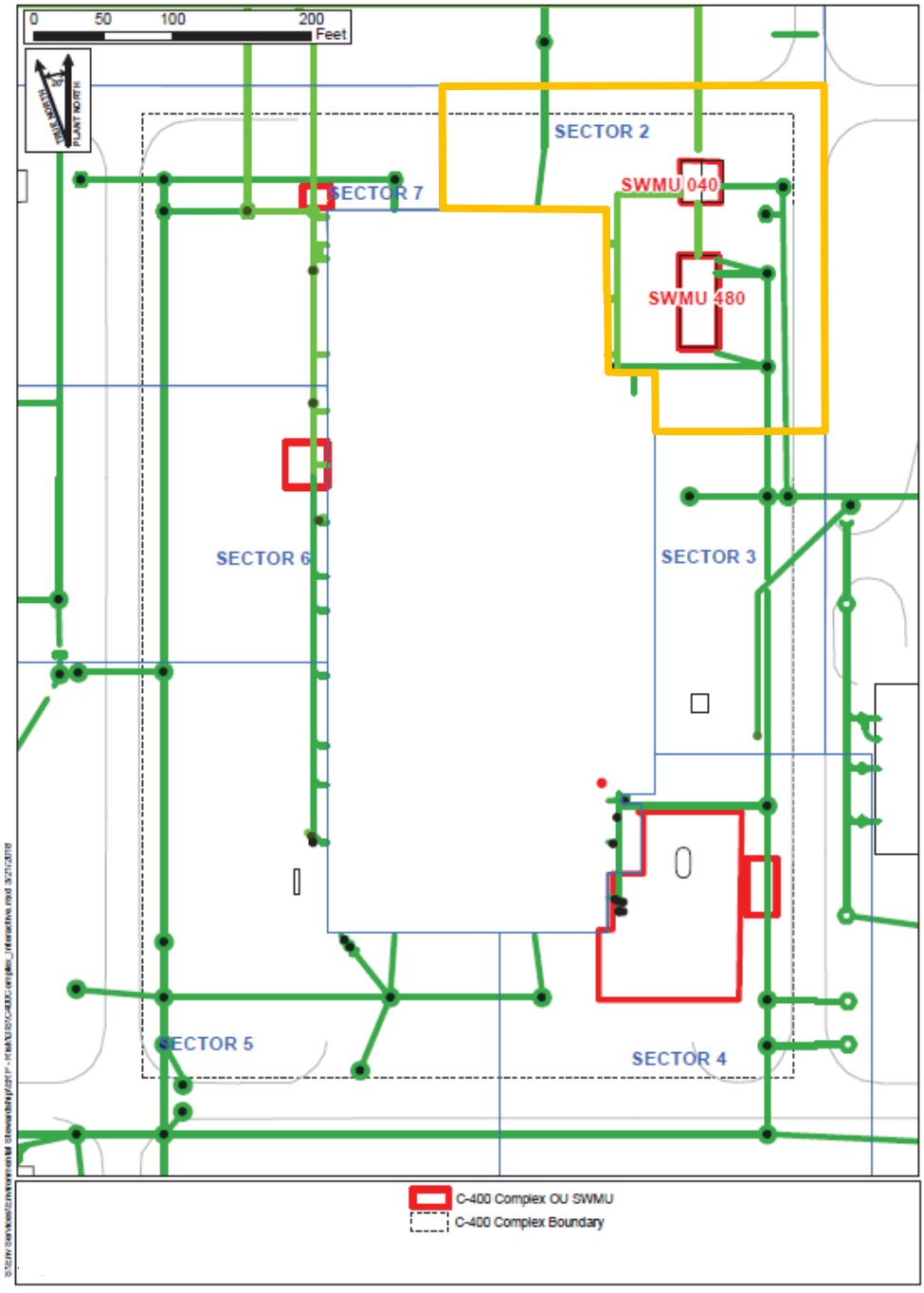
Sampling Plan Strategy
Sector 2

DRAFT – FOR DISCUSSION ONLY (5/15/2018)

Location of Sector 2



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Sector 2 Background

Concrete and asphalt pavement covers much of current area of Sector 2

- Area of ~38,000 ft^2
- Concrete apron on north end of building is original construction
- Limited area of exposed soil

