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

MEETING NUMBER: WMA-A-AX-DQO-2017-6
MEETING DATE: June 15, 2017
LOCATION: 3110 Port of Benton Boulevard, Richland, WA
ATTENDEES:

Jim Alzheimer (Ecology)
Mike Barnes (Ecology)
Jan Bovier (DOE-ORP)
Joe Caggiano (Ecology)
Ryan Childress (Terra Graphics)
Kathi Dunbar (WRPS)
Jim Field (WRPS)
Paul Gassman (WRPS)
Bob Hiergesell (WRPS)
Doug Hildebrand (DOE-RL)
Scott Luke (WRPS)
Jeff Lyon (Ecology)
Jeremy Lynn (CHPRC)
Dan Parker (WRPS)
MD Rahman (INTERA)
Beth Rochette (Ecology)
Julie Robertson (Freestone)
Kim Schuyler (Freestone)
Kristin Singleton (WRPS)
Marysia Skorska (Ecology)
Harold Sydnor (WRPS)
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.

STATUS OF PRIOR MEETING NOTES: Ms. Robertson stated that meeting notes for the April 13, 2017, meeting (Meeting #4) had been entered into the Administrative Record and that the meeting notes for the May 25, 2017 meeting (Meeting #5) were being reviewed by WRPS and DOE.

CONSTITUENT LIST: Ms. Tabor provided Handout #1 to support the discussion. Ms. Tabor explained that the proposed WMA A-AX list drew from the following inputs: the 2011 WMA A-AX list, the WMA C list of primary and secondary constituents (**ACTION 2017-06-15-01**), the Best Basis Inventory (BBI), and the lists used in the single-shell tank component closure DQO and the groundwater quality assessment plan for WMA A-AX. Key information that was discussed by the meeting participants included the following information.

- More constituents were evaluated for WMA C soils than were included in the tank closure DQO.
- Lanthanum, silicon, Ra-226, and thorium 232 were initially proposed as "eliminate"; these will be changed to "retain." The change results in the inclusion of all the BBI constituents. See related **ACTION 2017-06-15-02**.

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- All constituents from the groundwater quality assessment plan for WMA A-AX were retained except sulfide. Ms. Tabor noted that sulfide is not part of tank waste, and an interagency agreement to exclude sulfide from tank DQO processes was addressed in DOE letter 11-TBD-020 and Ecology response 11-NWP-053.
- All WMA C primary list metals were retained. Thorium metal (a WMA C secondary list metal) was initially proposed as "eliminate" but based on discussion at the meeting will be retained (**ACTION 2017-06-15-03**). Hexavalent chromium values were proposed to be estimated from total chromium analysis, but agreement was not reached on this proposal, and further discussion will be required regarding hexavalent chromium (**ACTION 2017-06-15-04**).
- All WMA C anions except sulfide were retained.
- All WMA C small organic acids except ferrocyanide were retained (**ACTION 2017-06-15-05**).
- All volatile organics and semi-volatile organics were proposed for elimination. One attendee from Ecology expressed concern about the proposal, so the matter will be reviewed on a later date (**ACTION 2017-06-15-06**).
- All WMA C pesticides were retained.
- Both gasoline-range organics and diesel-range organics were proposed for elimination.
- PCB aroclors were retained, but PCB congeners were proposed for elimination.
- Total organic carbon was not on the list at WMA C but was added for WMA A-AX.
- All radionuclides on the BBI, including Ra-226 and Th-232 (see above), except Th-228 and Th-230, were retained. It was noted that values for Th-228 may be generated with the analysis for Th-232. Mr. Hildebrand suggested that the groundwater monitoring plan addressing the requirements of the *Atomic Energy Act* (DOE/RL-2015-56) be reviewed and referenced in the constituent table (**ACTION 2017-06-15-07**).

In summary, the attendees agreed to the WMA A-AX list of constituents as modified at the meeting, with the exception of volatile organics, semi-volatile organics, and hexavalent chromium (**Agreement 8** dated 06/15/2017). Follow-up discussion will be needed for these constituents.

ACCEPTABLE LEVELS FOR DECISION AND ESTIMATION STATEMENTS: Ms. Schuyler provided Handout #2 to support the discussion. The attendees discussed the information in the handout and agreed to accept the table as presented (**Agreement 9** dated 06/15/2017).

NUMBER OF SAMPLES (SHALLOW VS. DEEP): Ms. Tabor provided Handout #3 to support the discussion. The attendees discussed the information in the handout and agreed to accept the WMA A-AX proposal with clarification added regarding the taking of duplicate samples (**Agreement 10** dated 06/15/2017). The intent is to take a duplicate at one of the four surface (not shallow) sample locations (**ACTION 2017-06-15-08**).

REVIEW OF DQO PROCESS DISCUSSIONS TO DATE: Ms. Robertson provided Handouts #4 and #5, which summarize discussions to date.

- Background Information: Ecology suggested a change on page 1 of Handout #5 that would highlight that the previously agreed to DQO scope and objectives apply to the larger WMA A-AX DQO process, but that the DQO process will be carried out as an iterative process conducted at various smaller WMA A-AX focus areas (the first of which is A-104/105) as deemed appropriate by the Tri-Parties. The existing DQO Process text at the bottom of page 1 of Handout #5 will be moved to the top of the page, before the DQO scope and objectives (**ACTION 2017-06-15-09**).

- Step 1 – Define the Problem: No change.
- Step 2 – Identify the Goals of the Study: No change at this time (see ACTION 2017-05-25-03).
- Step 3 – Data Inputs: The revised version of Table 4, Basis for Identification and Setting of Acceptable Levels for Decision and Estimation Statements (Handout #2) was accepted by the attendees earlier in the meeting, closing Action 2017-05-25-04. Table 5 of Handout #5 is being reviewed by Ecology (Action 2017-05-25-05).
- Step 4 – Define the Boundaries of the Study: Ms. Tabor led a discussion of information added to pages 10-12 of Handout #5 to address the sampling unit, constraints to sampling/data collection, and smallest decision unit. A figure depicting the horizontal boundary of the A-104/105 focus area (as defined in the May 25, 2017, meeting) was included in the handout, as well as Table 6, which identifies practical constraints on data collection. Ecology requested a correction on page 10, second bullet under **Study Boundaries**, to reflect that samples taken at depths <15 ft bgs also support the ecological assessment (**ACTION 2017-06-15-10**). The attendees agreed that the information provided for Step 4 was acceptable after incorporation of the change to the second bullet under **Study Boundaries** (**Agreement 11** dated 06/15/2017).

AGREEMENTS AND ACTIONS: A summary of agreements and actions are provided in the tables below. Several new actions were recorded at this meeting.

NEXT MEETING: The next meeting has been scheduled for July 13, 2017, at 11:30 am. The discussion will focus on DQO Steps 5 and 6. Another meeting was tentatively set for July 27, 2017, to discuss Step 7 and review open items related to Steps 2 through 6.

