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MEETING NOTES
Data Quality Objectives for the Waste Management Area A-AX

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MEETING NUMBER: WMA-A-AX-DQO-2017-8
MEETING DATE: July 24, 2017
LOCATION: 3100 Port of Benton Blvd, Room 3A/3B

ATTENDEES:

Jim Alzheimer (Ecology)	Jim Field (WRPS)	Alan Olander (WRPS)
Mike Barnes (Ecology)	Paul Gassman (WRPS)	MD Rahman (INTERA)
Marcel Bergeron (WRPS)	Melissa Holm (WRPS)	Beth Rochette (Ecology)
Jan Bovier (DOE-ORP)	Scott Luke (WRPS)	Kim Schuyler (Freestone)
Ryan Childress (Terra Graphics)	Jeff Lyon (Ecology)	Harold Sydnor (WRPS)
Kathi Dunbar (WRPS)	Jeremy Lynn (CHPRC)	Cindy Tabor (WRPS)

BACKGROUND INFORMATION: These meetings are to promote discussions among Washington State Department of Ecology (Ecology), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy Office of River Protection (DOE-ORP), and Washington River Protection Solutions (WRPS) to develop data quality objectives (DQO) for Waste Management Area (WMA) A-AX vadose zone soil. Representatives from the DOE Richland Operations Office (DOE-RL) and the Central Plateau contractor (CH2MHILL Plateau Remediation Contractor [CHPRC]), were invited to participate to promote integration. A DQO process for the same purpose was started in 2011 but was suspended prior to completion in May 2011. Agreements and progress made as part of the 2011 effort will be leveraged in support of the current DQO process.

Lists of agreements and actions (including the status of any actions) are documented in the meeting notes.

PURPOSE OF MEETING: This meeting was called to continue the WMA A-AX vadose zone characterization DQO process initiated in January 2017.

STEP 7: Mr. Childress provided a handout entitled, "Step 7- Develop Plan for Obtaining Data" to support the discussion. A poster-size version of Figure 1 (included in Handout #1) was displayed on the wall. Ms. Tabor noted that only Step 7 information would be discussed during this meeting and that any unresolved comments or concerns on any of the DQO steps would be addressed during the final planned meeting to be held on August 7, 2017.

Specific sampling Information discussed in the meeting included drilling method (direct push) and sampling strategy, characterization borehole locations, and approximate push depths for vertical and angled boreholes. It was identified that two direct push borings would be drilled at each location; one for geophysical logging, a second for soil sampling. Geophysical logging results would be used to help determine the depth from which soil samples will be collected. It was identified that Ecology would be involved in sample depth selection process.

Ms. Tabor identified that during the May 2017 meeting, four direct push locations were discussed; however, since that meeting additional discussions (both internally and with Ecology) indicated that a fifth location would be beneficial to characterize the focus area around Tanks A-104 and A-105. She also

WMA A-AX, S-2-4

noted that the boundary for the focus area would need to be modified for inclusion on Direct Push Location #1 (refer to Figure 1 in Handout #1).

Ms. Tabor briefly referenced Table 5 (refer to Handout #1) which identifies appropriate field and analytical methods for vadose zone soil characterization (approved in a previous DQO meeting). Ms. Tabor also noted that the project is limited to sampling using direct-push drilling technology due to information included in Table 6 entitled, "Practical Constraints on Data Collection" (table agreed upon in WMA-A-AX-DQO-2017-6).

Mr. Childress launched the Leapfrog® viewer to display the vertical and horizontal locations of the proposed the five proposed direct push locations. He visually displayed A Farm infrastructure, ground penetrating radar (GPR), and leak assessment information during the discussion. He also presented proposed push location information in relation to tank depths, pipelines, retrieval information, and laterals.

A three-dimensional view of Location #1 showed that this push would start northwest of A-104 and be pushed in a southeastern direction below the tank. This location would be used to investigate the contaminant pathway and to confirm both leak-loss assessment information and previous drywell logging results.

Mr. Barnes identified that while field work was being conducted for WMA C, drill strings were snapped deep below ground surface. He asked if there was a contingency plan in place to address recovery of any tooling lost down the borehole if this also happens at WMA A-AX. Mr. Sydnor responded that field issues like this would need to be reviewed on a case by case basis and that Ecology would be contacted if an event like this occurred. Mr. Barnes asked for the DQO to identify that Ecology would be contacted if an issue occurred in the field that would necessitate abandonment of a borehole.

It was then identified that Location #2 would be the only vertical push and that it would be one of the deepest pushes (285 feet below ground surface, refer to page 4, Handout #1). This location would be immediately west of direct push location C9383, which was part of the 2014/2015 field campaign. It was identified that only logging was performed in 2014/2015 and that no sampling was performed at this location. Jim Alzheimer thought this location was too far away from the tanks and wanted to know if it could be moved closer to Tank A-105 and its laterals. Ms. Tabor indicated that Location #3 already was going directly under the laterals and that GPR information indicated that it would be difficult to move closer. Mr. Sydnor indicated that there were also constraints with how close direct push could be performed next to a tank (i.e., 5 feet). Ms. Holm identified that installing a direct push hole in the area suggested by Mr. Alzheimer was evaluated during the 2014/2015 campaign, and it was not possible to push there due to field constraints (e.g., cross list issues – maps identifying underground interferences through utilization of engineering information).

