

Commonwealth of Kentucky

Environmental Oversight Report 2014 Paducah Gaseous Diffusion Plant



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This 2014 Environmental Oversight Report, finalized in July 2015, was prepared by the Kentucky Division of Waste Management to report activities under the U.S. Department of Energy Federal Facility Agreement (FFA) and Agreement in Principle (AIP) grants covering the period from Jan. 1, 2014, to Dec. 31, 2014. This report summarizes activities undertaken by the Commonwealth of Kentucky (Kentucky) to oversee environmental restoration activities at the Paducah Gaseous Diffusion Plant (PGDP). Copies of the report are available from the Hazardous Waste Branch, Division of Waste Management, 200 Fair Oaks Lane, 2nd Floor, Frankfort, Kentucky 40601, phone 502-564-6716.

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ACRONYM and ABBREVIATION LIST

Agreement in Principle	AIP
Applicable or Relevant and Appropriate Requirements	ARAR
Area of Concern	AOC
Burial Ground Operable Unit	BGOU
Cabinet for Health and Family Services	CHFS
Citizens Advisory Board	CAB
Comprehensive Environmental Response, Compensation, and Liability Act	CERCLA
Decontamination and Decommissioning	D&D
Dense Non-Aqueous Phase Liquid	DNAPL
Department of Energy (US)	DOE
Engineering Evaluation/Cost Analysis	EE/CA
Environmental Indicators	EI
Environmental Management	EM
Environmental Protection Agency (US)	EPA
Environmental Restoration	ER
Feasibility Study	FS
Federal Facilities Agreement	FFA

Gallons Per Minute	gpm
Groundwater Operable Unit	GWOU
In Situ Object Counting System	ISOC
Kentucky Department for Environmental Protection	KDEP
Kentucky Division of Waste Management	KDWM
Kentucky Ordnance Works	KOW
Kentucky Pollutant Discharge Elimination System	KPDES
Land Use Control Implementation Plan	LUCIP
Maximum Concentration Level	MCL
Memorandum of Agreement	MOA
Monitoring Well	MW
National Priorities List	NPL
Nevada Test Site	NTS
Non-Detect	ND
North-South Diversion Ditch	NSDD
Northeast Plume Containment System	NEPCS
Northwest Plume Groundwater System	NWPGS
Not Applicable	NA
Paducah Gaseous Diffusion Plant	PGDP

Paducah Remediation Services	PRS
Parts Per Billion	ppb
Parts Per Million	ppm
Polychlorinated Biphenyl	PCB
Principal Threat Waste	PTW
Proposed Remedial Action Plan	PRAP
Radiation Health Branch	RHB
Rapid Bioassessment Protocol	RBP
RCRA Facility Investigation	RFI
Record of Decision	ROD
Regional Groundwater Aquifer	RGA
Remedial Design/Site Investigation	RD/SI
Remedial Design Work Plan	RDWP
Remedial Investigations/Feasibility Study	RI/FS
Resource Conservation and Recovery Act	RCRA
Sampling and Analysis Plan	SAP
Scrap Metal Removal Project	SMRP
Site Management Plan	SMP
Soils Operable Unit	SOU

Solid Waste Management Unit	SWMU
Solid Waste Management Unit Assessment Report	SAR
Surface Water Operable Unit	SWOU
Technetium-99	Tc-99
To Be Considered	TBC
Total Suspended Solids	TSS
Trichloroethene	TCE
University of Kentucky	UK
Upper Continental Recharge System	UCRS
United States Enrichment Corporation	USEC
United States Geological Survey	USGS
Uranium Hexafluoride	UF₆
Uranium Tetrafluoride	UF₄
Volatile Organic Compound	VOC
Waste Acceptance Criteria	WAC
West Kentucky Wildlife Management Area	WKWMA

Introduction

In July 2013, the Paducah Gaseous Diffusion Plant (PGDP) ended over 60 years of continuous production of enriched uranium. The PGDP is located on a 3,556-acre federal reservation in northwestern McCracken County. Most of the operations at the PGDP occurred inside a fenced security area of approximately 750 acres, surrounded and bounded by the West Kentucky Wildlife Management Area (WKWMA). Since construction, the PGDP has been owned by the United States Department of Energy (DOE) or its predecessor U.S. government agencies. The United States Enrichment Corp. (USEC) assumed responsibility for operation and maintenance of the PGDP production facilities in July 1993. Although DOE retains ultimate responsibility for environmental restoration and waste management, DOE has employed a series of support contractor teams to assist the implementation of various activities at the site. LATA Kentucky was the PGDP general support contractor to DOE throughout the period covered (CY 2014) by this report.

A variety of environmental concerns have been identified at the site since 1988. Historical PGDP activities have adversely affected soil, sediment, surface water, and groundwater. Groundwater sampling and analysis has detected concentrations of both trichloroethene (TCE) and Tc-99, a radioactive byproduct of historic PGDP process operations. Soils and sediment sampling and analysis have detected the presence polychlorinated biphenyls (PCBs) and uranium. In addition, historic surface water studies have documented PCB concentrations in fish collected from both Bayou Creek (west of the site) and Little Bayou Creek (east of the site).

Site cleanup activities at the PGDP occur in a sequenced approach consisting of pre-shutdown and post-shutdown activities. The pre-shutdown scope is associated with media-specific Operable Units (OUs). An OU is a grouping of areas or sources that share common attributes such as contaminated media type (groundwater surface water, soil) and associated exposure pathways (ingestion, inhalation, dermal exposure). Post-shutdown activities will focus on D&D of the remaining PGDP as well as upon potentially contaminated media that is presently unknown or currently inaccessible.

At the PGDP, media-specific OUs were established by developing a site conceptual risk model for each solid waste management unit (SWMU) and Area of Concern (AOC). This process

included a qualitative evaluation of contaminant types and concentration, release mechanisms, likely exposure pathways, estimated points of exposure, and potential receptors. Current and reasonably foreseeable future land assumptions were also included in the evaluation.

The media-specific OUs identified for the PGDP are:

Pre-GDP Shutdown

- Surface Water OU
- Groundwater OU
- Burial Grounds OU
- Soils OU
- Decontamination and Decommissioning (D&D) OU

Post- GDP Shutdown

- GDP Lagoons and Ditches OU
- GDP Groundwater Sources OU
- Additional Burial Grounds Sources OU
- Soils and Slabs OU
- GDP D&D OU

A Final Comprehensive Site OU evaluation will occur following completion of D&D of the PGDP and completion of clean-up of the media-specific OUs.

Public Participation

Citizens Advisory Board (CAB)

The Paducah Citizens Advisory Board (CAB) is a stakeholders' board that provides advice and recommendations to DOE regarding environmental management programs at the PGDP.

KDWM and CHFS are non-voting, ex-officio members who serve as advisors and inform the CAB on their respective agencies' policies and views.

Kentucky's Oversight Program

The Commonwealth of Kentucky (hereafter referred to as Kentucky) is responsible for overseeing the environmental cleanup of the PGDP. Kentucky's Energy and Environment Cabinet (EEC) has designated the Hazardous Waste Branch (HWB) within the Division of Waste Management (DWM) to serve as the lead agency to coordinate this oversight and to implement both the Agreement in Principle (AIP) and the Federal Facility Agreement (FFA) programs for Kentucky. The CHFS Radiation Health Branch (RHB) also serves a critical role in implementing these two oversight programs. State agencies and other organizations assisting the HWB and RHB with oversight responsibilities include:

- Division of Waste Management (DWM)
- Division of Water (DOW)
- Division for Air Quality (DAQ)
- Kentucky Department of Fish and Wildlife Resources (KDFWR)
- University of Kentucky Research Consortium Energy and Environment (KRCEE)

In addition to intra-state governmental coordination, coordination with both federal agencies and citizens groups is necessary and expected. Kentucky regularly cooperates and interacts with U.S. DOE, the U.S. Environmental Protection Agency (EPA), and the Paducah CAB.

Federal Facility Agreement / Site Management Plan

The FFA is a three-party agreement between DOE-Paducah, EPA Region 4 and the Kentucky Energy and Environment Cabinet. It was developed to ensure compliance with and to avoid duplication between the cleanup provisions of the Resource Conservation and Recovery Act (RCRA) and those of CERCLA. Moreover, the FFA outlines regulatory structure and guides interactions between the three parties. The FFA allows Kentucky and EPA to address

contaminated areas at the PGDP that are not subject to permitting but nonetheless require remediation and provides a framework for project management, investigation and remediation.

The Site Management Plan (SMP) is an appendix to the FFA that serves to define and document operable units (OUs) requiring investigation and cleanup. The SMP is revised annually and provides enforceable milestones for the investigation and cleanup of the site. Milestones are set for the current fiscal year (FY) and the following two years. Longer term out-year milestones are set for completion of the larger media-type OUs. The SMP also documents the three-party prioritization strategy for the complete remediation of the PGDP. The FFA parties meet to scope revisions for the document in the months leading up to the document's annual revision on Nov. 15.

The FY 2014 annual revision was approved by Kentucky on Feb. 25, 2014 and by EPA on Feb. 24, 2014.

Site Management Plan Documents Reviewed In 2014

2015 Annual Revision to Site Management Plan (1301&D1). Comments issued 12/15/14.

Agreement in Principle (AIP)

Under the AIP program, Kentucky¹ conducts independent environmental monitoring activities and oversees monitoring activities conducted by DOE. Additionally, the program serves to disseminate information relevant to ongoing site cleanup activities to concerned citizens and the public in general.

The fundamental goal of the AIP program is to allow Kentucky to conduct independent and impartial assessments of the potential environmental impacts of past, present and future DOE activities at the PGDP. Since 1991, the AIP has been periodically renegotiated and extended.

Kentucky AIP Program Elements for 2014

One of the primary goals of the Agreement in Principle (AIP) is to monitor current site activities through sampling and observation to identify possible threats to human health and the environment. Another goal is to ensure that DOE's environmental data is accurate and that interpretations made from the data reflect the actual environmental conditions at the areas evaluated.

To achieve these goals, AIP staff routinely observes DOE facilities and operations to identify any environmental issues or concerns. Any resulting environmentally significant conditions or practices are then brought to DOE's attention.

¹ For the purposes of this report, all references to activities conducted by the Paducah Gaseous Diffusion Plant Section of the Division of **Waste** Management (KDWM) of the Department for Environmental Protection (KDEP), in Energy and Environment Cabinet (EEC) will be referred to as Kentucky. References to activities by other state government agencies that are not part of the ECC (and in some cases, not part of KDWM) will be specified as appropriate.

AIP staff also collect independent environmental (soil, surface water and groundwater) samples, split environmental samples with DOE, and work with various independent research organizations, such as the University of Kentucky, under a Memorandum of Agreement (MOA) for the AIP program. For some projects, these research organizations also collect independent environmental samples. These samples are routinely sent to an independent laboratory under contract to the AIP program. AIP sampling includes the collection of groundwater samples at the request of nearby property owners from private residential wells as a means to inform the public of current groundwater conditions near the PGDP boundaries; split environmental samples obtained to independently validate DOE's sampling results; and historically have split tissue samples collected from animals living near the PGDP to monitor the biota.

For 2014, the primary AIP independent contract laboratory was TestAmerica Laboratories (TAL) located in Earth City, Missouri. TAL is an accredited, independent laboratory that meets or exceeds the requirements set forth by governing EPA standards. The CHFS analyzes airborne and surface water samples for Gross Alpha and Gross Beta concentrations using continuous monitoring equipment. AIP staff directly receives all analytical data from TAL and CHFS. The results are interpreted and shared formally with the appropriate parties.

AIP Groundwater Investigations

Residential Wells Sampled in 2014

During 2014, AIP staff collected samples from five different residential wells and 90 different monitoring wells. In all, AIP staff sampled some wells more than once for a total of 125 sampling events during 2014. The five residential wells were sampled twice; the first sampling event AIP split samples with DOE Contractors in February and the second time AIP collected samples independent of DOE. The 2014 AIP Groundwater Sampling Locations maps show all wells sampled during the 2014 reporting period. The vast majority of the wells sampled were less than two miles from PGDP plumes and/or less than two miles from the PGDP.

The residential wells sampled by AIP staff were located outside of the plumes with the exception of R2, which is located in the West Kentucky Wildlife Management Area. During this reporting period, AIP independently confirmed that no residential wells sampled in 2014 were being impacted by the plumes. The fact that the wells were sampled independently, that the samples were analyzed by an independent lab and that the results were independently reviewed and interpreted by AIP staff, almost certainly gave most, if not all, of the residents a higher level of assurance that their well water had not been impacted by the PGDP groundwater plumes. For all residential wells sampled, the results and a discussion of the results were sent directly to the residents.

In 1988, when TCE and Tc-99 were discovered at off-site water wells, nearby residents using groundwater wells for domestic use were provided alternative water supplies. In response, DOE created a water policy that provides alternative water sources at no costs to residents that may be affected by contaminated groundwater. In exchange, residents must agree to refrain from using the groundwater. This policy is used to prevent the public from potential exposure to contaminants. In 2014 AIP staff focused on sampling residential wells in the area (to monitor for any evidence that the plume had not expanded west toward Bethel Church Road). Based upon the sampling results, the plume does not appear to have migrated west towards Bethel Church Road. During 2015 the wells on the east side boundary of the water policy will be sampled.

