CHPRC-1702032

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DISTRIBUTION
PROJECT MANAGERS MEETING,
200 AREA GROUNDWATER and SOURCE OPERABLE UNITS
May 18, 2017

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Minutes of the 200 Area Project Managers' Meeting of May 18, 2017 are attached. Minutes are comprised of the following:

Attachment 1	**Signature Page**
Attachment 2	**Agenda**
Attachment 3	**Attendance Record**
Attachment 4	**Milestones and Operations**
Attachment 5	**Groundwater Monitoring Report**
Attachment 6	**TPA-CN-0759 DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan, Rev. 5**
Attachment 7	**TPA-CN-0764 DOE/RL-2010-88 Rev. 0 Sampling and Analysis Plan for Uranium Sequestration Pilot Test**
Attachment 8	**TPA-CN-0766 DOE/RL-2010-87, Field Test Plan for the Uranium Sequestration Pilot Test, Rev. 0**
Attachment 9	**Documents for the AR**
Attachment 10	**Action Items**

Meeting Minutes Transmittal/Approval
Project Managers' Meeting
200 Area Groundwater and Source Operable Units
May 18, 2017

APPROVAL: _____ **DATE:** 5/18/2017
Michael Cline, 200 Area Unit Manager, DOE/RL

APPROVAL: _____ **DATE:** 5/18/2017
Al Farabee, 200 Area Project Manager, DOE/RL

APPROVAL: Craig Cameron **DATE:** 5/18/2017
Craig Cameron, 200 Area Project Manager, EPA

APPROVAL: Nina M. Menard **DATE:** 5/18/2017
Nina Menard, 200 Area Project Manager, Ecology

HFFACO Action Plan Section 4.1 requires signature of agreements and commitments made during the Project Manager Meeting. Approval of these minutes documents approval of agreements and commitments documented in Attachment 4 and 5 to these minutes. Approval does not apply to any other attachments, which are included in these minutes for informational purposes.

200 AREA PROJECT MANAGERS MEETING

May 18, 2017

AGENDA

- March and April Data
- Operational Status and Milestones by OU
  - Deep Vadose Zone
  - 200-IS-1 and 200-EA-1
  - 200-SW-2
  - 200-SW-1
  - 200-BC-1 and 200-WA-1
  - 200-CW-1, 200-CW-3, 200-OA-1
  - 200-BP-5 and 200-PO-1
  - M-015 Milestone Series
  - 200-PW-1/3/6 and 200-CW-5
  - 200-UP-1
  - 200-ZP-1
  - 200 Area Groundwater/200 West P&T Facility
  - M-016 Milestone Series
  - M-024 Milestone Series
  - 200 Area RCRA TSD Closures
  - Canyon Facilities
  - Waste Site Removal

- Approved TPA Change Notices
  - TPA-CN-0759 DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan, Rev. 5
  - TPA-CN-0764 DOE/RL-2010-88 Rev. 0, Sampling and Analysis Plan for Uranium Sequestration Pilot Test
  - TPA-CN-076 DOE/RL-2010-87, Field Test Plan for the Uranium Sequestration Pilot Test, Rev 0.
- Documents for the Administrative Record
- Action Items
- Future Meetings will held in 2420 Stevens Drive Room 153 from 3:00-4:00pm
  - July 20
  - September 21
  - November 16

200 Area Project Managers' Status Meeting
May 18, 2017

PRINTED NAME	ORGANIZATION	O.U. ROLE	TELEPHONE
Jane V Borghese	EPSP	TPA	
JOE AXTELL	DOE-RL	200-WA-1	373-6687
Kate Amrhein	DOE-RL	200-UP-1, 200-ZP-1	376-9391
Scott Davis	MSA - TPA	TPA	376-8757
John Randall	CHPRC	S&GRP	617-803-6037
Michael Clune	DOE-RL	PM	509-376-6070
Emily Laija	EPA	EPA	376-4919
Craig Cameron	EPA	PM	376-8665
Marty Dambacs	CHPRC	Contractor	438-5516
Stephanie Schleif	Ecology	Ecology	372-7929
Gretchen Hanson	CHPRC		373-7553

200 Area Project Managers' Status Meeting
May 18, 2017

PRINTED NAME	ORGANIZATION	O.U. ROLE	TELEPHONE
Kelly Elsethagen	ECY	200-SW-1/2 Project Mgr	372-7923
Elis Eberlein	ECY	200-SW-2 Lead	372-7906
Bob Long	DOE-RL		376-7754

200 Area Project Managers' Status Meeting
May 18, 2017

PRINTED NAME	ORGANIZATION	O.U. ROLE	TELEPHONE
Benjamin Vanrah	DOE	EA-1	376-9623
Shelley Gmon	ODOE		(541) 240-0141
Nina Menard	ECY		372-7941

