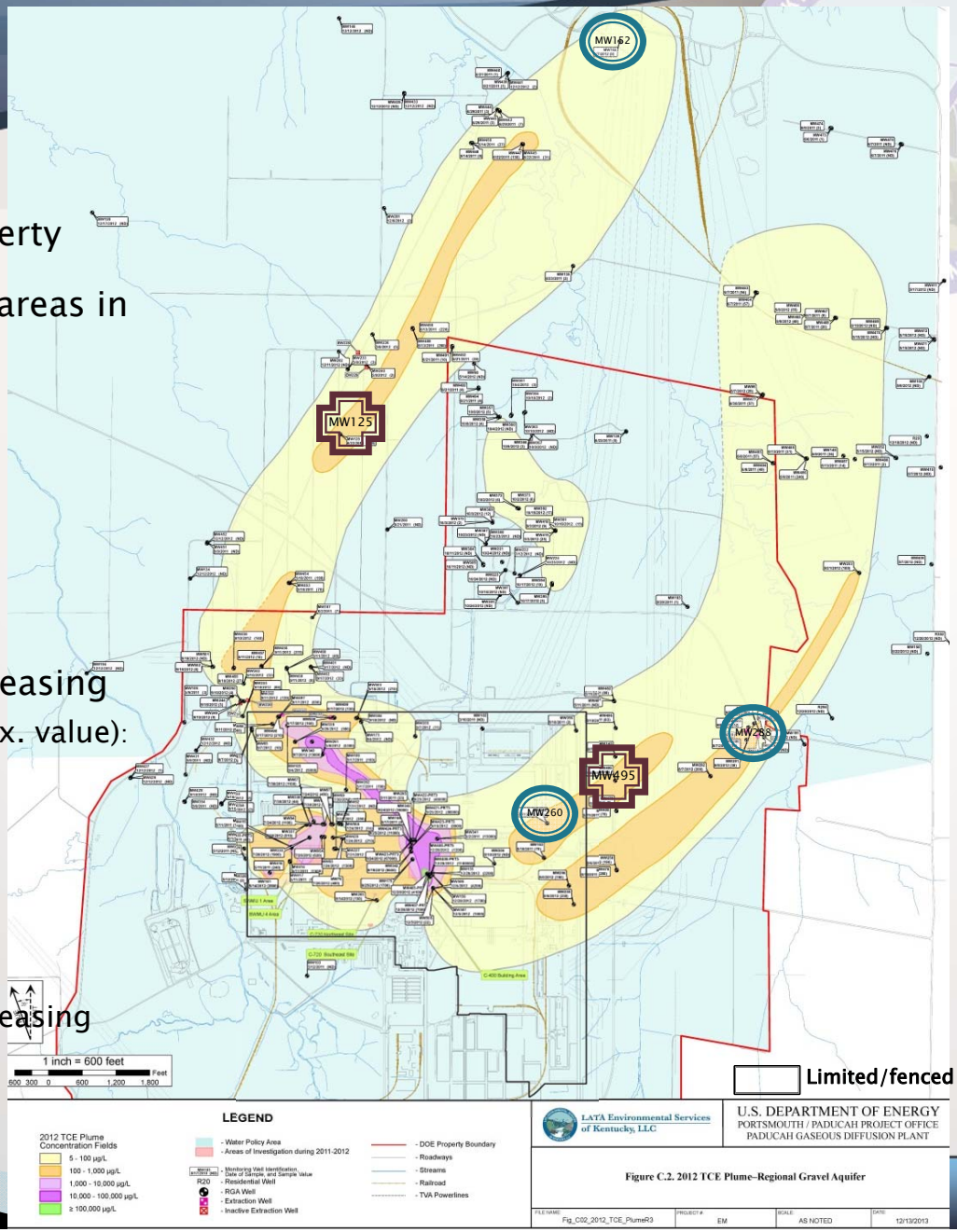
Recap: VI Default CSM Summary and Guidance

- CSM includes soil/vadose zone and groundwater sources
  - CSM shows proximity to higher conc's has higher VI potential
- CSM shows differential migration due to geology (silt/clay)
  - Less potential for migration through silt/clay
- CSM shows differential migration due to hydrogeology
  - Less potential with greater depth to contaminated water
  - Groundwater infiltration of clean water in distal plume areas
  - Plume orientation (less migration in distal areas w/lower plume conc.)
- Guidance includes potential for attenuation via biological processes
- Guidance includes differential potential related to building foundation type and condition and adjacent near-surface soil/cover composition

Recap: PGDP CSM: 2012 Plume Map

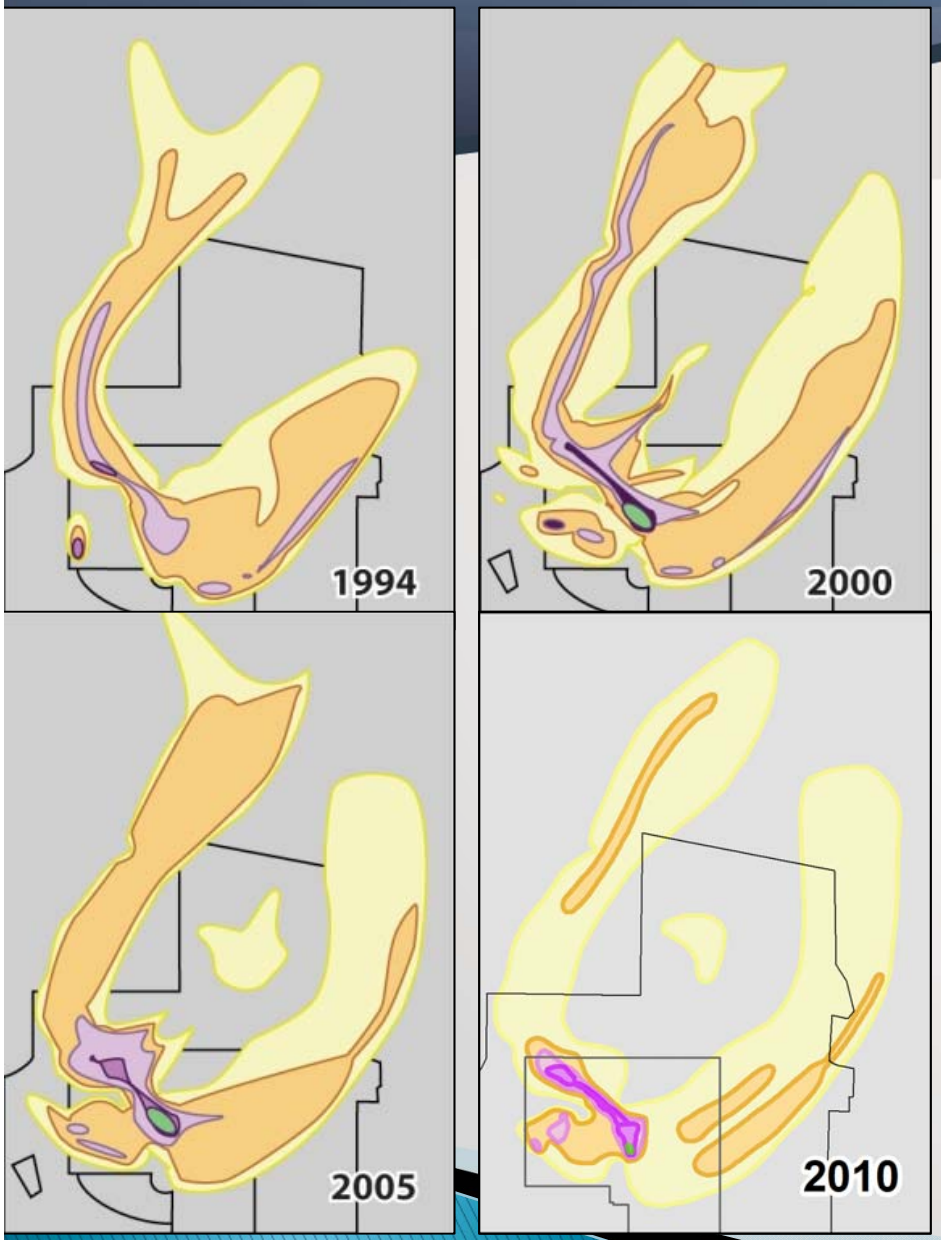
Trichloroethene (TCE) in Regional Gravel Aquifer (RGA)

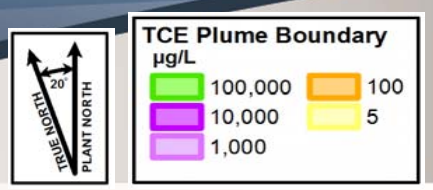
- PGDP RGA TCE Plume extends off-property
- VI focus on distal (off-property) plume areas in the Water Policy Area (shaded in blue)
  - 7 residences above/near plume
- 2012 RGA *distal* plume TCE conc's
  - NW Plume Area Range: ND (<1 µg/L) – 420 µg/L
    - Max at MW125
  - NE Plume Range: ND (<1 µg/L) – 510 µg/L
    - Max at MW495
- Intrawell comparisons show conc's decreasing
  - NW Plume Examples (2012% decrease fr. max. value):
    - MW125: 44% decrease since 2005
    - MW152: 89% decrease since 2011
  - NE Plume Examples:
    - MW260: 56% decrease since 1997
    - MW288: 93% decrease since 1996
- Bottom Line: RGA concentrations low and decreasing

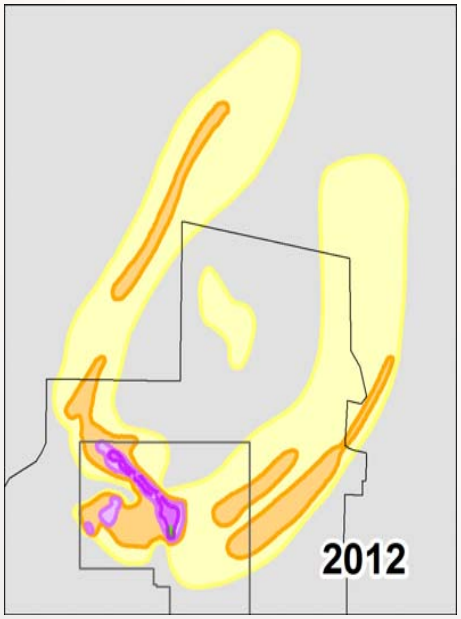


Recap: PGDP CSM: RGA TCE Plumes Over Time 1994-2012

TCE Conc's and Areal Extent Decreasing



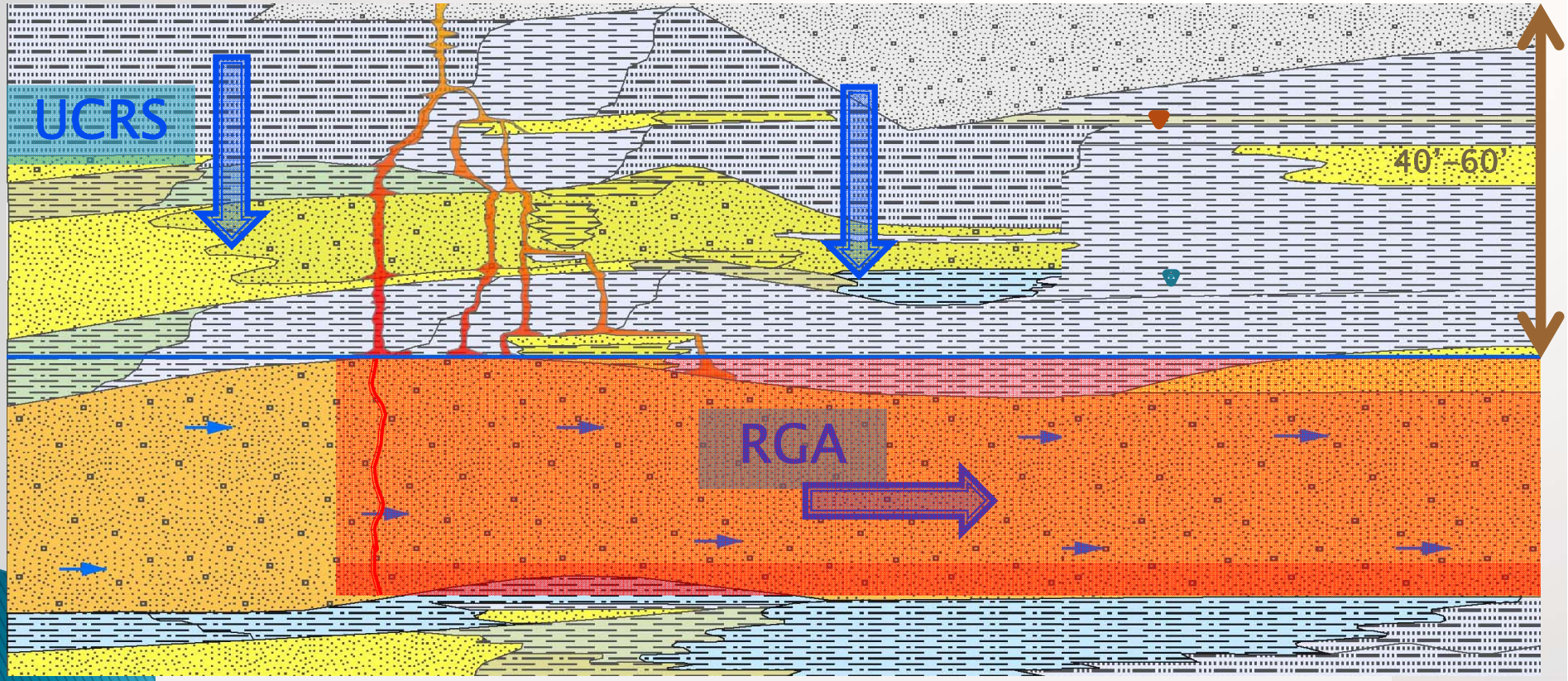




- Areal extent of 100 µg/L contour decreasing over time
- NOTE: TCE conc's in Upper RGA typically lower than in Lower RGA, as expected due to PGDP CSM