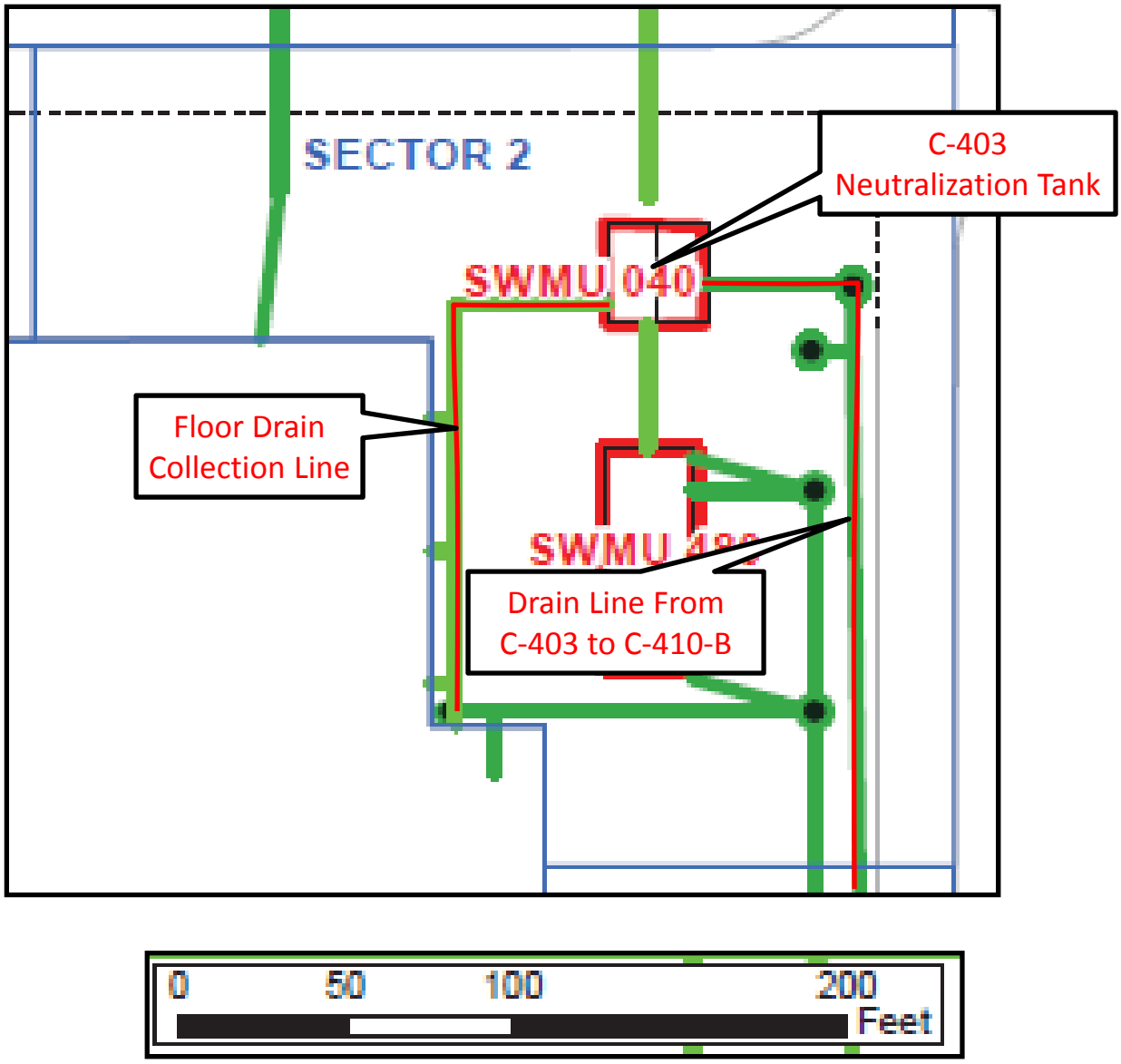
Key context from WAG 6 RI

- Surface soils are sparsely represented
  - PAHs are present (detects in 3 of 6 samples), locally elevated
  - PCBs are present above the WAG 6 screening level in 1 sample

- 31 subsurface soil samples from 19 locations
  - Sampled between 5 and 49 ft bgs
  - Analyzed for VOCs, SVOCs, and metals
  - 22 samples screened for PCBs – not a problem
  - PAHs present near building (all detections -3 locations - below 1,000 ug/kg)