Mr. Childress identified that Locations #3, #4, and #5 would be pushed to investigate Tank A-105. These locations would be used to investigate the contaminant pathway and to confirm both leak-loss assessment information and previous drywell logging results. During the May 2017 DQO meeting, two rather than three locations were proposed around Tank A-105. An additional push was added to better characterize the area (Location #4) and one of the angles of another location (Location #5) was adjusted to allow for more characterization closer to the area under the laterals. It is anticipated that all three of

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these locations will provide information to support retrieval (risk-informed retrieval process), performance assessment, and characterization efforts. It was also identified that Location #4 would be pushed closest to Tank A-105 (~7.5 feet below ground surface).

It was also identified that none of these locations would be pushed to groundwater and that they would end in the vadose zone.

Ms. Rochette inquired how the drilling locations and depths were decided. Mr. Childress stated the goals of the investigation were to push below the tanks and laterals and also to drill as deep as possible (e.g., investigate targeted areas). Mr. Sydnor added that Locations #3 and #4 were selected because, at those locations, it was possible to target anticipated contamination while drilling to a deep depth. Target areas were selected, and angles were chosen, to allow access to specific locations and depths given existing physical constraints that limit access.

Ms. Tabor identified that the number of samples to be collected was included in the handout for reference purposes, as it is a part of Step 7. The number of samples was previously agreed upon in WMA-A-AX-DQO-2017-6 (Agreement 10 dated 6/15/2017). She did note that the total proposed drill depths, which had been previously provided with the number of samples information, required updating based on the refinement of the five proposed direct push locations.

Ms. Schuyler then discussed physical properties (refer to Table 8 in Handout #1, page 9). These physical properties will be added to the larger Table 8 file entitled, "Analytical Performance Requirements for Chemical Constituents". All physical properties identified in the table were obtained for WMA C characterization efforts, with the exception of particle size distribution. It was identified that 222-S laboratory personnel indicted that they could perform particle size distribution but have not done so previously. It was also identified that this property would be included in Table 8 but only performed if enough sample volume recovered. At this time, it was been identified that 50-100 grams are needed to perform the test and 100% sample recovery from the field is 594 grams.

Additional physical properties not to be performed for this focus area were identified (refer to Handout #1 pages 9 and 10, bulletized list). These properties along with the six to be added to Table 8 will be included in Table 6, "WMA A-AX Analyte Rationale" (see Handout #3 attached to the 7/13/2017 DQO meeting notes) for consideration at other focus areas.

Mr. Childress next discussed drywell logging and indicated that all drywells within the proposed modified boundary in Figure 2 (refer to Handout #1) would be logged using spectral gamma logging system and additionally neutron moisture, and temperature data would be obtained. The modified boundary would include Direct Push Location #1 and drywells 10-01-11 and 10-01-01. The modified boundary was agreed upon by the group. (Note: The agreement to the modified boundary is identified in Agreement 5 below).

Mr. Childress also discussed three dry wells, which have had observed corrosion issues:

- 10-06-12 - Out of horizontal boundary of focus area and has broken casing in the ground at approximately 54 feet below ground surface. Will not be considered for logging under this focus area study.
- 10-05-02 - Broken casing in the ground at approximately 60 feet below ground surface.
- 10-05-10 - Broken casing in the ground at approximately 60-70 feet below ground surface. The casing has been pulled.

Mr. Lyon asked if there was a lithology change at this depth and could it have something to do with the corrosion. Ms. Tabor identified that the direct push Location #2 was in this area and could be used to investigate this depth. Mr. Childress indicated that backfill ends approximately 50 feet below the ground surface. He also identified that down-hole camera would be utilized during the drywell logging campaign to assess conditions as necessary and possible.

Mr. Lynn also identified that a well in the southern area of the farm (299-E25-236) had corrosion issues.

Ms. Tabor indicated that logging of the laterals would not be performed for this focus area and identified that Mr. Olander was investigating if this work could be performed in the future. Mr. Alzheimer indicated that this logging effort would probably not be needed now but would likely be conducted later to support retrieval. Mr. Lyon asked Mr. Olander about the farm leak detection monitoring (LDM) and if high resolution resistivity (HRR) was going to be deployed. Mr. Olander said that he would really like to use the laterals/infrastructure available if possible but has not thought of a way to do so yet. He also identified that the laterals could not be used for HRR electrodes because it cannot be proved that they are electrically isolated from each other.

The next discussion point was surface geophysical exploration (SGE). It was identified that the only thing that would be done for the focus area with respect to SGE would be to install electrodes in the direct push logging holes as they are being decommissioned. It is possible that there may be a use for these electrodes at a later date. It was also identified that the electrodes are relatively inexpensive. Mr. Sydnor mentioned the angle pushes would have fewer electrodes than vertical pushes.