Recap: PGDP Dissolved Phase Conceptual Site Model[3]

- GW flow vertical through UCRS (40'–60' thick) and horizontal (lateral) through RGA
- In distal areas of plume *(outside source areas)* RGA contamination would have to migrate upward against clean downward UCRS GW gradient to reach vadose zone



[3]Adapted from DOE 2011. Revised Proposed Plan for Volatile Organic Compound Contamination at the C-400 Building at the Paducah Gaseous Diffusion Plant

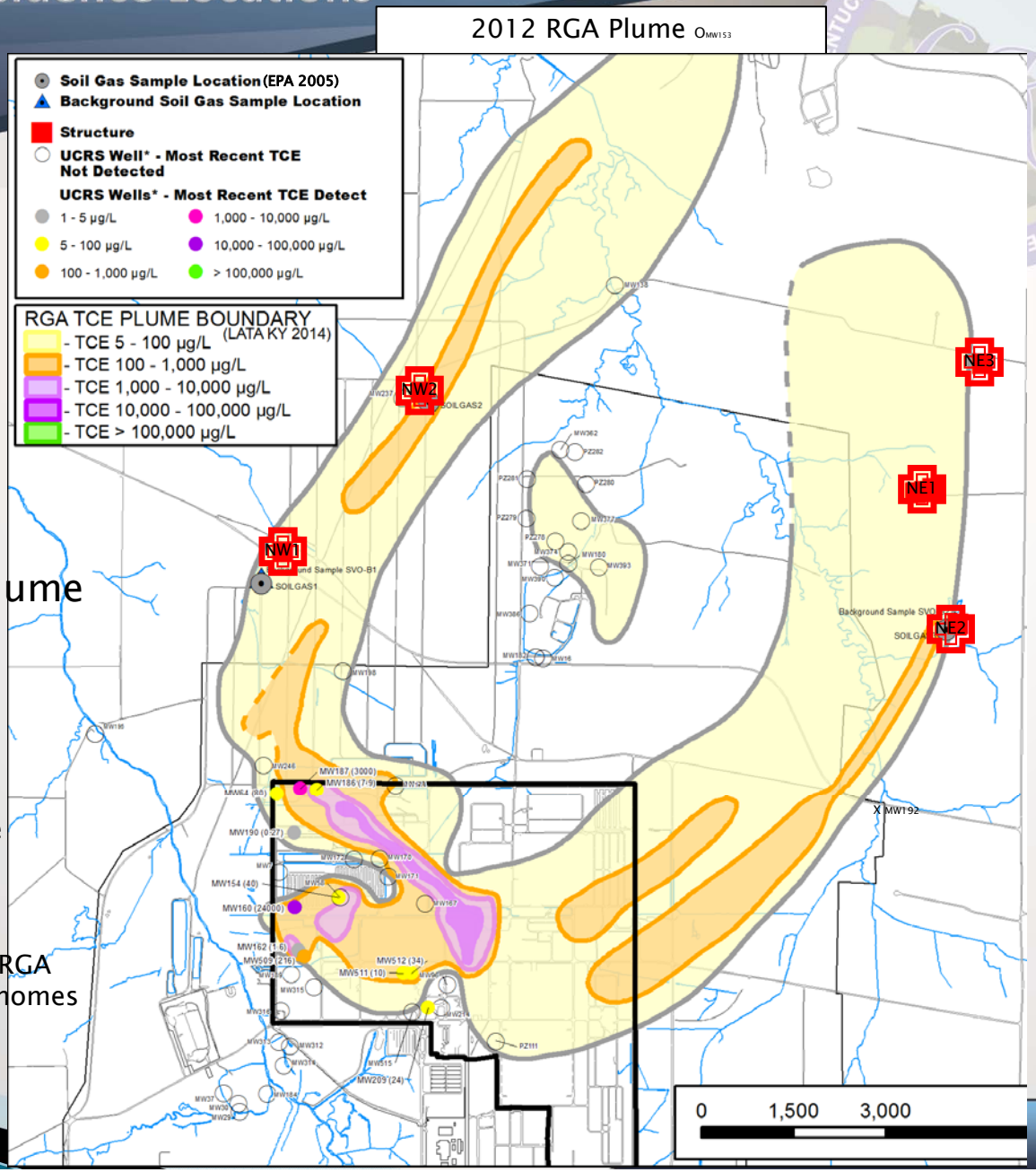
First water in UCRS (typ.)

RGA potentiometric surface (typ.)

Recap: PGDP CSM

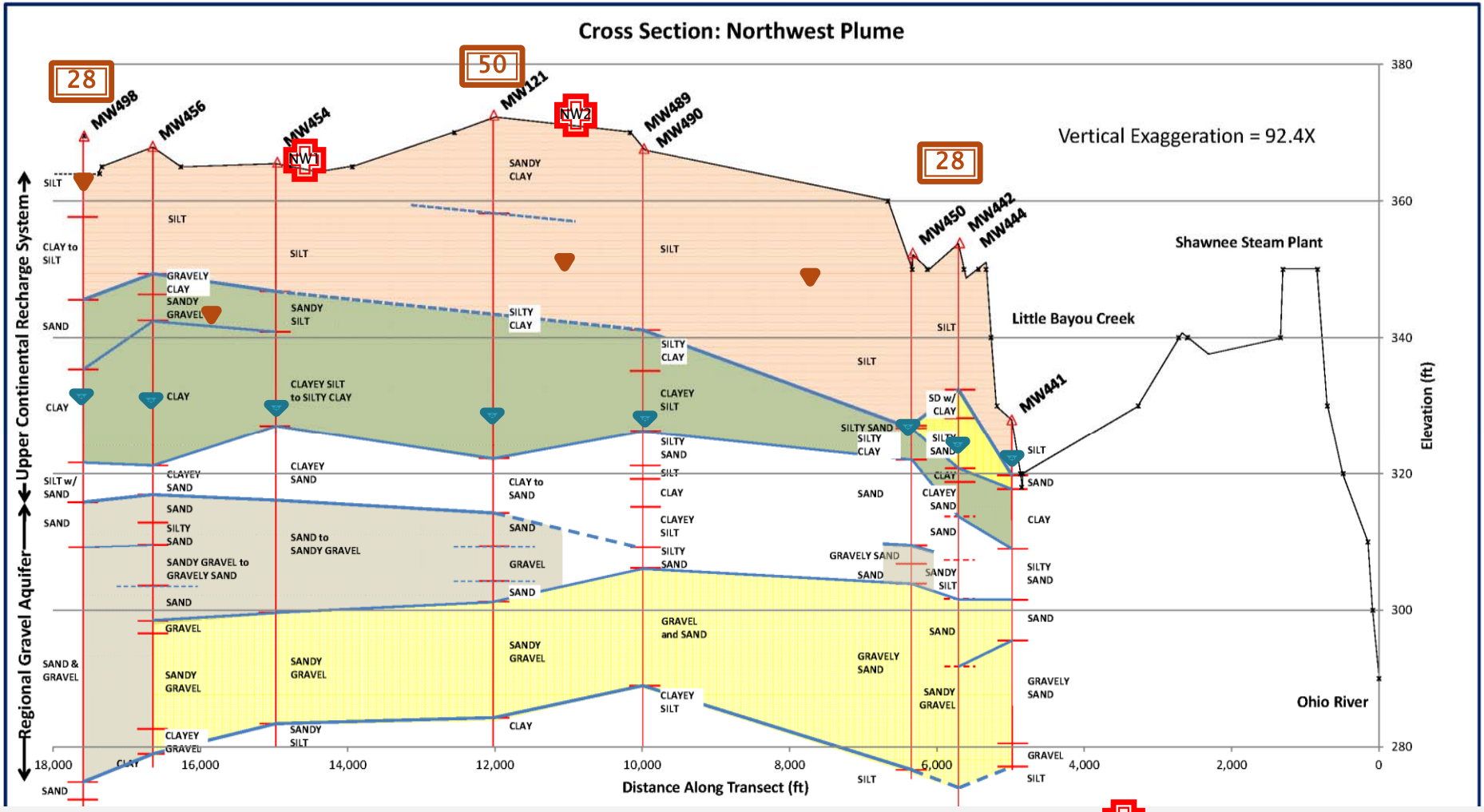
Scoping Meeting 1: Residence Locations

- 2 residences in NW Plume
  - NW1 along edge of current RGA plume
  - NW1 does not have nearby UCRS well
  - Other UCRS wells in better locations:
    - Over higher concentrations in plume
    - Some closer to plant source
  - NW2 over 100+ ug/L plume
  - NW2 has UCRS well nearby
- 5 residences above/near NE Plume
  - NE1 has 3 clustered residences
  - NE1 has no UCRS well nearby
  - NE2 has no UCRS well nearby
  - Closest UCRS well located south and not over plume
  - NE3 is not over 1 ug/L RGA [TCE] plume
- PGDP VI CSM
  - VOCs must migrate from contaminated RGA up through UCRS silt/clay/GW to reach homes