- Identified areas of contamination
  - Floor drain collection line on outer perimeter of the building (drained to C-403/SWMU 40)
    - Radionuclides detected between 15 and 40 ft bgs
  - C-403 Neutralization Tank and drain line from C-403/SWMU 40 to C-410-B Lagoon
    - Radionuclides detected in C-403 backfill (to 30 ft depth)
    - Radionuclides, silver, and antimony detected in soils adjacent and below drain line from C-403 to C-410-B Lagoon

Sector 2 WAG 6 RI
Identified Areas of Contamination



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Sector 2 Sampling Strategies: Targeted ~~vs Random~~

Anticipated remedial action(s)

- Excavation of C-403 (certain)
- Removal of surface soil (likely action)

Primary recognized uncertainties

- Nature and extent of surface soil contamination (addressed by surface soil removal)
- Near-field extent (lateral and vertical) of metals and radionuclides associated with identified areas of contamination

Sample strategies

- ~~No surface soil samples collected for targeted sampling approach. (2) Confirmatory surface soil samples planned. Baseline Risk Assessment requires surface soil samples.~~
- Sample 3 subsoil horizons
  - HU1: ~ 10 ft depth
  - HU2A: ~ 20 ft depth
  - HU3: ~ 35 ft depth

- Targeted – contaminant sources and COCs from WAG 6 RI Baseline Risk Assessment
  - Sampling to update extent of contaminants

