



ERM

Revised Interim Remedial Action Measure 1 Performance Monitoring Well Network Installation Work Plan

Arkema, Inc. Facility
Portland, Oregon

PREPARED FOR
Legacy Site Services LLC

DATE
16 October 2025

REFERENCE
0773710



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ACRONYMS AND ABBREVIATIONS

Acronym	Description
Arkema	Arkema, Inc.
DNAPL	dense nonaqueous-phase liquid
ERM	Environmental Resources Management, Inc.
GWET	groundwater extraction and treatment
GWMWP	Arkema Quarterly Groundwater Monitoring Work Plan
I1TA	Interim Remedial Action Measure 1 Treatment Area
IRAM 1	Interim Remedial Action Measure 1
ISS	in situ stabilization/solidification
LSS	Legacy Site Services LLC
MCB	monochlorobenzene
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
ODEQ	Oregon Department of Environmental Quality
PDI	pre-design investigation
PFDR	ISS Pre-Final Design Report
PMWP	Performance Monitoring Plan for Interim Remedial Action Measure 1
Site	Arkema, Inc. Facility
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

PROFESSIONAL GEOLOGIST'S CERTIFICATION

I, Avery Soplata, Licensed Professional Geologist in the State of Oregon, hereby certify to the best of my knowledge and belief that this document is true and correct and has been prepared in accordance with general industry standards and applicable federal, state, and local requirements, and hereunto set out hand and affix my seal this 9 October 2025.



Exp. 10/1/2026

Avery Soplata, RG
Geologist

RESPONSES TO AGENCY COMMENTS

Legacy Site Services LLC (LSS) received the following comments on 10 September 2025 in response to the *IRAM 1 Performance Monitoring Well Network Installation Work Plan*, which was submitted to the Oregon Department of Environmental Quality (ODEQ) on 21 August 2025. Environmental Resources Management, Inc. (ERM) has prepared these responses on behalf of LSS and presented them below.

Comment #1:

Section 1.1 states "The primary objective of the PMWP is to establish a monitoring well network that will be used to evaluate the effect of IRAM 1 on MCB [monochlorobenzene] concentrations in groundwater near the I1TA [IRAM 1 Treatment Area]." However, many of the wells shown in Figure 3 are too distant from IRAM 1 Treatment Area to contribute to meeting this specific objective. Presumably each well cluster location was selected deliberately, and DEQ requests the specific monitoring objectives and justification for their locations be provided for all wells.

LSS/ERM Response:

Well locations proposed in the Work Plan were offset from the ISS monolith to support monitoring objectives, accommodate excavation layback requirements, and address site construction constraints such as subsurface utilities. A revised draft design and excavation approach, to be included in the ISS Final Design Report, has resulted in monitoring location adjustments. The new IRAM 1 performance monitoring well network is depicted in Figure 3. The monitoring objectives of each performance monitoring well cluster are detailed in Table 2.

Comment #2:

Monitoring with well cluster locations on the northwestern side of the NAPL plume and ISS area appears very limited. Consider adding additional cluster sets in this area (as suggested in the enclosed annotated figure) and moving the PW-10 cluster northward where the NAPL appears to expand in a northwesterly direction.

LSS/ERM Response:

The location of monitoring well cluster PMW-10 has been revised and monitoring well clusters PMW-17 and PMW-18 have been added to monitor the western side of the monolith. Additional monitoring well clusters (PMW-19 and PMW-20) have been added to the southeastern side of the monolith.

Comment #3:

The cross-section Figures 5 through 7 should include the extent of the proposed ISS so that this can be seen in relation to the proposed locations of the PMW cluster monitoring wells.

LSS/ERM Response:

The draft ISS design has been added to Figures 5 through 7 as it is presently understood, pending ODEQ review of the upcoming ISS Final Design Report.



1. INTRODUCTION

Environmental Resources Management, Inc. (ERM) has prepared this *Revised Interim Remedial Action Measure 1 Performance Monitoring Well Network Installation Work Plan* (PMWP) for the Arkema, Inc. (Arkema) Facility (the Site) on behalf of Legacy Site Services LLC (LSS), agent for Arkema. The Site is located at 6400 NW Front Avenue, in Portland, Oregon (Figure 1). The purpose of the PMWP is to propose a groundwater monitoring well network that will be used to evaluate the performance of Interim Remedial Action Measure 1 (IRAM 1). The goal of IRAM 1 is to address the monochlorobenzene (MCB) source area that originated in the former Acid Plant Area of the Site. The treatment area of IRAM 1 is referred to as IRAM 1 Treatment Area (I1TA). I1TA focuses on dense nonaqueous-phase liquid (DNAPL) hot spots present in soil and groundwater. IRAM 1 consists of excavation, in situ stabilization/solidification (ISS), and possibly in situ chemical oxidation technologies.

Two phases of pre-design investigation (PDI) were completed in August 2024 and October 2024. The objective of these investigations was to delineate the horizontal and vertical extent of DNAPL within the MCB source area, and thereby the extents of I1TA. The Phase 1 PDI identified the general extent of DNAPL, and the Phase 2 PDI refined the results to more accurately locate the edges of the DNAPL. For the purposes of these investigations, the DNAPL area was identified by positive or negative results using an OIL-IN-SOIL™ kit. Results from the Phase 1 PDI investigation and the conceptual design for the IRAM 1 are presented in the *In Situ Stabilization Pre-Design Investigation* (ERM 2024). The results of the Phase 2 PDI investigation and the pre-final design of the IRAM 1 are presented in the *ISS Pre-Final Design Report* (PFDR; ERM 2025). IRAM 1 will be implemented in accordance with the forthcoming Final Design Report, and this PMWP is intended to propose a performance monitoring well network that will be used to evaluate the effectiveness of IRAM 1. A discussion of how the effectiveness of IRAM 1 will be evaluated will be included in a forthcoming memorandum, *Groundwater Data Evaluation Regarding the Source Control Measure and Interim Remedial Action Measures* (Groundwater Data Memo).

1.1 PERFORMANCE MONITORING PLAN OBJECTIVES

The primary objective of the PMWP is to establish a monitoring well network that will be used to evaluate the effect of IRAM 1 on MCB concentrations in groundwater near the I1TA. This work plan includes details on the installation of the proposed performance monitoring well locations, their screen elevations, and methods of construction. As discussed in Section 2, some of the performance monitoring well locations will be installed and sampled in September 2025 and/or October 2025, and the remaining wells will be installed later in 2026 after IRAM 1 is complete. The sampling frequency and analytical methods used will be discussed in the forthcoming Groundwater Data Memo.

1.2 BACKGROUND

1.2.1 SITE LOCATION AND SETTING

The Site is located at 6400 NW Front Avenue in the Northwest Industrial area of Portland, Oregon, and is bound by Front Avenue on the north and west, the Willamette River on the east, and an



asphalt roofing manufacturer on the south. The Site lies on the southwest bank of the lower Willamette River between River Mile 6.9 and River Mile 7.6, immediately upstream of the Burlington Northern Santa Fe Railroad Bridge and adjacent to the Portland Harbor Superfund site.