Recap: PGDP CSM: Northwest Plume Cross-Section

~25-50' Clay/Silt Between Contaminated RGA and Surface



NW2 Projected residence location

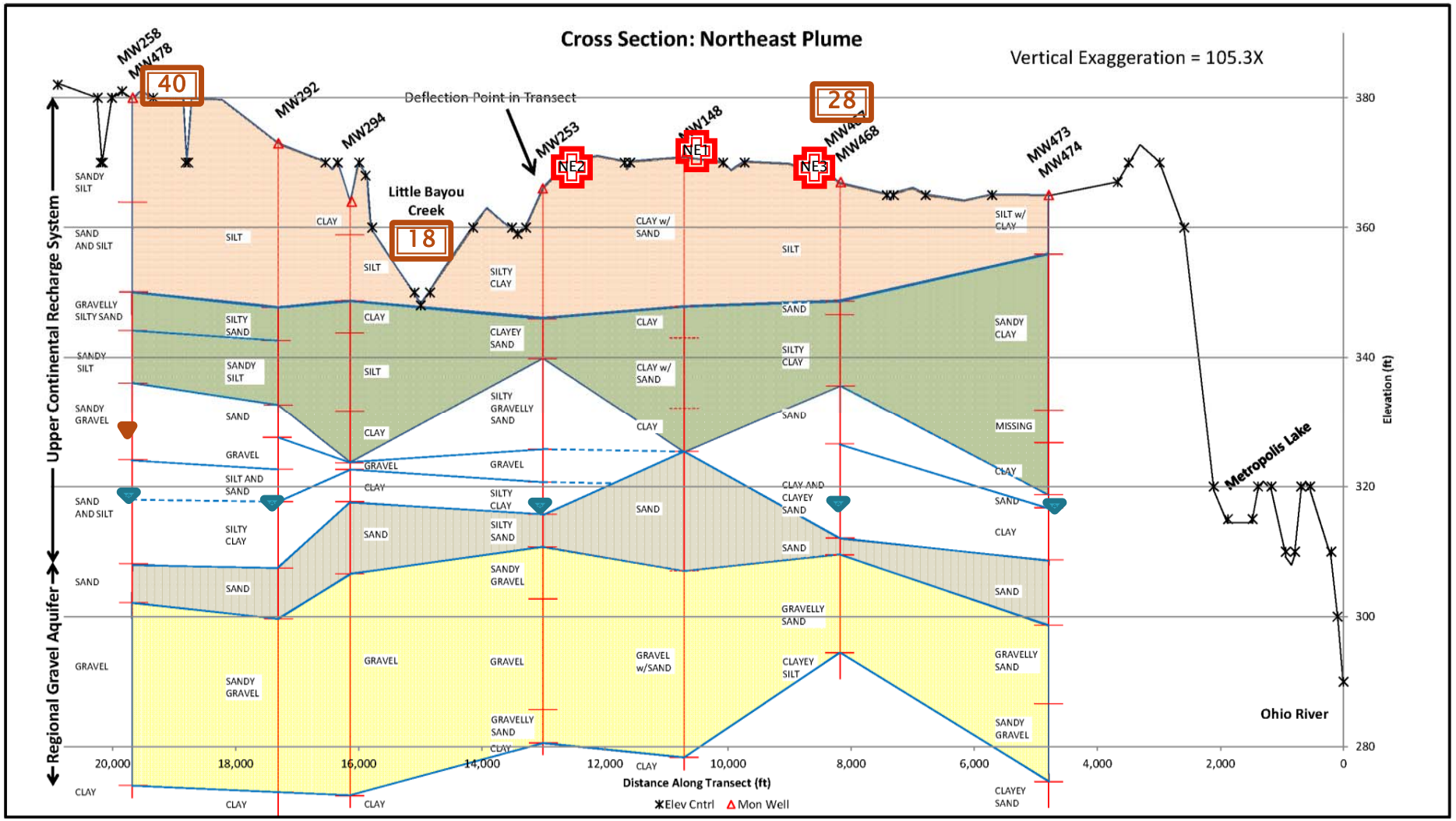
Approximate UCRS first water

Approximate RGA potentiometric surface

50 Approximate clay/silt thickness

PGDP CSM: Northeast Plume Cross-Section

Clay/Silt Between Contaminated RGA and Surface



Projected residence location

Approximate UCRS first water

Approximate RGA potentiometric surface

Approximate clay/silt thickness

Recap of VI Default CSM Summary and Guidance
Compare Against *PGDP Conditions*

- Vapor Source: *RGA GW source at PGDP deep*
  - *Only one potential pathway from single deep RGA (plume) source to residences*
  - *RGA PGDP plume GW source concentrations low and decreasing*
- Vadose Zone Geology: *40–60' soil [incl. >25' silt/clay] between source and residences*
- Vadose Zone Hydrology : *UCRS high moisture/saturated, contaminated water deep, overlying clean UCRS water. Downward hydraulic gradient of clean infiltrating water through UCRS*
- Vadose Zone Biochemistry: *potential for attenuation in UCRS , no additional PGDP TCE sources, UCRS moisture/saturation*
- Building Foundation: *no basements in 7 residences over/near plume*

Recap: CSM Factors Affecting VI and Screening Levels
Compare to PGDP Conditions

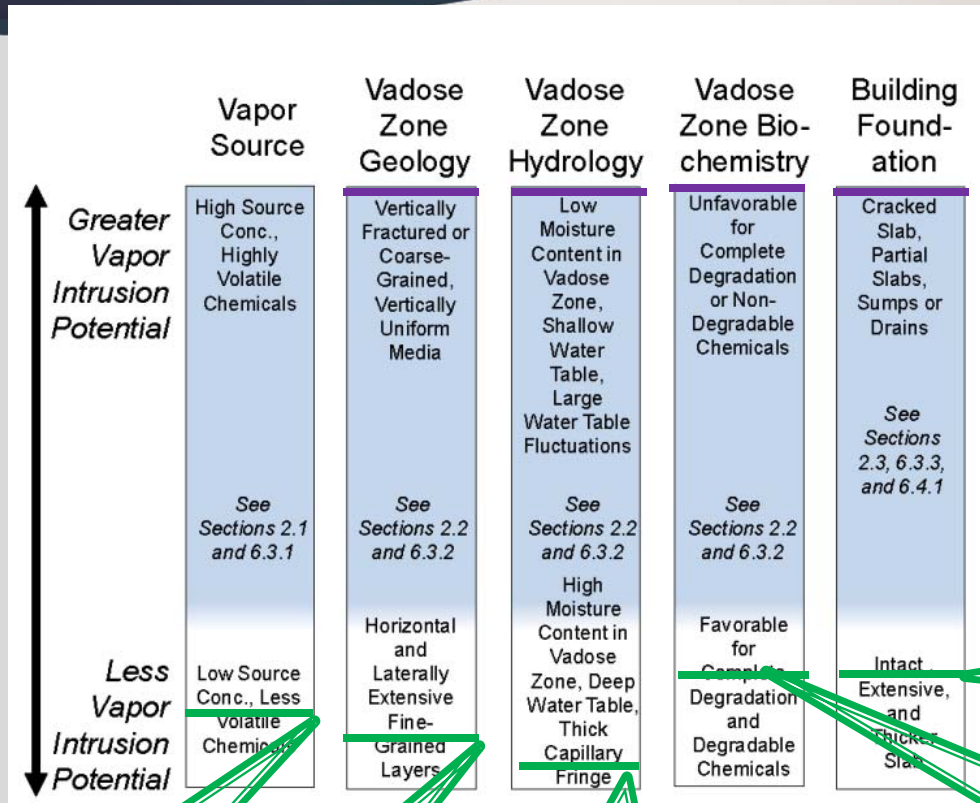


Figure 2-2 Some Factors that Affect Vapor Intrusion

UCRS at PGDP:

- ❑ Not vertically fractured
- ❑ Typically fine-grained with multiple layers
- ❑ Saturated/high moisture in vadose zone
- ❑ Has small water table fluctuations

RGA at PGDP:

- ❑ Low and decreasing TCE conc's
- ❑ Water table fluctuations irrelevant due to overlying UCRS

Default VI screening levels protective even under much greater vapor intrusion potential than PGDP

Few structures, no wells, no basements; few surface barriers, foundation conditions unknown

Low & decreasing concentrations

Fine-grained; not vertically fractured

Deep (contaminated) water table; intervening high moisture/saturated UCRS

Low conc's of TCE; RGA aerobic degradation attacks daughters/lowers [TCE]; UCRS conditions favorable for localized reductive dechlorination

Recap: EPA Draft 2013 VI Guidance, 1
Against *PGDP Conditions*

Three features must exist for hazardous vapors to reach the interior of buildings from the subsurface environment underneath or near a building:

1. A source of hazardous vapors must be present in the soil or in groundwater underneath or near a building *(RGA plume at 40–60' bgs)*

2. Vapors must form and have a pathway along which to migrate toward the building *(overlying UCRS silt/clay/soil and groundwater; pathway not likely complete)*

3. Entry routes must exist for the vapors to enter the building and driving forces must exist to draw the vapors into the building *(limited apparent entry routes [i.e., no basements]; no surface barriers to outgassing, limited surface soil permeability)*

D-16

Recap: PGDP CSM for VI: Adapted from Draft EPA VI Guidance[1]

Silt, clay, and water between RGA contamination and residences

UCRS depth to water and lithology varies across the site

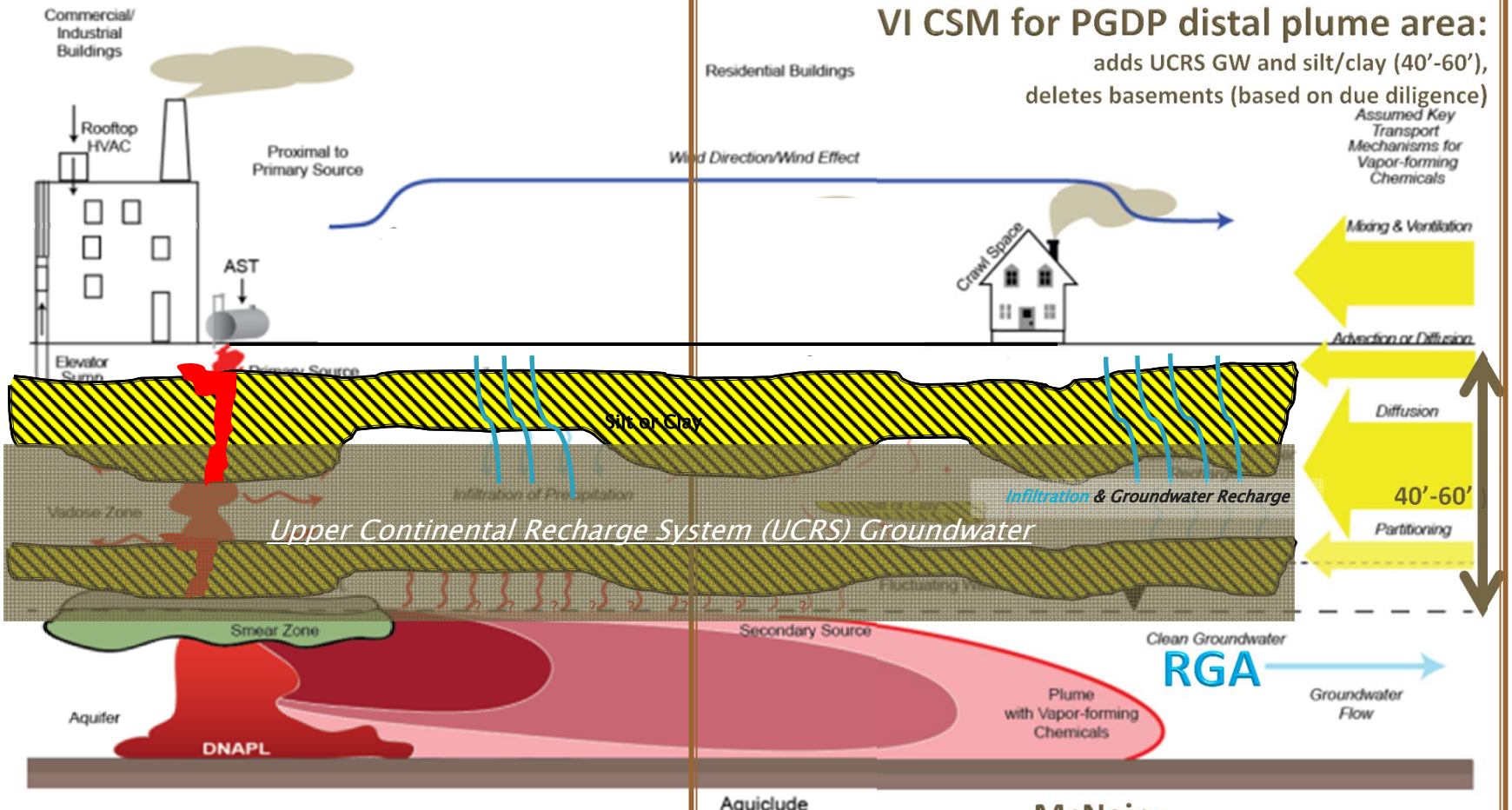


Figure 2-1 Illustration of Conceptual Model of Vapor Intrusion

Note: Q_{soil} represents soil gas entry; Q_{bldg} represents building ventilation.