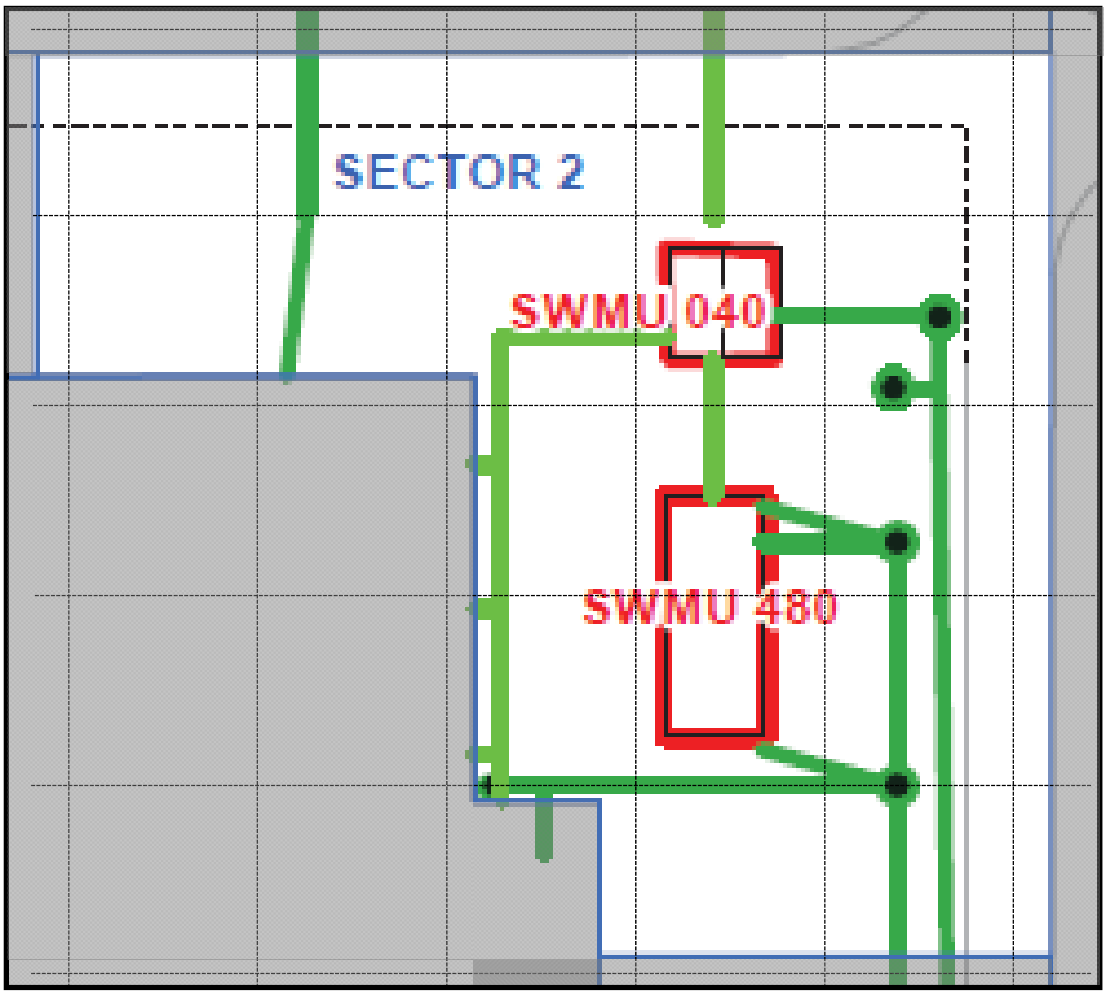
~~OR~~

- ~~Random – taking no benefit from WAG 6 RI~~
  - ~~Sampling to support baseline risk assessment and define nature and extent~~

How Many Subsoil Samples?

Sector 2 consists of approximately 38,000 sq ft:

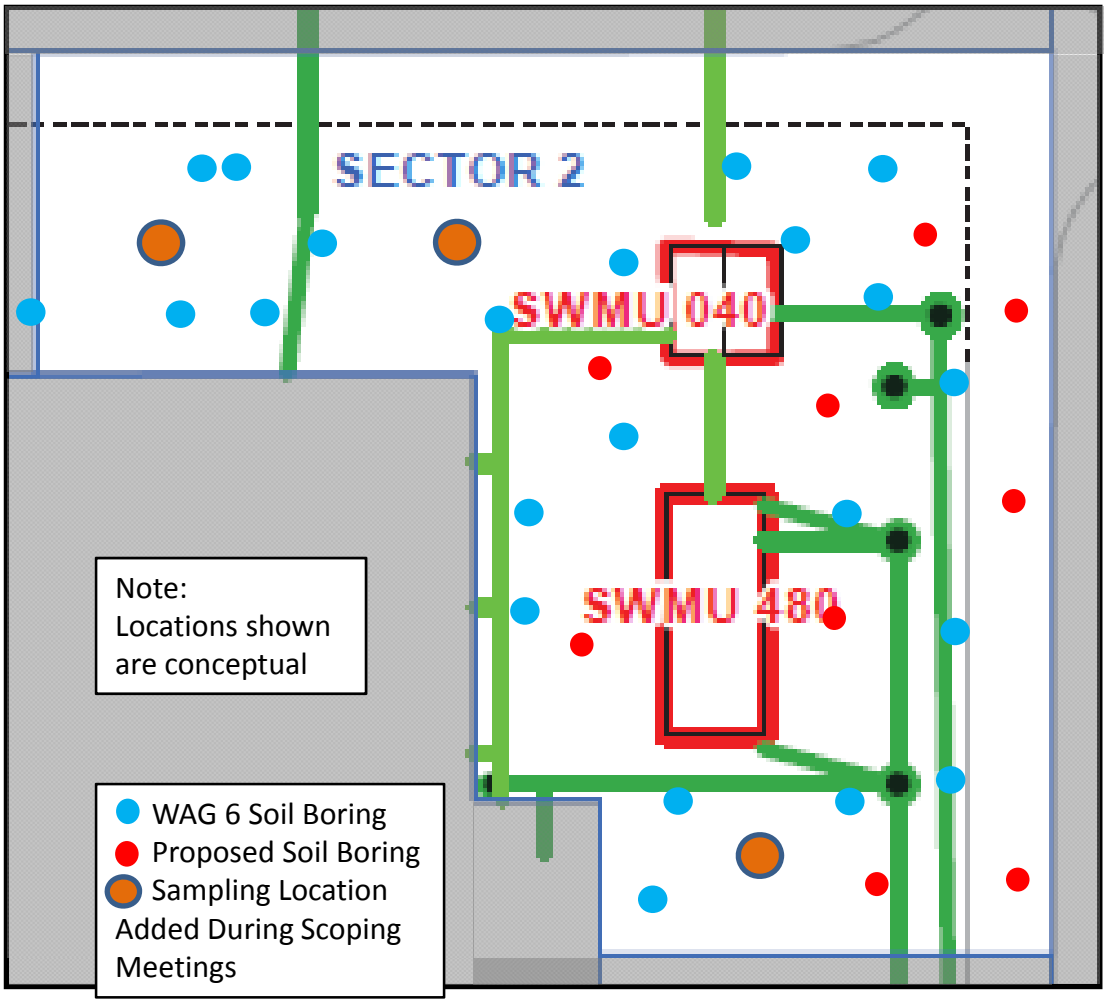
If each sample characterizes a 50 ft x 50 ft area, ~9 samples are required to characterize the site with 95% confidence at 80% coverage