JAN B BOVIER	Jan B Bovier	7/13/2017
DOE Project Manager (print)	DOE Project Manager (signature)	Date
Jeff Lyon		7/13/2017
Ecology Project Manager (print)	Ecology Project Manager (signature)	Date

DATE	AGREEMENTS
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	4. The DQO will move forward with a modified scope. The DQO will evaluate the Tank 241-A-104/105 focus area. Additional information is needed on an accelerated timeline regarding the movement of contaminants in the environment that came from releases from these tanks. Information from the resulting investigation will inform the development of the model being developed for the 241-A/AX performance assessment.

05/25/17	5. **Boundaries**: The parties agreed to a 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.
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.

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.
2017-03-30-04	Tabor	Report back about whether an engineering evaluation has been or could be developed to determine whether temperatures seen in 2014 at direct push boreholes can be explained by thermal heat propagating from Tanks A-104/105.	In progress. Tabor, Barnes, Olander to meet 06/21/17 to discuss subsurface heat propagation.
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.

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-05-25-02	Levitt	Evaluate whether microgravity is applicable next to tanks and at what distance it might be applicable.	In progress.
2017-05-25-03	Tabor	Review Table 3 of Handout #2, containing the PSQs, alternative actions, and decision/estimation statements, with Skorska (Ecology).	Open.
2017-05-25-04	Tabor	Provide revised Table 4 of Handout #2 (Data Inputs/basis for identifying acceptable levels) for Ecology review.	Closed 06/15/2017.
2017-05-25-05	Barnes	Ecology review Table 5 of Handout #2 listing potentially appropriate field and analytical methods and provide feedback.	In progress.
2017-05-25-06	Tabor	Provide briefing on deep vadose zone project applicability to A-104/105 focus area.	In progress. Tentatively planned for July 2017 meeting.
2017-06-15-01	Tabor	Add information to the constituent list providing the basis for identification of WMA C **primary constituents**.	New.
2017-06-15-02	Tabor and Field	Revise constituent list to retain **lanthanum, silicon, Ra-226, and thorium 232**. Review and revise as necessary the constituent list "rationale for decision" for these four constituents and for lithium.	New.
2017-06-15-03	Tabor	Modify constituent list to retain **thorium metal**.	New.
2017-06-15-04	Tabor	Report back with information to support developing an agreement regarding whether analysis for **hexavalent chromium** should be conducted in addition to total chromium.	New.
2017-06-15-05	Tabor	Report back regarding whether **cyanide analysis** looked for free CN vs. total CN at WMA C.	New.
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.	New.

ACTIONS (2 pages)			
Action Number	**Actionee**	**Description**	**Status**
2017-06-15-07	Tabor	Review groundwater monitoring plan addressing the requirements of the Atomic Energy Act (**DOE/RL-2015-56**) and reference in the constituent table	New.
2017-06-15-08	Tabor	In Handout # 3 attached to the 06/15/2017 meeting notes, clarify that a duplicate sample will be obtained at 25% of surface sample locations.	New.
2017-06-15-09	Robertson	The existing **DQO Process text** at the bottom of page 1 of Handout #5 attached to the meeting notes from 06/15/17 will be moved to the top of the page, before the DQO scope and objectives.	New.
2017-06-15-10	Tabor	On page 10 of Handout #5 attached to the meeting notes from 06/15/17, correct the second bullet under **Study Boundaries** to reflect that samples taken at depths <15 ft bgs also support the ecological assessment.	New.

Handout #1
Constituent List

Constituent	Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation Corrective Measures Study (RPP-RPT-38152, Rev 0)[a]	Single-Shell Tank Component Closure Data Quality Objectives (RPP-23403, Rev. 6)	Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX (DOE/RL-2009-70)	Standard Best-Basis Inventory Constituents	Recommendation	Rationale for Decision
Metals						
Aluminum – Al	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Antimony – Sb	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Arsenic – As	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Barium – Ba	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Beryllium – Be	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Bismuth – Bi	S	X		X	Retain	Constituent listed in WMA C and SST DQO
Boron – B	S	X			Retain	Constituent listed in WMA C and SST DQO
Cadmium – Cd	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Calcium - Ca	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cerium – Ce	S	X			Retain	Retained based on tank waste and self boiling tanks. The rare earths are naturally occurring in the vadose zone.
Chromium – Cr	P	X	X	X	Retain	Constituent listed in WMA C and SST DQO. Currently total chromium is being used as a surrogate for hexavalent chromium. Analytical method for hexavalent chromium requires analyses in 24 hours.
Chromium - hexavalent CrVI	P				Retain Estimated from Chromium	Currently total chromium is being used as a surrogate for hexavalent chromium. Analytical method for hexavalent chromium requires analyses in 24 hours.
Cobalt – Co	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Copper – Cu	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Europium – Eu	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Iron – Fe	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Lanthanum – La	S	X		X	Eliminate	The rare earths are naturally occurring in the vadose zone.
Lead – Pb	P	X	X	X	Retain	Constituent listed in WMA C and SST DQO
Lithium - Li	P	X			Retain	Constituent listed in WMA C and SST DQO
Magnesium - Mg	P	X			Retain	Constituent listed in WMA C and SST DQO
Manganese – Mn	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Mercury – Hg	P	X	X	X	Retain	Constituent listed in WMA C and SST DQO
Molybdenum - Mo	P	X			Retain	Constituent listed in WMA C and SST DQO
Neodymium – Nd	S	X			Retain	Retained based on tank waste and self boiling tanks. The rare earths are naturally occurring in the vadose zone.
Nickel – Ni	P	X	X	X	Retain	Constituent listed in WMA C and SST DQO
Niobium – Nb	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Palladium – Pd	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.

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Phosphorus - P	P	X			Retain	Constituent listed in WMA C and SST DQO
Potassium - K	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Praseodymium – Pr	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Rhodium – Rh	S	X			Retain	Constituent listed in WMA C and SST DQO
Rubidium – Rb	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Ruthenium – Ru	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Samarium – Sm	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Selenium – Se	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Silicon – Si	S	X		X	Eliminate	Silicon is part of the media being analyzed (sand, gravel and silt and clay)
Silver – Ag	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Sodium - Na	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Strontium – Sr	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Sulfur – S	S	X			Retain	Constituent listed in WMA C and SST DQO
Tantalum – Ta	S	X			Retain	Constituent listed in WMA C and SST DQO
Tellurium – Te	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Thallium – Tl	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Thorium – Th	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Tin – Sn	S	X			Retain	Constituent listed in WMA C and SST DQO
Titanium – Ti	S	X			Eliminate	The rare earths are naturally occurring in the vadose zone.
Tungsten – W	S	X			Retain	Constituent listed in WMA C and SST DQO
Uranium – U	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Vanadium – V	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Yttrium – Y	S	X			Retain	Constituent listed in WMA C and SST DQO
Zinc – Zn	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Zirconium – Zr	S	X		X	Retain	Constituent listed in WMA C and SST DQO
Anions						
Bromide Br-	S	X			Retain	Constituent listed in WMA C and SST DQO
Chloride – Cl-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Fluoride – F-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Nitrate – NO3-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Nitrite – NO2-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Phosphate – PO4	S	X		X	Retain	Constituent listed in WMA C and SST DQO
Sulfate – SO42-	P	X		X	Retain	Constituent listed in WMA C and SST DQO