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[1]EPA 2013, OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air (External Review Draft)

Recap: CSM Summary of VI Potential at PGDP

- VI potential from RGA low (see VI factors discussion)
  - Intervening UCRS GW/silt/clay impede migration of VOCs from RGA upward through UCRS
  - VI potential limited because:
    - Affected GW won't significantly migrate upward against clean UCRS water w/downward hydraulic gradient
    - Including through >25' of silt/clay and through ~25' more soil
    - Then outgas into vadose zone, migrate through low perm. Loess, and then preferentially into residences without basements when soil gas can freely exchange with ambient air adjacent to residences
- PGDP VISL will be much higher than default VISL
  - Default VISL designed to be protective for shallow water contamination in sand unit
  - PGDP has deep contamination at low concentrations with intervening UCRS
- Few residences (7) near/above RGA plume
  - Plume at 1.2 ug/L TCE does not add residences to study area
- CSM shows VI potential low
  - Plan to address spatial/temporal gaps in evidence as necessary

Summary Scoping Meeting 1: SAP Outline
Developed Using the DQO Process

Problem Statement: *Determine whether multiple lines of evidence (e.g., groundwater (GW) data, soil gas data, site specific geology) indicate that Vapor Intrusion (VI) is occurring in the water policy area.*

--Adapted from U.S. Environmental Protection Agency (EPA) letter, dated 9/30/2014: ". . . a vapor intrusion study is conducted if current groundwater data indicate a study is warranted."

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<u>Investigation SAP Outline from Scoping Meeting 1:</u>

- Review VI screening level for default site; estimate VISLs for site-specific PGDP
- Measure VOC concentrations in first *available* water
  - Compare concentrations to default VISLs
  - Identify TCE, cis/trans-1,2-DCE, VC that exceed default VISLs in first available water
  - Determine follow-on sampling / evaluation needed for those locations with results > default VISL concentrations

Summary Scoping Meeting 1: Water Policy Area

Sampling Details

- NW1: Collect 5 UCRS samples from NW Plume wells (including more-contaminated areas)
  - If all UCRS well [VOC]s < default VISLs, VI pathway considered incomplete
  - UCRS water/soil gas sample nearer residence may be needed
  - NOTE: R2 [TCE] (residential) RGA > 1.2 ug/L but < estimated PGDP VISL
- NW2: RGA well has [TCE] > 1.2 ug/L; collect UCRS sample from nearby well
  - If UCRS well [VOC] < default VISL, VI pathway considered incomplete
  - NOTE: Confirm distance from well to residence
- NE1: Collect RGA sample from R31 (residential well). Alternate location MW149
  - Compare concentrations to default VISLs and PGDP VISLs
  - If [VOC] < default VISL, VI pathway considered incomplete
  - If [VOC] > default VISL but < PGDP VISLs, evaluate need for additional sample(s); possible resolution: new first water (and soil gas if practical) sample
- NE2: Collect DPT first water sample; may collect soil gas sample
  - Use DPT first water result; compare against default VISL
  - If exceed default VISL, identify needed additional samples
  - NOTE: Nearest RGA well (MW253) has ~100 ug/L TCE; value > default VISL but < PGDP VISL estimate
- NE3: No additional sampling
  - Nearby RGA well results < VISL default screening levels

Summary of Issues Raised During 1st Scoping Meeting

- Sample type preference hierarchy
- Difficulty getting UCRS DPT/grab GW and/or soil gas sample
- Extent of UCRS GW/silt/clay
- Impact of UCRS GW/silt/clay on PGDP site specific VISL
- Plume at 1.2 ug/L does not add residences to study area

Summary of Issues Raised After 1st Scoping Meeting

Clarifications

- Expressed preference for sampling close to residences
- Attempt soil gas sampling from DPT?
- Clarify decision rules relative to VOCs vs TCE

Summary of Issues Raised After 1st Scoping Meeting

Comments for Further Discussion

- Propose modify NW1 sampling to collect water/soil gas near house
- Improve decision-rule clarity
- Confirm NW2 UCRS well distance to R17 residence
- Identify how to collect soil gas from DPT
- Sampling and Analysis Plan to use VISL Calculator 3.3.1 May 2014 values
- EPA Region 4's practice of response actions due to indoor air
- Develop decision rules for soil gas sample results
- Discuss sequencing of data collection and review, i.e. groundwater, soil gas, sub-slab, indoor air, ambient air
- DPT results are "grab" samples
- Soil gas results at PGDP not representative of VI potential due to tight soil
- DPT vs. new well for UCRS water samples

Discussion of Issues Raised During 1st Scoping Meeting

Preliminary Responses

- Sample type preference hierarchy
  - *UCRS well first water samples above higher concentration areas of plume and nearer PGDP*
- Difficulty getting UCRS grab/DPT GW and/or soil gas sample
  - *For DPTs, propose multi-depth installation: collect water from shallowest with water*
  - *Soil gas from shallow DPT?*
    - *Soil gas not representative of VI potential due to inability to get good sample at PGDP*
    - *No reasonable soil gas benchmark*
- Extent of UCRS GW/silt/clay
  - *Confirmed UCRS GW expressed in most wells*
  - *UCRS GW/silt/clay present near residences*
- Impact of UCRS GW/silt/clay on PGDP VISL
  - *Default VISL appropriate for contaminated shallow GW in sandy soils with basements*
  - *PGDP VISL should be >120 ug/L (estimated) due to UCRS GW/clay/silt*
- Plume at 1.2 ug/L does not add residences to study area
  - *See NE3*

Sample Type Preference Hierarchy at PGDP

1. UCRS well water samples from first water over RGA plume
   - *Reproducible, best evidence, indicative of degree of migration of PGDP-related source*
2. UCRS well samples from deeper water w/[VOC] < default VISL
   - *Reproducible, indicative of degree of migration from PGDP RGA plume*
   - *VI potential from deeper samples lower than from shallower samples with same [VOC]*
3. RGA well samples w/[VOC] < default VISL
   - *Reproducible, related to migration potential from plume, but lower potential (deeper)*
   - *If [TCE] > default VISL, additional evaluation needed*
4. If [VOC] at depth > default VISL (+no UCRS well), DPT from first water
   - *Not reproducible; potential for false positive by dragging VOC down;*
   - *Other non-PGDP plume source(s)?*
5. If 1-4 above have [VOC] > default VISL, soil gas
   - *Difficult to get representative sample at PGDP; gas sample not representative of VI potential*
     - *Multiple attempts over decades*
     - *Typically no TCE in soil gas except within 500' of DNAPL in UCRS soil*
     - *VISL benchmarks for subslab soil not appropriate for UCRS soil gas*

Discussion of Issues Raised After1st Scoping Meeting
Clarifications

Clarifications

- Sampling location preference close to residences
  - *Distances will be in SAP*
  - *Residence location preference to be balanced against first water over plume centroid*
  - *With single PGDP-related pathway from plume, first-water over centroid more important*

- Attempt soil gas sampling from DPT?
  - *Tentatively propose 3-depth DPTs, collect water from shallowest expressed*
  - *No soil gas (due to questions about representativeness of soil gas results from PGDP)*
  - *No reasonable soil gas benchmark for PGDP UCRS*
  - *Even if soil gas sample can be collected using low flow/high vacuum, results would not reflect VI potential through actual PGDP UCRS soil/GW*

- Clarify decision rules relative to VOCs vs TCE
  - *Acknowledged. Will refine in Scoping Meeting 2*

Discussion of Issues Raised After1st Scoping Meeting, 1

Further Discussion

- Modify NW1 sampling to collect water/soil gas near house?
  - *No: residence location preference balanced against first water over plume centroid*
  - *No: value of soil gas sample questionable due to questions about representativeness*
- Improve decision-rule clarity
  - *Acknowledged. Meeting 2 to resolve*
- Confirm NW2 UCRS well distance to R17 residence (300')
  - *UCRS well near NW Plume centroid, adjacent to RGA well*
- How to collect soil gas from DPT
  - *Propose no soil gas from DPT due to tight soils*
  - *Unlikely to get sample under normal protocol*
  - *Low flow sample may be possible but conc's won't reflect VI/gas migration potential*
    - *If no sample at -100" wc vacuum, no significant migration in absence of vacuum*
- SAP to use VISL Calculator 3.3.1 (May 2014) default values
  - *No 1,2-DCE values*
  - *Default VISL values for only TCE and vinyl chloride*

Discussion of Issues Raised After1st Scoping Meeting, 2

Further Discussion

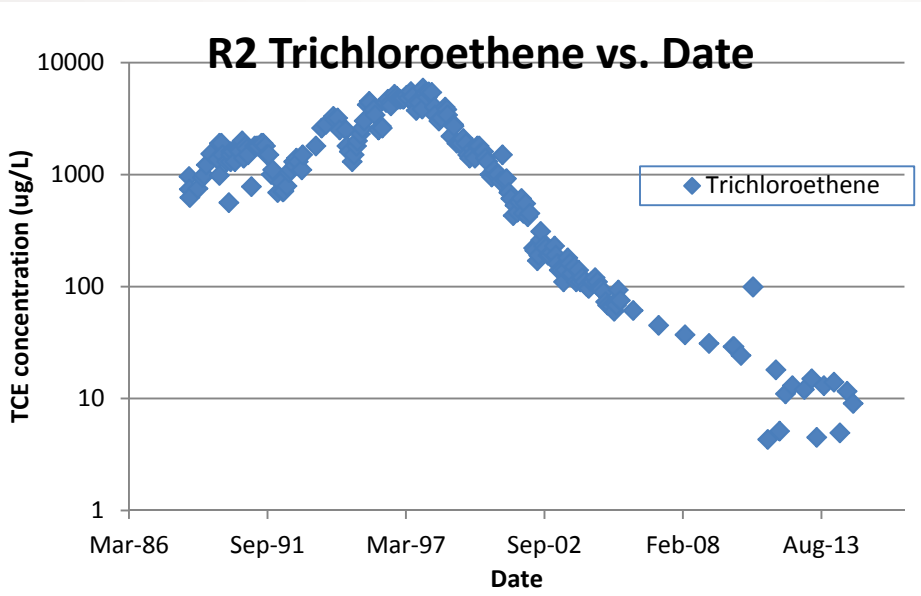
- EPA Region 4's practice of response actions due to indoor air
  - *Have not received*
- Develop decision rules for soil gas sample results
  - *Due to tight soils, value of soil gas results at PGDP questionable*
- Discuss sequencing of data collection and review, i.e. groundwater, soil gas, sub-slab, indoor air, ambient air
  - *Groundwater, soil gas if collected*
- DPT results are "grab" samples
  - *Agreed*
- Soil gas results at PGDP not representative of VI potential due to tight soil
  - *Soil gas value not representative of actual VI potential; no benchmark for soil gas*
- DPT vs. new well for UCRS water samples
  - *First water UCRS sample superior to DPT*

Summary of Scoping Meeting 1

Location NW1: WKWMA House (near R2 well)