Sector 2 - Option 1:
Targeted Sampling Approach

Example targeted approach:

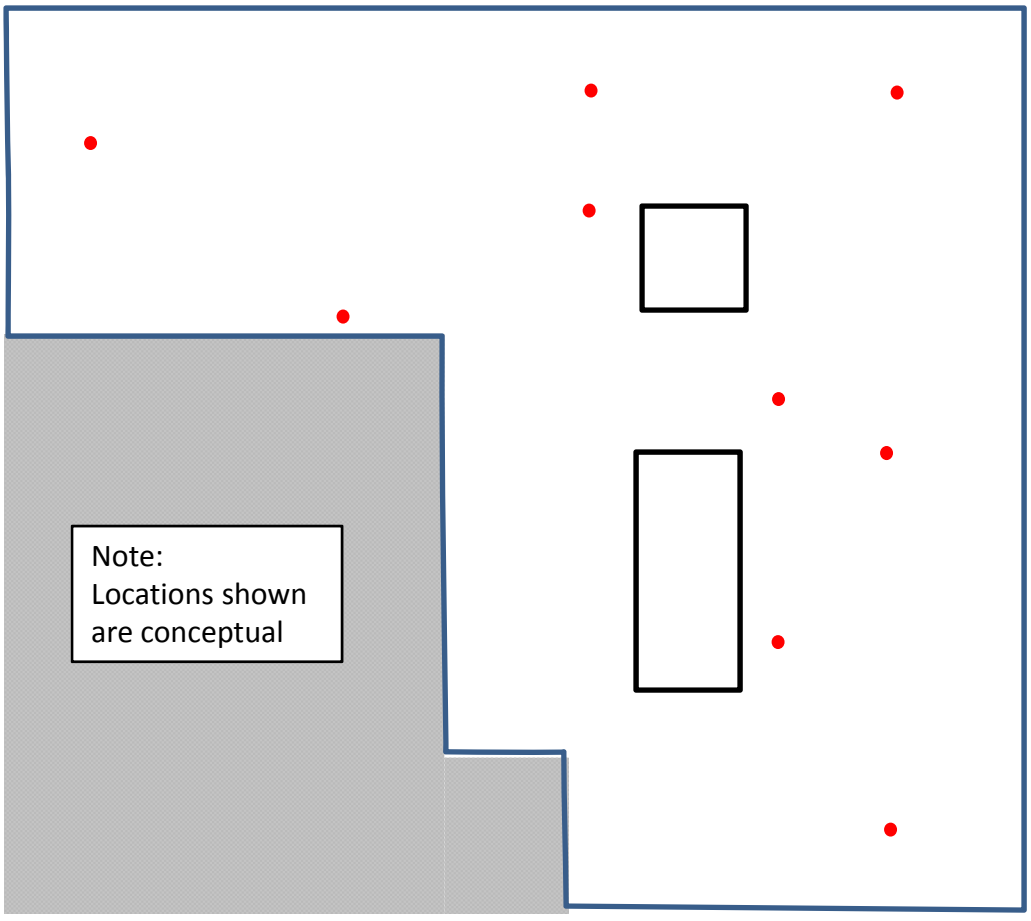
- Assumes C-403 Neutralization Tank (SWMU 40) will be excavated
- Assumes removal of surface soil
- Approximates an even distribution around the remaining contaminant sources to define contaminant levels at the contaminant sources and away from the sources
- Samples will be collected from HU1, HU2, and HU3 depths at each proposed sample location
- Total of ~~9~~ 12 soil borings/~~27~~ ~~36~~ soil samples
- ~~2 Confirmatory surface soil samples~~



~~Sector 2 – Option 2:~~
~~Random Sampling Approach~~
~~Sample all 3 HUs in each borehole~~

~~Example random approach (9 total sample locations):~~

- ~~50 ft x 50 ft grid further refined into 9 cells per grid~~
- ~~Assumes all potential sample locations are of equal value (sampling locations identified at C-403/SWMU-40 location would be moved to an adjacent grid cell)~~
- ~~Samples will be collected from HU1, HU2, and HU3 depths at each sample location~~
- ~~Total of 9 soil borings/27 soil samples~~