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Sulfide – S2-	E		X		Eliminate	Sulfides were not routinely used in Hanford Site processes. Limited use of sulfide may have occurred during the ferrocyanide processing of ^{137}Cs in the tanks. The other possible source of sulfides would be from the reduction of sulfates. However, this is unlikely in the high nitrate tank waste matrices. Soluble sulfide is not very stable and is easily oxidized by air. Any sulfide remaining in the waste is most likely present as insoluble metal sulfide. In addition, previous analyses of tank waste have not detected sulfides in the Hanford Site tanks.
Small Organic Acids						
Acetate – C2H3O2-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Formate – CHO2-	P	X			Retain	Constituent listed in WMA C and SST DQO
Glycolate – C2H3O3-	P	X			Retain	Constituent listed in WMA C and SST DQO
Oxalate – C2O42-	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cyanides						
Cyanide – CN-	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Ferrocyanide – Fe(CN)64-	P	X			Eliminate	No ferrocyanide waste in WMA A-AX tank waste.
Ammonium Ion						
Ammonium – NH4+	P	X			Retain	Constituent listed in WMA C and SST DQO
VOCs						WMA C, containing no self-boiling tanks, received much of the organic waste (OWW). Note that sampling for organics was discontinued at the WMA C as they were only detected a few times. At WMA A-AX, containing self-boiling tanks, received less organic waste (OWW) than WMA C (Reference: HNF-3588, RPP-21854, HNF-4240). Additionally, total organic carbon, an overall indicator of organics, is not associated with Tanks A-104 and A-105 (BBI shows 0 kg for total organic carbon).
1,1,1-Trichloroethane	E	X	X		Eliminate	
1,1,2,2-Tetrachloroethane	E	X	X		Eliminate	
1,1,2,2-Tetrachloroethene	E	X	X		Eliminate	
1,1,2-Trichloro-1,2,2-trifluoroethane	E	X			Eliminate	
1,1,2-Trichloroethane	E	X	X		Eliminate	
1,1,2-Trichloroethylene	E	X	X		Eliminate	
1,1-Dichloroethene	E	X	X		Eliminate	
1,2-Dichloroethane	E	X	X		Eliminate	
2-Butanone (MEK)	E	X	X		Eliminate	
2-Nitropropane	E	X			Eliminate	

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2-Pentanone	E	X			Eliminate	
2-Propanone (Acetone)	E	X	X		Eliminate	
4-Methyl-2-pentanone (MIBK)	E	X	X		Eliminate	
Benzene	E	X	X		Eliminate	
Carbon disulfide	E	X	X		Eliminate	
Carbon tetrachloride	E	X	X		Eliminate	
Chlorobenzene	E	X	X		Eliminate	
Chloroethene (vinyl chloride)	E	X	X		Eliminate	
Chloroform	E	X	X		Eliminate	
Cis-1,2-dichloroethene	E				Eliminate	
Dichloromethane (methylene chloride)	E	X	X		Eliminate	
Diethyl ether	E	X			Eliminate	
Ethyl Acetate	E	X			Eliminate	
Ethylbenzene	E	X	X		Eliminate	
Isobutanol	E	X	X		Eliminate	
Methanol	E	X			Eliminate	
m-Xylene	E	X	X		Eliminate	
n-Butyl alcohol (1-butanol)	E	X			Eliminate	
o-Xylene	E	X	X		Eliminate	
p-Xylene	E	X	X		Eliminate	
Tetrahydrofuran	E	X			Eliminate	
Toluene	E	X	X		Eliminate	
Trans-1,2-dichloroethene	E				Eliminate	
trans-1,3-dichloropropene	E	X	X		Eliminate	
Trichlorofluoromethane	E	X	X		Eliminate	
Xylenes	E	X	X		Eliminate	
SVOCs						WMA C, containing no self-boiling tanks, received much of the organic waste (OWW). Note that sampling for organics was discontinued at the WMA C as they were only detected a few times. At WMA A-AX, containing self-boiling tanks, received less organic waste (OWW) than WMA C (Reference: HNF-3588, RPP-21854, HNF-4240). Additionally, total organic carbon, an overall indicator of organics, is not associated with Tanks A-104 and A-105 (BBI shows 0 kg for total organic carbon).
1,1-Biphenyl	S				Eliminate	
1,1-Dimethylhydrazine	S	X			Eliminate	
1,2,4-Trichlorobenzene	P	X	X		Eliminate	

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1,3-Dichlorobenzene	S	X			Eliminate	
1,4-Dichlorobenzene	S	X			Eliminate	
1,4-Dinitrobenzene	S	X			Eliminate	
2,4,5-Trichlorophenol	P	X	X		Eliminate	
2,4,6-Trichlorophenol	P	X	X		Eliminate	
2,4-Dinitrotoluene	P	X	X		Eliminate	
2,6-Bis (tert-butyl)-4-methylphenol	P	X			Eliminate	
2-Chlorophenol	P	X	X		Eliminate	
2-Ethoxyethanol	P	X			Eliminate	
2-Methylphenol (o-cresol)	P	X	X		Eliminate	
2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	S	X			Eliminate	
3-Methyl-2-butanone	S	X			Eliminate	
4-Methylphenol (p-cresol)	P	X	X		Eliminate	
Acenaphthene	P	X	X		Eliminate	
Acetophenone	S	X			Eliminate	
Benzo(a) anthracene	P				Eliminate	
Benzo(a)pyrene	P	X			Eliminate	
Benzo(b)fluoranthene	P				Eliminate	
Benzo(k)fluoranthene	P				Eliminate	
Bis(2-ethylhexyl)phthalate	P				Eliminate	
Butylbenzylphthalate	P	X	X		Eliminate	
Chrysene	P				Eliminate	
Cresylic acid (cresol, mixed isomers) (Total Cresols)	P	X			Eliminate	
Cyclohexanone	P	X			Eliminate	
Dibenz(a,h)anthracene	P	X			Eliminate	
Dibutyl phosphate	E				Eliminate	
Di-n-butylphthalate	P	X	X		Eliminate	
Di-n-octylphthalate	P	X	X		Eliminate	
Ethylene glycol	E				Eliminate	
Fluoranthene	P	X	X		Eliminate	
Hexachlorobutadiene	P	X	X		Eliminate	
Hexachloroethane	P	X	X		Eliminate	
Hexachloronaphtahlene	S	X			Eliminate	
Hexafluoroacetone	S	X			Eliminate	
Indeno (1,2,3-cd) pyrene	P				Eliminate	