Location NW1

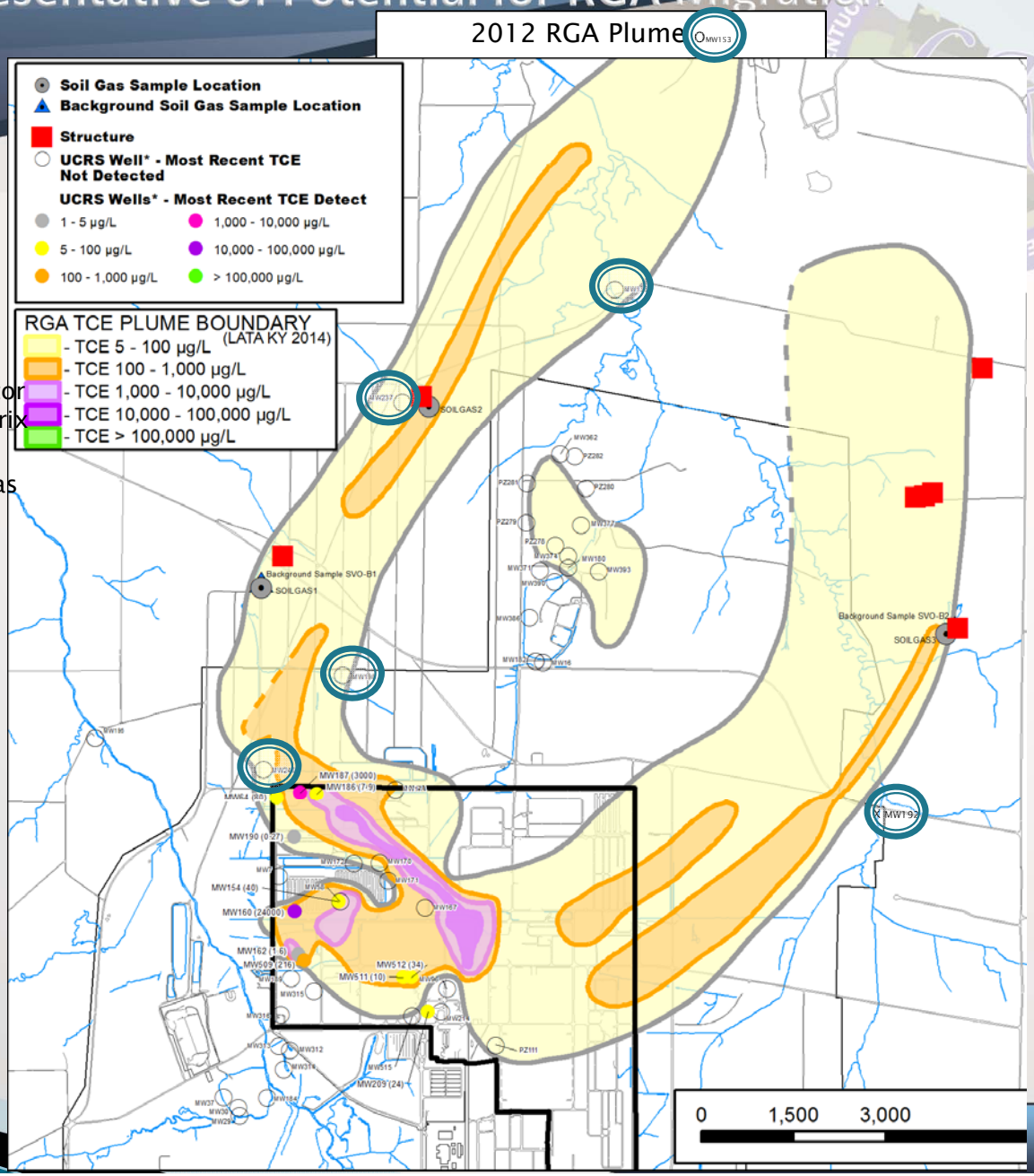
- At current edge of NW Plume
- R2 [TCE] decreased to ~10 ug/L (RGA)
  - Level below estimated PGDP VISL
- Study question: RGA conc's < PGDP VISL
- UCRS wells over higher distal conc. area
  - 198, 246, 153, 237, 138 provide lines of evidence
  - 198: most recent ND
  - 246: all results ND
  - 153: all results ND
  - 237: most ND; max 4 ug/L
  - 138; all ND
  - NOTE: Although NE Plume UCRS well 192 has all results ND, well not above plume / deeper UCRS well
- Identified potential need for new sample closer to residence



Summary of Scoping Meeting 1

UCRS Wells More Representative of Potential for RGA Migration

- UCRS wells above more-concentrated areas of plume
  - MWs: 198, 246, 153, 237, 138
  - If [VOC] in UCRS wells < default VISLs, VI pathway (from PDGP plume) incomplete
  - [VOC] in UCRS may confirm attenuation factor 2 orders of magnitude higher for UCRS matrix (silt/clay)
  - NOTE: Although NE Plume UCRS well 197 has results ND, well not above plume
- Compare recent results with historical UCRS results
- NOTE: Historical NW Plume RGA [VOC] higher
  - Demonstrates single PGDP TCE migration mechanism not a VI issue
  - Superior to *new* first-water sample near residence
    - *Because over higher concentration areas*
    - *Existing wells allow historical data comparability*



Summary of Scoping Meeting 1

Location NW2: R17 Residence

- NW2: RGA well has [TCE] > 1.2 ug/L but < PGDP VISL (recently 6-46 ug/L)
  - Historical RGA results as high as 1,800 ug/L
- Collect UCRS sample from MW237 (adjacent to 4 RGA wells)
- Distance from residence to MW237 = 300'
- Compare new UCRS results with historical values and default VISLs
  - If below default VISL, VI pathway considered incomplete

Summary of Scoping Meeting 1

Location NE1: R31 Residence

- NE1: Collect RGA sample from R31 (alternate MW149)
  - Historical R31 results typically < VISL
- Compare RGA result to default VISL (and estimated PGDP VISL)
  - If result >default VISL evaluate need for additional sample
  - Possible resolution: DPT water/soil gas or new UCRS well

Summary of Scoping Meeting 1

Location NE2: Residence

- No wells with shallow UCRS sample above plume and nearby
- NE2: New water/soil gas sample
  - DPT vs new well?
- Compare UCRS water result to default VISL
- Discuss value of soil gas sample / decision rule development / benchmark

Summary of Scoping Meeting 1

Location NE3: Residence

- NE3: Recent (and historical) RGA [TCE] < VISL
- No additional samples required; document in SAP

Sampling Considerations

UCRS Well/DPT, First Groundwater

- UCRS well samples at locations above distal RGA Plume including new wells, if any
  - Using Standard Operating Procedure for collecting UCRS well sample
- DPT grab sample
  - Open-ended DPT rods or Geoprobe SPT16/SP22 sampler (0.65" ID screen)
  - Three depths: 10', 20', 30'
  - Leave overnight
  - Next day: Identify shallowest boring with water
  - Sample water
  - May sample shallower boring for soil gas, if available
- Use bailer or discrete depth sampler (see SAP)
- Fix-based Laboratory
- Abandonment via coated bentonite pellets (1/4-inch diameter pellets)
- Location via GPS

Sampling Considerations

DPT Sampling, Soil Gas

- General rule: 3 to 10 "pore volumes" are used as a criterion for purging
  - Pore volume includes:
    - The open volume of the sample chamber
    - Pore space of the sand pack,
    - Dry bentonite seal of the vapor implant system, and
    - Inside volume of tubing used for sampling
  - Pore volumes are specific to each sampling effort and a major factor in the time required for purging

- Equilibration time before sampling
  - DPT: at least two hours
  - Hollow stem or hand auger: at least 48 hours
  - Rotosonic or air rotary: varies from a few days to a few weeks

- Flow conditions
  - Sustain 100 mL/min with a vacuum of 100" (or less) water column for 3-10 pore volumes
  - If cannot maintain 100 mL/min flow, sample not representative of VI potential

Updated Sampling Plan Outline as Adjusted for 2nd Scoping Meeting
After Update, Go to Sampling Plan Development?

- Update Sampling and Analysis Plan for 5 Areas:
  - NW 1
  - NW2
  - NE1
  - NE2
  - NE3: Document rationale for sampling/no sampling in SAP
- Confirm tentative sampling approach
  - Existing UCRS wells
  - New UCRS wells?
  - New DPTs?
  - DPT soil gas?
- Update decision rules
- Sampling plan development schedule
  - Use existing SOPs

BACKUP to

Second Sampling and Analysis Plan Scoping Meeting: Evaluation of Vapor Intrusion (VI) at the Paducah Gaseous Diffusion Plant (PGDP) Water Policy Area

Recap of VI Guidance as Adapted to PGDP Site
Summary of Sampling and Analysis Plan Outline from Scoping Meeting 1
Additional Discussion/Backup/Evaluation
Evaluation of Proposed Changes to Plan
Monitoring Program Details

4/22/2015

Step 1 Summary: PGDP Conditions Show Lower VI Potential

UCRS Groundwater and Silt/Clay Are Barriers to Vapor Migration

- The Regional Gravel Aquifer (RGA) contamination is a potential source of hazardous vapors in groundwater underneath or near a building
- However, TCE vapors must travel upward through the UCRS groundwater (against the hydraulic gradient of clean infiltrating water) for vapors to reach the subsurface
- And, vapors must travel through low perm strata (silt/clay) to enter the building even though there is no surface barrier to outgassing to ambient air
- **Bottom Line Conclusion: RGA TCE conc's are low/decreasing and UCRS GW and soil matrix are barriers to VI with little potential for migration to few residences**

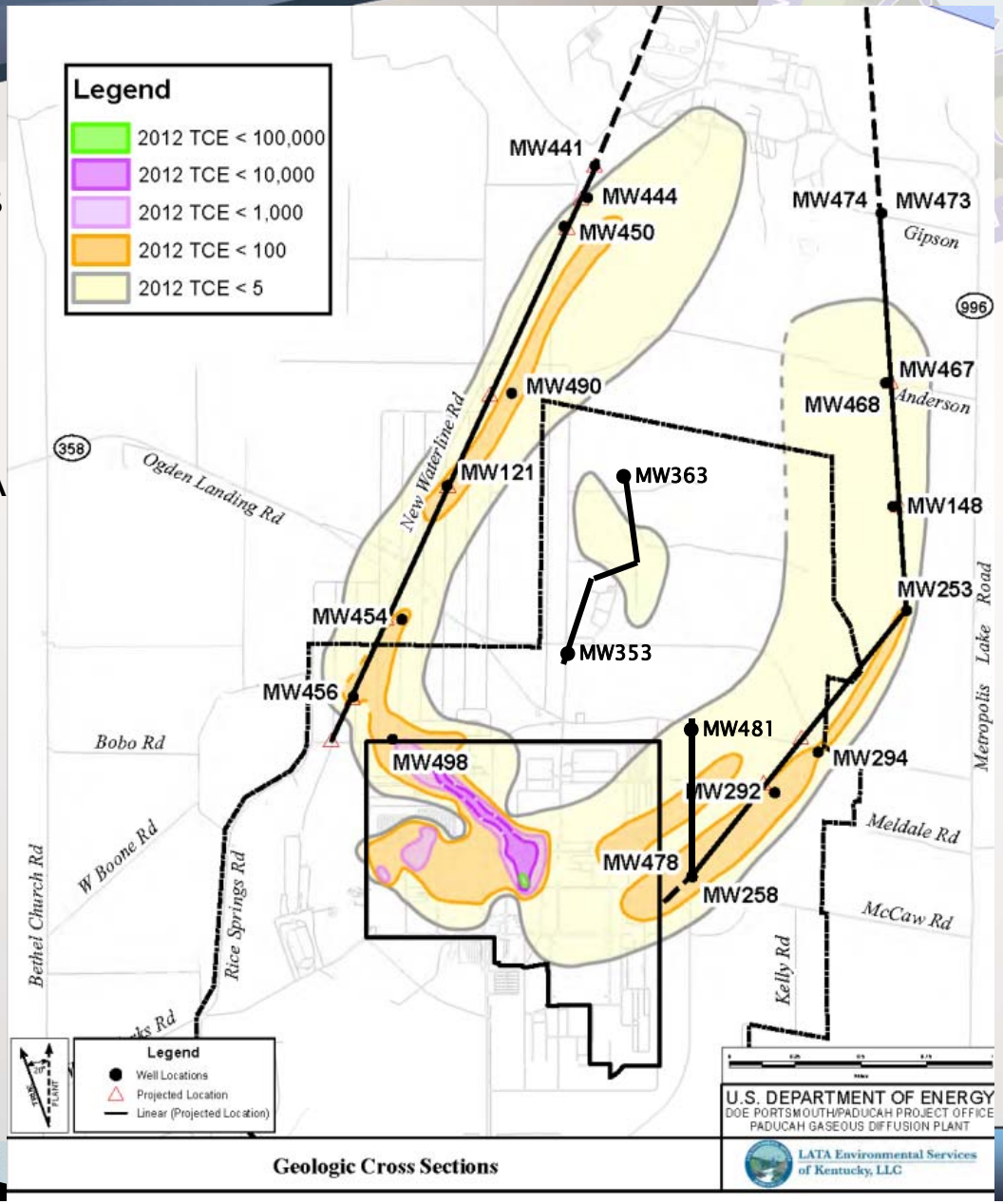
Step 1 Summary: State the Problem:

- *Determine whether groundwater (GW) data indicate a VI study is warranted*
- *Propose evaluation to confirm UCRS GW data (when combined with other PGDP information) is sufficient to demonstrate VI not an issue*