Starting in 1941, various chemicals were produced at the Site, including sodium chlorate, potassium chlorate, chlorine, sodium hydroxide, dichlorodiphenyltrichloroethane, sodium orthosilicate, magnesium chloride hexahydrate, ammonia, ammonium perchlorate, sodium perchlorate, and hydrochloric acid. Most recently, the Site was a chlor-alkali plant until the plant shut down in 2001. The plant was decommissioned and dismantled in 2004. The *Remedial Investigation Report* (ERM 2005) described historical Site operations and manufacturing processes.

Currently, most of the Site is paved, gravel-covered/capped, or covered with building foundations. The only structures currently present are the building constructed to house the groundwater extraction and treatment (GWET) system, three small motor-control buildings, a temporary trailer used as the Site office, and the original plant administration building. The only current activities at the Site are general maintenance and those associated with remediation.

For more detailed information on the Site background, history, geology, and hydrostratigraphy, refer to the PFDR (ERM 2025).

1.2.2 EXTENT OF I1TA

The extent of I1TA is defined by the area and depth intervals in which DNAPL was observed during the Phase 1 and Phase 2 PDI. The DNAPL extent identified during the Phase 1 and Phase 2 PDI is presented on Figure 2, and analytical data, boring logs, photographs, and additional discussion are presented in the PFDR. The delineated area of I1TA encompasses the former Manufacturing Process Residue Pond, and a small portion of the Overflow Trench (i.e., dichlorodiphenyltrichloroethane trench; ERM 2024 and 2025). The former Manufacturing Process Residue Pond and Overflow Trench are the two areas where disposal of spent MCB (i.e., DNAPL) historically occurred. Portions of the Overflow Trench and Manufacturing Process Residue Pond were both excavated to approximate depths between 8 and 12 feet, respectively, in 2000 (ERM 2001).

2. IRAM 1 MONITORING WELL NETWORK

The proposed IRAM 1 performance monitoring network is detailed in Table 1 and Figure 3 and consists of 26 Shallow Zone wells, 26 Intermediate Zone wells, 30 Deep Zone wells, 5 Gravel Zone wells, and 20 Basalt Zone wells. Objectives of each proposed monitoring well cluster are included in Table 2.

This well network includes a combination of proposed new wells and existing wells, including 25 existing wells that are currently monitored as part of quarterly monitoring (ERM 2019) and

six existing wells that are not currently monitored. Figures 4 through 7 present cross-sectional views of monitoring locations near I1TA, including approximate well screen depths.

Proposed new groundwater monitoring wells include 20 well clusters with up to five wells each, one in each aquifer zone (Shallow, Intermediate, Deep, Gravel, Basalt Zones) where present. Where possible, existing wells have been incorporated into the clusters.

Of these 20 well clusters:

- Thirteen will be installed and sampled during a baseline event prior to IRAM 1 implementation: **PMW-01 – PMW-09, PMW-14, PMW-18 – PMW-20.**
- Eight will be installed after IRAM 1 completion, as they lie within the high construction risk areas, including within or in close proximity to the ISS footprint, and anticipated excavation area: **PMW-07, PMW-10 through PMW-13, PMW-15 – PMW-17.**
- **PMW-11, PMW-12, and PMW-13** will be installed at an angle trending from ground surface towards the Willamette River to monitor groundwater concentrations as near to the top of the riverbank as possible. The angle of drilling is anticipated to be approximately 20 degrees and may be adjusted based on field observations by the driller.
- **PMW-15 and PMW-16** are anticipated to contain only Deep and Basalt Zone wells and will be located within the monolith footprint to monitor groundwater quality below the ISS prism. The PMW-15 monitoring cluster is located beneath the thickest section of the DNAPL plume, while the PMW-16 cluster is placed beneath the region where DNAPL impacts are observed in the Intermediate Zone.

In total, up to 77 new monitoring wells will be installed as part of the IRAM 1 performance monitoring network (Table 1).

2.1 SUBSURFACE CLEARANCE

ERM will review subsurface utility records, as-built drawings, and historical information to select drilling locations that are sufficiently far from known existing surface and subsurface utilities. An underground services alert dig ticket will be requested through the Oregon Utility Notification Center. ERM will subcontract a private utility locator to conduct a private utility locate. Based on the results of the private utility locate, some of the proposed monitoring well locations may be adjusted to avoid underground utilities.

Based on the review of subsurface utilities and the private utility locate, ERM will determine whether any well installation locations need to be precleared using an air-knife and vacuum truck, and if so, which ones. A subcontractor will conduct any preclearance, which ERM will oversee in accordance with ERM's subsurface clearance procedures.

2.2 MONITORING WELL DRILLING

ERM personnel will oversee the advancement of the monitoring wells detailed in Table 1.

Monitoring well installation will be completed using sonic drilling technology operated by a subcontractor. No plugs/seals will be installed between the aquifer zones during drilling, except for the Basalt-Deep Zone contact. Continuous soil cores will be collected from each Basalt Zone



boring, then logged and photo-documented by a qualified ERM staff member. For each well cluster, the target hydrostratigraphic zones of the subsequent Shallow, Intermediate, and Deep Zone borings will also be logged and photo-documented by a qualified ERM staff member. Each boring log will then be reviewed by an Oregon Registered Geologist. Soil lithology will be logged and classified according to the Unified Soil Classification System.

If visual indications of DNAPL (red/pink staining, sheen, strong odor) are encountered during drilling of the proposed monitoring wells, drilling will pause while soil is tested using an OIL-IN-SOIL™ kit. This kit provides a graduated jar, oil-soluble indicator dye, water-soluble contrast dye, and styrene indicator ball. Unconsolidated soil is added to the jar to the first line, then warm tap water is added to the second line. The jar is capped and shaken for 30 seconds or until the dye cube is completely dissolved, then allowed to settle for 1 minute. Red staining of the styrene indicator ball is a positive indication of nonaqueous-phase liquid with a detection limit of 500 parts per million. Warm tap water will be kept in an insulated carafe at the sampling location.

If the presence of DNAPL is confirmed, an analytical soil sample will be collected for volatile organic compound (VOC) analysis in accordance with methods described in Section 2.4, Well Development. Following sample collection, the DNAPL-impacted borehole will be grouted, and the field team will proceed to a new step-out drilling location.

2.3 WELL CONSTRUCTION

Following drilling, 2-inch monitoring wells will be installed in each boring. Table 1 and Figures 5 through 7 present anticipated monitoring well total depths and well screen intervals based on a review of nearby geology. Actual elevations of monitoring well screens will be based on field observations of lithology and moisture content to place the screen in the target hydrostratigraphic zone. The purpose of the Gravel and Basalt Zone wells is to collect groundwater data from the permeable zone under the Deep Zone. At locations where the Gravel Zone is thinner than 3 feet, the Gravel and Basalt Zones may be screened together in one monitoring well. The Gravel and Basalt Zones will be screened together when lithology in each zone is similar, as determined based on field observation.