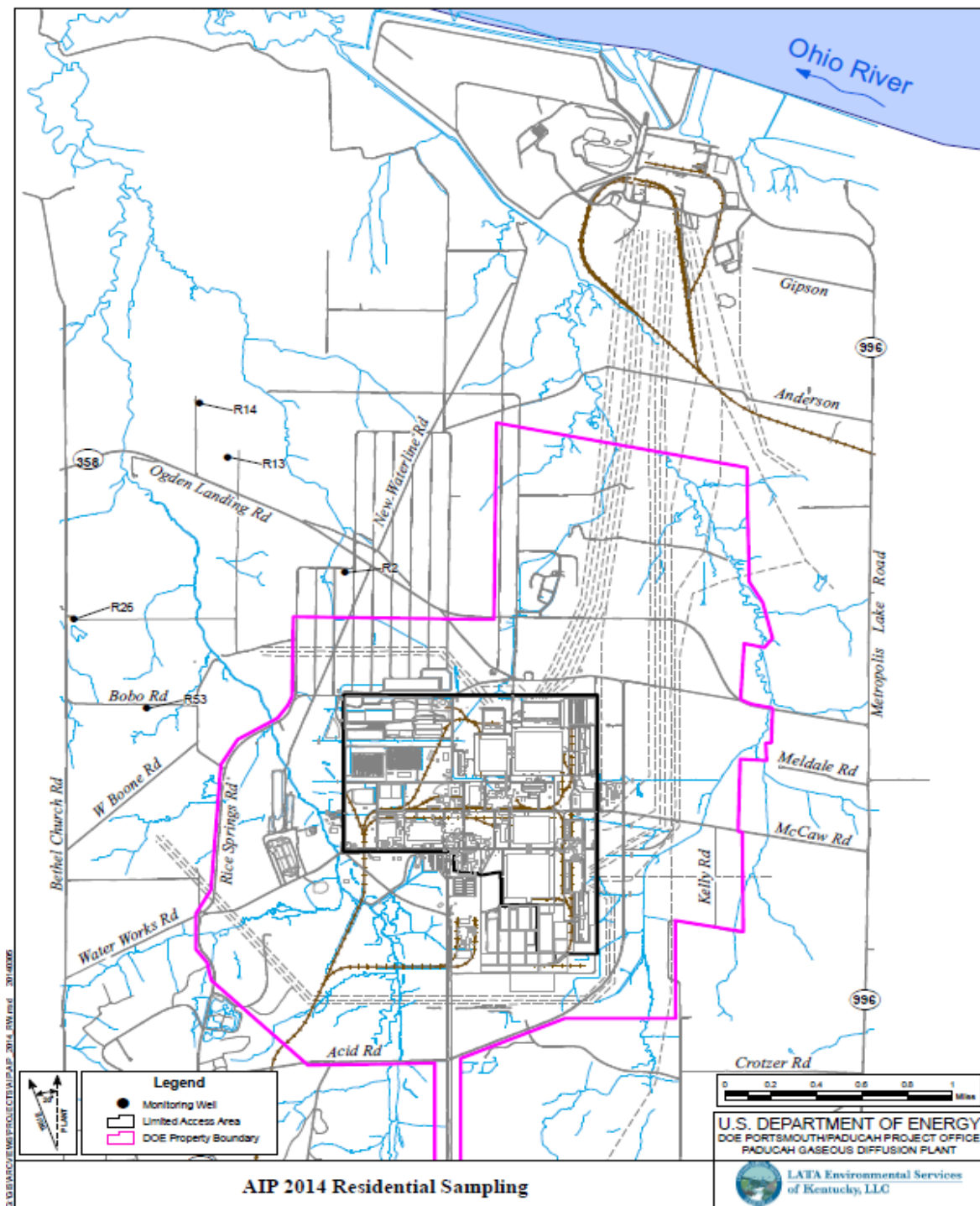


Figure 1. AIP 2014 Residential Wells Sampled

Monitoring Wells Sampled by Kentucky AIP

The objectives of the AIP sampling activities for monitoring wells were significantly different from the objectives of the residential well sampling. Sampling of residential wells was targeted toward determining whether PGDP plumes had negatively affected nearby drinking water resources. The 90 monitoring wells sampled involved 113 sampling events in 2014. Each of these sampling events was located either within the known plume footprint or in close proximity to the plumes. These sampling events were conducted to evaluate and substantiate DOE's sampling procedures and to verify the quality of their laboratory analysis. AIP staff split samples with DOE on 12 of the 113 sampling events conducted in 2014. The concentrations detected by DOE for TCE and Tc-99 at various monitoring well locations are used to determine the nature and extent of contaminant plumes at PGDP as presented in DOE site plume maps.

In most cases, AIP staff arranged to split samples with DOE during their scheduled sampling activities. A total of 71 of the 113 sampling events involved single samples collected from monitoring wells during 2014. A total of 17 wells were sampled twice. Two monitoring wells were sampled four times, once each quarter during 2014 by AIP staff. One well (MW100) that was sampled two times was of special concern due to its close proximity to the eastern edge of the Northeast Plume. AIP staff will continue to closely evaluate this particular well over time.

Split sampling activities demonstrated a general similarity between those samples collected and analyzed by Kentucky and those collected and analyzed by DOE. There were two instances in which neither Kentucky nor DOE detected TCE. During the split sampling events, Kentucky monitored DOE's sampling procedures to verify this work was performed in compliance with EPA Standard Operating Procedures for field measurements and sampling methods.

Of the 11 monitoring well samples split by Kentucky and DOE and analyzed for Tc-99, four had similar Tc-99 concentrations. On six occasions, neither Kentucky nor DOE detected Tc-99. During the July 22, 2014 sampling event for MW-90A, Kentucky had the higher reading while DOE had the non-detect reading. The wells are located at the C-404 Landfill inside the fenced PGDP facility.

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Well #	Date	AIP TCE ug/L	DOE TCE ug/L	Relative % Difference	AIP Tc-99 pCi/L	DOE Tc-99 pCi/L	Relative % Difference
MW372	1/14/14	6.5 RL 1.0	6.9 RL 1.0	5.9	121.30 +/-1.87	131 +/-15.1	7.6
MW373	1/14/14	6.2 RL 1.0	6.4 RL 1.0	3.2	43.83 +/-1.52	37.8 +/-12.5	14.7
MW374	1/14/14	ND	U	NA	U	U	NA
MW375	1/15/14	ND	U	NA	U	U	NA
MW357	1/15/14	5.1 RL 1.0	5.6 RL 1.0	9.3	35.57 +/-1.48	30.4 +/-12.2	15.6
MW358	1/15/14	5.2 RL 2.0	5.8 RL 1.0	10.9	39.60 +/-1.50	26.5 +/-17.2	39.6
MW509	6/26/14	190 RL 20	216 RL4	12.8	NA	NA	NA
MW90A	7/22/14	33 RL 2.0	46.2 RL1	33.3	11.68 +/-1.41	U	31.8
MW93	7/22/14	2200 RL100	2710 RL 50	20.7	U	U	NA
MW84	7/22/14	990 RL 50	1270 RL 25	24.7	U	U	NA
MW87	7/22/14	920 RL 25	1030 RL 25	11.2	U	U	NA
MW420	7/22/14	140 RL 10	203 RL 5.0	36.7	U	U	NA

Table 1. AIP/DOE DATA Comparison

RL = reporting limit, ND = Non detect, NA = not applicable, U = undetected

AIP staff conducted split sampling at select wells associated with the C-404 Hazardous Waste Landfill. Split samples were collected to help verify the accuracy of DOE's environmental data by comparing it to AIP's independently collected, analyzed and verified data.

As illustrated on the 2014 AIP Groundwater Sampling Locations map, many of the monitoring wells sampled were clustered in an area near the S, T and U-Landfills. This area has been of special concern because of the uncertainty surrounding the source of groundwater contamination found in this area. Sampling in this area has been focused on determining whether or not there are separate primary or secondary source areas in the vicinity of the solid waste landfills (and the associated old NSDD), or if the contamination is associated with the sources located within the main PGDP central complex (such as the C-400 Building).

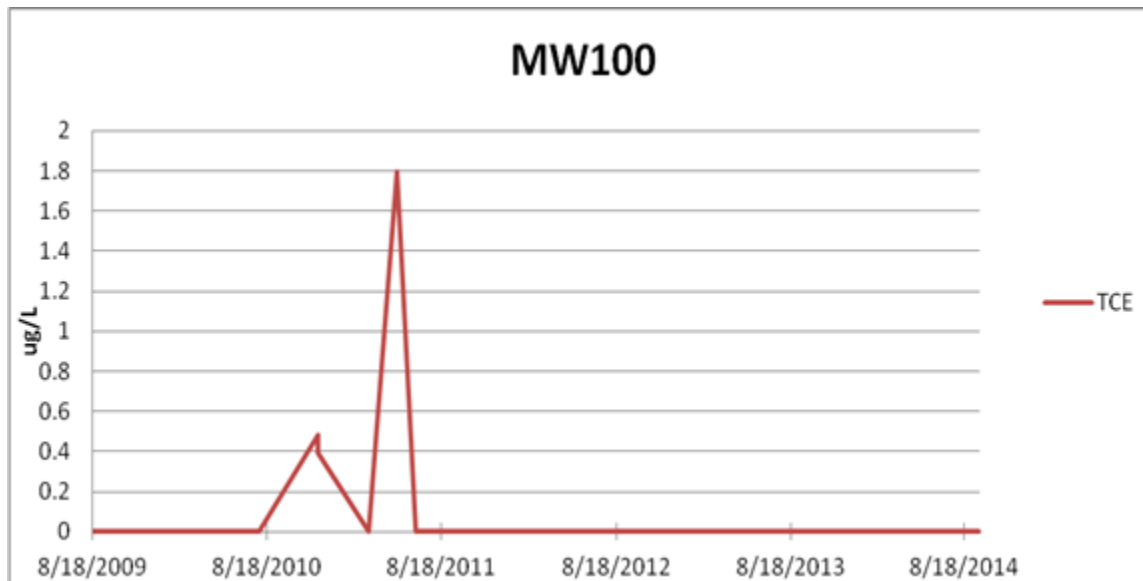


Figure 2. Monitoring Well 100 Sampling Results

MW100 was of special concern due to its close proximity to the eastern edge of the Northeast Plume. MW100 had detections of TCE two of the three times it was sampled in 2010 and 2011. The detections were below the laboratory reporting limit of 1.0 ug/L and the EPA's maximum contaminant limit (MCL) of 5 ug/L, respectively. AIP staff will continue to closely evaluate this particular well over time. In general, the monitoring well and residential well sampling, conducted by AIP staff, has produced results that are consistent with those obtained by DOE. This can be viewed as a line of evidence to support the general validity of DOE data collection and analysis of contaminant plumes at PGDP during the reporting period. AIP independent oversight of DOE's groundwater sampling program helps to ensure that results obtained by DOE are accurate, reproducible and verifiable. Furthermore, AIP independent oversight helps to ensure that isoconcentration contours generated in maps produced by DOE can be verified and relied upon by regulators and the public.