Constituent	Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation Corrective Measures Study (RPP-RPT-38152, Rev 0)[a]	Single-Shell Tank Component Closure Data Quality Objectives (RPP-23403, Rev. 6)	Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX (DOE/RL-2009-70)	Standard Best-Basis Inventory Constituents	Recommendation	Rationale for Decision
Isodrin	S	X			Eliminate	
m-Cresol (3-Methylphenol)	P	X	X		Eliminate	
Methylhydrazine	S	X			Eliminate	
Monobutyl phosphate	E				Eliminate	
N,N-Diphenylamine	S	X			Eliminate	
Naphthalene	P	X	X		Eliminate	
Nitric acid, propyl ester	S	X			Eliminate	
Nitrobenzene	P	X	X		Eliminate	
N-Nitrosodi-n-butylamine	S	X			Eliminate	
N-Nitroso-di-n-propylamine	P	X	X		Eliminate	
N-Nitrosomethylethylamine	S	X			Eliminate	
N-Nitrosomorpholine	P	X	X		Eliminate	
N-Nitroso-N, N-dimethylamine	S	X			Eliminate	
Octachloronaphthalene	S	X			Eliminate	
1,2-Dichlorobenzene	P	X	X		Eliminate	
o-Nitrophenol	P	X	X		Eliminate	
p-Chloro-m-cresol (4-Chloro-3-methylphenol)	P	X	X		Eliminate	
Pentachloronaphthalene	S	X			Eliminate	
Pentachloronitrobenzene (PCNB)	S	X			Eliminate	
Phenol	S	X			Eliminate	
p-Nitrochlorobenzene	S	X			Eliminate	
Pyrene	P	X	X		Eliminate	
Pyridine	P	X	X		Eliminate	
Tetrachloronaphthalene	S	X			Eliminate	
Toxaphene	S	X			Eliminate	
Tributyl phosphate	P	X			Eliminate	
Pesticides						
Aldrin	P	X			Retain	Constituent listed in WMA C and SST DQO
Benzene hexachloride (including lindane) (Alpha, beta, gamma)	P	X			Retain	Constituent listed in WMA C and SST DQO
Chlordane	P				Retain	Constituent listed in WMA C DQO
DDT/DDD/DDE (total)	P				Retain	Constituent listed in WMA C DQO
Dieldrin	P	X			Retain	Constituent listed in WMA C and SST DQO
Endrin	P	X			Retain	Constituent listed in WMA C and SST DQO
Heptachlor/heptachlor epoxide (total)	P				Retain	Constituent listed in WMA C DQO

Constituent	Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation Corrective Measures Study (RPP-RPT-38152, Rev 0)[a]	Single-Shell Tank Component Closure Data Quality Objectives (RPP-23403, Rev. 6)	Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX (DOE/RL-2009-70)	Standard Best-Basis Inventory Constituents	Recommendation	Rationale for Decision
Hexachlorobenzene	P	X			Retain	Constituent listed in WMA C and SST DQO
Pentachlorophenol	S	X			Retain	Constituent listed in WMA C and SST DQO
GRO/DRO						
Gasoline-Range Organics	E				Eliminate	
Diesel-Range Organics	E				Eliminate	
PCBs						
Aroclors	P	X	X		Retain	Constituent listed in WMA C and SST DQO
Congeners	E				Eliminate	
Other						
TOC (total organic carbon)				X	Add	
Radionuclides						
Am-241	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Carbon C-14	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cm-242	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cm-243	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cm-244	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cobalt Co-60	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Cs-137	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Eu-152	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Eu-154	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Eu-155	P	X		X	Retain	Constituent listed in WMA C and SST DQO
I-129	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Ni-63	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Np-237	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Pu-238	P			X	Retain	Constituent listed in WMA C DQO
Pu-239	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Pu-240	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Pu-241	P			X	Retain Estimated from Pu 238 and Pu 239/240	Constituent listed in WMA C DQO

Constituent	Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation Corrective Measures Study (RPP-RPT-38152, Rev 0)[a]	Single-Shell Tank Component Closure Data Quality Objectives (RPP-23403, Rev. 6)	Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX (DOE/RL-2009-70)	Standard Best-Basis Inventory Constituents	Recommendation	Rationale for Decision
Ra-226	S			X	Eliminate	TPA-CN-668 removed Radium-226 and 228 from DV-1 SAP. ---Potassium 40, radium 226, radium 228, thorium 228, thorium 230, and thorium 232 are naturally occurring background radionuclides identified by consensus of Tri Party managers as not directly related to Hanford Operations or processes in the Central Plateau.---
Sb-125	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Se-79	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Sn-126	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Sr-90	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Tc-99	P	X		X	Retain	Constituent listed in WMA C and SST DQO
Th-228	P	X			Eliminate	TPA-CN-668 removed Radium-226 and 228 from DV-1 SAP. ---Potassium 40, radium 226, radium 228, thorium 228, thorium 230, and thorium 232 are naturally occurring background radionuclides identified by consensus of Tri Party managers as not directly related to Hanford Operations or processes in the Central Plateau.---
Th-230	P	X			Eliminate	TPA-CN-668 removed Radium-226 and 228 from DV-1 SAP. ---Potassium 40, radium 226, radium 228, thorium 228, thorium 230, and thorium 232 are naturally occurring background radionuclides identified by consensus of Tri Party managers as not directly related to Hanford Operations or processes in the Central Plateau.---
Th-232	P	X		X	Eliminate	TPA-CN-668 removed Radium-226 and 228 from DV-1 SAP. ---Potassium 40, radium 226, radium 228, thorium 228, thorium 230, and thorium 232 are naturally occurring background radionuclides identified by consensus of Tri Party managers as not directly related to Hanford Operations or processes in the Central Plateau.---
Tritium H-3	P	X		X	Retain	Constituent listed in WMA C and SST DQO
U-233	P	X		X	Retain	Constituent listed in WMA C and SST DQO
U-234	P	X		X	Retain	Constituent listed in WMA C and SST DQO
U-235	P	X		X	Retain	Constituent listed in WMA C and SST DQO
U-236	P	X		X	Retain	Constituent listed in WMA C and SST DQO
U-238	P	X		X	Retain	Constituent listed in WMA C and SST DQO