Each new monitoring well will be constructed with 2-inch diameter, Schedule 40 polyvinyl chloride casing, and 5-foot sections of 0.010-inch machine-slotted polyvinyl chloride well screen with a sand pack. The screened borehole annulus will be packed with 10/20 Colorado silica sand to 1 foot above the screened interval. The borehole annulus will then be filled with bentonite chips to approximately 2 feet below ground surface and then the chips will be hydrated. The monitoring wells will be completed at ground surface with flush-mounted well boxes set in concrete.

2.4 WELL DEVELOPMENT

At least 24 hours after construction, well development will be performed using a surge block to push water back and forth through the well screen and filter pack. The water and particulates will then be removed using a bailer and submersible pump. Following Oregon Department of Environmental Quality (ODEQ) requirements (ODEQ 1992), well development will be conducted until:

- The total amount of water introduced during drilling, plus a minimum of 5 to 10 well volumes, has been removed from the well;
- The water is chemically stable; and
- The water is as free of sediment as possible.

Turbidity measurements, color, and depth to water will be recorded during development. Development will be conducted until turbidity is below 50 nephelometric turbidity units and water appears sediment-free upon observation, or until 5 to 10 well volumes are removed.

2.5 EQUIPMENT DECONTAMINATION AND INVESTIGATION-DERIVED WASTE

Sampling, drilling, and other field equipment will be decontaminated prior to use between sampling locations. Sampling equipment will be scrubbed with an aqueous solution of laboratory-grade detergent, followed by a rinse with tap water, followed by an isopropyl alcohol rinse, followed by a rinse with deionized water. The drilling subcontractor will decontaminate all downhole equipment on a temporary decontamination pad prior to and after installation of each monitoring well. Sampling equipment will be hand-washed over 5-gallon buckets prior to sampling activities.

Solid investigation-derived waste from preclearance and drilling will be containerized in a double-lined and covered roll-off box suitable for asbestos-containing material, if encountered. Soil will be segregated into different containers depending on the anticipated disposal pathway (e.g., asbestos-containing material, state-only hazardous waste). Composite samples will be analyzed in accordance with requirements specified by the waste disposal facility based on generator knowledge. ERM will conduct data validation of the laboratory analytical data, and once determined, will have the waste hauled from the Site to an appropriate waste management facility.

Decontamination and development water will be contained in 300-gallon intermediate bulk containers (totes) and then processed in the GWET system.

2.6 SURVEY

A subcontractor will survey the ground surface and top-of-well casing for each of the installed wells. The horizontal coordinate measurement will be reported to the nearest 0.1 foot using the North American Datum of 1983 (NAD83) Oregon State Planes North datum. Elevation will be measured to the nearest 0.01 foot using the North American Vertical Datum of 1988 (NAVD88).

3. PERFORMANCE MONITORING BASELINE SAMPLING

The proposed IRAM 1 performance monitoring baseline sampling is detailed in Table 3. The baseline groundwater sampling event will be conducted prior to IRAM 1 implementation. The baseline sampling event will include all wells within the IRAM 1 performance monitoring network, except those to be installed after IRAM 1 implementation (Table 3).

During the baseline groundwater sampling event, all performance monitoring wells will be sampled for VOCs (United States Environmental Protection Agency [USEPA] Method 8260D and/or 8260D Low Level), pesticides (USEPA Method 8081B and/or 8081B Low Level), perchlorate



(USEPA Method 314), and chloride (USEPA Method 300). The selection of analytes for subsequent quarterly monitoring events will be guided by baseline groundwater sampling results. Sampling of the IRAM 1 performance monitoring network will follow the procedures outlined in the *Arkema Quarterly Groundwater Monitoring Work Plan* (ERM 2019).

4. REPORTING

Following the baseline groundwater sampling event, ERM will obtain analytical laboratory reports from Eurofins. ERM will perform data validation following appropriate USEPA protocols. ERM will submit a Quarterly Groundwater Monitoring Report within 60 days after data validation. The Quarterly Groundwater Monitoring Report will include field procedures, groundwater elevation data, groundwater analytical data, and potential deviations from this plan.

5. SCHEDULE

Pending ODEQ approval of the PMWP, associated fieldwork and reporting will follow this tentative schedule:

- **Performance monitoring well installation, Phase 1:** Starts August or September 2025, pending ODEQ approval of this plan.
- **Baseline groundwater monitoring:** Expected December 2025, following the installation of Phase 1 performance monitoring wells. Concurrent with Quarter 4 2025 groundwater monitoring.
- **Receipt of analytical results and data validation:** Expected January 2026.
- **Submission of Quarter 4 2025 Groundwater Monitoring Report to ODEQ:** Within 60 days after data validation. Will include baseline groundwater monitoring results.
- **Remaining IRAM 1 performance monitoring well installation:** Expected Quarter 3 2026, after IRAM 1 implementation is substantively completed.

6. REFERENCES

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TABLES

Table 1
Proposed IRAM 1 Monitoring Network
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon

Location ID	Aquifer Screened Zone	Proposed Well	Drilling Method	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval		
						Top (ft bgs)	Bottom (ft bgs)	Screen Slot Size (in)
MWA-22	Shallow	--	HSA	36.0	35.0	24.7	34.7	0.01
MWA-41	Shallow	--	HSA	35.0	38.2	28.7	37.5	0.01
MWA-42	Shallow	--	HSA	33.5	31.6	21.6	30.8	0.01
MWA-63	Shallow	--	HSA	30.5	30.0	19.8	29.6	0.01
MWA-82	Shallow	--	DPT	32.0	31.7	21.5	31.5	0.01
PA-03	Shallow	--	DPT	30.0	27.5	22.2	27.2	0.01
PA-04	Shallow	--	DPT	35.0	28.7	23.3	28.3	0.01
PA-08	Shallow	--	DPT	32.0	32.0	27.0	32.0	0.01
PA-09	Shallow	--	DPT	32.0	32.0	27.0	32.0	0.01
PA-31	Shallow	--	HSA	28.5	25.5	20.0	25.0	0.01
PA-36	Shallow	--	HSA	40.0	38.7	33.2	38.2	0.01
PMW-01s	Shallow	X	Sonic	25.0	25.0	20.0	25.0	0.01
PMW-03s	Shallow	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-04s	Shallow	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-05s	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-06s	Shallow	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-07s ¹	Shallow	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-09s	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-10s ¹	Shallow	X	Sonic	30.0	30.0	25.0	30.0	0.01
PMW-11s ¹	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-12s ¹	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-13s ¹	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-14s	Shallow	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-17s ¹	Shallow	X	Sonic	30.0	30.0	25.0	30.0	0.01
PMW-18s	Shallow	X	Sonic	30.0	30.0	25.0	30.0	0.01
PMW-19s	Shallow	X	Sonic	30.0	30.0	25.0	30.0	0.01
MWA-54i	Intermediate	--	HSA	41.5	41.0	36.1	40.6	0.01
MWA-81i	Intermediate	--	Sonic	48.0	47.4	42.2	47.2	0.01
PA-10i	Intermediate	--	DPT	40.0	38.5	33.2	38.2	0.01
PA-15i	Intermediate	--	DPT	45.5	45.5	40.5	45.5	0.01
PA-16i	Intermediate	--	DPT	46.5	46.5	41.5	46.5	0.01
PA-17iR	Intermediate	--	Sonic	44.0	44.0	38.0	43.0	0.01
PA-32i	Intermediate	--	Sonic	41.0	41.0	35.5	40.5	0.01
PA-37i	Intermediate	--	Sonic	48.0	45.5	40.0	45.0	0.01
PA-44i	Intermediate	--	Sonic	47.0	47.0	41.5	46.5	0.01
PMW-01i	Intermediate	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-02i	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-03i	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-04i	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-05i	Intermediate	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-06i	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-07i ¹	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-09i	Intermediate	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-10i ¹	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-11i ¹	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-12i ¹	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-13i ¹	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-14i	Intermediate	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-17i ¹	Intermediate	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-18i	Intermediate	X	Sonic	35.0	35.0	30.0	35.0	0.01
PMW-19i	Intermediate	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-20i	Intermediate	X	Sonic	40.0	40.0	35.0	40.0	0.01
MWA-31i(D)	Deep	--	HSA	60.0	60.1	54.8	59.8	0.01
MWA-56d	Deep	--	Sonic	61.0	60.8	55.5	60.3	0.01
MWA-58d	Deep	--	Sonic	63.0	61.7	56.4	61.1	0.01
PA-18d	Deep	--	DPT	46.5	44.5	42.2	44.2	0.01
PA-22d	Deep	--	Sonic	63.0	63.0	58.0	63.0	0.01
PA-23d	Deep	--	Sonic	84.0	83.5	78.3	83.3	0.01
PA-24d	Deep	--	Sonic	86.0	84.0	78.8	83.8	0.01
PA-25d	Deep	--	Sonic	83.0	83.0	78.0	83.0	0.01
PA-26d	Deep	--	Sonic	83.0	83.0	78.0	83.0	0.01
PA-27d	Deep	--	DPT	49.0	48.0	45.7	47.7	0.01
PMW-01d	Deep	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-02d	Deep	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-03d	Deep	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-04d	Deep	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-05d	Deep	X	Sonic	65.0	65.0	60.0	65.0	0.01
PMW-06d	Deep	X	Sonic	60.0	60.0	55.0	60.0	0.01
PMW-07d ¹	Deep	X	Sonic	60.0	60.0	55.0	60.0	0.01
PMW-08d	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-09d	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-10d ¹	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-11d ¹	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-12d ¹	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-13d ¹	Deep	X	Sonic	50.0	50.0	45.0	50.0	0.01
PMW-14d	Deep	X	Sonic	60.0	60.0	55.0	60.0	0.01
PMW-15d ¹	Deep	X	Sonic	60.0	60.0	55.0	60.0	0.01
PMW-16d ¹	Deep	X	Sonic	55.0	55.0	50.0	55.0	0.01
PMW-17d ¹	Deep	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-18d	Deep	X	Sonic	40.0	40.0	35.0	40.0	0.01
PMW-19d	Deep	X	Sonic	55.0	55.0	45.0	55.0	0.01
PMW-20d	Deep	X	Sonic	55.0	55.0	45.0	55.0	0.01
PMW-08g	Gravel	X	Sonic	90.0	90.0	80.0	90.0	0.01
PMW-17a ¹	Gravel	X	Sonic	70.0	70.0	65.0	70.0	0.01
PMW-18a	Gravel	X	Sonic	45.0	45.0	40.0	45.0	0.01
PMW-19a	Gravel	X	Sonic	70.0	70.0	65.0	70.0	0.01
PMW-20g	Gravel	X	Sonic	70.0	70.0	65.0	70.0	0.01
PMW-01b	Basalt	X	Sonic	90.0	90.0	80.0	90.0	0.01
PMW-02b	Basalt	X	Sonic	65.0	65.0	55.0	65.0	0.01
PMW-03b	Basalt	X	Sonic	65.0	65.0	55.0	65.0	0.01
PMW-04b	Basalt	X	Sonic	65.0	65.0	55.0	65.0	0.01
PMW-05b	Basalt	X	Sonic	90.0	90.0	80.0	90.0	0.01
PMW-06b	Basalt	X	Sonic	95.0	95.0	85.0	95.0	0.01
PMW-07b ¹	Basalt	X	Sonic	105.0	105.0	95.0	105.0	0.01
PMW-08b	Basalt	X	Sonic	105.0	105.0	95.0	105.0	0.01
PMW-09b	Basalt	X	Sonic	100.0	100.0	90.0	100.0	0.01
PMW-10b ¹	Basalt	X	Sonic	95.0	95.0	85.0	95.0	0.01
PMW-11b ¹	Basalt	X	Sonic	70.0	70.0	60.0	70.0	0.01
PMW-12b ¹	Basalt	X	Sonic	70.0	70.0	60.0	70.0	0.01
PMW-13b ¹	Basalt	X	Sonic	65.0	65.0	55.0	65.0	0.01
PMW-14b	Basalt	X	Sonic	80.0	80.0	70.0	80.0	0.01
PMW-15b ¹	Basalt	X	Sonic	100.0	100.0	90.0	100.0	0.01
PMW-16b ¹	Basalt	X	Sonic	70.0	70.0	60.0	70.0	0.01
PMW-17b ¹	Basalt	X	Sonic	80.0	80.0	70.0	80.0	0.01

Table 1
Proposed IRAM 1 Monitoring Network
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon

Location ID	Aquifer Screened Zone	Proposed Well	Drilling Method	Borehole Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval		Screen Slot Size (in)
						Top (ft bgs)	Bottom (ft bgs)	
PMW-18b	Basalt	X	Sonic	55.0	55.0	45.0	55.0	0.01
PMW-19b	Basalt	X	Sonic	80.0	80.0	70.0	80.0	0.01
PMW-20b	Basalt	X	Sonic	80.0	80.0	70.0	80.0	0.01

Notes:
bgs = below ground surface
DPT = direct push technology
ft = feet
HSA = hollow stem auger
in = inches
1 = Groundwater monitoring well to be installed after ISS implementation

Table 2
Proposed Monitoring Network Objectives
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon

Location ID	Monitoring Objectives
PMW-01	Monitor groundwater levels and COC concentrations upgradient of the I1TA.
PMW-02 & PMW-03	Monitor groundwater levels and COC concentrations on the northwestern side of the I1TA and on the interior and exterior of the groundwater barrier wall, respectively.
PMW-04 & PMW-14	Monitor groundwater levels and COC concentrations on the northeastern side of the I1TA, exterior of the groundwater barrier wall and adjacent to the riverbank.
PMW-05 & PMW-06	Monitor groundwater levels and COC concentrations on the eastern side of the I1TA, and on the exterior and interior of the groundwater barrier wall, respectively.
PMW-07	Installed after ISS implementation to monitor groundwater levels and COC concentrations on the eastern side of the I1TA between the DNAPL and petroleum-based NAPL plumes.
PMW-08	Monitor cross-gradient groundwater levels and COC concentrations southeast of the I1TA, in between the I1TA and the central portion of the groundwater barrier wall.
PMW-09	Monitor groundwater levels and COC concentrations near the southeastern corner of the I1TA.
PMW-10 & PMW-17	Installed after ISS implementation to monitor groundwater levels and COC concentrations on the western and southwestern side of the I1TA, respectively.
PMW-11, PMW-12, & PMW-13	Installed at an approximately 20-degree angle after ISS implementation to monitor groundwater levels and COC concentrations on the downgradient north end of the I1TA, exterior of the groundwater barrier wall and adjacent to the riverbank.
PMW-15 & PMW-16	Installed after ISS implementation within the I1TA footprint and will include Deep and Basalt Zone wells screened below the ISS monolith. The PMW-15 monitoring cluster is planned to be positioned beneath the thickest portion of the DNAPL plume, and the PMW-16 cluster is expected to be located beneath the area where DNAPL impacts have been identified in the intermediate zone.
PMW-18	Monitor groundwater levels and COC concentrations southwest of the I1TA as groundwater migrates towards the northern end of the groundwater barrier wall.
PMW-19 & PMW-20	Monitor groundwater levels and COC concentrations east of the I1TA near the middle of the groundwater barrier wall on its exterior and interior, respectively.

Notes:

COC = contaminant of concern
 DNAPL = dense nonaqueous phase liquid
 I1TA = Interim Remedial Action Measure 1 Treatment Area
 ISS = in situ solidification and stabilization
 NAPL = nonaqueous phase liquid
 PMW = performance monitoring well

**Table 3
Proposed Groundwater Monitoring Schedule
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon**

Location ID	Aquifer	Proposed Well	Groundwater Level Measurement	VOCs (USEPA 8260D or 8260DLL) Pesticides (USEPA 8081B or 8081BLL) Perchlorate (USEPA 314) Chloride (USEPA 300) ⁴
				Baseline Sampling ³
MWA-22	Shallow	--	X	X
MWA-41 ¹	Shallow	--	X	X
MWA-42	Shallow	--	X	X
MWA-63 ¹	Shallow	--	X	X
MWA-82 ¹	Shallow	--	X	X
PA-03 ¹	Shallow	--	X	X
PA-04 ¹	Shallow	--	X	X
PA-08 ¹	Shallow	--	X	X
PA-09 ¹	Shallow	--	X	X
PA-31 ¹	Shallow	--	X	X
PA-36	Shallow	--	X	X
RW-12	Shallow	--	X	X
PMW-01s	Shallow	X	X	X
PMW-03s	Shallow	X	X	X
PMW-04s	Shallow	X	X	X
PMW-05s	Shallow	X	X	X
PMW-06s	Shallow	X	X	X
PMW-07s ²	Shallow	X	X	--
PMW-09s	Shallow	X	X	X
PMW-10s ²	Shallow	X	X	--
PMW-11s ²	Shallow	X	X	--
PMW-12s ²	Shallow	X	X	--
PMW-13s ²	Shallow	X	X	--
PMW-14s	Shallow	X	X	X
PMW-17s ²	Shallow	X	X	--
PMW-18s	Shallow	X	X	X
PMW-19s	Shallow	X	X	X
MWA-54i	Intermediate	--	X	X
MWA-81i ¹	Intermediate	--	X	X
PA-10i ¹	Intermediate	--	X	X
PA-15i ¹	Intermediate	--	X	X
PA-16i ¹	Intermediate	--	X	X
PA-17iR ¹	Intermediate	--	X	X
PA-32i ¹	Intermediate	--	X	X
PA-37i	Intermediate	--	X	X
PA-44i ¹	Intermediate	--	X	X
PMW-01i	Intermediate	X	X	X
PMW-02i	Intermediate	X	X	X
PMW-03i	Intermediate	X	X	X
PMW-04i	Intermediate	X	X	X
PMW-05i	Intermediate	X	X	X
PMW-06i	Intermediate	X	X	X
PMW-07i ²	Intermediate	X	X	--
PMW-09i	Intermediate	X	X	X
PMW-10i ²	Intermediate	X	X	--
PMW-11i ²	Intermediate	X	X	--
PMW-12i ²	Intermediate	X	X	--
PMW-13i ²	Intermediate	X	X	--
PMW-14i	Intermediate	X	X	X
PMW-17i ²	Intermediate	X	X	--
PMW-18i	Intermediate	X	X	X
PMW-19i	Intermediate	X	X	X
PMW-20i	Intermediate	X	X	X
MWA-31i(d) ¹	Deep	--	X	X
MWA-56d ¹	Deep	--	X	X
MWA-58d ¹	Deep	--	X	X
PA-18d ¹	Deep	--	X	X
PA-22d ¹	Deep	--	X	X
PA-23d ¹	Deep	--	X	X
PA-24d ¹	Deep	--	X	X
PA-25d ¹	Deep	--	X	X
PA-26d ¹	Deep	--	X	X

**Table 3
Proposed Groundwater Monitoring Schedule
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon**

Location ID	Aquifer	Proposed Well	Groundwater Level Measurement	VOCs (USEPA 8260D or 8260DLL) Pesticides (USEPA 8081B or 8081BLL) Perchlorate (USEPA 314) Chloride (USEPA 300) ⁴
				Baseline Sampling ³
PA-27d ¹	Deep	--	X	X
PMW-01d	Deep	X	X	X
PMW-02d	Deep	X	X	X
PMW-03d	Deep	X	X	X
PMW-04d	Deep	X	X	X
PMW-05d	Deep	X	X	X
PMW-06d	Deep	X	X	X
PMW-07d ¹	Deep	X	X	--
PMW-08d	Deep	X	X	X
PMW-09d	Deep	X	X	X
PMW-10d ²	Deep	X	X	--
PMW-11d ²	Deep	X	X	--
PMW-12d ²	Deep	X	X	--
PMW-13d ²	Deep	X	X	--
PMW-14d	Deep	X	X	X
PMW-15d ²	Deep	X	X	--
PMW-16d ²	Deep	X	X	--
PMW-17d ²	Deep	X	X	--
PMW-18d	Deep	X	X	X
PMW-19d	Deep	X	X	X
PMW-20d	Deep	X	X	X
PMW-08g	Gravel	X	X	X
PMW-17g ²	Gravel	X	X	--
PMW-18g	Gravel	X	X	X
PMW-19g	Gravel	X	X	X
PMW-20g	Gravel	X	X	X
PMW-01b	Basalt	X	X	X
PMW-02b	Basalt	X	X	X
PMW-03b	Basalt	X	X	X
PMW-04b	Basalt	X	X	X
PMW-05b	Basalt	X	X	X
PMW-06b	Basalt	X	X	X
PMW-07b ¹	Basalt	X	X	--
PMW-08b	Basalt	X	X	X
PMW-09b	Basalt	X	X	X
PMW-10b ²	Basalt	X	X	--
PMW-11b ²	Basalt	X	X	--
PMW-12b ²	Basalt	X	X	--
PMW-13b ²	Basalt	X	X	--
PMW-14b	Basalt	X	X	X
PMW-15b ²	Basalt	X	X	--
PMW-16b ²	Basalt	X	X	--
PMW-17b ²	Basalt	X	X	--
PMW-18b	Basalt	X	X	X
PMW-19b	Basalt	X	X	X
PMW-20b	Basalt	X	X	X