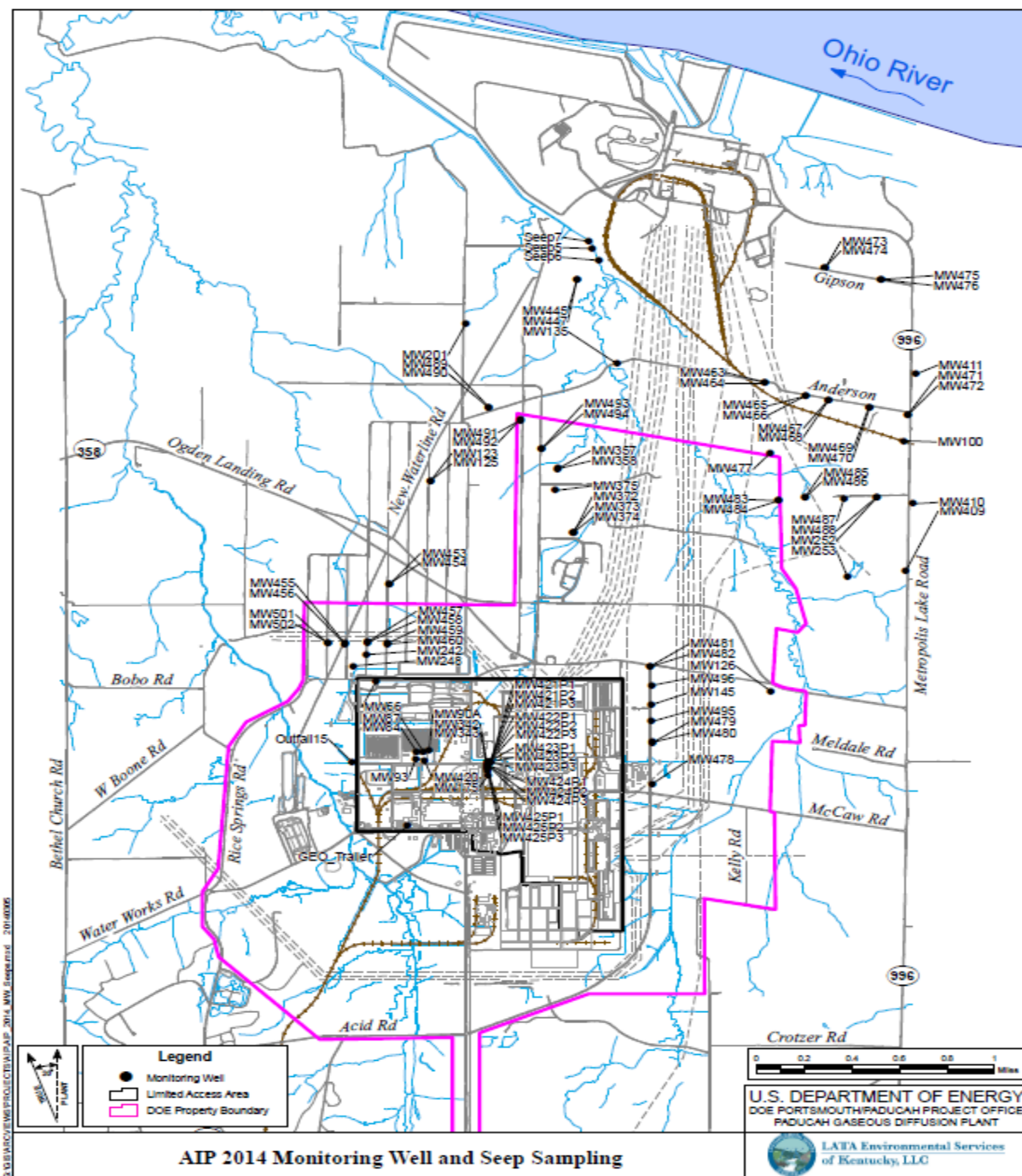


Figure 3. AIP 2014 Monitoring Well and Seep Sampling

Seeps Sampled by Kentucky AIP

Six seeps in Little Bayou Creek (LBC) were added to Kentucky's sampling program in 2002; a seventh seep was discovered and added in June 2007. These seeps are located where groundwater is upwelling in a channelized portion of LBC, along a Porter's Creek Clay exposure. The locations of the seeps can change after major storm events, when high flow causes changes in depositional features (sand bar shifting) and in the banks of the creek (sloughing). The base flow in LBC is comprised primarily of discharges from plant outfalls. These seeps are located downstream of the Paducah site, 2 miles from the plant and 2 miles from the confluence of LBC and the Ohio River.

Two AIP independent water (seep) samples were collected during 2014 from LBCSP5 for volatile organic compounds and technetium-99. The location can be seen on the 2014 AIP Monitoring Well and Seep Sampling Locations map (Page 21). Both events had detectable levels of TCE: 40 ug/L RL 2.0 and 33 ug/L RL 5.0. Water samples were collected on June 19, 2014 and September 18, 2014 from LBCSP5 for technetium-99 the results are as followed: 22.21 pCi/L (+/- 1.43) and 24.98 pCi/L (+/- 1.46). Seeps 6 and 7 were not sampled in 2014.

Anthropogenic Recharge Monitoring

Water level measurements were taken monthly on four wells in the central portion of the plant to monitor for changes in water levels due to the USEC shutdown. This project was discontinued in mid-2014 because water lines in the plant remain charged and water level measurements are showing only seasonal variations.

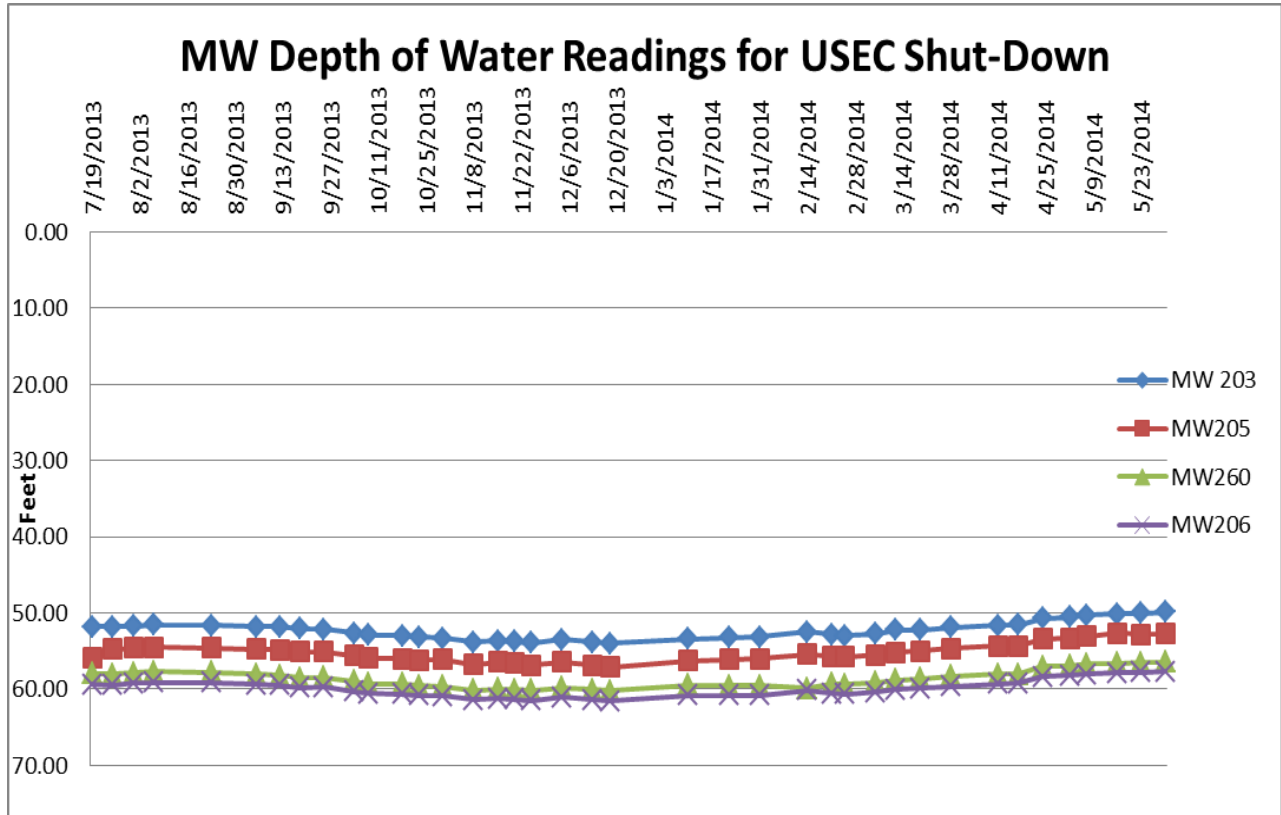


Figure 4. Anthropogenic Recharge Monitoring

Targeted Assessment of Chromium Values in Groundwater

Wells on the east side of the plant and wells between the 616 lagoons and the NW pump and treat withdrawal system were assessed for total Chromium levels. The provisional RGA background from the Risk Methods document for chromium is 134 ug/l; the MCL is 100 ug/l. None of the wells in the northwest showed total chromium greater than 30 ug/l in the last 10 years. MW 173, 174, 499, 500, 503 and 504 were assessed.

Three of the wells on the east showed total chromium at levels greater than the MCL and background. MW 163 in the deep RGA had a maximum level of 1090 ug/l in 2003 and most recently showed 197 ug/l in 2012. MW 260 in the deep RGA maximum was 249 ug/l in 2009 and showed 169 ug/l in 2012. MW 145 in the upper RGA maximum was 722 ug/l in 2008 with the most recent result of 188 ug/l in 2012. Chromium levels have risen from non-detect levels in

the 1990s. The following wells on the east were assessed: MW 206, 260, 164, 163, 256, 255, 144, 145, 495, 479, 480 and 496.

NW Plume Pumping Well Area of Influence/Cone of Depression Assessments

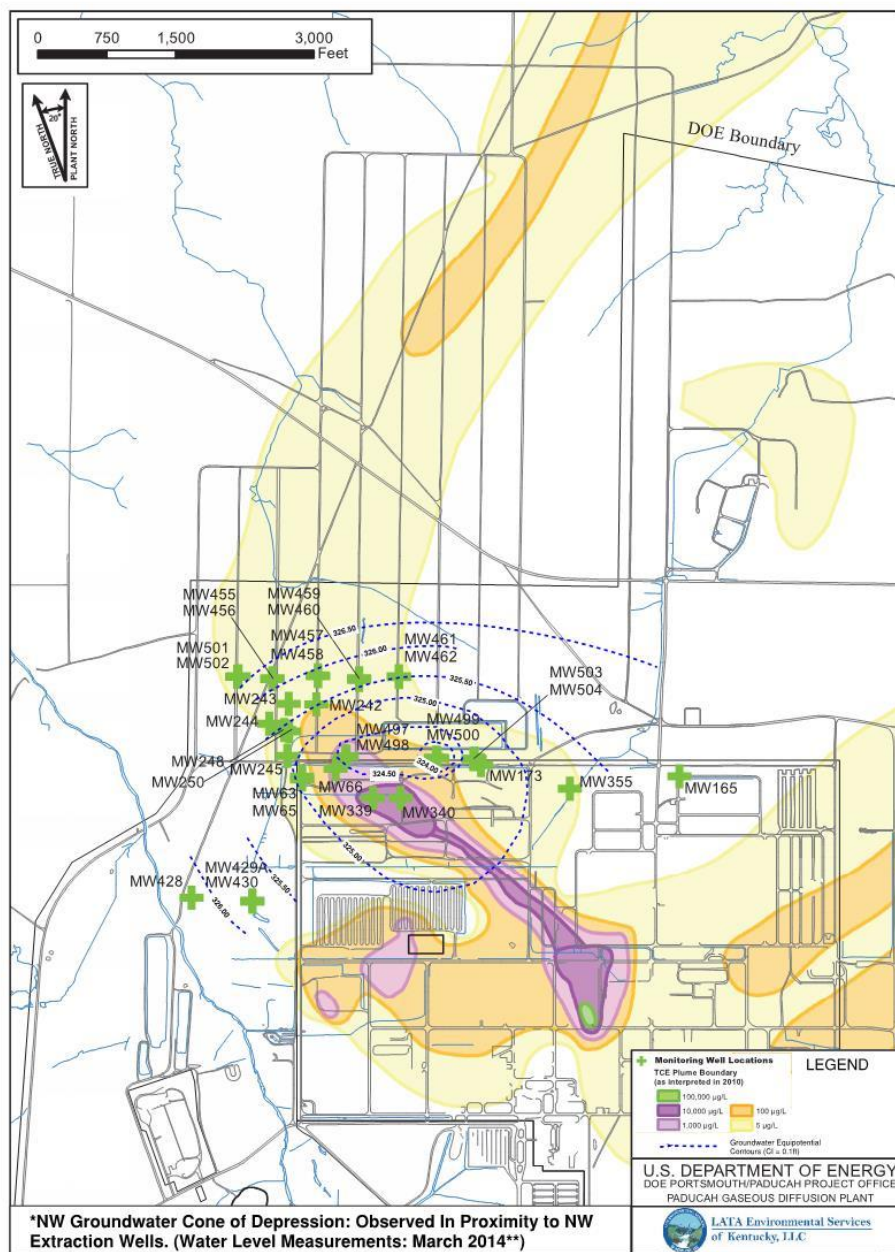
Water levels in wells in the northwest portion of the plant were measured quarterly in 2014. March, June and December water level studies indicate that the high concentration portion of the plume is captured laterally within the cone of depression of EW 232 and EW 233. The September study was conducted during a time when the pump and treat system had been shut down for several days due to electrical problems, so it is not representative of normal operating conditions.

In order to assess whether the high concentration portion of the northwest plume is captured vertically, TCE levels in middle and deep RGA wells proximal to the pump and treat system were compared from 2009 through 2014. The new extraction wells EW 232 and EW233 went online in August 2010. These wells are located further east of the original EW 230 and EW 231. The new extraction wells were optimally placed to account for the eastward shifting of the high concentration portion of the plume. The new extraction wells are screened in the upper and middle portions of the RGA.

From 2009 through 2014, lower RGA wells MW 339 and MW 261, located upgradient of the extraction wells, have decreased TCE concentrations by two and one orders of magnitude, respectively. MW 498, located immediately adjacent to EW 232 has also decreased TCE concentration by two orders of magnitude. During this time MW 456, on the western edge of the plume, downgradient of the extraction wells, decreased TCE concentrations by one order of magnitude. Furthermore, MW 458, MW 460 and MW 454 downgradient of the extraction wells in the centroid of the plume all increased TCE concentrations by an order of magnitude. During the same time period, middle RGA wells MW 243, MW 248 and MW 250, located on the western side of the plume showed concentrations of TCE decreased by one to two orders of magnitude. MW 242, located closer to the centroid of the plume remained unchanged.

MW 66, a shallow RGA well upgradient of the extraction wells decreased TCE concentration by one order of magnitude. The other proximal shallow RGA wells showed little change in TCE concentrations from 2009 through 2014.

Over the past five years, the concentration of TCE in deep RGA wells upgradient of the extraction wells has decreased rather dramatically. Over the same time period, TCE concentrations in proximal deep downgradient wells have increased. This appears to indicate that the new extraction wells are not entirely capturing the TCE contamination in the deep RGA, resulting in by-pass.



*This figure is modified from DOE Document PAD-ENM-0055/R3 Environmental Monitoring Plan Fiscal Year 2014: Figure C.6 (Page C-29)
** March 2014 water level measurements also presented graphically on Figure 5 as blue line.