Neither SGE field work nor reprocessing of data was recommended for the focus area. It was identified that reprocessing of data may be beneficial in the future but only if there were improvements to software (e.g., removal of infrastructure issues). It was also identified that performing well to well SGE might be beneficial at a later date (e.g., additional direct push deep electrodes will be available).

AGREEMENTS AND ACTIONS: A summary of agreements and actions are provided in the tables below for reference purposes, as they were not fully discussed in the meeting. Note that Ms. Tabor asked Mr. Lyon if there was any progress on Action 2017-06-15-06 (inclusion of volatile organics and semivolatile organics). Ms. Rochette indicated that a meeting was scheduled later that week to discuss. During this meeting, several agreements were identified (Agreements 15 and 16 and modified boundary [Agreement 5]), but no new actions were identified.

NEXT MEETING: The next meeting has been scheduled for August 7, 2017, to discuss any remaining open items related to Steps 1 through 7.

JAN B BOVIER	Jan B Bovier	8/17/2017
DOE Project Manager (print)	DOE Project Manager (signature)	Date
Jeffery J. Lyon		8/23/2017
Ecology Project Manager (print)	Ecology Project Manager (signature)	Date

DATE	AGREEMENTS (2 pages)
01/26/2017	1. DOE-ORP acknowledged the need for a Phase 2 RFI at WMA A-AX.
01/26/2017	2. Available tank waste and concrete condition information will be considered for inclusion in the RFI/CMS report(s).
01/26/2017	3. **Problem Statement**: "Vadose zone contamination in and adjacent to the A-AX Tank Farms may pose a current and future risk to human health and the environment, including groundwater, that requires corrective action to support closure."
03/30/17; 07/13/17	4. The DQO will move forward with a modified scope. The DQO Revision 0 will evaluate the Tank 241-A-104/105 focus area. It is agreed that there is a priority to collect additional information from the release areas associated with Tanks 241-A-104 and -105 in order to assess the movement of contamination in the environment. Information from the resulting investigation will inform the development of the model being developed for the 241-A/AX performance assessment.
05/25/17 07/24/17	5. **Boundaries**: The parties agreed to revise Tank A-104/105 focus area horizontal boundary as shown on the first page of Handout #1 attached to the 05/25/2017 DQO meeting notes, a vertical boundary extending from ground surface to the groundwater, and a temporal boundary driven by planned retrieval operations. **Note**: The parties agreed to further revise the Tank A-104/105 focus area horizontal boundary as shown in Figure 2 of Handout #1 attached to the 07/24/17 meeting notes.
05/25/17	6. The parties agreed to the **scope, objectives, and DQO approach**: as described in Handout #2 attached to the 05/25/2017 DQO meeting notes.
05/25/17	7. The parties agreed to the **Goal of the study** as described in Handout #2 attached to the 05/25/2017 DQO meeting notes.
06/15/17	8. The parties agreed to use the **list of constituents** contained in Handout #1 attached to the 06/15/2017 meeting notes, except that further discussion is required regarding volatile organics, semi-volatile organics, and hexavalent chromium.
06/15/17	9. The parties agreed to the information in Handout # 2 attached to the 06/15/2017 meeting notes, describing the **basis for identification and setting of acceptable levels for decision and estimation statements**.
06/15/17	10. The parties agreed to the information in Handout # 3 attached to the 06/15/2017 meeting notes, describing the **number of samples** that will be taken. Clarification will be provided regarding duplicate sampling at 25% of surface sample locations.
06/15/17	11. The parties agreed to the Step 4 information on pages 10-12 of Handout # 5 attached to the 06/15/2017 meeting notes, describing the **sampling unit, constraints to sampling/data collection**, and **smallest decision unit**. The second bullet under **Study Boundaries** will be corrected to reflect that samples taken at depths <15 ft bgs also support the ecological assessment.
07/13/17	12. The parties agreed on the contents of **Step 2** as modified in the 07/13/17 meeting (Handout #2).
07/13/17	13. The parties accepted Table 5 (**Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization**) as shown in Handout #2 attached to the 07/13/2017 DQO meeting notes.

07/13/17	14. The parties agreed on the contents of **Step** 4 as shown in Handout #2 attached to the 07/13/2017 DQO meeting notes.
7/24/2017	15. **Sampling Strategy, General Collection, and Design**: The parties agreed to the field methodologies (sampling and logging), direct push locations for logging and sampling (except for Location #2), drywell logging locations, and SGE electrode installation as described in the 7/24/2017 DQO meeting notes.
7/24/2017	16. **Step 3**: As described in the 7/24/2017 DQO meeting notes, the parties agreed on physical properties to be added to Table 6 (see Handout #3 attached to the 7/13/2017 DQO meeting notes) and Table 8 (see Handout #1 attached to the 07/13/2017 DQO meeting notes).