Constituent	Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation Corrective Measures Study (RPP-RPT-38152, Rev 0)[a]	Single-Shell Tank Component Closure Data Quality Objectives (RPP-23403, Rev. 6)	Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area A-AX (DOE/RL-2009-70)	Standard Best-Basis Inventory Constituents	Recommendation	Rationale for Decision
	Detected both Shallow and Deep at WMA C (RPP-RPT-58339, Rev. 0, Phase 2 RCRA Facility Investigation Report for Waste Management Area C)					
	Detected Shallow at WMA C (RPP-RPT-58339, Rev. 0, Phase 2 RCRA Facility Investigation Report for Waste Management Area C)					
	Detected Deep at WMA C (RPP-RPT-58339, Rev. 0, Phase 2 RCRA Facility Investigation Report for Waste Management Area C)					

[a] P=Primary, S=Secondary, and E=Eliminated as defined in RPP-PLAN-38777, Rev.3, Sampling and Analyis Plan for Phase 2 Characterization of Vadose Zone Soil in Waste Management Area C

Handout #2

Table 4 Basis for Identification and Setting of Acceptable Levels for Decision and Estimation Statements				
PSQ	**Type of Data**		**Potential Sources for Information Inputs**	**Basis for Setting Acceptable Levels**
#1 Does contamination in the WMA A-AX vadose zone soil exceed acceptable levels?	Radionuclide (Analytical and geophysical)	Shallow zone (<4.6m [<15 ft] bgs)	• Previously reported analytical data • Previously reported geophysical data • Collect additional soil samples for laboratory analysis • Perform additional geophysical logging • Field screening with radiological detection equipment	CERCLA • Ecological protection • Human health soil direct contact o Residential[1] o Tribal[1] o Outdoor worker
		Deep zone (>4.6m [>15 ft] bgs)	• Previously reported analytical data • Previously reported geophysical data • Collect additional soil samples for laboratory analysis • Perform additional geophysical logging • Field screening with radiological detection equipment	CERCLA • Human health soil direct contact o Construction worker
		Ground surface to water table	• Previously reported analytical data • Collect additional soil samples for laboratory analysis	CERCLA • Groundwater Protection – Site specific model

Table 4 Basis for Identification and Setting of Acceptable Levels for Decision and Estimation Statements				
PSQ	**Type of Data**		**Potential Sources for Information Inputs**	**Basis for Setting Acceptable Levels**
#1 Does contamination in the WMA A-AX vadose zone soil exceed acceptable levels?	Chemical (Analytical and geophysical)	Shallow zone (<4.6m [<15 ft] bgs)	• Previously reported analytical data • Collect additional soil samples for laboratory analysis	CERCLA • Ecological protection • Human health soil direct contact o Residential[1] o Tribal[1] o Outdoor worker WAC • Unrestricted Land Use - Soil (WAC 173-340-740 and -750) • Industrial Properties – Soil (WAC 173-340-745 and -750)
		Ground surface to water table	• Previously reported analytical data • Collect additional soil samples for laboratory analysis	WAC • Groundwater Protection - Fixed parameter 3-phase partitioning model (WAC 173-340-747(4)) • Groundwater Protection – Site specific model

Table 4 Basis for Identification and Setting of Acceptable Levels for Decision and Estimation Statements			
PSQ	**Type of Data**	**Potential Sources for Information Inputs**	**Basis for Setting Acceptable Levels**
Estimation			
#2 — Is information available to define the chemical/physical properties of WMA A-AX vadose zone soil that can impact contaminant movement through the WMA A-AX vadose zone soil?	• Physical properties (e.g., bulk density and pH) • Technical Evaluation (e.g., hydraulic properties)	• Information from previous investigations • Collect additional soil samples • Batch and column leach tests • Sequential extraction tests	Acceptable levels do not apply for preliminary conceptual site model evaluation. This is a judgmental assessment.
#3 — Is information available to define the chemical/physical properties of tank waste that can impact contaminant movement through the WMA A-AX vadose zone soil?	• Leaching characteristics of tank waste based on batch and column leaching tests • Sequential extraction to estimate the labile fraction (readily leachable fraction) of constituents • Mineral phase identification within the tank waste residuals • Physical properties (e.g., bulk density and pH)	• Process history • Residual waste inventory • Batch leaching kinetics and partitioning behavior of tank waste • Leaching kinetics of tank waste	Acceptable levels do not apply for preliminary conceptual site model evaluation. This is a judgmental assessment.

Table 4 Basis for Identification and Setting of Acceptable Levels for Decision and Estimation Statements			
PSQ	**Type of Data**	**Potential Sources for Information Inputs**	**Basis for Setting Acceptable Levels**
#4 — Is information available to define whether, and where, tank waste passed through WMA A-AX vadose zone soil and, therefore, could exist elsewhere in the environment?	Fate and transport inputs: • Evaluation of mineralogical changes due to waste-sediment interaction and mineral phase identification • 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) • pH variations	• Documentation and history of releases from SSTs • Documentation of Unplanned Releases • Documentation and history of other releases • Previous investigations: o RPP-14430, *Subsurface Conditions Description of the C and A-AX Waste Management Area* o RPP-35484, *Field Investigation Report for Waste Management Areas C and A-AX* • Conduct additional surface geophysical exploration • Results and conclusions resulting from any new geophysical logging or soil sample collection	Acceptable levels do not apply for preliminary conceptual site model evaluation. This is a judgmental assessment.

Note: Relevant background level information is contained in the following documents:

- DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*
- DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides*
- ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site*

[1] Residential and tribal scenarios will be evaluated to assist interested parties in providing input on the remedial alternatives as part of the CERCLA modifying criteria.

Handout #3

Number of Samples Collected At WMA C per Direct Push Location

- Each sampling location consists of one surface sample and duplicate, three shallow samples (5 to 7, 10 to 12, and 14 to 16 ft below ground surface [bgs]), and at least four additional samples down to a depth of 200 to 240 ft bgs or refusal.
- 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.
- For depths greater than 15 ft bgs, the depth location for sampling individual horizons will be selected by reviewing the gamma 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:

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

Note: Average Total Depth was ~175 ft bgs and Median Total Depth was ~210 ft bgs.

Recommended Number of Samples Collected From WMA A-AX per Direct Push Location

- Each sampling location consists of one surface sample, two additional shallow samples (7 to 9 and 12 to 14 ft bgs), and at least seven additional samples down to a depth of ~240 -285 ft bgs or refusal. A duplicate sample will be collected at 25% of the surface sample locations.
- 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.
- For depths greater than 15 ft bgs, the depth location 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:

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

Note: Proposed Vertical Total Depths for 4 boreholes are 240 (two locations), 260, 285 ft bgs.