Figure 5. March 2014 NW GW Cone of Depression

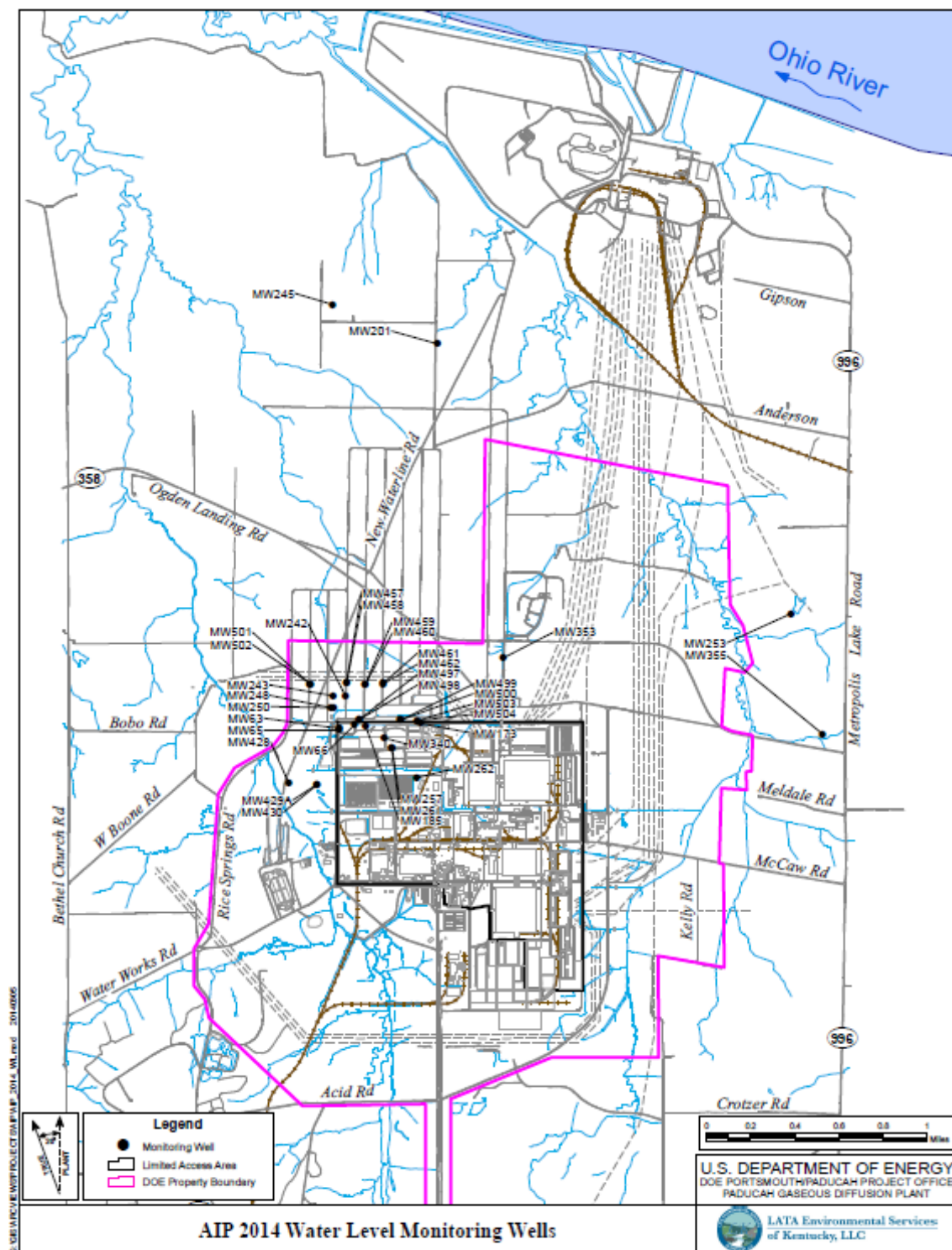


Figure 6. AIP 2014 Water Level Monitoring Wells

AIP Oversight Activities

During 2014 AIP staff observed portions of the PGDP reservation on a weekly basis. Locations within the security fence that were routinely observed included areas adjacent to the process buildings (C-310, C-331, C-333, C-335, C-337), the C-340 Metals Plant, the C-400 Maintenance Facility and ERH unit, the C-410 Feed Plant, the C-600 Steam plant, former scrap metal yards, cylinder yards, process and sanitary wastewater treatment facilities, the C-404 Landfill, and classified burial grounds. Those areas beyond the security fence that were observed weekly included wastewater lagoons, the Northeast and Northwest plume pump-and-treat units, the C-613 Sedimentation Basin, the closed K-Landfill, the water treatment plant and lagoons, and plant outfalls (001, 015, 008, 016, 006, 009, 017, 013, 012, 011, 010, 002). No significant issues requiring DOE's attention were noted during any oversight activity. The following is a short list of oversight activities that were completed in 2014:

- Site preparation for the deep soil mixing project at SWMU 1 was conducted during July, August and September. AIP conducted 22 visits to the project during this time.
- During demolition of the C410-420 Feed Plant, 96 site visits were completed.
- Approximately 6,875 nickel ingots are stored on-site near the C-746-A Warehouse. About 50 of the ingots contain trace amounts of asbestos. These nickel ingots were observed three times in 2014 to ensure that they are completely covered with the required tarps.
- The C-746-U Landfill was visited on a weekly basis during the year. The specific areas of the landfill that were observed included the landfill working face, the leachate collection building, the sedimentation basin, Outfalls 019 and 020, and the closed S & T Landfill. In addition, Outfall 020 was sampled 18 times this year.
- A total of 176 monitoring well inspections were completed. The well components inspected included the well padlock, outer casing condition, protective bollards and the concrete pad.

UK Monitoring Well Abandonment

On March 17 and 18, 2014, 10 monitoring wells originally installed by UK in the 1990s were abandoned in place by Chase Environmental Group. The wells were located near Bayou and Little Bayou creeks in the West Kentucky Wildlife Management Area. Their original purpose was to aid in understanding the interaction between the plumes and the creeks. The outer steel casings of the wells were removed. Bentonite pellets were poured into the inner casings until full. Then the inner casings were pulled out or broken off at ground level. After the casings were removed, the holes were filled with Bentonite pellets and covered with soil. The outer casings, inner casings and concrete pads were removed for proper disposal.

Sediment Basin Sampling Methodology

The C-613 Northwest Storm Water Control Facility (a.k.a. the C-613 Sediment Basin) was constructed as part of the first phase of the scrap metal removal project. The sediment basin began operation in March 2003, has a capacity of 4.5 million gallons and was designed to collect surface water runoff from the 27-acre former scrap yard area. The sediment basin collects storm water runoff and allows the associated sediment a period of time to settle, after which the storm water is discharged through the Kentucky Pollutant Discharge Elimination System (KPDES) Outfall 001 into Bayou Creek. The Outfall 001 regulatory discharge limits are defined in the Division of Water (DOW) Permit as: Total Suspended Solids (TSS) will not exceed 30 mg/L averaged over a 30-day period, and shall not exceed a pH range of six to nine standard units.

Since sediment basin sampling began in 2003, the sampling regimen has been significantly modified twice. Frequent, non-periodic samples were collected from 2003 to 2007. These sample results identified specific contaminants of concern, provided baseline analyte concentrations and allowed for the determination of trends. After sufficient information was collected, a quarterly sampling regimen was established at the beginning of 2008. This quarterly regimen was performed from 2008 to 2011. Due to the stabilization of reported analyte concentrations as well as budgetary constraints, the sampling regimen was again modified at the beginning of 2012 when the frequency of sample collection was reduced from

quarterly to semi-annually. The sampling regimen for 2014 consisted of one discharge and one non-discharge sampling event per year to continue assessment of possible changes in contaminant concentrations that sediment basin releases may have on WKWMA receptors.

2014 Sampling Regimen:

Part 1) Sediment Basin Inlet, KPDES Outfall 001 and Iron Bridge Sampling Points

Purpose: Samples are collected from the basin inlet (Sediment Basin), outlet (Outfall 001) and at a point (Iron Bridge) where WKWMA receptors can be exposed to Bayou creek water. Samples are always collected during a sediment basin discharge event.

Part 2) KPDES Outfall 001 and Iron Bridge Sample Points (Annual)

Purpose: This annual sample is collected to determine analyte concentrations when there is not an active discharge from the sediment basin. This sample is referred to as a non-discharge event. This sample is collected during a period of both steady rainfall and stream flow. This sampling event was designed to be representative of an average WKWMA receptor's possible contaminant exposure during normal stream flow.

Each sample is analyzed for the following analytes:

Total Suspended Solids (TSS)

Metals, including Uranium and Mercury

Gross Alpha and Beta activity

Isotopic Uranium (U-234, U-235 and U-238)

Note that the elements silicon, boron and molybdenum were removed from the metals analysis as concentrations were historically stable (silicon and boron), or not historically detected (molybdenum).

Results: TSS and pH

During the 2014 reporting period, neither the TSS concentrations nor the pH limits exceeded DOW KPDES Outfall 001 permit requirements. Flocculent, a material used to enhance particulate precipitation, was not used during 2014. Since completion of the (former) scrap metal removal project, the land surface has been maintained as a well-developed grass cover.

It has been observed that there is a greater absorption of rainfall into the soil due to the vegetative cover and increased soil stability. This effect continues to result in lower sediment basin turbidity measurements and TSS sample results. Based on a comparison of these sample results and the Outfall 001 discharge requirements, Kentucky concludes that the sediment basin continues to perform its primary design function, which is to comply with DOW KPDES requirements.

Results: Uranium Metal, Uranium radionuclides and alpha and beta

Concentrations of uranium metal (U), uranium isotopes (U-234, U-235 & U-238) and gross alpha(α) and beta (β) readings have been historically consistently lower at Outfall 001 than in the sediment basin. For the first time in the history of sampling the sediment basin, the Nov 24, 2014 discharge sampling event reported that concentrations of uranium metal and the alpha reading were higher at the outlet (Outfall 001) than in the inlet. The concentration of uranium metal was 7 percent greater and the alpha reading was 26 percent higher. The cause of this is unknown, and additional sampling is scheduled to be performed in 2015 in an attempt to verify or deny this phenomena. Theories and speculations as to the cause are as follows:

- Surface water runoff in the sediment basin is not being given enough time to settle.
- The amount of sediment that has been precipitated to the bottom of the sediment basin has reached a point where it needs to be removed.
- The reported concentrations are within the range of statistical sample deviation, casting doubt that the higher-at-the-outlet results are truly accurate.

The following is a presentation of the 2014 analytical results for the C-613 sediment basin:

Part 1 Discharge Event Samples Collected on Nov. 24, 2014:

U) Inlet: 93.0 µg/L	Outlet: 100.0 µg/L
α) Inlet: 21.5 pCi/L	Outlet: 29.0 pCi/L
β) Inlet: 53.4 pCi/L	Outlet: 46.3 pCi/L
U-234) Inlet: 34.5 pCi/L	Outlet: 18.4 pCi/L
U-235) Inlet: 2.35 pCi/L	Outlet: 1.71 pCi/L
U-238) Inlet: 63.8 pCi/L	Outlet: 35.6 pCi/L

Part 2 Non-Discharge Event Samples Collected on November 17, 2014:

The non-discharge sample was collected when the sediment basin was not being actively discharged. Samples were collected at KPDES Outfall 001 (Outlet) and at the “Iron Bridge” sample point, which is considered to be representative of the possible contaminant exposure to an average WKWMA receptor.