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-03-30-03	Lyon/Bovier	Ecology and DOE-ORP will identify whether there are other potential 241-A/AX focus areas of interest and their level of interest in other focus areas relative to the Tanks A-104/105 focus area.	Open. Ecology identified the areas near Tanks A-103, AX-102, and AX-104 as being of interest.
2017-04-13-02	Bovier/Lyon	Discuss how DQO Step 4, define the boundaries of the study, will be addressed for the whole of WMA A-AX.	Open.
2017-05-25-01	Tabor	Evaluate borehole placement/configuration after getting updated GPR results.	Open. On hold until conduct GPR study.
2017-05-25-02	Levitt	Evaluate whether microgravity is applicable next to tanks and at what distance it might be applicable.	In progress.
2017-06-15-06	Lyon	Ecology review basis for retaining or eliminating **volatile organics** and **semi-volatile organics** in preparation for further discussion with DOE and WRPS.	Open. Ecology will discuss organics at an internal meeting scheduled for 7/25/2017.
2017-07-13-01	Rahman	Investigate whether there is an unrestricted level for lead that should be included in Table 8.	In progress. Internal meeting with Intera scheduled for 7/27/2017
2017-07-13-02	Rochette and Barnes	Review Tables 8, 9, and 10 and provide feedback regarding "acceptable levels" by 07/24/17.	In progress. Comments on direct contact values in Table 8 were received from Rochette on 7/20/2017. Additional comments will be received by 7/27/2017.

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-07-13-03	Gassman	Work with lab to identify an achievable detection limit for hexavalent chromium.	In progress. The detection limit is 0.045 µg/g
2017-07-13-04	Bergeron	Review proposal to delete Decision Rule 1 (Table 11/Step 5) language regarding use of maximum concentration or use of 95% UCL.	In progress. Internal meeting with INTERA scheduled for 7/27/2017.
2017-07-13-05	Tabor	Provide figures from EA-1 identifying where data is being gathered near WMA A-AX.	In progress.
2017-07-13-06	Robertson	Add bullet on page 1 of Handout #2 (scope) to clarify that groundwater characterization is outside the scope of this DQO process	In progress.
2017-07-13-07	Robertson	Change last sentence on page 3 of 11 of Handout #2 to state "Data supporting the DQO effort (collected prior to and collected using this DQO process) will be used to develop and refine the conceptual site model."	In progress.
2017-07-13-08	Robertson	Update last sentence on page 7 of 11 of Handout #2 to delete hexavalent chromium.	In progress.

Handout #1
Step 7

STEP 7- Develop Plan for Obtaining Data

FOR REFERENCE ONLY - Table 5 (Agreed upon in **WMA-A-AX-DQO-2017-7**) identifies a range of field and analytical methods (e.g., ground penetrating radar, geophysical logging, and direct push) that could be used for vadose zone soil characterization.

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization

Potentially Appropriate Field Method/Analytical Method	Parameter	Possible Limitations
Ground Penetrating Radar (GPR): Radar-reflection surface geophysical survey technique that detects contrasts in di-electric constants in the below-grade environments from the surface.	Underground structures or interferences	Requires subjective interpretation of the reflected signals. Lack of reflective below-grade surfaces or the presence of interfering matrices can complicate or invalidate the findings. The presence of nearby buildings and utilities can interfere with reflected signals. Fines (e.g., clay and heavy fly ash) can act as a reflector to the radar signal.
Electromagnetic Induction (EMI): Surface geophysical survey technique that measures electrical conductivity in below-grade soils based on detected changes in electrical fields. Generally used to support the interpretation of GPR surveys.		The presence of nearby buildings and utilities can interfere with reflected signals.
Surface Geophysical Exploration: Electrical Resistivity Imaging can be acquired to develop shallow and deep, 2-dimensional and 3-dimensional images.	Resistivity (conductivity)	Results are impacted by interference from infrastructure such as pipelines, tanks, buildings, and other large features.
Large Diameter Hole (LDH) Conventional Drilling (e.g., cable tool):	Geophysical Logging and Laboratory Analysis	Most drilling methods have difficulty in cobbles and boulders. Waste/tailings are brought to the surface and need to be properly contained and disposed, increasing cost and risk of exposure to workers. Not viable for new exploration in the tank farms due to waste generation and logistics (e.g., dome loading and access).
LDH Geophysical Logging	Gross and isotopic gamma emissions	Larger size instrument has lower detection limits (more sensitive) but does not fit into a small diameter hole (SDH) (<3-inch); therefore, is not a compatible technology for use with direct push methods. The count rate can effect accuracy and precision of measurements.
	Gamma emissions from fission products, Am-241, Pu-239, and Np-237	This method does not assess radionuclides or daughter products that do not emit gamma rays. The gamma energies from these isotopes are at the