Handout #4

Status of A-AX DQO Process

DQO Step	STEP COMPONENT	AGREEMENT DATE
Background Information	Overall	05/25/2017
	Scope Refer to Agreement 4 recorded in 03/30/2017 meeting notes and to DQO Handout from 05/25/2017.	03/30/2017; 05/25/2017
	Objectives Refer to DQO Handout from 05/25/2017.	05/25/2017
	Approach Refer to DQO Handout (Table 1) from 05/25/2017.	05/25/2017
Step 1: Define the Problem	Overall	05/25/2017
	Problem Statement Refer to Agreement 3 recorded in the 01/26/2017 meeting notes and to DQO Handout from 05/25/2017.	01/26/2017; 05/25/2017
	Team Members Refer to DQO Handout (Table 2) from 05/25/2017.	05/25/2017
Step 2: Identify the Goals of the Study	Overall	Not Complete
	Goal of Study Refer to DQO Handout from 05/25/2017.	05/25/2017
	Principal Study Questions, Proposed Alternative Actions, and Decision/Estimation Statements Refer to DQO Handout (Table 3).	In Progress
Step 3: Information Inputs	Overall	Not Complete
	Basis for ID and Setting of Acceptable Levels Refer to DQO Handout (Table 4).	In Progress
	Field and Analytical Methods Refer to DQO Handout (Table 5).	In Progress
Step 4: Boundaries	Overall	Not Complete
	Vertical, Horizontal, and Temporal Boundaries: Refer to Agreement 5 recorded in 05/25/2017 meeting notes.	05/25/2017

Status of A-AX DQO Process

DQO Step	STEP COMPONENT	AGREEMENT DATE
	Sample Unit	Not Complete
Step 5: Analytic Approach	Overall	Not Complete
Step 6: Performance or Acceptance Criteria	Overall	Not Complete
Step 7: Sampling and Analysis Plan	Overall	Not Complete
	Potential Direct Push Locations Refer to first page of Handout #1 attached to the 05/25/2017 DQO meeting notes.	In progress
	Number of Samples	In progress

Handout #5

WMA A-AX DATA QUALITY OBJECTIVES (DQO) PROCESS SUMMARY
Hand Out for June 15, 2017

BACKGROUND INFORMATION

DQO Scope and objectives

The DQO scope was outlined as follows (**WMA-A/AX-DQO-2017-1**):

- The DQO process will address vadose zone contamination in and around A-AX tank farms.
- Data will be used to develop an assessment of risk to human health and the environment including the future risk to groundwater.
- Data will be used to evaluate alternatives in a CMS and in the selection of a proposed remedy.
- The corrective action decisions supported by the data collected under this DQO will be consistent with and support final closure of A-AX tank farms.
- This DQO will not address data requirements of SST residual waste sampling and analysis or other data required to address closure associated with ancillary equipment in the tank farm. These data requirements will be addressed in a separate DQO for the closure of the SST system.

DQO objectives (**WMA-A-AX-DQO-2017-3** for bullets 2 and 3, and **WMA-A/AX-DQO-2017-4** for bullet 1):

- Define the WMA A-AX vadose zone characterization data necessary to guide planning to make vadose zone soil remedial decisions, support an evaluation of risks by direct contact and to ecological receptors, and support integration of vadose zone and groundwater decisions.
- Optimize a data collection program that will be used to support the Phase 2 RFI/CMS characterization of WMA A-AX and to support risk-informed retrieval efforts.
- Support refining the preliminary conceptual site model (CSM).

DQO Process

The DQO development is a seven step process. The DQO process for WMA A-AX will be iterative, with revisions being prepared to address focus areas, as needed. It will be setup to ensure that the data needs to support the performance assessment (PA) and risk-informed retrieval process and ultimately the Phase 2 RFI/CMS efforts are achieved. The steps and the manner in which they will be applied at WMA A-AX are identified in Table 1 below (**WMA-A/AX-DQO-2017-4**).

Table 1. WMA A-AX DQO Approach		
Step	**Purpose of Step**	**WMA A-AX DQO Document Information**
1	**State the Problem** *Define the problem that necessitates the study, identify the planning team, examine budget, and schedule.*	**The problem statement will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
2	**Identify the Goal of the Study** *State how environmental data will be used in meeting objectives and solving the problem, identify study questions, define alternative outcomes.*	**The goal of the study will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
3	**Identify Information Inputs** *Identify data and information needed to answer study questions.*	**The information inputs will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
4	**Define the Boundaries of the Study** *Specify the target population and characteristics of interest, define spatial and temporal limits, scale of inference.*	**Each revision will be specific to a focus area.**
5	**Develop the Analytical Approach** *Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions and findings.*	**The analytical approach will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
6	**Specify Performance or Acceptance Criteria** *Specify probability limits for false acceptance decision errors.*	**Performance/Acceptance Criteria will be the same for each revision of the DQO.** It will address the overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS.
7	**Develop the Plan for Obtaining Data** *Select the resource-effective sampling and analysis plan that meets the performance criteria*	**Each revision will be specific to a focus area.**

Note: Steps that reflect the "overall issue of collecting WMA A-AX data to support the PA, retrieval, and RFI/CMS" will be reviewed to determine if any specifics are needed for Focus Area Evaluation.

STEP 1 – DEFINE THE PROBLEM

Step 1 of the seven-step DQO process is to clearly define the problem (the reason analytical data are needed) so that the focus of the project is clear.

DQO problem statement

Considering the DQO scope, and after review of available information, the concise statement of the problem was identified as follows (**WMA-A-AX-2017-1**):

> ***Vadose zone contamination in and adjacent to the A-AX tank farm may pose a current and future risk to human health and the environment, including groundwater, which requires corrective action to support closure.***

The DQO project team is identified as follows (**WMA-A-AX-2017-1**; modifications proposed **WMA-A-AX-2017-5**):

Table 2. DQO Planning Team Members

Organization	Name	Function/Decision Authority
U.S. Department of Energy – Office of River Protection (ORP)	Jan Bovier	ORP Project Lead
U.S. Department of Energy – Operations Office (RL)	Doug Hildebrand	RL Lead - Integration with 200-EA-1 and Groundwater OUs
Washington State Department of Ecology (Ecology)	Mike Barnes Jeff Lyon Joe Caggiano Elizabeth Rochette Marysia Skorska Jim Alzheimer	Lead WMA A-AX DQO Tank Farms Project Manager Technical Support Technical Support Technical Support Technical Support
Washington River Protection Solutions	Scott Luke Paul Rutland Cindy Tabor/Ryan Childress Julie Robertson Jim Field Robin Varljen Kristin Singleton/Marcel Bergeron Harold Sydnor Kathi Dunbar Steve McKinney/Paul Gassman Bob Hiergesell Duc Nguyen	DQO Facilitator Vadose Zone Project Director Project Lead Regulatory Support Leak Assessments and Process Knowledge Regulatory Compliance Risk Assessment Field Characterization/Sampling and Analysis QA Laboratory Interface WMA A-AX PA Integration DQO Oversight
CHPRC	Bert Day Lee Broulliand/Jeremy Lynn Greg Thomas Curt Wittreich	200-EA-1, 200-DV-1, and 200-IS-1 200-PO-1 200-BP-5 Groundwater OU Integration

STEP 2 – IDENTIFY THE GOALS OF THE STUDY

Step 2 identifies the decisions information that requires new environmental data to address the problem and identifies decision statements for Estimation problems identifies what needs to be estimated to solve the "problems" stoted in Step 1 and associated key assumptions.