PGDP CSM: Geologic Cross Sections

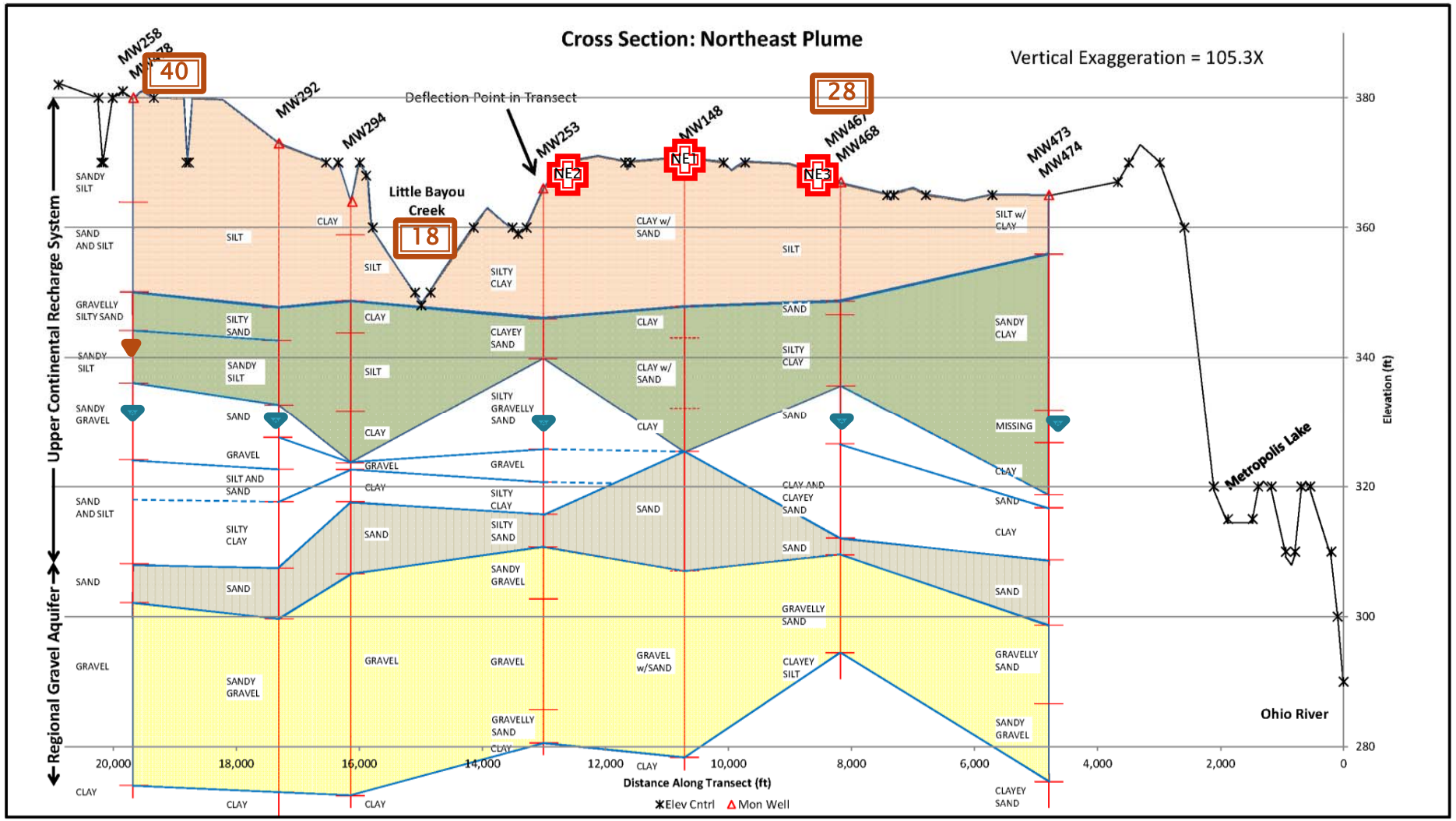
Prepared from Well Logs for Wells Shown

- Four recently prepared cross sections
  - NW Plume
  - NE Plume
  - Landfills
  - East Side
- Show UCRS silt and clay between RGA and vadose zone



PGDP CSM: Northeast Plume Cross-Section

Clay/Silt Between Contaminated RGA and Surface

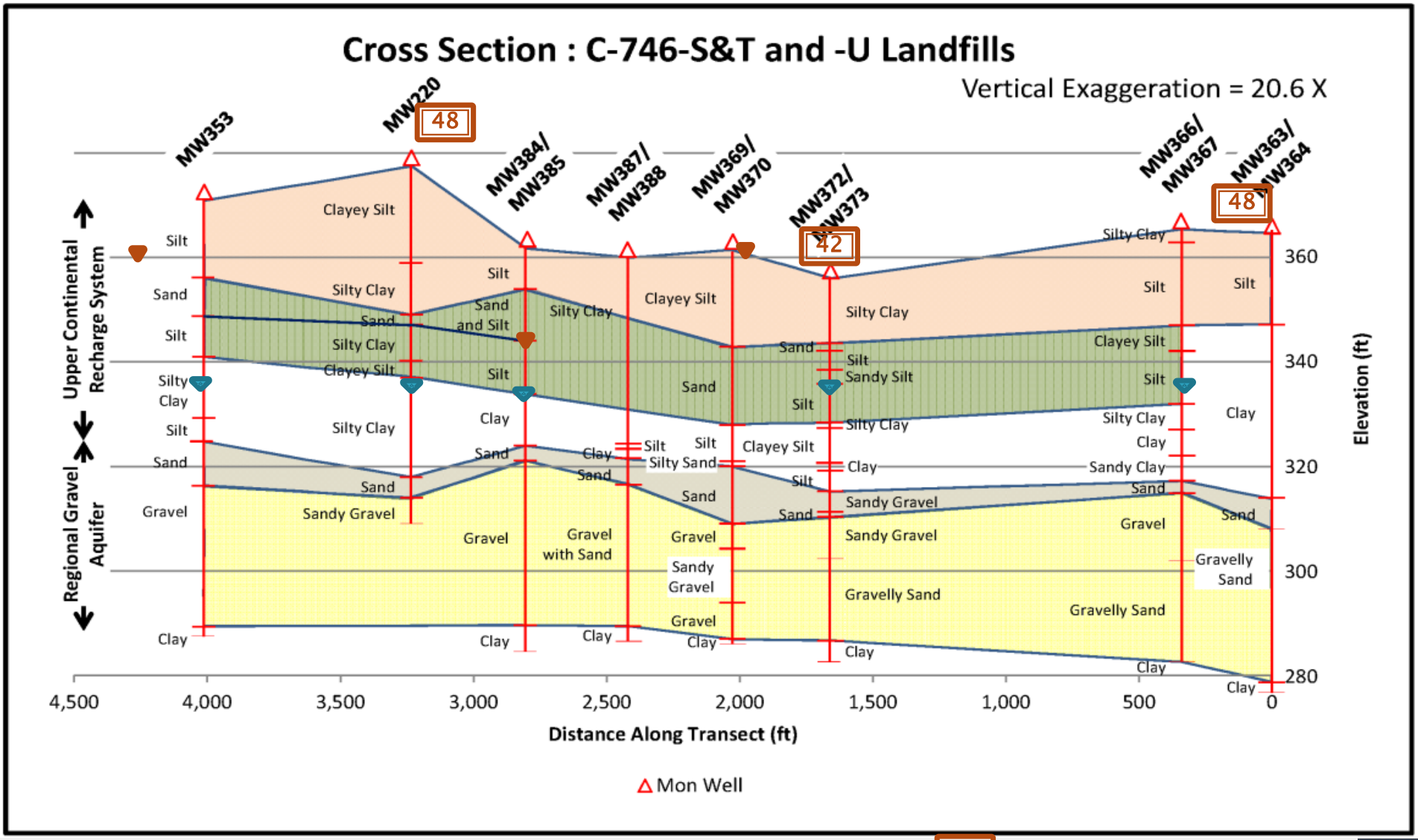


Approximate UCRS depth to water | Approximate RGA potentiometric surface | 28 Approximate clay/silt thickness

D-41

CSM Development: Landfill Area Cross-Section

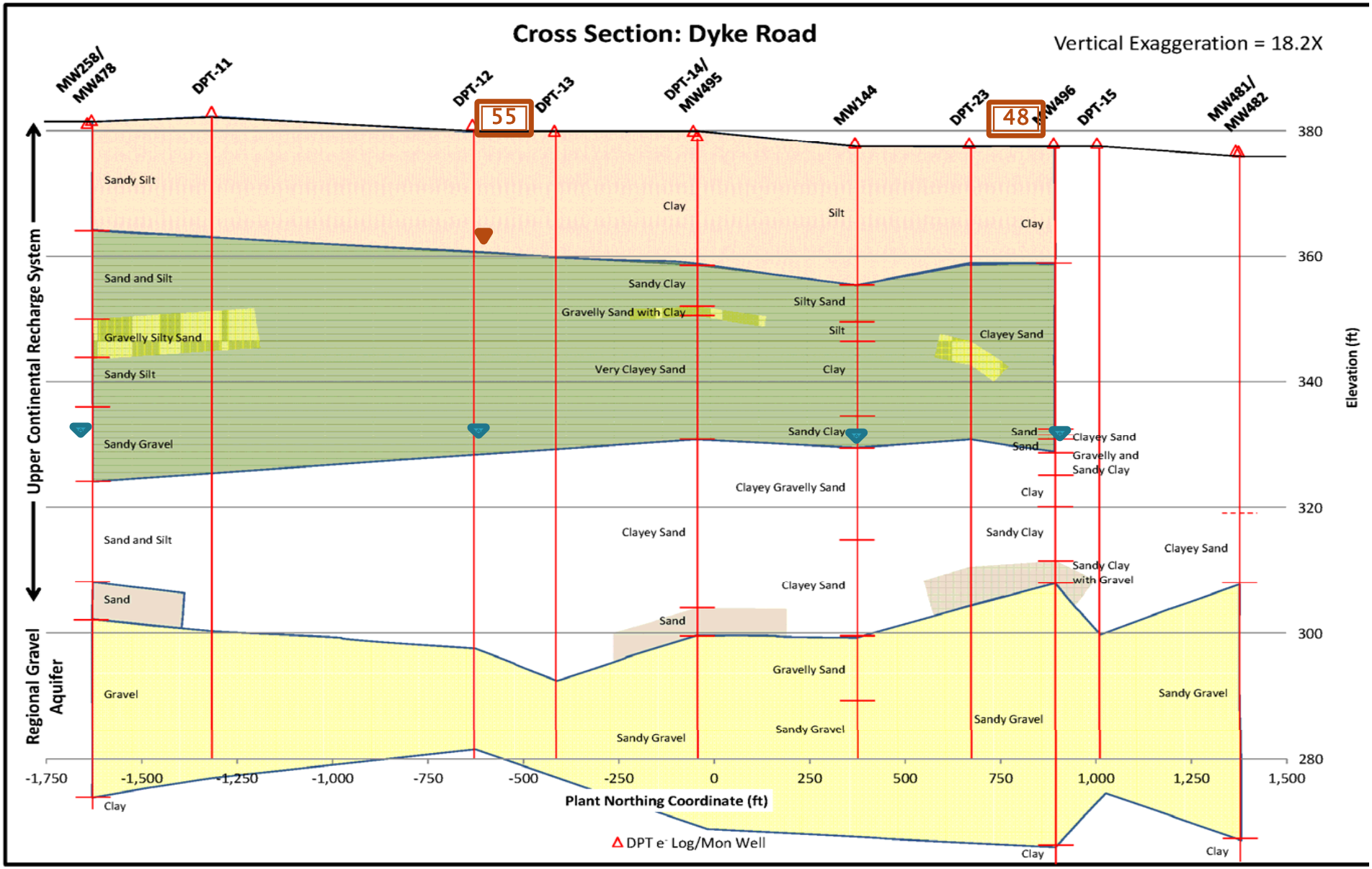
Clay/Silt Between Contaminated RGA and Surface



Approximate UCRS depth to water Approximate RGA potentiometric surface 48 Approximate clay/silt thickness