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Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization		
Potentially Appropriate Field Method/Analytical Method	**Parameter**	**Possible Limitations**
	It is considered by some to be more accurate than sampling and laboratory assay because the assay is performed in situ with less disturbance of the sample, there is higher vertical spatial resolution, and the sample size is much larger. This method may also be more economical than traditional sampling and analysis.	low end of the spectrum, which results in high numerical minimum detectable activities and possible matrix effects from other isotopes. This technique requires the use of a single casing (installed by drilling or driving) in contact with the soil formation. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
	Neutron emissions from plutonium	Because of the very low incidence of spontaneous plutonium fission and alpha-N reactions, the passive neutron profile is orders of magnitude lower than the gamma emission. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
	Active neutron emissions from transuranics	Although neutron activation methods have been developed, they are not expected to be useful for this initial characterization effort. At present, these techniques are too expensive and time consuming, and logistical problems are associated with the handling of intense sources or generators. The detector is too large to fit in a SDH (<3-inch); therefore, is not a compatible technology for use with direct push methods.
LDH Geophysical Logging (continued)	Beta emissions	Not a fully developed technology.
	Neutron moisture	Moisture zones can be very thin and can be missed based on data collection intervals (distance and time).
	Temperature	Difficult differentiating/determining source and extent of high temperatures (e.g., soil versus infrastructure).
Laboratory Analysis for LDH	Chemical and radiological constituents and physical properties	Highly contaminated samples may require use of on-site laboratories, with associated impacts (e.g., high cost, reduced analyte lists, matrix effects, degraded detection limits, and long turnaround times). Lower contamination levels may allow use of offsite laboratories, avoiding these limitations.
Small Diameter Hole (SDH) Direct Push	Geophysical Logging and Laboratory Analysis	Direct-push methods may be ineffective in cobbly or rocky soils.

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Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization

Potentially Appropriate Field Method/Analytical Method	Parameter	Possible Limitations
SDH Geophysical Logging	Gross and isotopic gamma emissions	The smaller diameter detectors are not as sensitive as those used in LDH (Detection limits are not as low from instruments used in LDH.)
	Beta emissions	Not a fully developed technology.
	Neutron moisture	Moisture zones can be very thin and can be missed based on data collection intervals (distance and time).
	Temperature	Difficult differentiating/determining source and extent of high temperatures (e.g., soil versus infrastructure).
Laboratory Analysis for SDH	Chemical and radiological constituents and physical properties	Small sample size leads to difficulty to with large analysis list and low detection limits.
Note: Reinterpreting available data (e.g., surface geophysical exploration data) and/or determine if analysis on existing cores could be performed.		

3

SOIL SAMPLING

A.) Sampling Strategy and General Collection Techniques

- Direct Push – Dual String sample collection
- Two direct push borings per location, one for geophysical logging and second for soil sampling
- Sample depth meetings after geophysical logging

Note: Gyroscope will be used on angle pushes to confirm borehole path

B.) Sampling Design

A random sampling strategy cannot be applied in WMA A-AX because of the extensive amount of interferences caused by buried infrastructure and topographic constraints. Therefore, a non-probabilistic (or judgmental) sampling strategy that targets locations based on existing knowledge will be used. This approach provides the highest potential for confirming and characterizing known and suspected releases in and around WMA-AX and will help refine the WMA-AX conceptual site models.

Sample Locations (Refer to Figure 1 for Direct Push Locations)

Direct Push Location Strategy for Tanks 241-A-104 and 241-A-105

Location #	Approximate Location	Input Factors Associated with Location / Reason for Sampling	Target Depth (bgs) Angle Pipe Run *Minimum distance from Tank*
1	Northwest of Tank 241-A-104 (Angle push going southwest and directly under the tank)	• Tank A-104 designated as a leaker (~2,000 gallons) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-1) • Higher temperature and gross gamma readings in laterals (14-04-01 and 14-04-02, RPP-ENV-37956, Rev. 2 [Figures B2-11 through B2-13]) • Higher temperature and gross gamma readings in drywells (10-04-04 and 10-04-05) • Higher SGE conductivity area (RPP-ENV-37956, Rev. 2, Figure 3-9) **Assess Tank A-104 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**	174 ft 45 246 ft *15.75 ft*
2	North and between Tanks 241-A-104 and 241-A-105 (Vertical push)	• Tanks A-104 and A-105 designated as a leaker (~2,000 gallons and ~2,000 to 40,000 gallons, respectively) • Direct push log at Location C9383, temperature of ~120 ºF, ~50 ft bgs • Possible location for deep push ~285 ft bgs **Assess Tanks A-104 and A-105 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**	285 ft None 285 ft *54 ft*

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Direct Push Location Strategy for Tanks 241-A-104 and 241-A-105