79

Notes:

LL = low level

VOCs = volatile organic compounds

USEPA = United States Environmental Protection Agency

1 = Part of the current quarterly groundwater monitoring scope presented in the Arkema Quarterly Groundwater Monitoring Work Plan (ERM 2019).

2 = To be installed after IRAM 1 implementation.

3 = Baseline sampling will not include monitoring wells to be installed after IRAM 1 implementation.

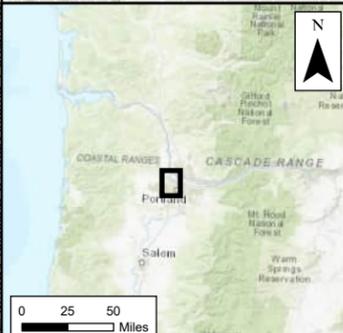
4 = The selection of analytes for quarterly groundwater monitoring events will be guided by baseline groundwater sampling results.



FIGURES



DRAWN BY: GIS
 FILE: M:\USProjects\S\11Total\Arkema_Portland\Groundwater_Source_Control\maps\ISS_PDI_Workplan.aprx | REVISED: 04/25/2024 | SCALE: 1:63,360 when printed at 11x17



Legend
 — Parcel and Property Boundaries

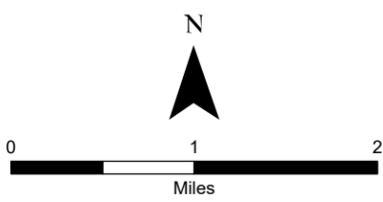


Figure 1
Site Location
 Former Arkema Inc. Facility,
 Portland, Oregon



Source: Esri - World Topographic Map; NAD 1983 StatePlane Oregon North FIPS 3601 Feet Intl



Legend

- ◆ Monitoring Well
- ⊕ Piezometer
- ⊠ Recovery Well
- ⊠ Extraction Well
- Barrier Wall Alignment
- - - Parcel and Property Boundaries
- ▭ Extraction Trench
- ISS Extent
- DNAPL Plume
- Petroleum-based NAPL Plume

Note:
 All features within the ISS mixing extent are to be abandoned, except for EW-4, EW-5, EW-6, and MWA-85.

ISS Footprint and design is preliminary; final design will be included in the upcoming ISS Final Design Report.

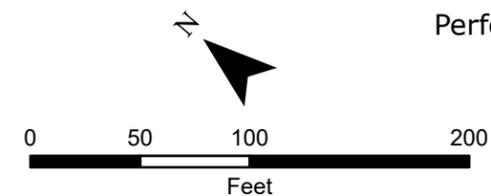


Figure 2
 IRAM 1 Treatment Area
 Performance Monitoring Plan, IRAM 1
 Former Arkema Inc. Facility,
 Portland, Oregon





Legend

- Proposed PMP Well
- Shallow Zone Monitoring Well
- Shallow Zone Piezometer
- Shallow Zone Recovery Well
- Intermediate Zone Monitoring Well
- Intermediate Zone Piezometer
- Deep Zone Monitoring Well
- Deep Zone Piezometer
- Monitoring Well not on PMWP
- Piezometer not on PMWP
- Extraction Well not on PMWP
- Recovery Well not on PMWP
- Barrier Wall Alignment
- Parcel and Property Boundaries
- ISS Extent
- DNAPL Plume
- Petroleum-based NAPL Plume

Note:
All features within the ISS mixing extent are to be abandoned, except for EW-4, EW-5, EW-6, and MWA-85.

ISS Footprint and design is preliminary; final design will be included in the upcoming ISS Final Design Report.

Proposed IRAM 1 Performance Monitoring Locations
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon

Figure 3





Legend

- Proposed PMP Well
- ◆ Shallow Zone Monitoring Well
- Shallow Zone Piezometer
- ⊕ Shallow Zone Recovery Well
- ◆ Intermediate Zone Monitoring Well
- Intermediate Zone Piezometer
- Deep Zone Piezometer
- ◆ Monitoring Well not on PMWP
- Piezometer not on PMWP
- ⊕ Extraction Well not on PMWP
- ⊕ Recovery Well not on PMWP
- Cross Section Transect
- Barrier Wall Alignment
- Parcel and Property Boundaries
- ISS Extent
- DNAPL Plume
- Petroleum-based NAPL Plume

Note:
All features within the ISS mixing extent are to be abandoned, except for EW-4, EW-5, EW-6, and MWA-85.

ISS Footprint and design is preliminary; final design will be included in the upcoming ISS Final Design Report.