U) Outlet: 5.4 µg/L	Iron Bridge: 7.4 µg/L
α) Outlet: 1.70 pCi/L	Iron Bridge: 2.12 pCi/L
β) Outlet: 7.49 pCi/L	Iron Bridge: 4.66 pCi/L
U-234) Outlet: 0.78 pCi/L	Iron Bridge: 1.88 pCi/L
U-235) Outlet: 0.09 pCi/L	Iron Bridge: 0.17 pCi/L
U-238) Outlet: 1.64 pCi/L	Iron Bridge: 2.51 pCi/L

Sediment basin sampling has been performed regularly since the sediment basin became operational. The following data was compiled from 2003 to 2014 concerning average uranium concentrations (averaged from all results available for a given year) as well as the annual discharge through the sediment basin (in gallons). The average yearly rainfall in the Paducah, Kentucky area is 49.1 inches. Average Uranium metal concentrations, sediment basin discharge volume, annual rainfall and percentage of annual rainfall for each year from 2003 through 2014 are as follows:

2003: Inlet: 346.0 µg/L	Outlet: 156.0 µg/L
Annual Discharge: Not Applicable	Rainfall: 47.84 inches (97% of Average)
2004: Inlet: 371.0 µg/L	Outlet: 206.0 µg/L
Annual Discharge: Partial Year Only	Rainfall: 40.66 inches (82% of Average)
2005: Inlet: 458.0 µg/L	Outlet: 193.0 µg/L
Annual Discharge: 57,800,000 Gallons	Rainfall: 37.45 inches (76% of Average)
2006: Inlet: 454.0 µg/L	Outlet: 244.0 µg/L
Annual Discharge: 101,100,000 Gallons	Rainfall: 67.11 inches (136% of Average)
2007: Inlet: 276.0 µg/L	Outlet: 36.0 µg/L
Annual Discharge: 34,000,000 Gallons	Rainfall: 43.33 inches (88% of Average)
2008: Inlet: 338.0 µg/L	Outlet: 110.0 µg/L
Annual Discharge: 51,000,000 Gallons	Rainfall: 53.69 inches (109% of Average)
2009: Inlet: 439.0 µg/L	Outlet: 46.0 µg/L

Annual Discharge: 45,000,000 Gallons Rainfall: 55.60 inches (113% of Average)

2010: Inlet: 176.7 µg/L Outlet: 93.3 µg/L
Annual Discharge: 32,550,000 Gallons Rainfall: 36.67 inches (74% of Average)

2011: Inlet: 188.0 µg/L Outlet: 75.7 µg/L
Annual Discharge: 51,012,000 Gallons Rainfall: 74.85 inches (152% of Average)

2012: Inlet: 196.0 µg/L Outlet: 31.3 µg/L
Annual Discharge: 2,820,000 Gallons Rainfall: 30.06 inches (61% of Average)

2013: Inlet: 78.5 µg/L Outlet: 57.5 µg/L
Annual Discharge: 24,439,000 gallons Rainfall: 60.3 inches (122% of Average)

2014: Inlet: 93.0 µg/L Outlet: 100.0 µg/L
Annual Discharge: 30,663,000 gallons Rainfall: 46.84 inches (95% of Average)

Based on an analysis of the analytical data, Kentucky concludes that the concentration of uranium metal originating from the northwest corner drainage basin and discharged at Outfall 001 varies directly with the volume of rainfall and subsequent runoff. The data also shows that the concentration of uranium metal has historically decreased by roughly two-thirds between the inlet and Outfall 001, although this was not the case during 2014. The decrease in radionuclide activity has historically been more pronounced, with reductions of two-thirds to three-fourths between the inlet and Outfall 001, although the alpha reading was higher at Outlet 001 in 2014.

Average inlet concentrations have varied during the 12-year reporting period: outlet concentrations at Outfall 001 (2007 to 2014) continue to trend downwards. The highest reported average inlet concentration was 458.0 µg/L in 2005 and the lowest was 31.3 µg/L in 2012. The highest reported average outlet (Outfall 001) concentration was 244.0 µg/L in 2006 and the lowest was 31.3 µg/L in 2012 (which was the driest year during the twelve years of data collection). The average outlet concentration of 100.0 µg/L for 2014 was the seventh-lowest and was also less than the twelve-year running average of (112.4 µg/L).

Based on continuing data analysis and field observations, Kentucky concludes that former scrap yard storm water runoff continues to contribute to the off-site migration of metals and low-level radionuclides. Data shows that operation of the sediment basin has a pronounced effect on the

reduction of radionuclide activity and turbidity. Therefore, Kentucky believes that operation of the C-613 sediment basin should continue.

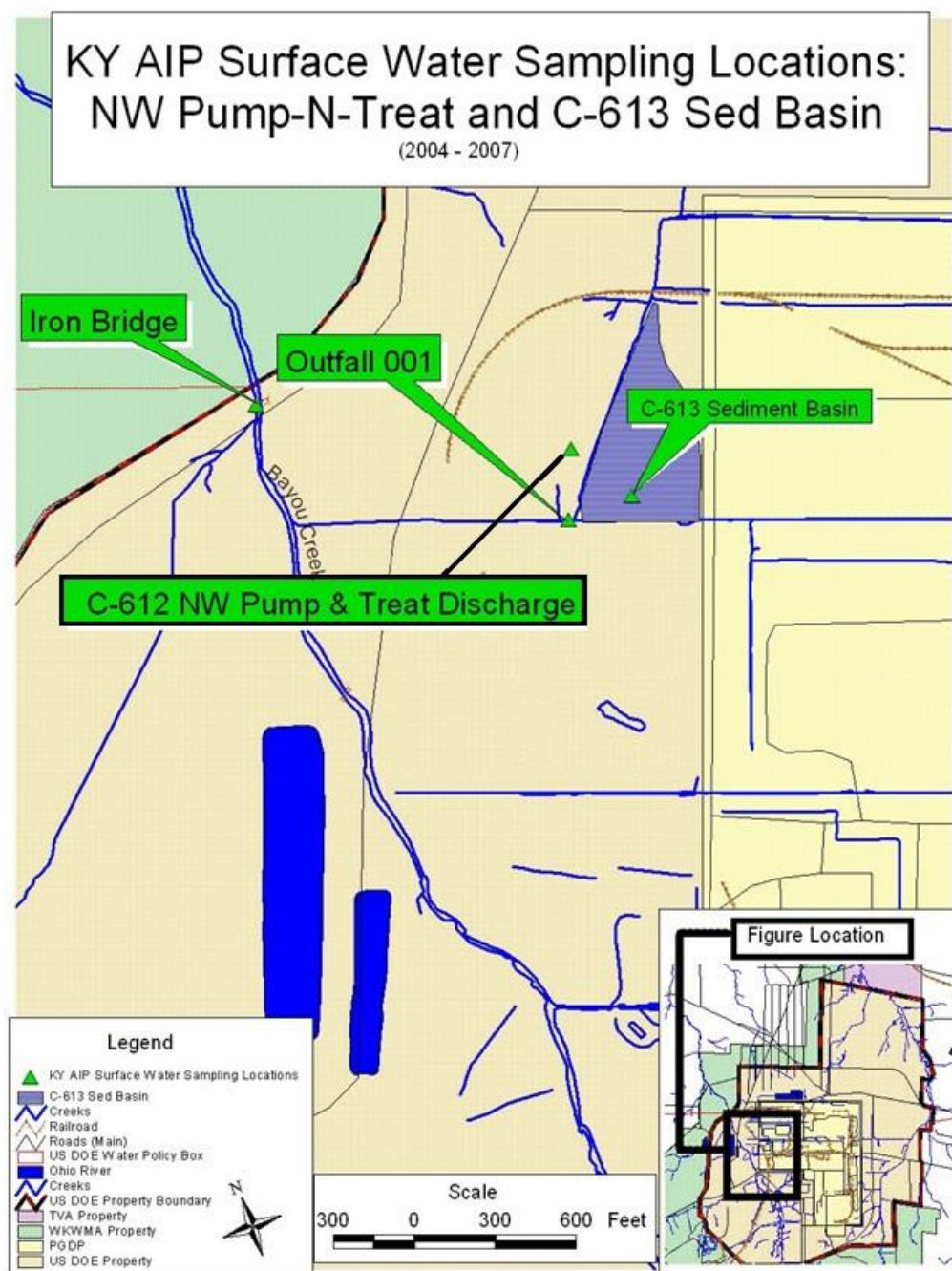


Figure 7. AIP Surface Water Sampling Locations: NW Pump and Treat and C-613 Sed Basin

Radiation Health Branch AIP Sampling

The Radiation Health Branch (RHB) has a robust environmental monitoring program, funded by the AIP, designed to ensure that there is no danger to public health from PGDP's radionuclide releases to groundwater, surface water, or air. In 2014, RHB collected 1,564 samples and analyzed those samples plus an additional 129 samples collected by EEC.

Groundwater

RHB monitors groundwater by collecting quarterly samples at 10 wells surrounding the site (Figure 9). Gross alpha/beta analysis is performed on the samples. Additional isotope specific analyses may be performed based on the results of the gross measurement.

The majority of the locations sampled are private drinking water wells that are potentially impacted by the TCE/Tc-99 plume travelling away from the site. These wells are no longer used for drinking water. RHB continually evaluates the results from this activity, along with results from third party activities and other activities at the site, to determine the need for additional monitoring locations or modification of current locations.

In 2014, there were no abnormal measurements from RHB groundwater monitoring efforts.

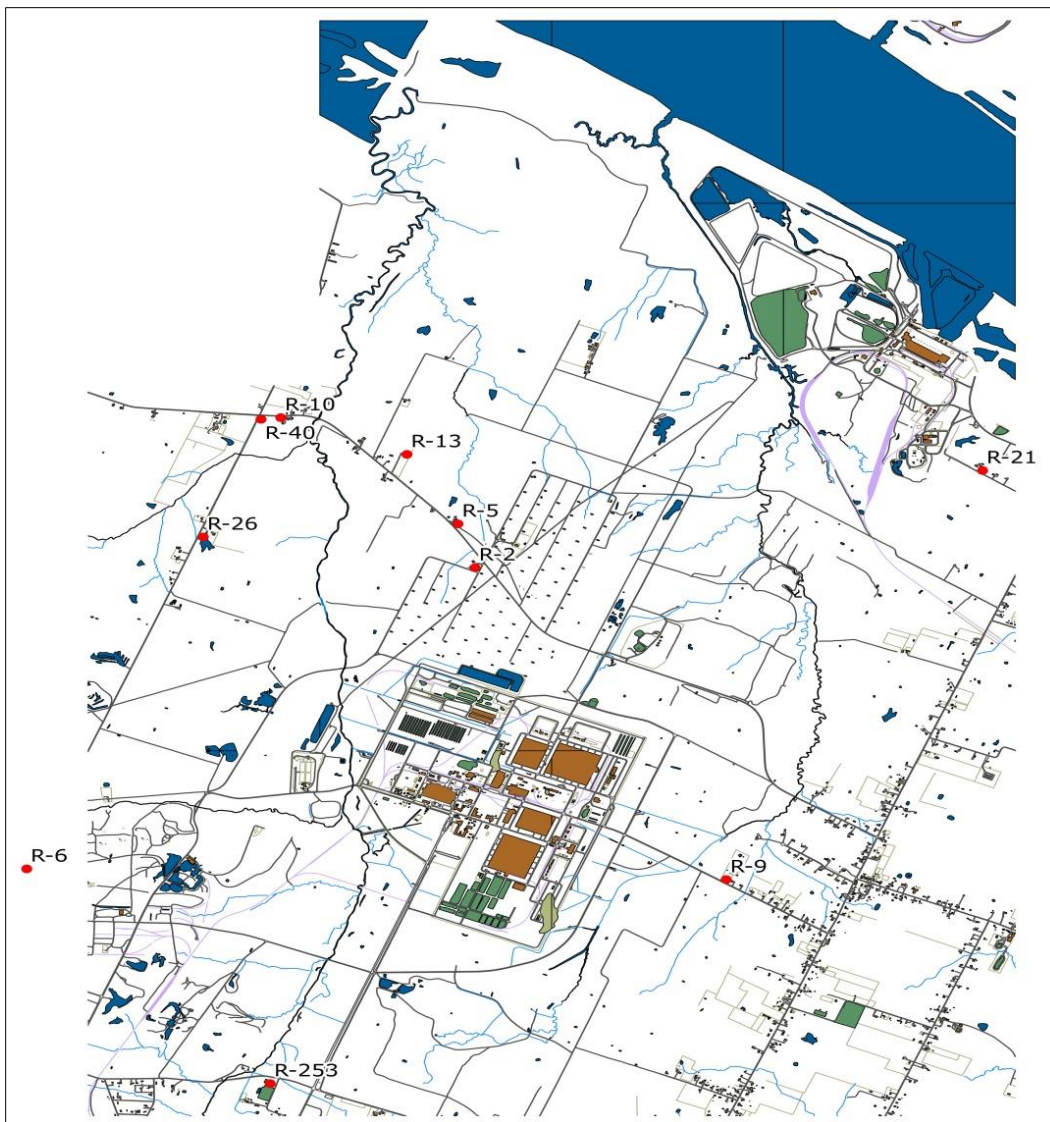


Figure 8. RHB Groundwater Monitoring Locations

Surface Water

RHB monitors surface water by taking quarterly samples at 32 locations surrounding the site (Figure 10) and through continuous sampling (ISCO) at an additional eight locations (Figure 11). Gross alpha/beta analysis and isotope specific analyses are performed on the ISCO samples which are collected and composited over 21-day periods.

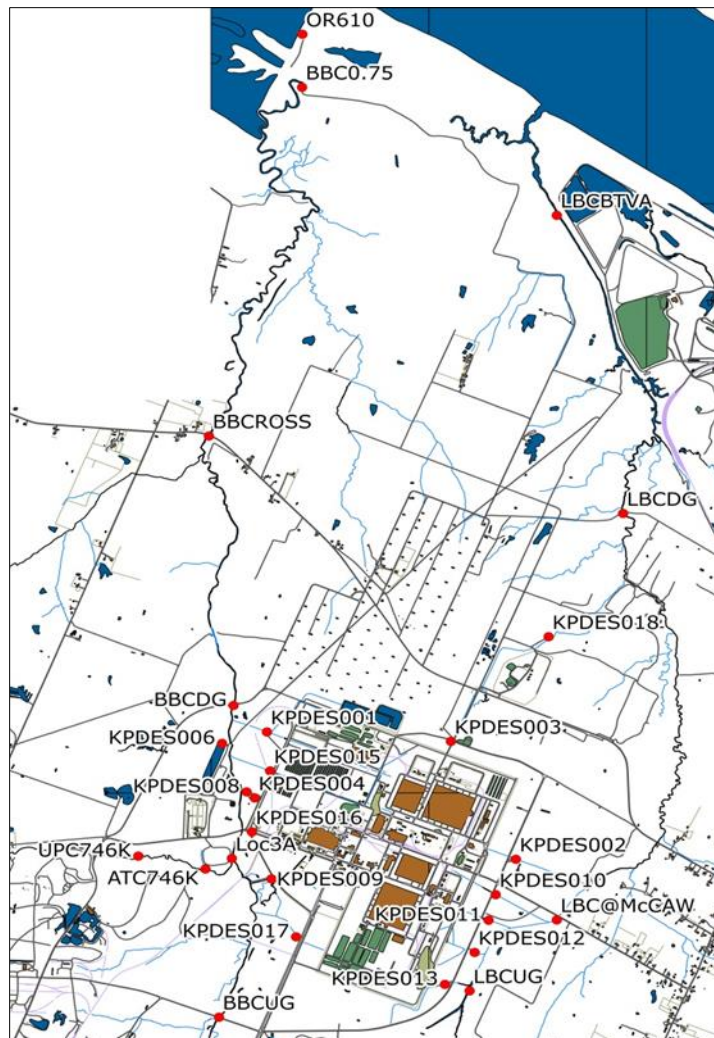


Figure 9. RHB Quarterly Surface Water Sampling Locations

The locations for surface water monitoring were selected based on outfalls from the site, locations of known runoff from contaminated areas, and historical sampling locations. Background monitoring sites are located upstream in Bayou Creek (ISCO B and BBCUG), upstream in Little Bayou Creek (LBCUG), upstream of the C-746-K Landfill (UPC746K), and approximately five miles to the southeast on Massac Creek (a known unimpacted local waterway, not shown on map).