Location #	Approximate Location	Input Factors Associated with Location **Reason for Sampling**	Target Depth (bgs) **Angle** Pipe Run *Minimum distance from Tank*
3	North of Tank 241-A-105 (Angle push towards southwest-side of tank	• Tanks A-104 and A-105 designated as a leaker (~2,000 gallons and ~2,000 to 40,000 gallons, respectively) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-2) • Higher temperature and gross gamma readings in laterals (14-05-01,14-05-02, and 14-05-03, RPP-ENV-37956, Rev. 2 [Figures B3-18 through B3-19]) • Higher temperature readings in drywells (10-05-09, 10-04-04 and 10-04-05) • Abandoned drywell 10-05-11 indicated casing corrosion (~ 64 ft bgs) • Higher SGE conductivity area ((RPP-ENV-37956, Rev. 2, Figure 3-9) **Assess Tanks A-105 and A-104 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**	241 ft **30** 279 ft *23 ft*
4	Northeast side of Tank 241-A-104 (Angle push going south and under the east-side of tank)	• Tank A-105 designated as a leaker (~2,000 to 40,000 gallons) • Possible leak location area (RPP-ENV-37956, Rev. 2, Figure 4-2) • Higher temperature and gross gamma readings in laterals (14-05-01,14-05-02, and 14-05-03, RPP-ENV-37956, Rev. 2 [Figures B3-18 through B3-19]) • Higher temperature readings in drywell (10-05-05) • Abandoned drywell 10-05-02 indicated casing corrosion (~ 64 ft bgs) **Assess Tank A-105 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**	127 ft **50** 197 ft *7.5 ft*
5	North of Tank 241-A-105 (Angle push going under the north side of tank	• Tank A-105 designated as a leaker (~2,000 to 40,000 gallons) • Higher temperature and gross gamma readings in laterals (14-05-01,14-05-02, and 14-05-03, RPP-ENV-37956, Rev. 2 [Figures B3-18 through B3-19]) • Corrosion observed at drywells 10-05-02 and 10-05-10 **Assess Tank A-105 - magnitude and pathway of contamination for modeling, risk, and nature and extent.**	285 ft **15** 295.29 ft *29 ft*

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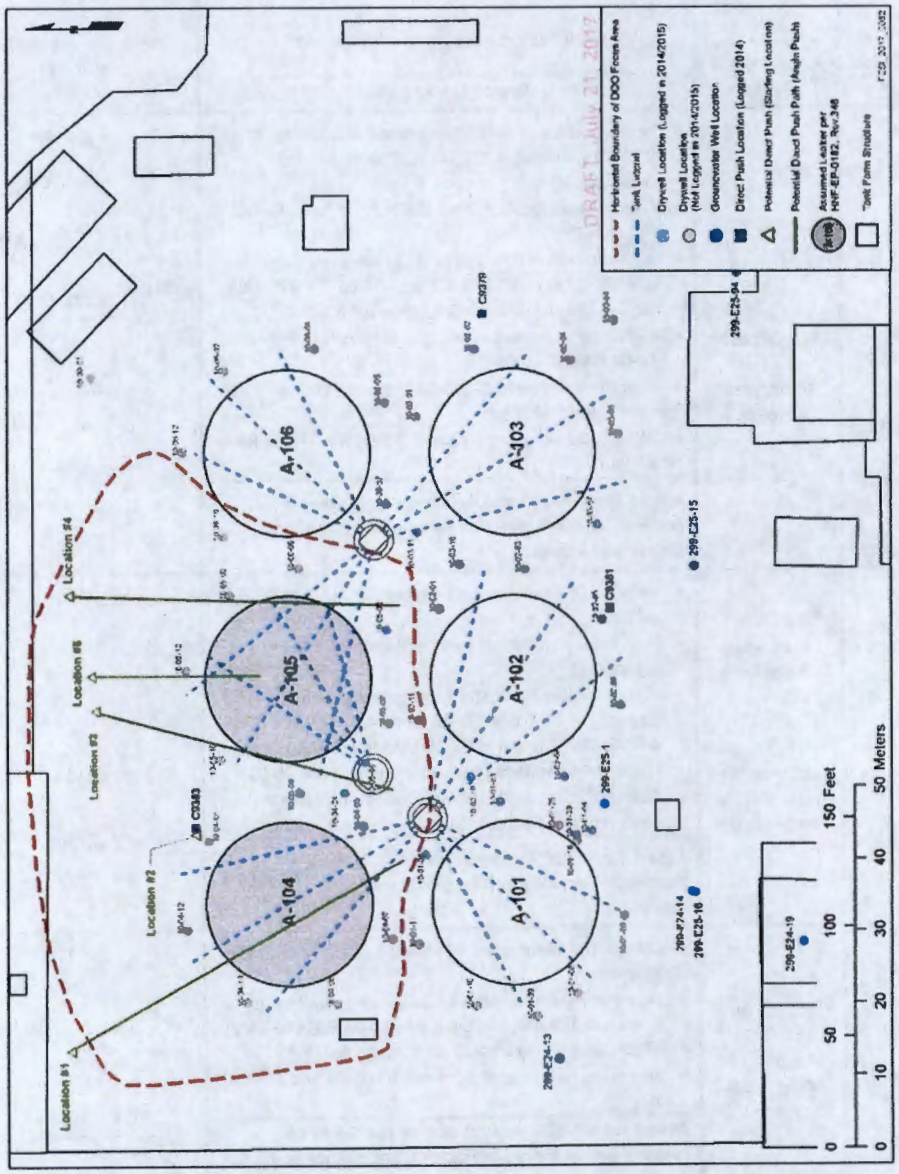