Goal of the study (WMA-A-AX-2017-1):

> ***The goal is to ensure the appropriate vadose zone soil characterization data needs are identified to support corrective measure decisions for WMA A-AX, recognizing the need to integrate characterization and closure actions with ongoing and nearby operations and waste site/groundwater remedial actions.***

The Principal Study Questions, Alternative Actions, and Decision/Estimation Statements are described in Table 3 (**WMA-A-AX-2017-4**; modifications proposed **WMA-A-AX-2017-5**).

Table 3. Principal Study Questions, Alternative Actions, and Decision/Estimation Statements

Principal Study Question (PSQ)	Proposed Alternative Actions (AA)	Decision/Estimation Statement (DS/ES)
#1— Is there sufficient chemical/radiological concentration and distribution data to perform risk assessment for WMA A-AX vadose zone soil (exceedances of applicable levels to define magnitude and extent of risk issues). **Proposed PSQ:** *Does contamination in the WMA A-AX vadose zone soil exceed acceptable levels?*	If yes, use existing data to develop risk assessment in support of the RCRA facility investigation report and performance assessment. If not, collect data or determine if other information can be used. **Proposed AA:** *If contamination exceeds acceptable levels, evaluate the need for corrective measures; otherwise, document that corrective action is not required.*	**#1** — Determine whether or not the chemical/radiological concentration and distribution data are sufficient to perform risk assessment for WMA A-AX vadose zone soil. **Proposed DS:** *Determine whether contamination exceeds acceptable levels and, therefore, whether there is a need to evaluate corrective measures.*
#2— Is there sufficient chemical/radiological concentration and distribution data to define the WMA A-AX vadose zone soil nature and extent of contamination (exceedances of applicable levels to define magnitude and extent of contamination). **Proposed PSQ:** *Incorporate purpose into first PSQ/DS and delete this one.*	If yes, use existing data to refine the conceptual/numerical site models and develop the RCRA facility investigation report. If not, collect data or determine if other information can be used. **Proposed AA:** *Delete.*	**#2** — Determine whether or not the chemical/radiological concentration and distribution data are sufficient to define WMA A-AX vadose zone soil nature and extent of contamination. **Proposed DS:** *Incorporate purpose into first PSQ/DS and delete this one.*

Table 3. Principal Study Questions, Alternative Actions, and Decision/Estimation Statements		
Principal Study Question (PSQ)	**Proposed Alternative Actions (AA)**	**Decision/Estimation Statement (DS/ES)**
#3 – Is there sufficient information about vadose zone soil chemical/physical properties to determine how contaminants move through vadose zone soil in and near WMA A-AX? **Proposed PSQ**: *Is information available to define the chemical/physical properties of WMA A-AX vadose zone soil that can impact contaminant movement through the WMA A-AX vadose zone soil?*	If yes, use existing vadose zone soil chemical/physical property data to refine the conceptual/numerical site models. If not, collect data or determine if other information could be used. **Proposed AA:** *If information is available to define the vadose zone soil properties, then incorporate those properties into the contaminant modeling; otherwise evaluate the need to collect additional information to model contaminant movement.*	**#3** – Determine whether or not there is sufficient information about vadose zone soil chemical/physical properties that could affect contaminant movement through vadose zone soil in and near WMA A-AX. **Proposed Estimation Statement**: *Identify whether information to define the chemical and physical properties of WMA A-X vadose zone soil, which can impact contaminant movement through the WMA A-AX vadose zone soil, is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*
#4 – Is there sufficient information about tank waste chemical/physical properties that could affect contaminant movement through the WMA A-AX vadose zone soil? **Proposed PSQ:** *Is information available to define the chemical/physical properties of tank waste that can impact contaminant movement through the WMA A-AX vadose zone soil?*	If yes, use existing tank waste chemical/physical property data to refine the conceptual/numerical site models. If not, identify tank waste chemical/physical property data needs to be considered as a part of a future tank DQO. **Proposed AA:** *If information is available to define the tank waste properties, then incorporate those properties into the contaminant modeling; otherwise evaluate the need to collect additional information to model contaminant movement.*	**#4** – Determine whether or not there is sufficient information about tank waste chemical/physical properties that could affect contaminant movement through the WMA A-AX vadose zone soil. **Proposed Estimation Statement**: *Identify whether information to define the chemical and physical properties of tank waste, which can impact contaminant movement in the WMA A-AX vadose zone soil, is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*
#5 – Does the available contaminant concentration data provide sufficient information to determine whether, and if so, where waste passed through the WMA A-AX vadose zone soil? **Proposed PSQ:** *Is information available to define whether, and where, tank waste passed through WMA A-AX vadose zone soil and, therefore, could exist elsewhere in the environment?*	If yes, use existing contaminant concentration data to evaluate the leak loss interpretation. If not, collect data or determine if other information could be used. **Proposed AA:** *If information is available to define whether, and where, tank waste passed through WMA A-AX vadose zone soil, then incorporate that information into the contaminant modeling; otherwise, evaluate the need to collect additional information to model contaminant movement.*	**#5** – Determine whether or not there is sufficient contaminant concentration data to determine whether waste passed through the WMA A-AX VZ soil. **Estimation statement:** *Identify whether information to define whether, and where, tank waste passed through WMA A-AX vadose zone soil is available, and evaluate whether to use the existing information for modeling or to collect additional information to model contaminant movement.*

Table 3. Principal Study Questions, Alternative Actions, and Decision/Estimation Statements		
Principal Study Question (PSQ)	**Proposed Alternative Actions (AA)**	**Decision/Estimation Statement (DS/ES)**
Note: Estimation Statements for Focus Area Tanks A-104/105~~: Use data to~~ support the continued development of the conceptual site model, support risk informed retrieval, and evaluate leak assessment interpretation.		

STEP 3 - DATA INPUTS

This step identifies the specific data required to answer the study questions, also identified as DQO data inputs.

Per EPA QA/G4 the major outputs of Step 3 are:

- *Identification of the **types** (e.g., chemical/physical properties), **as well as sources** of information needed to resolve the decision or estimates*
- *Identification of the **basis** of information (e.g., regulations, guidance, and permits) that will guide or support choices to be made in later steps of the DQO process; information on the number of variables (analytes) that will need to be collected; and types of information (e.g., action limits, uncertainty requirements) needed to meet performance or acceptance criteria*
- *Selection of, and information on the performance of, appropriate **sampling and analysis methods** for generating the information.*

Table 4 identifies bases for acceptable levels for Decision Statement #1. The contents of Table 4 were presented for discussion during DQO Meeting **WMA-A-AX-DQO-2017-4**. In consideration of concerns raised about the contents of Table 4, the table will be reconfigured to address all the QA/G4 information requirements. A table listing specific analytes is in development.