CSM Development: East Side Cross-Section

Clay/Silt Between Contaminated RGA and Surface



Approximate UCRS depth to water

Approximate RGA potentiometric surface

48 Approximate clay/silt thickness

PGDP CSM Summary

- RGA TCE contamination is potential source, but
  - RGA distal plume conc's are low and decreasing
- For a VI issue, contaminated water/vapors from TCE in the RGA must move upward through UCRS against downward clean GW gradient and continue to migrate through UCRS vadose zone silt/clay; but
- UCRS has
  - Fine-grained soils; not vertically fractured (see cross-sections)
  - Deep (contaminated) RGA GW; but intervening saturated / high-moisture UCRS
  - Low TCE conc's; TCE recalcitrant but RGA aerobic degradation eliminates daughters and lowers TCE conc's
  - UCRS conditions favorable for reductive dechlorination
  - UCRS hydraulic gradient of clean water is nearly completely vertical
  - No wells in use, no basements, few residences
  - Although slab conditions unknown, few adjacent surface barriers to limit venting of vapors

Step 1. State the Problem Summary:

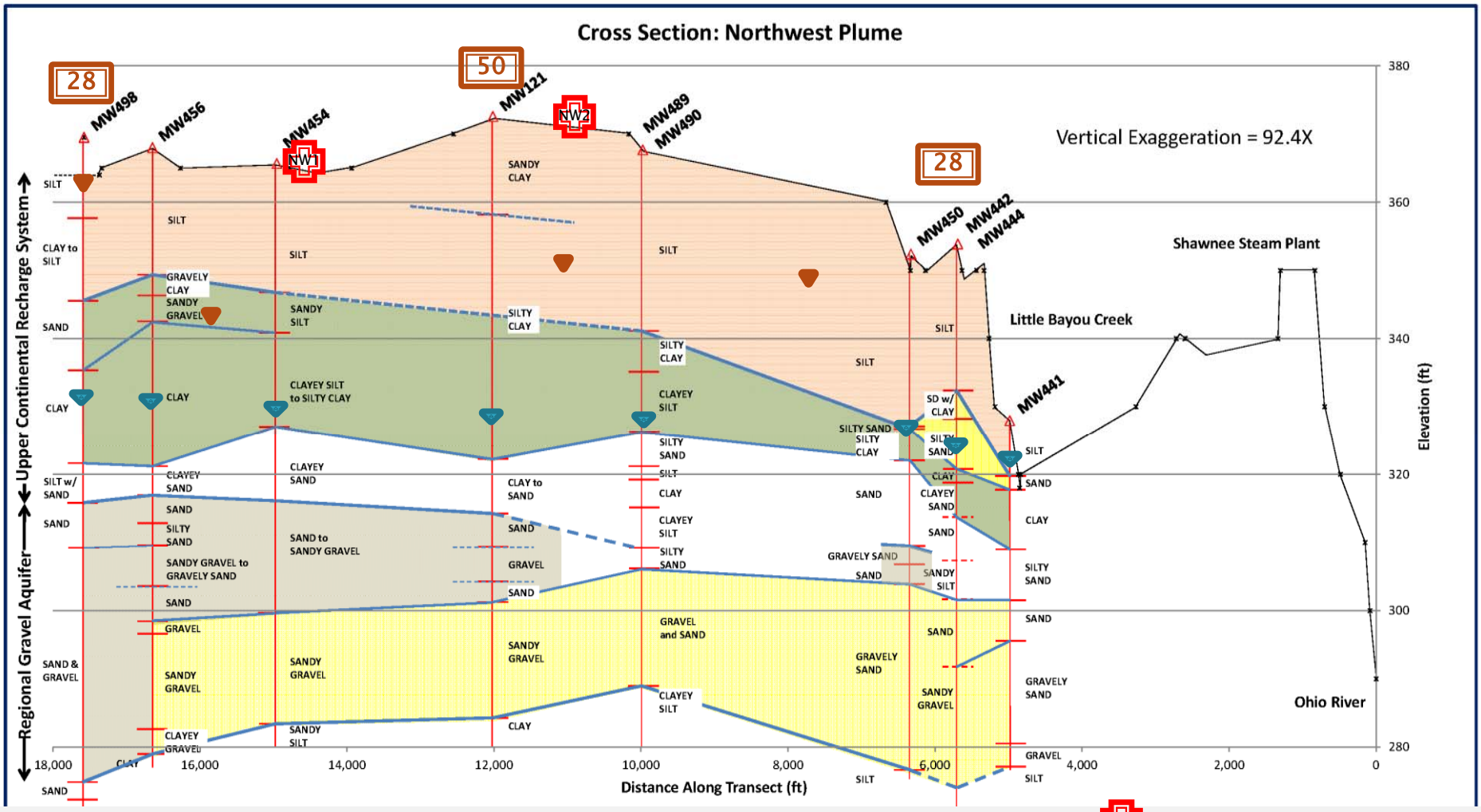
- *Evaluation shows low potential for PGDP VI due to geologic conditions*
- *UCRS GW between RGA and surface further limits VI migration potential*
- *Additional PGDP information supplied to*
  - *Support CSM and evaluate PGDP conditions against VI driving factors*
  - *Present the historical record*

BACKUP: Variability in Amounts of Intervening UCRS Water/Silt/Clay

- Confirmed UCRS GW (at > 333.3') at all UCRS well locations except
  - In the vicinity of the landfills
  - Near C-400
  - Near creeks where UCRS is incised
- GW below 333.3' may be UCRS or RGA. Confirmed UCRS GW expressed except
  - When near-surface soils impermeable/lateral UCRS water not present (near landfills)
  - When UCRS is sandy, infiltration limited, and water percolates to RGA easily (near C-400)
  - When UCRS is incised by surface water (near creeks)
- UCRS silt/clay present across site
  - See cross-sections for depiction of ~thickness of UCRS silt/clay
  - See cross-sections for depiction of ~RGA and UCRS water levels
- Intervening GW and silt/clay adds attenuation of VOCs
  - PGDP RGA TCE VISL estimated at > 120 ug/L

Recap: PGDP CSM: Northwest Plume Cross-Section

~25-50' Clay/Silt Between Contaminated RGA and Surface



NW2 Projected residence location

Approximate UCRS first water

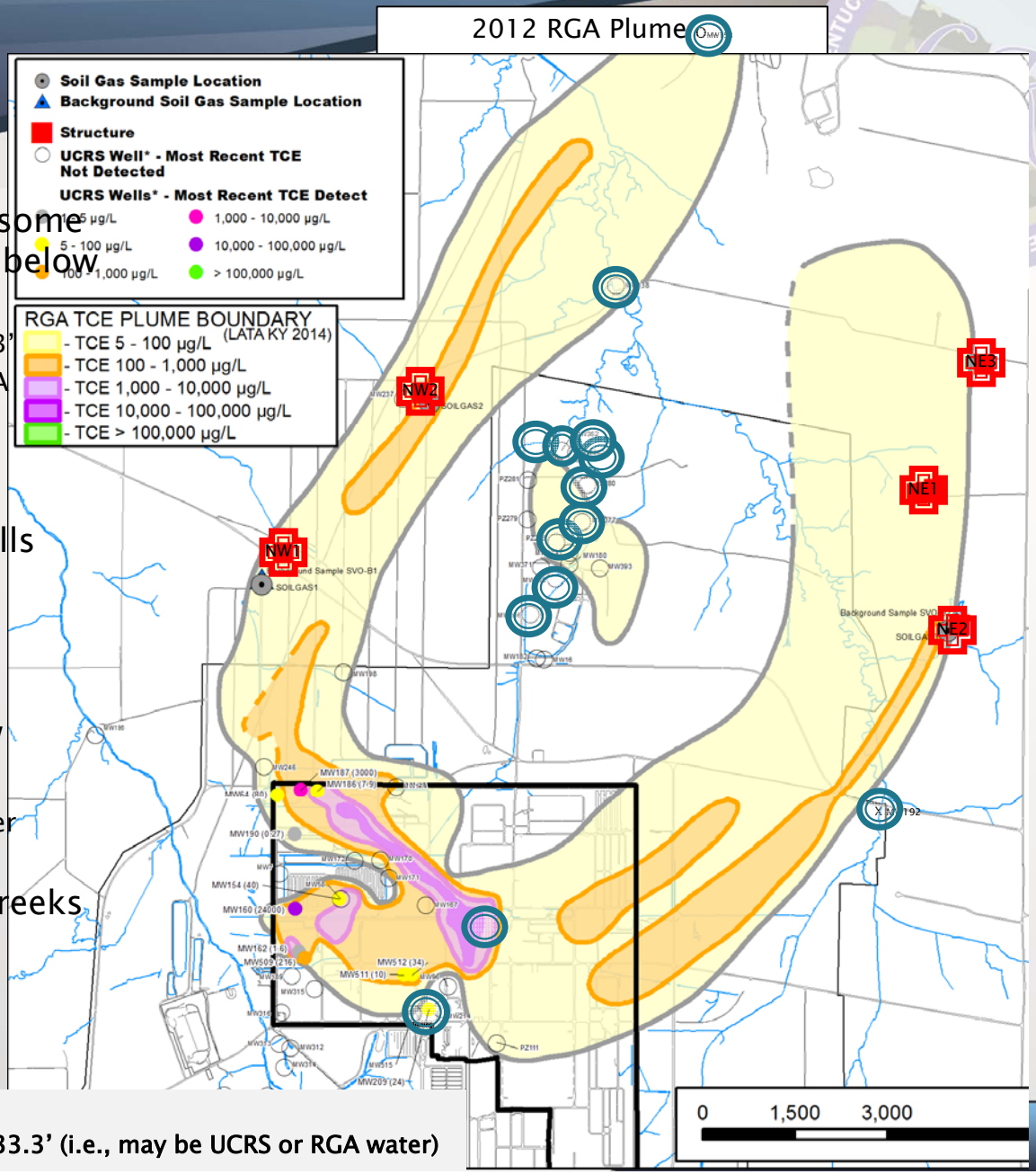
Approximate RGA potentiometric surface

50 Approximate clay/silt thickness

UCRS Groundwater Expressed Except as Shown

Confirmed UCRS GW Not Expressed Near Landfills, C-400, Near Creeks

- All UCRS wells have had water but some wells have first water at elevations below 333.3'
  - Confirmed UCRS GW has elevation > 333.3'
  - Deeper water may be either UCRS or RGA
  - 153, 390, 192, 368, 138, 365, 69, 377, 359, 376, 389, 362, 374, 177
- Lack of confirmed UCRS GW, landfills
  - Disturbed native soils
  - Additional clay
  - No horizontal UCRS communication
- Lack of C-400 confirmed UCRS GW
  - Sandier UCRS allows GW to drain to RGA
  - Overlying buildings limit infiltration water
- Lack of confirmed UCRS GW near creeks
  - Deeply incised UCRS
  - Adjacent lands should include UCRS GW



NW1 Residence Location

Location of UCRS wells with first water below 333.3' (i.e., may be UCRS or RGA water)

Collect Soil Gas from UCRS DPT/Wells?