Figure 1: Direct Locations (Boundary Agreed upon in WMA-A-AX-DQO-2017-7)

Number of Samples

FOR REFERENCE ONLY - Recommended Number of Samples (Agreed upon in WMA-A-AX-DQO-2017-6)

- Each sampling location consists of one surface sample, two additional shallow (0 to 15 ft bgs) samples, and at least seven deep (>15 ft bgs) samples.
- A duplicate sample will be collected at 25% of the surface sample locations (i.e., a duplicate surface sample will be collected at one in four surface locations).
- Shallow samples taken from below the surface will be taken at ~7 to 9 ft bgs and ~12 to 14 ft bgs. The purpose of collecting samples in the first 15 ft is to provide data for the direct exposure pathway and to provide initial data for ecological risk.
- Deep samples will be taken down to a depth of ~240 to 285 ft bgs or refusal. The depths for sampling individual horizons will be selected by reviewing the gamma, temperature, and moisture logs of the first direct push and the following information: any leak loss inventory information pertinent to the site, geologic summary of the area, operational history, and historical characterization data at that site.

Summary per Sampling Borehole:

- 3 Shallow Sample Depths (0-15 ft bgs)
- 7 Deep Sample Depths (>15 ft bgs to Total Depth).

Note: Proposed Vertical Total Depths for 5 boreholes are 127, 174, 241, and 285 ft bgs (two locations).

Physical Sample Yield

- Three 6" x 1.08" ID stainless steel liners
- One 4" x 1.08" ID sampler shoe
- 16.5 cubic inches total in liners, and 3.65 cubic inches in shoe
- Results in 20.15 cubic inches (330 cc) of material
- Using the average density of Hanford soils (1.8 g/cc) = 594 g sampled materials at 100% recovery

C.) Timing issues for sample collection, handling, and analysis

FOR REFERENCE ONLY – Table 7 (Agreed upon in WMA-A-AX-DQO-2017-6)

Table 7. Practical Constraints on Data Collection	
Constraint	**Details**
Physical access	Placing driven soil probes, borings, or excavations near tank farm system structures (i.e., SSTs, lines, diversion boxes, catch tanks) will pose additional access challenges because of the following: • Limited access to some locations because of topography. • Surface and subsurface obstructions.
Methods	The methods selected for investigations, such as excavations (e.g., trenching, test pits), driven soil probes, or borings, will influence the following: • An investigative method is selected depending on data needs (sample volume, number of samples, depth, potential radiological content, instrumentation installed, geophysical logging needs, location, groundwater well installed, etc.) not vice versa.
Radiological controls	Radiological issues that could influence the ability to perform the work involve the following: • Handling contaminated samples (high or very high radiation).
Field screening techniques	The ability of field screening to meet quality assurance/QC or detection requirements may be limited as follows: • Gross gamma logging in soils may be limited by background radiation levels from adjacent structures (e.g., pipelines or diversion boxes). Small diameter gross gamma tool has a higher quantification level than the large diameter spectral tools. Therefore, very low levels of cobalt will not be detected by a small diameter logging tool. • Passive neutron logging may be limited because of lower than expected quantities of neutron-emitting isotopes.
Analytical laboratory capabilities	Radiological controls and constraints at the sampling location (primarily high contamination levels) that delay delivery of the samples to the laboratory, causing exceedance of hold time limits. • Radiological controls and constraints at the laboratory (primarily high contamination levels) that delay analysis, causing exceedance of hold time limits. • Highly contaminated samples may require substantial dilution causing inability to analyze other contaminants effectively (e.g., reduced contaminant concentrations below detection limits).

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D.) ANALYTICAL METHODS

Analytical methods were discussed in Meeting 7, with the exception of physical properties. The following information regarding physical properties will be added to **"Table 8. Analytical Performance Requirements for Chemical Constituents"**

Table 8. (continued)

Constituent	Primary Method	Quality Control Acceptance Criteria	
		Accuracy	Precision
		Laboratory Control Sample Recovery (%)	Relative Percent Difference
Physical Properties			
Soil density (PSQ #2, PSQ #3)	Gravimetric	—	≤30
pH (PSQ #2, PSQ #3)	9040C	± 0.1 pH units	—
Percent solids (PSQ #2, PSQ #3)	Gravimetric	80-120	—
Percent water (PSQ #2, PSQ #3)	Gravimetric	80-120	≤30
Specific conductance (PSQ #2, PSQ #3)	9050A	—	—
Particle size distribution[a] (PSQ #2, PSQ #3)	ASTM D 422/ ASTM D 6913	—	—

[a] Proposing to add this physical property analysis based on 222-S laboratory's ability to perform.

Based on the sampling methodology using direct push, which will be employed at this focus area (Tanks A-104 and A-105), the above physical properties will be performed. The sample size associated with direct push is smaller (~600 grams) and will not support additional analysis (other than analytes in Tables 8-10).