Subsoil Sample Approach Summary

2 Options:

1) Targeted Sampling Approach
   - Risk Screening Investigation based on WAG 6 RI Baseline Risk Assessment
   - Sampling and analysis to confirm nature of contamination and characterize current extent of contamination
   - Strengths
     - Uses existing knowledge (WAG 6 RI characterization)

~~2) Random Sampling Approach: Sample all HUs in Each Borehole~~
   - ~~Baseline Risk Assessment Investigation~~
   - ~~Sampling and analysis to identify risk drivers and define extent~~
   - ~~Strengths~~
     - ~~Simplifies selection of soil boring location~~
   - ~~Weakness~~
     - ~~Ignores existing data (for baseline risk) WAG 6 data could be used qualitatively for determining response action.~~
     - ~~Likely requires 2nd stage of sampling to define extent adequately~~

<u>Preference is 1) Targeted Sampling Approach</u>

Sector 2 Analyses

Option 1: Targeted Sampling Approach (based on WAG 6 RI Baseline Risk Assessment)

- Metals (chromium as total chromium)
- PCBs
- Radionuclides
- SVOCs
- VOCs (includes toluene)

~~Option 2: Random Sampling Approach~~

- ~~COPCs as defined in Table 2.1 of Risk Methods Document~~
  - ~~Including all metals (chromium as total, only)~~
  - ~~Including toluene~~
  - ~~Excluding dioxins/furans~~

Groundwater samples: sample existing UCRS well MW177 for same chemical analytical suites as soil sampling approach

Adaptation of Table 2.1 Significant Chemicals and Radionuclides of Potential Concern at PGDP

from *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

DOE/LX/07-0107&D2/R8/V1

Inorganic Chemicals		Organic Compounds				Radionuclides	
Analyte	CAS Number	Analyte	CAS Number	Analyte	CAS Number	Analyte	CAS Number
Aluminum	7429-90-5	Acenaphthene	83-32-9	~~Total Dioxins/Furans~~	~~1746-01-6~~	Americium-241	14596-10-2
Antimony	7440-36-0	Acenaphthylene	208-96-8	~~2,3,7,8-HpCDD~~	~~37871-00-4~~	Cesium-137+D	10045-97-3
Arsenic	7440-38-2	Acrylonitrile	107-13-1	~~2,3,7,8-HpCDF~~	~~38998-75-3~~	Neptunium-237+D	13994-20-2
Barium	7440-39-3	Anthracene	120-12-7	~~2,3,7,8-HxCDD~~	~~34465-46-8~~	Plutonium-238	13981-16-3
Beryllium	7440-41-7	Benzene	71-43-2	~~2,3,7,8-HxCDF~~	~~55684-94-1~~	Plutonium-239	15117-48-3
Boron	7440-42-8	Bromodichloromethane	75-27-4	~~OCDD~~	~~3268-87-9~~	Plutonium-240	14119-33-6
Cadmium	7440-43-9	Carbazole	86-74-8	~~OCDF~~	~~39001-02-0~~	Technetium-99	14133-76-7
~~Chromium III~~	~~16065-83-1~~	Carbon tetrachloride	56-23-5	~~2,3,7,8-PeCDD~~	~~36088-22-9~~	Thorium-230	14269-63-7
~~Chromium VI~~	~~18540-29-9~~	Chloroform	67-66-3	~~1,2,3,7,8-PeCDF~~	~~57117-41-6~~	Uranium-234	13966-29-5
Total Chromium	7440-47-3	1,1-Dichloroethene	75-35-4	~~2,3,4,7,8-PeCDF~~	~~57117-31-4~~	Uranium-235+D	15117-96-1
Cobalt	7440-48-4	1,2-Dichloroethane	107-06-2	~~2,3,7,8-TCDD~~	~~1746-01-6~~	Uranium-238+D	7440-61-1
Copper	7440-50-8	1,2-Dichloroethene (mixed)	540-59-0	~~2,3,7,8-TCDF~~	~~5127-31-9~~		
Fluoride	16984-48-8	trans-1,2-Dichloroethene	156-60-5	Total Carcinogenic PAHs	50-32-8		
Iron	7439-89-6	cis-1,2-Dichloroethene	156-59-2	Benz(a)anthracene	56-55-3		
Lead	7439-92-1	Dieldrin	60-57-1	Benzo(a)pyrene	50-32-8		
Manganese	7439-96-5	Ethylbenzene	100-41-4	Benzo(b)fluoranthene	205-99-2		
Mercury	7439-97-6	Fluoranthene	206-44-0	Benzo(k)fluoranthene	207-08-9		
Molybdenum	7439-98-7	Fluorene	86-73-7	Chrysene	218-01-9		
Nickel	7440-02-0	Hexachlorobenzene	118-74-1	Dibenz(a,h)anthracene	53-70-3		
Selenium	7782-49-2	Naphthalene	91-20-3	Indeno(1,2,3-cd)pyrene	193-39-5		
Silver	7440-22-4	2-Nitroaniline	88-74-4	Total PCBs	1336-36-3		
Thallium	7440-28-0	N-Nitroso-di-n-propylamine	621-64-7	Aroclor 1016	12674-11-2		
Uranium	NA	~~Pentachlorophenol~~	~~87-86-5~~	Aroclor 1221	11104-28-2		
Vanadium	7440-62-2	Phenanthrene	85-01-8	Aroclor 1232	11141-16-5		
Zinc	7440-66-6	Pyrene	129-00-0	Aroclor 1242	53469-21-9		
		Tetrachloroethene	127-18-4	Aroclor 1248	12672-29-6		
		Toluene	108-88-3	Aroclor 1254	11097-69-1		
		1,1,1-Trichloroethane	71-55-6	Aroclor 1260	11096-82-5		
		1,1,2-Trichloroethane	79-00-5	Vinyl chloride	75-01-4		
		Trichloroethene	79-01-6	Xylenes (Mixture)	1330-20-7		
				p-Xylene	106-42-3		
				m-Xylene	108-38-3		
				o-Xylene	95-47-6		