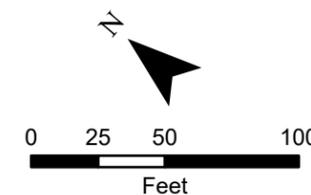
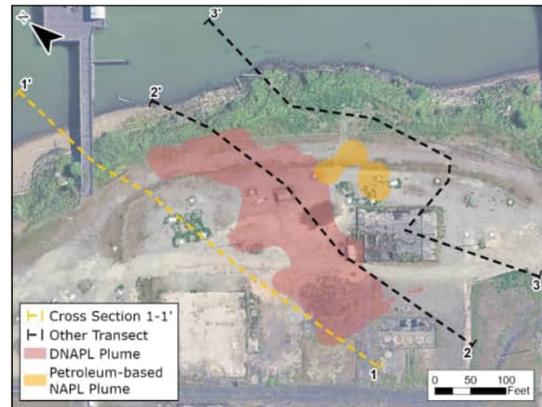
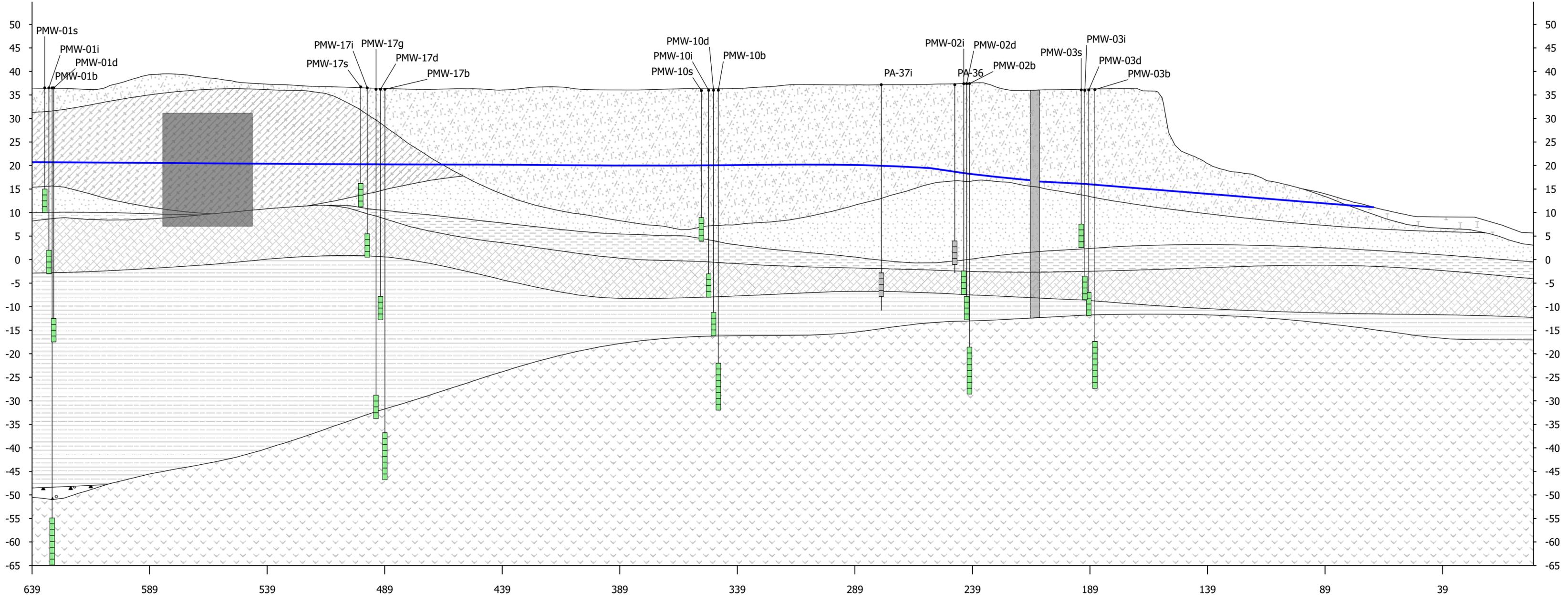


Figure 4

IRAM 1 Performance Monitoring Transect Locations
IRAM 1 Performance Monitoring Well Network Installation Work Plan
Former Arkema Inc. Facility
Portland, Oregon





Legend

<p>Lithology</p> <ul style="list-style-type: none"> Fill Sandy Silt Fine to Medium Sand with Silt and Clay Interbedded Silt and Sand Fine Sand with Clay Silt with Clay Basalt Gravel River Sediment 	<p>Site Features</p> <ul style="list-style-type: none"> Groundwater Barrier Wall 	<p>Proposed IRAM 1 Performance Monitoring Wells</p> <ul style="list-style-type: none"> Proposed Screen Location 	<p>Existing Well Screen Location</p> <ul style="list-style-type: none"> Existing Well Screen 	<p>Surfaces</p> <ul style="list-style-type: none"> Potentiometric Surface (June 2022) 	<p>ISS</p> <ul style="list-style-type: none"> Target Mixing Zone
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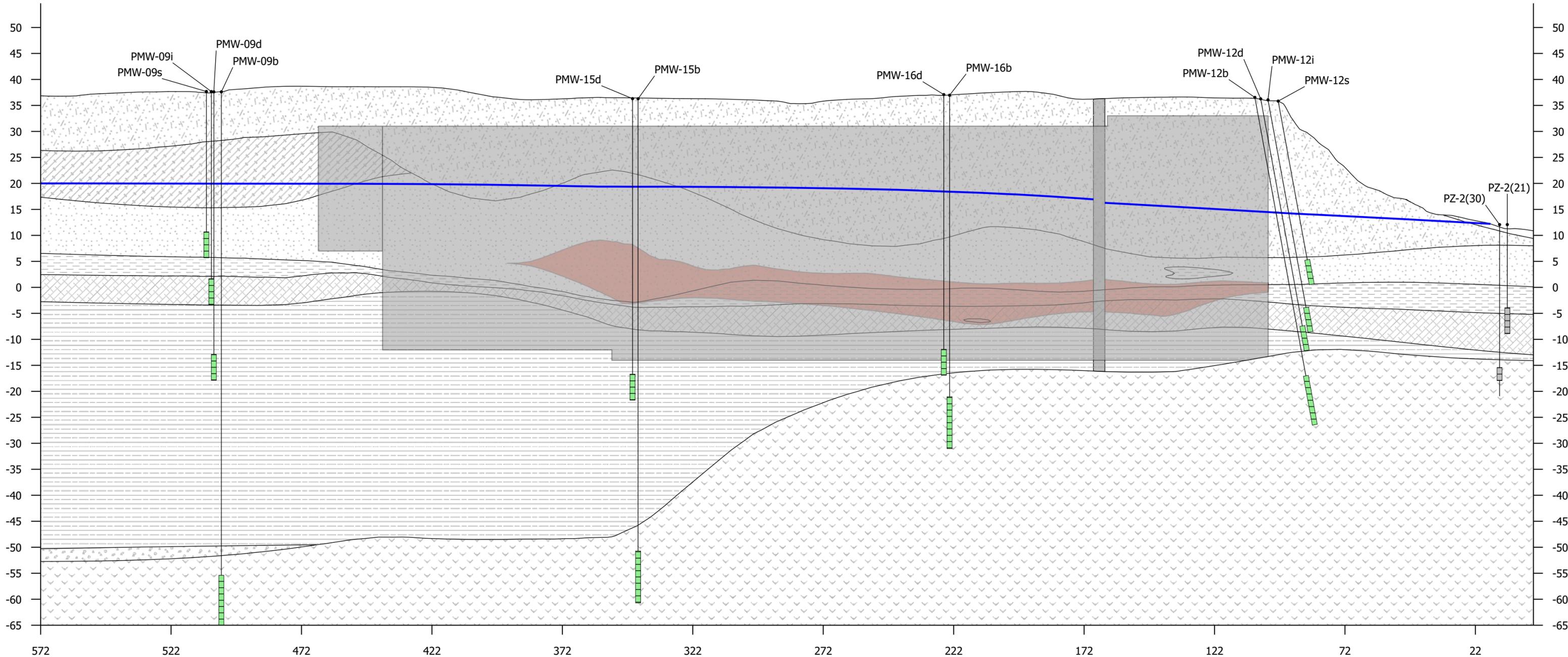
Vertical exaggeration: 2x

0ft 100ft

Notes:
 Shallow Zone potentiometric surface is representative of high groundwater elevation period during June 2022.
 Cross section geology generated from 3D geologic model.
 ISS footprint and design is preliminary; final design will be included in the upcoming Final Design Report.