In 2013, elevated levels of uranium were found leaving the C-746-U solid waste landfill in surface water. This contamination was likely sourced from recently removed paneling that had

high levels of surface contamination by a mobile uranium compound (likely uranyl fluoride (UO_2F_2)). In response, RHB began monitoring points in the discharge path from C-746-U, beginning in August, in order to ensure that effluent release limits were not exceeded. During 2014 the cumulative releases did not exceed the effluent release limits, and the uranium levels are slowly returning to normal.

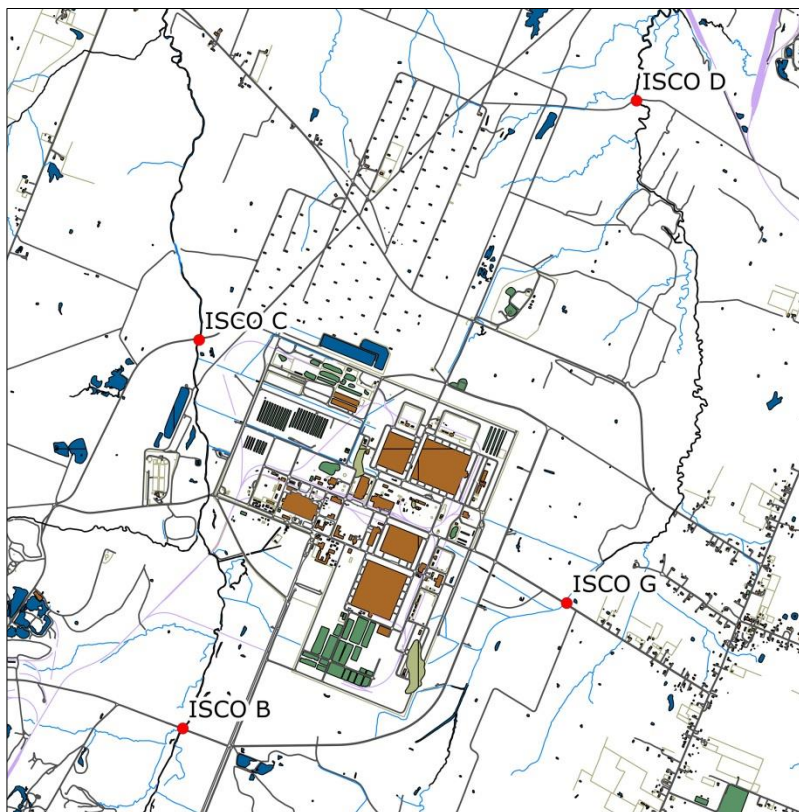


Figure 10. RHB ISCO Sampling Locations

In 2014, there were no abnormal or unexpected measurements from RHB surface water monitoring efforts aside from the elevated C-746-U samples.

Air

RHB monitors air by taking continuous samples at 10 locations surrounding the site (Figure 11) collected at 21-day periods. A gross alpha/beta analysis is performed on each filter, and the filters are composited quarterly for isotope specific analyses.

The locations for air monitoring were selected based on prevailing wind direction and expected release points/types from the plant. The background air monitor is approximately three miles southeast of the plant at the Barkley Regional Airport (not shown on map) and is > 90 degrees offset from prevailing winds. RHB continually evaluates the results from this activity, along with results from third party activities and activities at the site, to determine the need for additional monitoring locations or modification of current locations.

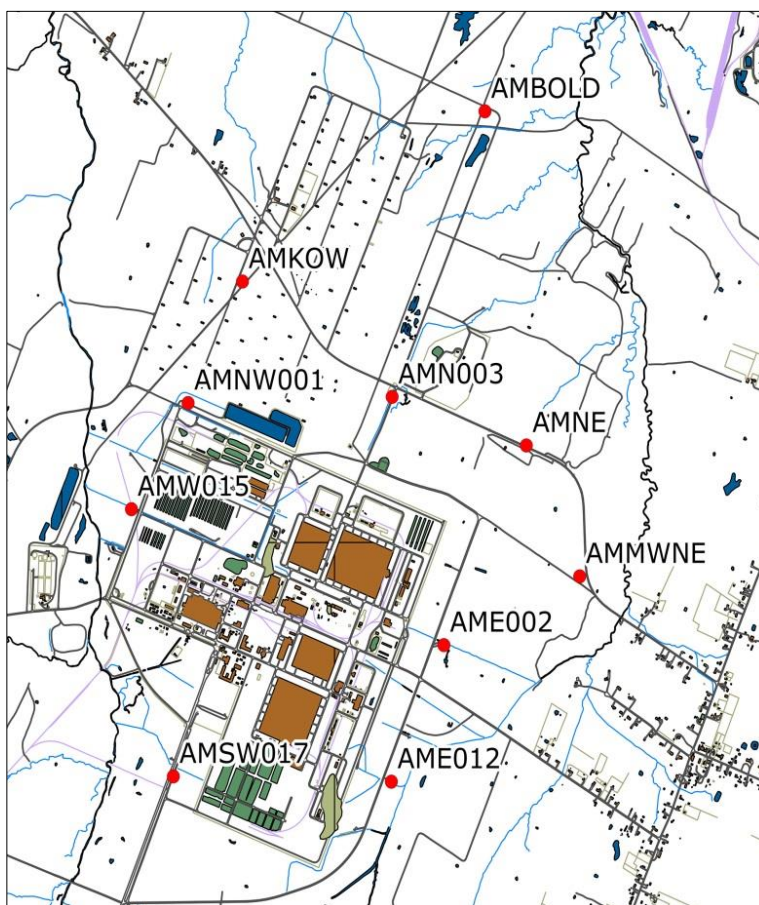


Figure 11. RHB Air Monitoring Locations

In January of 2012, due to reductions in the federal budget, the frequency of filter collection was reduced from weekly to once every 21 days. The potential consequences of this reduction are that there is an increased probability of overloading the filters in drier months due to increased dust and greater sampled volume, and a 200 percent increase in potential response time following a release. Both have yet to be an issue.

In 2014, there were no observed abnormal measurements from RHB air monitoring efforts.

Kentucky FFA Program Elements for 2014

Surface Water Operable Unit

The Remedial Investigation Report for the Surface Water OU is scheduled for completion in 2029. The Surface Water OU team did not meet in 2014.

Surface Water OU Documents reviewed in 2014:

No Surface Water OU documents were submitted by DOE or reviewed by Kentucky during 2014.

Groundwater Operable Unit

Northeast Plume Containment System (Pump-and-Treat)

The Northeast plume containment system is operated to contain the higher concentration portions of the Northeast Plume. Two groundwater extraction wells, pumping at a combined average rate of 170 gpm, send water to an air stripper, which treats the water to less than the MCL of 5 ppb trichloroethene prior to discharging it to a CERCLA outfall that flows to Little Bayou Creek. The extraction wells are located approximately 3000 feet northeast of the PGDP facility, near the crossing of Little Bayou Creek and Ogden Landing Road.

In 2014 the Northeast Plume system pumped 96,109,800 gallons of water from the two extraction wells which resulted in the removal of 8.6 gallons of TCE. Since Northeast Plume

pumping operations began on Feb. 28, 1997, more than 292 gallons of TCE has been removed from 1,455,431,917 gallons of extracted groundwater. An operational chart of the Northeast Plume breaks down the operational efficiency and gallons of water treated during each month in 2014 (Table 2).

In 2013 the FFA parties began a project to optimize the Northeast plume containment system. A Remedial Action Work Plan, an Operation and Maintenance Plan and an Explanation of Significant Difference to the 1995 Record of Decision were submitted and commented on. An effluent treatment standard (goal) for Tc-99 became the sticking point and DOE invoked informal dispute in November 2013. The two disputes on the RAWP and on the ESD were combined into one and the issue was elevated to formal dispute on Feb. 25, 2014. The dispute remained unresolved through the rest of 2014.

Month	% Operational	Gallons	Month	% Operational	Gallons
January	50	4,940,325	July	97	9,799,100
February	100	8,107,375	August	100	9,560,360
March	100	9,671,900	September	99.7	9,378,240
April	88	8,376,500	October	99.1	6,884,375
May	94	9,417,750	November	82.2	3,603,775
June	91	8,788,550	December	83.3	7,581,550

Table 2. Northeast Plume Containment System Data

Northeast Plume Optimization Documents Reviewed In 2014:

No new documents were submitted for review in 2014.



Figure 12. Northeast Plume Groundwater Treatment Trailer

Northwest Plume Groundwater System

The Northwest plume groundwater system consists of two extraction wells and the C-612 water treatment facility, which are located at the plant's northwest corner. The pump-and-treat system was optimized in 2010. The optimized system is performing as designed. In 2014 the Northwest Plume system pumped 104,671,200 gallons of water from the two extraction wells which resulted in the removal of 148.4 gallons of TCE. Since Northwest Plume pumping operations began on Aug. 28, 1995, more than 3,399 gallons of TCE has been removed from 1,966,176,467 gallons of extracted groundwater. An operational chart of the Northwest Plume breaks down the operational efficiency and gallons of water treated during each month in 2014 (Table 3).

Month	% Operational	Gallons	Month	% Operational	Gallons
January	99	9,758,400	July	95	9,502,280
February	99	8,940,314	August	93	9,340,640
March	100	9,889,656	September	44	4,030,440
April	93	9,044,020	October	97.7	8,783,703
May	91	9,139,445	November	99.2	9,031,354
June	91	8,046,265	December	99.7	9,164,683

Table 3. Northwest Plume Groundwater System Data

Northwest Plume Groundwater System Documents Reviewed In 2014:

No documents were submitted for review in 2014.

Southwest Plume Sources

SWMU 1 C-747-C Oil Landfarm

Several versions of the RDR and the RAWP for SMWU 1 were submitted to regulators in 2013 and 2014. The deficiencies and/or conditions identified by Kentucky and EPA were rooted in the overall uncertainty surrounding historical operations and lack of evidence to support precisely where the oil landfarm plots were physically located. Additional deficiencies were addressed concerning how information was compiled and presented in the document. Kentucky and DOE independently investigated the uncertainty surrounding the operation and physical location of the oil landfarm. Additional information was identified by both parties but persistent uncertainty associated with the actual location of the oil landfarm plots necessitated the need for additional soil borings. Scoping meetings were held in March of 2014 to identify and agree

upon four areas where the greatest amount of uncertainty remained. Additional meetings were held to discuss the potential for remnant surficial contamination and historical geophysical investigations conducted at SWMU 1. Kentucky expressed concerns during the document review process and meetings that previously identified geophysical anomalies may still be located in the ground, even though the RAWP stated that all anomalies had been historically removed. Kentucky's concern was that no documentation was available to support the historical removal of the anomalies. DOE agreed to excavate the top four feet of soil within the proposed mixing area and scan that material in order to create a safe environment, prior to mixing. During the removal process of the top four feet of soil, anomalies were uncovered and properly disposed of. In July 2014 DOE submitted an Addendum to the Remedial Action Work Plan, specifically Appendix C, which outlined the Sampling and Analysis Plan for the four additional samples. DOE issued a technical memorandum on Aug. 28, 2014, which outlined an agreement to collect the additional samples along with the basis for doing so. The site preparation work was completed in 2014 and remedial soil mixing did not occur until 2015.