- UCRS wells typically have water above screen above plumes
- General rule: 3 to 10 "pore volumes" are used as a criterion for purging
  - Pore volume includes:
    - the open volume of the sample chamber
    - pore space of the sand pack,
    - dry bentonite seal of the vapor implant system, and
    - inside volume of tubing used for sampling
  - Pore volumes are specific to each sampling effort and a major factor in the time required for purging
- Equilibration time before sampling
  - DPT: at least two hours
  - Hollow stem or hand auger: at least 48 hours
  - Rotosonic or air rotary: varies from a few days to a few weeks
- Flow conditions
  - Sustain 100 mL/min with a vacuum of 100" (or less) water column for 3-10 pore volumes
  - If cannot maintain 100 mL/min flow, sample not representative of VI potential

Location NE1: R31 Residence

STA_NAME	CHEMICAL_NAME	D_COLLECTED	RESULTS	UNITS	RSLTQUAL
R31	Trichloroethene	8/13/1988	1	ug/L	U
R31	Trichloroethene	12/15/1988	1	ug/L	U
R31	Trichloroethene	1/26/1989	1	ug/L	U
R31	Trichloroethene	3/21/1989	1	ug/L	U
R31	Trichloroethene	5/18/1989	1	ug/L	U
R31	Trichloroethene	7/18/1989	1	ug/L	U
R31	Trichloroethene	9/20/1989	1	ug/L	U
R31	Trichloroethene	11/27/1989	1	ug/L	U
R31	Trichloroethene	1/4/1990	1	ug/L	U
R31	Trichloroethene	3/2/1990	1	ug/L	U
R31	Trichloroethene	3/2/1990	5	ug/L	U
R31	Trichloroethene	6/21/1990	1	ug/L	U
R31	Trichloroethene	7/17/1990	1	ug/L	U
R31	Trichloroethene	9/6/1990	1	ug/L	U
R31	Trichloroethene	9/19/1990	1	ug/L	U
R31	Trichloroethene	9/24/1990	1	ug/L	U
R31	Trichloroethene	10/1/1990	1	ug/L	U
R31	Trichloroethene	10/8/1990	1	ug/L	U
R31	Trichloroethene	10/15/1990	1	ug/L	U
R31	Trichloroethene	10/22/1990	1	ug/L	U
R31	Trichloroethene	10/29/1990	1	ug/L	U
R31	Trichloroethene	11/5/1990	1	ug/L	U
R31	Trichloroethene	11/12/1990	1	ug/L	U
R31	Trichloroethene	11/19/1990	1	ug/L	U
R31	Trichloroethene	11/26/1990	1	ug/L	U
R31	Trichloroethene	12/3/1990	1	ug/L	U
R31	Trichloroethene	12/10/1990	1	ug/L	U
R31	Trichloroethene	12/17/1990	1	ug/L	U
R31	Trichloroethene	12/26/1990	1	ug/L	U
R31	Trichloroethene	1/7/1991	1	ug/L	U
R31	Trichloroethene	1/14/1991	1	ug/L	U
R31	Trichloroethene	1/21/1991	1	ug/L	U
R31	Trichloroethene	1/28/1991	1	ug/L	U
R31	Trichloroethene	2/4/1991	1	ug/L	U
R31	Trichloroethene	2/11/1991	1	ug/L	U
R31	Trichloroethene	2/19/1991	1	ug/L	U
R31	Trichloroethene	2/25/1991	1	ug/L	U
R31	Trichloroethene	3/4/1991	1	ug/L	U
R31	Trichloroethene	3/11/1991	1	ug/L	U
R31	Trichloroethene	3/18/1991	1	ug/L	U
R31	Trichloroethene	3/25/1991	1	ug/L	U
R31	Trichloroethene	4/1/1991	1	ug/L	U
R31	Trichloroethene	4/8/1991	1	ug/L	U
R31	Trichloroethene	4/15/1991	1	ug/L	U
R31	Trichloroethene	4/22/1991	1	ug/L	U
R31	Trichloroethene	4/29/1991	1	ug/L	U
R31	Trichloroethene	5/6/1991	1	ug/L	U
R31	Trichloroethene	5/13/1991	2	ug/L	
R31	Trichloroethene	5/20/1991	1	ug/L	U
R31	Trichloroethene	6/3/1991	1	ug/L	U
R31	Trichloroethene	6/10/1991	1	ug/L	U
R31	Trichloroethene	7/18/1995	1	ug/L	U

- NE1: Collect RGA sample from R31 (alternate MW149)
- Compare RGA result to default VISL (and estimated PGDP VISL)
  - If result >default VISL evaluate need for additional sample
  - Possible resolution: DPT water/soil gas or new UCRS well

Location NE3: Residence

- NE3: Recent (and historical) RGA [TCE] < VISL
- No additional samples required

STA_NAME	CHEMICAL_NAME	D_COLLECTED	RESULTS	UNITS	RSLT QUAL
MW469	Trichloroethene	3/31/2010	1	ug/L	U
MW469	Trichloroethene	6/15/2010	1	ug/L	U?
MW469	Trichloroethene	3/30/2011	1	ug/L	U
MW469	Trichloroethene	5/18/2011	1	ug/L	U
MW469	Trichloroethene	10/5/2011	1	ug/L	U
MW469	Trichloroethene	12/8/2011	1	ug/L	U
MW469	Trichloroethene	2/28/2012	1	ug/L	U
MW469	Trichloroethene	5/15/2012	1	ug/L	U
MW469	Trichloroethene	5/15/2012	1	ug/L	U
MW469	Trichloroethene	10/16/2012	1	ug/L	U
MW469	Trichloroethene	12/18/2012	1	ug/L	U
MW469	Trichloroethene	5/8/2013	1	ug/L	U
MW469	Trichloroethene	5/20/2014	0.38	ug/L	J

STA_NAME	CHEMICAL_NAME	D_COLLECTED	RESULTS	UNITS	RSLT QUAL
MW470	Trichloroethene	3/31/2010	1	ug/L	U
MW470	Trichloroethene	6/15/2010	1	ug/L	U?
MW470	Trichloroethene	3/30/2011	0.41	ug/L	J
MW470	Trichloroethene	5/18/2011	1	ug/L	U
MW470	Trichloroethene	10/5/2011	1	ug/L	U
MW470	Trichloroethene	12/8/2011	1	ug/L	U
MW470	Trichloroethene	2/28/2012	1	ug/L	U
MW470	Trichloroethene	5/15/2012	1	ug/L	U
MW470	Trichloroethene	5/15/2012	1	ug/L	U
MW470	Trichloroethene	10/16/2012	1	ug/L	U
MW470	Trichloroethene	12/18/2012	1	ug/L	U
MW470	Trichloroethene	5/8/2013	1	ug/L	UJ
MW470	Trichloroethene	10/14/2013	1	ug/L	U
MW470	Trichloroethene	5/20/2014	0.47	ug/L	J

Adjust VISL for PGDP

- The equation for the target groundwater concentration (Cgw) is:

$$Cgw = \frac{Cia,target}{AFgw \times (1000\ L/m^3) \times HLC}$$

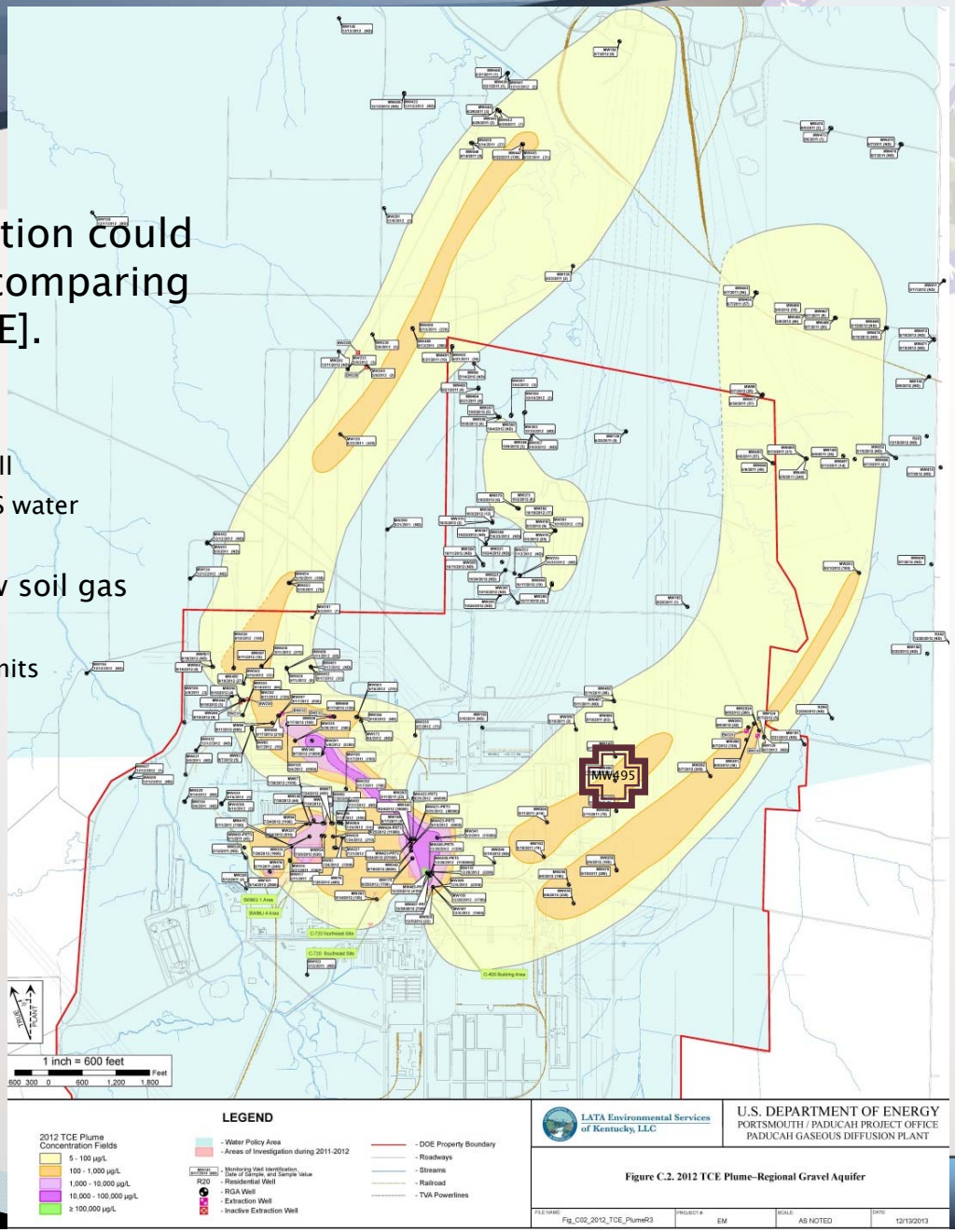
where Cia is the target indoor air concentration, AFgw is the generic attenuation factor for groundwater (default value = 0.001) and HLC is Henry's Law Constant

- Adjust VISL for PGDP by changing attenuation factor from 0.001 to 0.00001 to account for PGDP silt/clay and PGDP UCRS clean water

- Estimated PGDP VISL of >120 ug/L

Estimate PGDP VISL

- The degree of additional attenuation could be more precisely estimated by comparing RGA [TCE] to overlying UCRS [TCE].
  - Potential location: near MW495
  - Install new UCRS well at first water
    - Measure concentration in MW495 vs new well
    - Estimate attenuation between RGA and UCRS water
  - Could theoretically also measure shallow soil gas
    - Soil gas samples not representative
    - Attenuation estimate limited by detection limits



VISL Default Parameters

- Carcinogen averaging time — 70 years
- Exposure Duration — 26 years
- Exposure Frequency — 350 days/year
- Exposure Time — 24 hours/day

- Target ELCR — 1E-6

- Default Attenuation Factor — For sandy matrix, shallow soil/GW contamination

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APPENDIX E

DISCRETE DEPTH SAMPLER PROCESS

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Groundwater Sampling Steps for Vapor Intrusion Investigation—Discrete Depth Sampler

A discrete interval sample system, such as the Solinst Model 425 Discrete Interval Sampler, will be used to collect a grab groundwater sample. The following sampling steps may be modified based on brand, model, and/or field conditions at the discretion of the sampling team. Any deviations will be documented in the report. The discrete interval sample system consists of a stainless steel sampler with tubing. Water enters the sampler through a check-ball valve at the base of the sampler. A pressure attachment and pressure/vent switch (mounted on the reel for the sampler tubing) are used to apply and release pressure on the sampler. A compressed nitrogen cylinder is used to pressurize the sample system to avoid cross contamination from the air pumps and to minimize volatilization of contaminants in the groundwater sample within the discrete depth sampler.

Step 1: Begin the sampling process by measuring the depth to water using a water-level meter.

Step 2: Determine the operating pressure for the sampling system. The operating pressure [in pounds per square inch (psi)] is calculated as 10 plus the product of 0.43 and the submerged depth of the direct push technology (DPT) sample rods, in feet:

$$\text{Operating pressure (psi)} = [10 + (0.43 \times \text{submerged depth})]$$

Step 3: After pressurizing the discrete depth sample system to the operating pressure, lower the discrete depth sampler to the base of the DPT rods.

Step 4: Release the gas pressure on the discrete depth sampler (via the pressure/vent switch). Hydrostatic pressure will fill the sampler with water directly from the base of the DPT sample rods.

Step 5: After water has entered the sampler, repressurize the discrete depth sampler to the operating pressure to ensure the bottom valve is closed and retrieve the discrete depth sampler.

Step 6: Fill the VOC sample vials first by releasing pressure on the sampling system and then by using a sample release device to decant the sample through the bottom valve of the discrete depth sampler.

Step 7: Collect remaining water in a beaker and measure and record the sample water temperature. (The temperature measurement will be used in later calculations of the applicable Vapor Intrusion Screening Level.)

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