Figure 5
 Cross Section 1-1'
 IRAM 1 Performance Monitoring
 Well Network Installation Work Plan
 Former Arkema, Inc. Facility
 Portland, Oregon

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Legend

DNAPL Plume DNAPL	Site Features Groundwater Barrier Wall	Proposed IRAM 1 Performance Monitoring Wells Proposed Screen Location	Existing Well Screen Location Existing Well Screen	Surfaces Potentiometric Surface (June 2022)	ISS Target Mixing Zone
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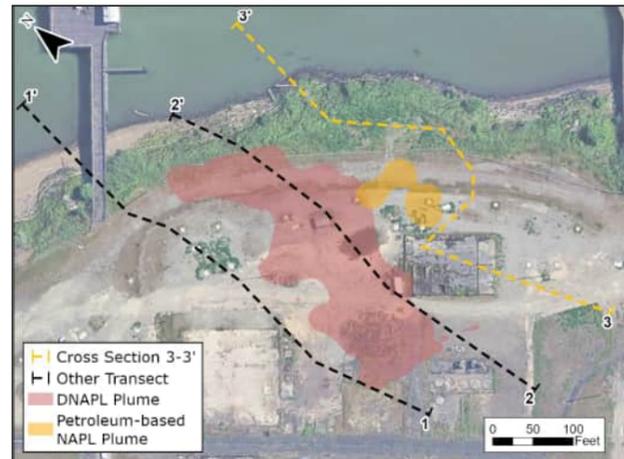
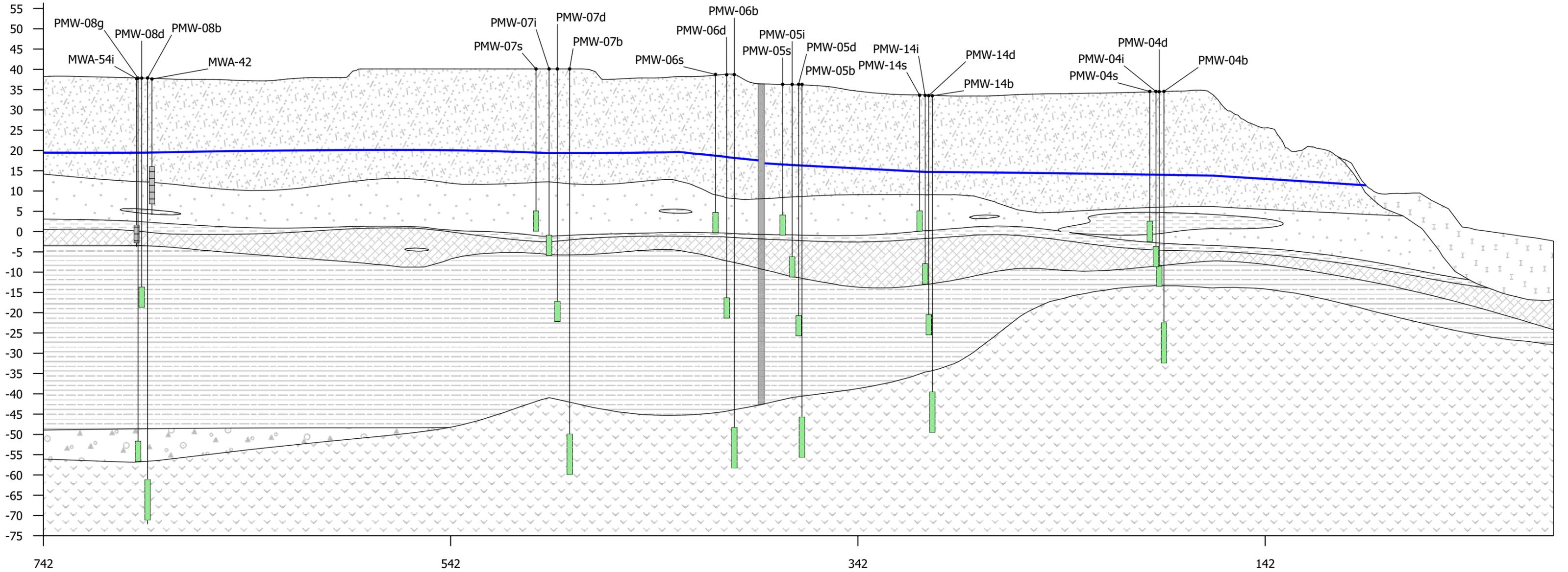
Notes:
 DNAPL = Soil with one or a combination of the following: visible DNAPL, staining, positive oil soluble dye test result.
 DNAPL Plume = The inferred extent of DNAPL based on the observations of DNAPL (visible DNAPL or positive Oil n Soil) made in soil borings.
 Shallow Zone potentiometric surface is representative of high groundwater elevation period during June 2022.
 Cross section geology generated from 3D geologic model.
 Additional cross sections displaying the extent of DNAPL are included in the 2025 In-Situ Stabilization Pre-Final Design Report.
 ISS footprint and design is preliminary; final design will be included in the upcoming Final Design Report.

Vertical exaggeration: 2x

0ft 100ft

Figure 6
 Cross Section 2-2'
 IRAM 1 Performance Monitoring Well
 Network Installation Work Plan
 Former Arkema, Inc. Facility
 Portland, Oregon

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Legend

<p>Lithology</p> <ul style="list-style-type: none"> Fill Fine to Medium Sand with Silt and Clay Interbedded Silt and Sand Fine Sand with Clay Silt with Clay Basalt Gravel River Sediment 	<p>Site Features</p> <ul style="list-style-type: none"> Groundwater Barrier Wall 	<p>Proposed IRAM 1 Performance Monitoring Wells</p> <ul style="list-style-type: none"> Proposed Screen Location 	<p>Existing Well Screen Location</p> <ul style="list-style-type: none"> Existing Well Screen 	<p>Surfaces</p> <ul style="list-style-type: none"> Potentiometric Surface (June 2022)
--	---	--	---	--

Vertical exaggeration: 2x

0ft 100ft

Notes:
 Shallow Zone potentiometric surface is representative of high groundwater elevation period during June 2022.
 Cross section geology generated from 3D geologic model.
 ISS footprint and design is preliminary; final design will be included in the upcoming Final Design Report.

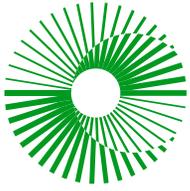
Figure 7

Cross Section 3-3'
 IRAM 1 Performance Monitoring Well
 Network Installation Work Plan
 Former Arkema, Inc. Facility
 Portland, Oregon



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