SWMU 211-A & 211-B (C-720 sites)

DOE formally recommended long-term monitoring (Alternative 2) with institutional controls as the remedy for SWMUs 211-A and 211-B. On Dec. 17, 2013, Kentucky formally accepted DOE's recommendation. On Feb. 25, 2014, EPA issued an Additional Work Request to DOE on the premise that "groundwater data be collected from additional monitoring wells before SWMU 211-A and 211-B remedies are selected." The remedial options for SWMU 211-A/B are long-term monitoring with land use controls (LUCs) or enhanced bioremediation with interim LUCs. EPA argued that additional monitoring wells "are necessary as part of the remedy regardless of which remedy is selected." EPA pointed out that no monitoring wells were located in areas where high concentrations of TCE was detected in soil samples, nor were any wells located down-gradient of those areas. EPA contended that additional groundwater data was necessary prior to selecting a remedy because "sources [DNAPL] may be underestimated by sampling only soils which indicate concentrations at discrete points." A conference call occurred on March 25, 2014 between the three parties to the FFA to discuss the merits of EPA's Additional Work Request. Several conference calls ensued to discuss how EPA's concerns would be addressed. Multiple time extensions were requested by DOE during the next several

months. On Oct. 29, 2014, DOE outlined the three-party agreements developed to satisfy EPA's Additional Work Request. The technical specifications of the agreement comprised of conducting vertical profiling throughout the depth of the RGA at six mutually selected locations. The remainder of the agreement outlined reporting and scheduling impacts. The sampling and analysis plan was scoped during two meetings held on Dec. 2 and 5 which resulted in an addendum to the Remedial Design Work Plan that was issued later on in 2015.

Southwest Plume Sources Documents Reviewed in 2014:

D2/A1 Remedial Action Work Plan (Addendum) for In Situ Source Treatment by Deep Soil Mixing of the Southwest Groundwater Plume Volatile Organic Compound Source at the C-747-C Oil Landfarm (Solid Waste Management Unit 1) DOE/LX/07-1287&D2/A1 – (KY Submitted Conditional Concurrence 06-17-2014)

D2/A1/R1 Remedial Action Work Plan (Addendum) for In Situ Source Treatment by Deep Soil Mixing of the Southwest Groundwater Plume Volatile Organic Compound Source at the C-747-C Oil Landfarm (Solid Waste Management Unit 1) DOE/LX/07-1287&D2/A1/R1 – (KY Submitted Approved 07-24-2014)

D2 Remedial Action Work Plan (Addendum) for In Situ Source Treatment by Deep Soil Mixing of the Southwest Groundwater Plume Volatile Organic Compound Source at the C-747-C Oil Landfarm (Solid Waste Management Unit 1) DOE/LX/07-1287&D2 – (KY Approved 01-08-2014)

Groundwater Remedial Action – C-400 Building

The C-400 Building was constructed early in the PGDP's history to serve as the primary parts cleaning facility for the plant. Soil and groundwater near the building are contaminated with trichloroethene (TCE), a solvent that for years was used to remove oil and grease from parts. The physical properties of this contaminant (e.g., it is denser than water) cause it to migrate downward, making it difficult to remove from the subsurface.



Figure 13. C-400 ERH System

Electrical Resistance Heating (ERH) was selected in an August 2005 ROD as the technology best suited to remediate subsurface TCE contamination at C-400. ERH relies upon electrical current and vapor extraction wells to heat and then removal volatile contaminants such as TCE from the subsurface. ERH was first demonstrated at PGDP during a treatability study in 2003 where approximately 1,900 gal of TCE was removed in the vicinity of a historic pipeline leak associated with C-400. During Phase I of the C-400 remediation project, ERH proved to be well suited to remediating near surface contaminated soils; however, the technology was found to be less effective within the deeper portions (60 to 100 ft. bgs) of the contaminated Regional Gravel Aquifer (RGA). When it became clear that another approach was needed to address TCE present in the lower portions of the RGA a decision was made to divide Phase II of the C-400 remedial action into two parts. In 2014 ERH operations conducted during Phase IIa effectively

treated near-surface contaminated soils by removing over 1,100 gal of TCE. Phase IIb operations will kick off in 2015 to focus on the lower RGA (60 to 100ft bgs).

Needing an alternative technology to ERH, DOE submitted a Revised Proposed Plan in late 2011 which promoted using In-Situ Chemical Oxidation (ISCO) in concert with emulsified zero valent iron to break down the TCE. ISCO requires that chemicals capable of reacting with and destroying TCE molecules be injected into the aquifer in areas where residual TCE is concentrated. Kentucky and EPA expressed some concern that this technology might prove inadequate to address the large quantities of TCE believed to be present in the RGA and suggested that DOE also evaluate Steam Enhanced Extraction (SEE) as an alternative technology. SEE uses high pressure steam injected into the aquifer to volatilize and break down the TCE. Preliminary computer evaluations of SEE's potential effectiveness in the RGA were performed by an experienced SEE vendor and a Clemson University researcher. DOE chose to undertake a Treatability Study in order to test a small uncontaminated area located adjacent to the C-400 Phase IIB treatment area. The treatability study was developed during a collaborative approach in order to determine if steam will advance through the RGA enough to effectively remove TCE economically within the lower RGA.

Phase IIa

FFA parties chose Electrical Resistance Heating (ERH) to treat high TCE concentrations located in the upper soil treatment zone (20-60' bgs) at the southeastern corner of the C-400 Building. DOE conducted field characterization efforts in early 2011 to refine TCE mass volume estimates remaining in the Phase II treatment zone. Based on that data DOE estimated the remaining TCE mass to be around 600 gallons. However, earlier mass estimates were extrapolated from various lines of evidence to form the upper bounds of the remaining TCE mass estimate to be 7,000 gallons.

Installation of the ERH system began during the fall of 2012 and the system was extensively tested prior to an official start date of July 30, 2013. Several natural and technical issues arose through the first several months of heating operations -- during which 220 gallons of Volatile Organic Compounds (VOCs) were removed from the subsurface. Once numerous issues were resolved a full system restart occurred on January 13, 2014. After the system was restarted an

additional 125 gallons of VOCs were removed during the first week alone. After the restart the system would remain operational 94% of the time. During the construction and operation of the project, Kentucky AIP program staff completed numerous site inspections.

Three metrics were established by the FFA parties as a goal to aide in the determination that subsurface heating had stabilized. Treatment zone target temperatures in the soil varied in relation to the potentiometric surface of the RGA. By mid-March 2014 the subsurface temperature exceeded the target temperature of 194F (above) and 199F (below) the RGA potentiometric surface, satisfying the first metric. The second metric was met by mid-June when more than 90% of the spatially located digital temperature monitoring sensors exceeded the respective depth-specific target temperatures. The third and final metric was used to confirm that heating of the subsurface was “maintained for the period of time necessary to achieve [VOC recovery] asymptosis.” The final project goal was met by late September 2014 once “the slope of the VOC recovery rate curve has approached zero at a slow rate of change” (asymptotic).

On Sept. 19, 2014 DOE submitted draft project specific documentation to illustrate that the three remediation goals were met for Phase IIa operations. On October 3, 2014 DOE officially submitted the project specific documentation along with a three page summary outlining each of the project goals and associated metrics. Both Kentucky and EPA verified and concurred on Oct. 9, 2014 that remediation goals were met for Phase IIa. The electrodes were de-energized while the vapor recovery system continued to operate for several days. The system was completely shut-down by mid-November and the dismantling and winterization of any remaining equipment followed.

Phase IIb

The D2 Treatability Study Work Plan for Steam Injection (Phase IIb) along with two versions of the Treatability Study Design, Design Drawings and Technical Specifications Package (Phase IIb) were reviewed by Kentucky and EPA. These documents outlined the consensus-based approach agreed upon by all three parties to the FFA. Phase IIb includes the installation and operation of one steam injection well along with multiple temperature sensors spatially located around the injection well. The treatability study was designed “to observe the movement and

distribution of steam using varying injection depths, rates, and pressures and provide data to refine the estimates of permeability, anisotropy/heterogeneity, and local extraction (well spacing, locations, steam injection rates, and timing) to assess the technical implementability and cost-effectiveness of steam injection.” Data collected during the Phase IIb treatability study will be inserted into multiple 2-D and 3-D computer models to evaluate variations in SEE design components necessary to optimize and predict full-scale SEE implementation, if warranted. The Phase IIb treatability study is currently scheduled for a field start in April 2015.

C-400 IRA Documents Reviewed In 2014:

D2 Treatability Study Work Plan for Steam Injection (Phase IIb), Groundwater Operable Unit DOE/LX/07-1294&D2 – (Kentucky Approved 03-20-2014)

D2 Treatability Study Design, Design Drawings and Technical Specifications Package for the C-400 Interim Remedial Action Phase IIb Steam Injection Treatability Study DOE/LX/07-1295&D2 (Kentucky Approved 06-19-2014)

D2/R1 Treatability Study Design, Design Drawings and Technical Specifications Package for the C-400 Interim Remedial Action Phase IIb Steam Injection Treatability Study DOE/LX/07-1295&D2/R1 (Kentucky Approved 07-21-2014)

D2/R1 Remedial Goals Met Letter for the Remedial Design Report, Certified for Construction Design Drawings and Technical Specifications Package for the Groundwater Operable Unit for the Phase IIa VOC Contamination at the C-400 Building DOE/LX/07-1272&D2/R1 (Kentucky Approved 10-09-2014)

Burial Grounds Operable Unit

The historic generation of various types of waste materials at the PGDP led to the on-site subsurface disposal of some of these wastes in areas referred to as Burial Grounds. The Burial Grounds Operable Unit is comprised of 10 such areas that are designated by their respective SWMU numbers: SWMU 2, the C-749 Uranium Burial Ground; SWMU 3, the C-404 Low-Level Radioactive Waste Burial Grounds; SWMU 4, the C-747 Contaminated Burial Yard and C-748-B

Burial Area; SWMU 5, the C-746-F Burial Yard; SWMU 6, the C747-B Burial Grounds; SWMU 7, the C-747-A Burial Grounds and Burn Area; SWMU 9, the C-746-S Landfill; SWMU 10, the C-746-T Landfill; SWMU 30, the C-747-A Burial Grounds and Burn Area and SWMU 145, the P Landfill.

SWMUs 5 and 6 are grouped together in a separate FS. SWMUs 2, 3, 7 and 30 are grouped together in an FS. SWMU 4 is following a separate path as it undergoes further sampling and investigation. SWMUs 9, 10 and 145 are deferred until 2026.

SWMUs 5 and 6

DOE issued the D2 Proposed Plan for SWMUs 5 and 6 on July 17, 2013. In it they proposed Alternative 5, a Kentucky Subtitle D Cap with Land Use Controls and Monitoring as the preferred alternative for both SWMUs. In their July 2013 board meeting, the Paducah Citizen's Advisory Board passed a recommendation to delay implementation of the preferred remedial action in the Proposed Plan for SWMUs 5 and 6 until the waste disposition study regarding use and location of an on-site CERCLA cell landfill was completed, until the community has had time to provide input to DOE relative to site redevelopment, until DOE and the community have had time to solicit and evaluate development proposals from interested parties and until uncertainties in funding relative to plant shutdown, demolition and remediation are resolved. In deference to the CABs request and in recognition of the CAB's argument that an apparent conflict existed between the CERCLA WDA and SWMUs 5 and 6 projects, Kentucky continued to request extensions on the review of the D2 Proposed Plan (PP) through the rest of 2013 and all of 2014. This allowed time for the location of the proposed GE-Hitachi plant to be revealed and for a discussion and CAB recommendation on the location of the proposed CERCLA cell to take place.

SWMUs 2, 3, 7 and 30

Given that the first Proposed Plan for SWMUs 2 and 3 will not be issued until 2022, DOE was granted an extension until March 30, 2014 to issue the D2 Feasibility Study for SWMUs 2, 3, 7 and 30. The D2 FS was issued on June 12, 2014 after multiple extensions. Kentucky

conditionally concurred with the D2 FS on Nov. 12, 2014 after three extension requests. EPA conditionally concurred with the document on Dec. 19, 2014.

SWMU 4

SWMU 4 is being investigated using a phased approach to sample collection with each subsequent phase being informed by the preceding one. In letters dated Feb. 4 and 7, 2014, Kentucky and EPA requested additional Phase III (60 ft.) borings to help refine the selection of the Phase IV (100 ft.) boring locations. On March 24, 2014, DOE agreed to the additional sampling. In April and May, meetings were held between the three parties to revise the sampling plan. DOE issued the revised Addendum to the Work Plan for SWMU 4 on Aug. 1, 2014, to accommodate the additional Phase III scope. Kentucky approved the revision on Aug. 28. Field work started on Sept. 22 and continued until Oct. 9. A change to the waste management plan was approved on Sept. 18.

Meetings were held in December to review the new Phase III data and plan the locations for the Phase IV deep borings. The three parties agreed on 7 of the 10 locations with quick turn-around of the sample data. This will allow the three parties to strategically place the other three boring locations based on the data obtained from the first seven Phase IV borings.

BGOU Documents Reviewed in 2014:

Feasibility Study for Solid Waste Management Units 2, 3, 7 and 30 of the Burial Grounds Operable Unit, DOE/LX/07-1274&D2. – (KY Conditional Concurrence 11-12-14).

Proposed Plan for the Burial Grounds Operable Unit Source Areas SWMUs 5 and 6, DOE/LX/07-1275&D2 – (KY Comments Pending)

Addendum to the Work Plan for the Burial Grounds Operable Unit Remedial Investigation/Feasibility Study, Solid Waste Management Unit 4 Sampling and Analysis Plan, DOE/OR/07-2179&D2/A2/R3. (KY approved 8-28-14).

Work Plan for the Burial Grounds Operable Unit Remedial Investigation/Feasibility Study, DOE/OR/07-2179&D2/R2 (revision to the Waste Management Plan to support SWMU 4). – (KY approved 9-18-14).