Proposal: *Update Table 4, Bases for Identification and Setting of Acceptable Levels for Decision and Estimation Statements, to focus more directly on the EPA QA/G4 Step 3 activities and outputs.*

Table 5 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. The contents of Table 5 were presented for discussion during DQO Meeting **WMA-A-AX-DQO-2017-4**.

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:	Resistivity (conductivity)	Results are impacted by interference from infrastructure such as pipelines, tanks, buildings, and other large features.

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization		
Potentially Appropriate Field Method/Analytical Method	**Parameter**	**Possible Limitations**
Electrical Resistivity Imaging can be acquired to develop shallow and deep, 2-dimensional and 3-dimensional images.		
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 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.	This method does not assess radionuclides or daughter products that do not emit gamma rays. The gamma energies from these isotopes are at the 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);

Table 5. Potentially Appropriate Field and Analytical Methods for Vadose Zone Soil for Characterization		
Potentially Appropriate Field Method/Analytical Method	**Parameter**	**Possible Limitations**
		therefore, is not a compatible technology for use with direct push methods.
	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 Constituent list will be discussed in future meetings	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.
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 Constituent list will be discussed in future meetings	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.		

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

Identify the target population of interest and specify the spatial and temporal features pertinent for decision making or estimation.

Per EPA QA/G-4, the major outputs of this step are as follows:

- *Definition of the target papulation with detailed descriptions of geographic limits (spatial boundaries)*
- *Detailed descriptions of what constitutes a sampling unit*
- *Time frame appropriate for collecting data and making the decision or estimate, together with those practical constraints that may interfere with data collection*
- *The appropriate scale for decision making or estimation.*

Focus Area:

Around Tanks A-104 and A-105

Target Population:

Vadose zone soil (surface to groundwater)

Study Boundaries (WMA-A/AX-DQO-2017-5):

Vertical spatial area of interest is soil depths from the following:

- 0 to 11 inches for soil contamination to support ecological and direct contact assessment. This depth supports not needing an excavation permit.
- <15 ft to support direct contact assessment and groundwater assessment
- >15 ft to support groundwater assessment.

The vertical boundary is from the ground surface to the capillary fringe immediately above groundwater. The horizontal spatial boundary for this focus area is the soil near Tanks A-104 and A-105 as shown in Figure 1.

The temporal boundary for data collection for this focus area is prior to retrieval of Tanks A-104 and A-105. The temporal boundary for the overall data collection in the WMA A-AX area will be the final CMS for WMA A-AX. Because the data will represent the condition of the contamination in the vadose zone between now and when the final CMS is completed, the timing of the sample collection must reflect these conditions. It is anticipated that this DQO will be in effect until the sampling and analysis for the soil remedy selection for WMA A-AX is complete.

Note that sampling or other data collection can be performed any time during the DQO affectivity period and should be integrated with similar activities whenever possible to realize efficiencies.

Sampling Unit:

The smallest sampling unit is the volume of material needed to conduct analytical testing. Note that there are various constraints that can impact the amount of volume that can be collected within tank farms (refer to Table 6).

Constraints to sampling/data collection:

The practical constraints associated with data collection are shown in Table 6.

Smallest decision unit:

The smallest unit on which decisions or estimates is considered to be a release site (i.e., an area in the vadose zone where there has potentially been an impact from a known or suspected release associated WMA A-AX).

Figure 1. Depiction of Horizontal Boundary of A-104/105 DQO Focus Area

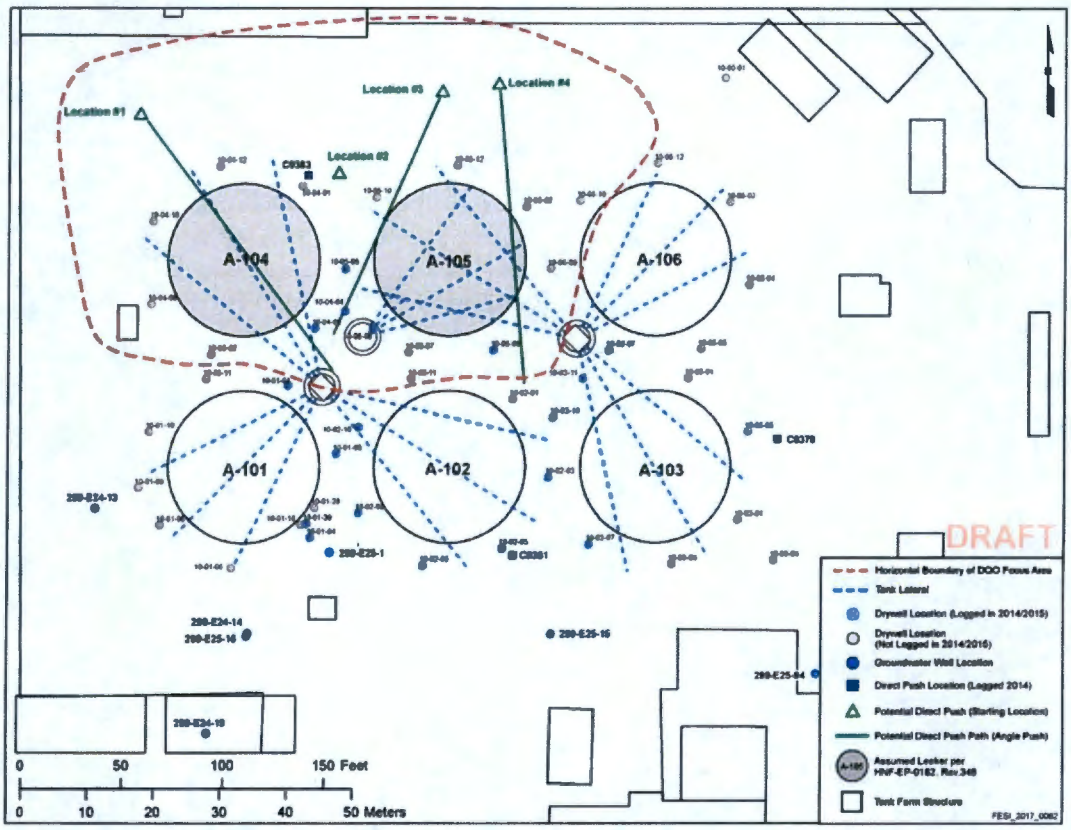

Table 6. Practical Constraints on Data Collection	
Constraint	**Details**
Physical access	Placing driven soil probes, borings, or excavations near tank farm system structures (i.e., SSTs, lines, diversion boxes, catch tanks) will pose additional access challenges because of the following: • Limited access 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).