[1] This list of chemicals, compounds, and radionuclides was compiled from COPCs retained as COCs in baseline risk assessments performed at PGDP between 1990 and 2013 (i.e., DOE 1996a; DOE 1996b; DOE 1999a; DOE 1999b; DOE 2000a; DOE 2001; DOE 2005; DOE 2008; DOE 2010; DOE 2013).

[2] List may be added to during project scoping based on additional information.

Sector 2 Possible Response Actions

Surface Soil

- Excavation, ~~if required~~

Subsurface Soil

- Above Water Table
  - Thermal – VOCs/SVOCs
  - Soil Vapor Extraction – VOC/SVOCs
  - Solidification/Stabilization - Inorganics/Radionuclides
  - Enhanced Bioremediation - VOCs/SVOCs/Inorganics (contaminant dependent)
  - Excavation and treatment/disposition – (Treatment - contaminant dependent)
  - Chemical Oxidation - VOCs/SVOCs/Inorganics (contaminant dependent)
  - Barrier/Slurry Wall – VOC/SVOCs/Inorganics
  - Combination of Technologies

- Below Water Table
  - Thermal – VOCs / SVOCs
  - Dual Phase Extraction – VOC / SVOCs
  - Soil Flushing – VOCs / Inorganics
  - Solidification/Stabilization - Inorganics / Radionuclides
  - Enhanced Bioremediation - VOCs/SVOCs/Inorganics (contaminant dependent)
  - Excavation and treatment/disposition – (Treatment-contaminant dependent)
  - Chemical Oxidation - VOCs/SVOCs/Inorganics (contaminant dependent)
  - Barrier/Slurry Wall – VOC/SVOCs/Inorganics
  - Pump and Treat – Contaminants dependent on treatment system
  - Combination of Technologies

Sector 2 – Geotechnical Samples

Geotechnical samples (in general):

- Engineering properties, transport properties, and risk assessment
- Geotechnical properties likely consistent across C-400 OU Complex
  - 1 boring (3 samples) per sector to define characteristic value and variability for C-400 OU Complex
  - Samples from minimally affected soil
- Examples of data needs for potential remedial actions
  - Geochemical and biological parameters that could affect chemical degradation and transformation
  - Modeling parameters including chemical parameters, mineralogy, reduction-oxidation potential, porosity, permeability, and stratigraphy
  - Potentiometric surfaces (groundwater flow direction)
  - Physical parameters including compaction, grain size, cation exchange, chemical oxygen demand, pH, permeability, genetic profiling, microbial community, NOD, and moisture content of soils