Burial Ground Units

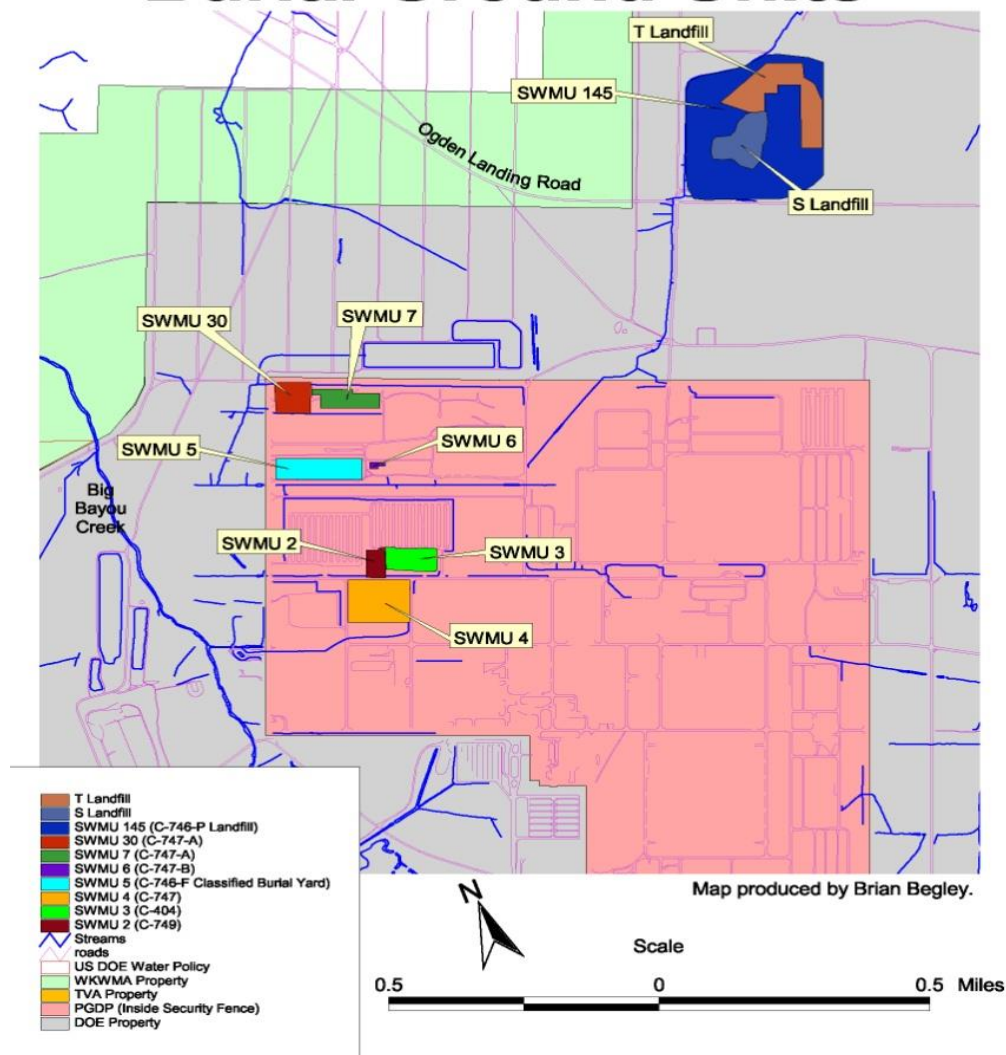


Figure 14. Burial Ground SWMUs

Soils Operable Unit

When the Soils OU RI1 was approved and shelved in 2013, it was planned that the 16 Soils SWMUs that required additional characterization would be the subject of a second RI. This project and the Sitewide Investigation were recognized as projects that could be expedited if

additional funds became available. In 2014 additional funding became available, so scoping began on these projects.

Scoping meetings, including a site walkdown, were held in March and April for the Soils OU RI2 project. The *Addendum to the Work Plan for the Soils OU RI/FS RI 2 Sampling and Analysis Plan* was issued on Aug. 25, 2014. EPA approved the document on Sept. 19, 2014 and Kentucky approved it on Sept. 25, 2014. Fieldwork began Oct. 15, 2014 and continued through the end of the year.

Scoping meetings for the Sitewide Evaluation were held in March, April, and May, which also included a site walkdown. The *Sitewide Evaluation Work Plan for Anomalies Located Outside the Limited Area* was issued on Aug. 30, 2014. It was approved by EPA on Sept. 19, 2014 and by Kentucky on Sept. 25, 2014. Field work began in mid-October and continued through the end of 2014.

Soils Operable Unit Documents Reviewed in 2014:

Addendum to the Work Plan for the Soils Operable Unit Remedial Investigation/Feasibility Study, Remedial investigation 2 Sampling and Analysis Plan, DOE/LX/07-0120&D2/R2/A1/R1. Kentucky approved 09-19-14.

Sitewide Evaluation Work Plan for Anomalies Located Outside the Limited Area, DOE/LX/07-1288&D2. Kentucky approved 09-19-14.

Decontamination and Decommissioning Operable Unit

The Decontamination and Decommissioning (D&D) Operable Unit has addressed inactive facilities at the Paducah site, some of which have been out of service for decades. The C-410/420 Complex is the last of the inactive facilities to be addressed under this Operable Unit.



Figure 15. C-410/420 Exterior

C-410/420 Complex Infrastructure D&D

Final work on the interior of the C-410/420 Complex concluded in 2013, rendering the structures amenable for demolition in 2014.

CY 2014 work focused on the main structures. A large segment of this work has been the careful removal of transite siding panels. The transite panels are asbestos containing material; the panel by panel removal has been deemed necessary to minimize breaking and any subsequent exposure to asbestos fibers. The removed panels are typically bundled and wrapped in plastic for disposition in the on-site solid waste landfill provided they meet radioactive limits for disposition in the landfill.

The vast majority of the demolition debris generated during this project has been characterized as low-level radioactive waste; either shipped or slated for off-site disposal. According to the approved Removal Action Work Plan the C-410/420 complex foundations and slabs will be addressed under a future CERCLA response (Soils and Slabs Operable Unit). Flowable fill

has/will be utilized to bring subsurface features such as basements and sumps to grade, followed by applying and maintaining sealant/fixatives to the slab and filled areas.

Completion of this removal action is scheduled for CY 2015.

Waste Management

Waste Disposition Alternatives (WDA) Project

During the next several decades large quantities of waste will be generated at the PGDP. Much of this waste will be in the form of concrete, structural steel and decommissioned equipment that will require disposal following decontamination and decommissioning of large process buildings. Lesser volumes of waste will be created as contaminated soils and burial grounds are remediated. As much as 3.7 million cubic yards of waste are projected to be generated at the PGDP during the course of site cleanup. The question as to where all of this waste will eventually be disposed is the subject of a DOE generated CERCLA waste disposal alternatives feasibility study currently under review by Kentucky and U.S. EPA.

The WDA Feasibility Study evaluates two general disposal options, on-site disposal versus off-site disposal. Since it is somewhat uncertain how much waste will actually require disposal, both the on-site and off-site alternatives are further broken down into subcategories based upon certain assumptions. The base case subcategory assumes that some of the waste generated will go to an existing on-site solid waste landfill. The high volume subcategory assumes that this landfill will not be available for use and that all waste will require disposal in a new on-site cell or transport and subsequent disposition in an off-site landfill. An on-site repository would allow the site to safely dispose of non-hazardous, hazardous, TSCA, low-level radioactive and low-level radioactive mixed wastes on-site, thereby avoiding more costly off-site disposal. However, the option to ship all or a portion of the waste off-site to a DOE owned or commercial waste facility still exists.

In a letter dated May 19, 2014, DOE initiated an informal dispute in response to certain conditions imposed by Kentucky and EPA that would need to be met prior to approval of the

feasibility study. The FFA parties then spent the remainder of the year working collaboratively in an attempt to resolve the disputed conditions. The FFA parties successfully resolved three of Kentucky's conditions during a June dispute resolution meeting. Additional progress in resolving the remaining conditions was made during meetings held in July and September.

While many of Kentucky's conditions focused on regulations, a few of conditions also sought to elicit a response or commitment from DOE with respect to matters of importance to the Commonwealth. For instance, Kentucky had requested that DOE perform a radon flux analysis for a potential on-site CERCLA landfill. This analysis would determine with some level of certainty whether a landfill containing those wastes projected to require disposal would be capable of releasing radon from its cap at flux rates in excess of 20 pCi/L/s, an emission limit required for capped uranium mill tailing piles. During informal dispute negotiations, DOE agreed to conduct this modeling. Subsequently, DOE convened a modeling workgroup charged with working out the details of how the radon modeling would be performed. Kentucky representatives participated in all workgroup sessions. In December, DOE presented a draft modeling approach which Kentucky approved.

Following approval of the feasibility study, DOE will issue a Proposed Plan that will include a description of its preferred alternative. The public will then be asked to provide input regarding this alternative. If the preferred alternative is on-site disposition of PGDP CERCLA waste, then DOE will also propose a single location for construction of an on-site waste repository. A decision as to whether the on-site option is selected is expected in 2015.

Waste Disposition Options Documents Reviewed in 2014:

No WDA documents were reviewed in 2014.

Solid Waste Management Units (SWMUs)

During the reporting period from Jan.1 to Dec. 31, 2014, Kentucky received one Solid Waste Management Unit Report (SAR) for a newly-discovered SWMU and eleven Revised SARs. Kentucky did not grant No Further Action (NFA) status for any SWMUs during 2014. There are currently no SWMUs listed in either Appendix A-4(a) (DOE Material Storage Areas for which the

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permittee has submitted SARs and are Under Review by the Cabinet) or in Appendix A-4(b) (SWMUs Under Review by the Cabinet) in the PGDP Permit. A summary of SWMU activity performed during 2014 is presented below.

REVISED AND NEWLY-DISCOVERED SWMU ASSESSMENT REPORTS SUBMITTED TO KENTUCKY BETWEEN JAN. 1 AND DEC. 31, 2014

SWMU Number	Description	OU Location	Sub-project	Status	SAR Report Date	Date(s) SAR Amended	Date of NFA or RFI
3	C-404 Low Level Radioactive Waste Burial Ground	BGOU & TSD	Remedial & Permitted	Requires RFI	8/24/87	3/31/03 & 11/7/14	Under Review
90	C-720 Petroleum Naphtha Pipe	N/A	N/A	NFA	12/1/14	N/A	Under Review
99A	C-745 Kellogg Building Site - Cylinder Yard	Soils & Slabs OU	N/A	Requires RFI	11/20/91	10/29/03 & 10/24/14	11/20/91
99B	C-745 Kellogg Building Site - Septic Tank/Leach Field	Soils OU	Remedial	Requires RFI	10/24/14	N/A	11/5/14
102A	Plant Storm Sewer - between the south side of the C-400 Building and Outfall 008	N/A	N/A	NFA	11/20/91	11/14/14	Under Review
102B	Plant Storm Sewer associated with C-333-A, C-337-A, C-340, C-535 and C-537	SWOU	Removal Action	Requires RFI	11/14/14	N/A	Under Review
194	McGraw Construction Facilities (Southside)	Soils OU & D&D OU	Remedial & DUF ₆	Requires RFI	7/6/93	8/28/03 & 12/1/14	Under Review
211A	C-720 TCE Spill Site Northeast	GWOU & Soils OU	SW Plume Sources & Remedial	Requires RFI	6/8/99	11/14/14	Under Review
211B	C-720 TCE Spill Site Southeast	GWOU & Soils & Slabs OU	SW Plume Sources & N/A	Requires RFI	11/14/14	N/A	Under Review
225A	OS-14	Soils OU	Remedial	Requires RFI	12/1/00	3/23/09 2/11/11 10/24/14	12/1/00
225B	Contaminated Soil Area near C-533-1 DMSA OS-14	Soils OU	Remedial	Requires RFI	10/24/14	N/A	11/5/14

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474	West of Vortec Site	Soils & Slabs OU	N/A	Requires RFI	1/19/01	7/3/07 10/24/14	8/14/09
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**SOLID WASTE MANAGEMENT UNITS THAT KENTUCKY GRANTED NO FURTHER ACTION
STATUS BETWEEN JAN. 1 AND DEC. 31, 2014**

SWMU Number	Description	OU Location	Sub-project	Status	SAR Report Date	Date(s) SAR Amended	Date of NFA or RFI
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SWMU Documents Reviewed In 2014:

10/24/14: Received Revised SARs for SWMUs 99A, 99B, 225A, 225B and 474

11/5/14: Approved the Revised SARs for SWMUs 99A, 99B, 225A, 225B and 474

11/7/14: Received Revised SAR for SWMU 3

11/14/14: Received Revised SARs for SWMUs 102A, 102B, 211A and 211B

12/1/14: Received Revised SAR for SWMU 194 and “Newly-Discovered” SWMU 90

It is noted that the “newly-discovered” SWMU 90 should have been submitted with the original Aug. 24, 1987 submittal of SARs 1 to 96. After extensive efforts by both the DOE and Kentucky, no SAR for SWMU 90 was found. Kentucky subsequently requested, and the DOE provided, a “newly-discovered” SAR for SWMU 90. Eight of the Revised SARs served to subdivide four SWMUs into A and B subsections based on additional data and information gained during site investigations. As of the end of the reporting period, seven of the Revised SARs are still under review, and a decision concerning their status and approval is expected in January of 2015.