Additional physical properties will be considered for other focus areas where large sample volumes can be collected. These additional physical properties (and those listed above) will be added to **"Table 6: WMA A-AX Analyte Rationale"** for consideration at other focus areas:

- Hydraulic properties (PSQ #2)
- Iron content and iron association (PSQ #2)
- Mineral phase identification including clay mineral identification (PSQ #2)
- Porosity (PSQ #2 and PSQ #3)
- Total alkalinity (PSQ #2 and PSQ #3)

- Redox potential (PSQ #2 and PSQ #3)
- Leaching characteristics of tank waste based on batch and column leaching tests (PSQ #3)
- Sequential extraction to estimate the labile fraction (readily leachable fraction) of constituents (PSQ #3)
- Mineral phase identification within the tank waste residuals (PSQ #3)
- Evaluation of mineralogical changes due to waste-sediment interaction and mineral phase identification (PSQ #4)
- Determination of vertical and lateral extent of contamination based on evaluation of pore water chemistry and sediment (by performing sequential extraction such as water extraction, bicarbonate extraction, acetic acid extraction, oxalic acid extraction, and total digestion) (PSQ #4)
- pH variations (PSQ #4)
- Total inorganic carbon (PSQ #2 and PSQ #3).

LOGGING

Direct Push

- Gross Gamma
- Spectral Gamma Logging System
- Neutron Moisture
- Temperature
- Gyroscope

Drywells

- Spectral Gamma Logging System
- Neutron Moisture
- Temperature
- Borehole Camera

Refer to Figure 2 for Drywell Logging Locations

Note: There is observed corrosion in drywells (10-05-10 [casing was pulled], 10-05-02, and 10-06-12)

SGE

Electrode Installment

During decommissioning in Direct Push borings an electrode can be installed at low cost.

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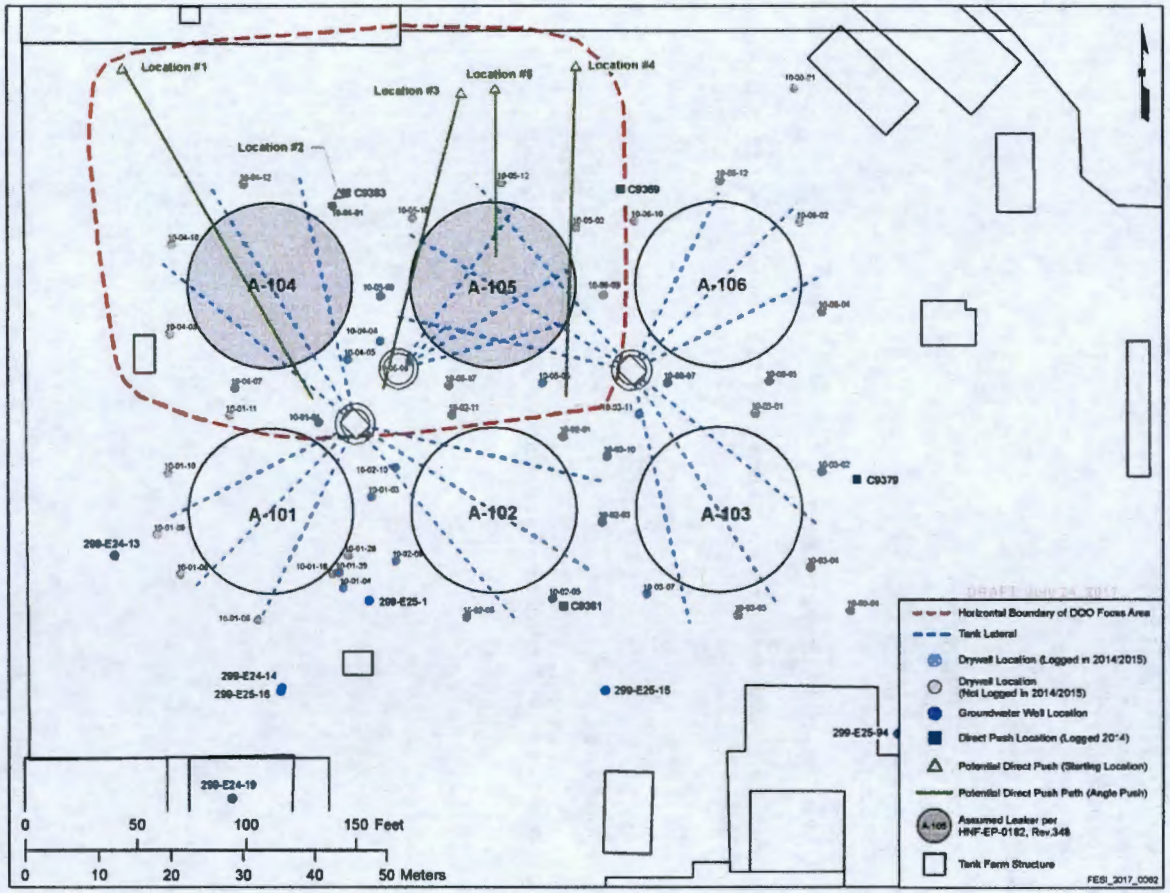

Figure 2: Drywell Logging Locations and Boundary Update