200 AREA PROJECT MANAGERS' MEETING

Milestones and Operations – March - April 2017 Status by OU
May 18, 2017

Deep Vadose Zone 200-DV-1 Ecology Lead (RL –Jim Hanson, CHPRC – Mark Byrnes)

- Ecology and EPA approved the two addenda that were prepared for DOE/RL-2011-104, Rev. 0, *Characterization SAP for the 200–DV-1 OU* on April 6, 2017. One addendum was prepared to include additional analyses to be performed on soil samples to support the evaluation of the monitored natural attenuation alternative in the feasibility study. The second addendum was prepared to address additional shallow soil sampling and analyses required to support the baseline risk assessment.
- Laboratory analyses performed by PNNL on soil core samples collected from the first 22 of 26 boreholes is complete. Two reports were issued on April 27, 2017. One report is titled "Contaminant Attenuation and Transport Characterization for S- and T Complex" (PNNL-26208). The second report is titled "Geochemical, Microbial, and Physical Characterization at B-Complex" (PNNL-26266). A third report titled "Hydraulic Analysis Report" is in preparation.
- The Operations Acceptance Testing for the BP-5 cross-site transfer line was completed on March 21, 2017. Perched water continues to be pumped directly to the 200 West P&T through this line.
- The revised TPA change notices were signed and approved on March 9, 2017, for DOE/RL-2010-88, Rev. 0, *SAP for the Uranium Sequestration Pilot Test* and DOE/RL-2010-87, Rev. 0, *Field Test Plan for the Uranium Sequestration Pilot Test* to make adjustments to the original proposed injection/monitoring well network. This change adjusted the injection and monitoring wells based on field conditions.
- Uranium Reactive Gas Sequestration Treatability Test drilling activities commenced on March 13, 2017. As of April 27, 2017, three of the five boreholes have been successfully drilled (C9519, C9518, and C9517, respectively) and the fourth borehole (C9515) began drilling on April 24, 2017. Well construction will commence after all the boreholes have been drilled.

Regulatory Agency Comments: Listed and completed PNNL documents will be provided to Dib Goswami and put into the AR

200-IS-1 Ecology Lead (RL- Doug Hildebrand, CHPRC – Bert Day)

- Awaiting Ecology comments on Change Package C-13-01. DOE provided the updated Change Package C-13-01 and four other change packages to better align the waste sites within the 200-IS-1 OU and several other OUs to Ecology on October 20, 2016, for review/comments.

M-015-112: Submit Draft B, 200-IS-1 OU Pipeline System Waste Sites RFI/CMS/RI/FS WP to Ecology, including a schedule of completion dates for major tasks and deliverables, 2/28/2014.

- Status: Dispute resolution. The parties are currently working on identifying the Work Plan scope (i.e., change package C-13-01), TSD identification, and associated revised delivery schedule. The dispute resolution has been extended to June 30, 2017.

Regulatory Agency Comments:

200-EA-1 Ecology Lead (RL- Doug Hildebrand and Ben Vannah, CHPRC – Bert Day)

- Reviewed the workbook with Ecology and discussed issues and concerns. Plan to set up a meeting in May to discuss workbook implementation.
- Completed all the waste site scoping summary workshops with Ecology on April 20, 2017. This effort identified the additional characterization that will be required in order to determine the nature and extent of contamination.

- Continued preparation of RFI/CMS & RI/FS work plan chapters 3 and 4, and SAP.
- Conducted a kickoff meeting and initiated prepration of the SAP for opportunistic sampling near the 216-A-29 ditch.

M-015-92A: Submit a RFI/CMS & RI/FS work plan for the 200-EA-1 OU (200 East Inner Area) to Ecology, 9/30/17

- Status: Discussions are underway with Ecology to extend the milestone since the workbook collaborative approach is taking more time. A draft change request has been given to Ecology to review recommending an extension to May 2018.

Regulatory Agency Comments:

200-SW-2 Ecology Lead (RL- Doug Hildebrand, CHPRC – Bert Day)

- Finalized the Field Summary Report for the Central Plateau Aerial Radiological Survey.

Regulatory Agency Comments:

200-SW-1 Ecology Lead (RL- Doug Hildebrand)

- No work planned for FY2017.

Regulatory Agency Comments:

200-BC-1 and 200-WA-1 EPA Lead (RL- Joe Axtell, CHPRC – Patrick Baynes)

- Initiated the cultural and ecological reviews for the U Plant area to enable characterization field work to begin in early FY2018.

Regulatory Agency Comments: EPA has grave concerns about the field characterization not starting until FY2018 may endanger milestone completion.

200-BP-5 and 200-PO-1 Ecology Lead (RL – James Hanson, CHPRC – Curt Wittreich)

- Transmitted the Draft A 200-BP-5 RI Report and Draft A 200-PO-1 RI Report Addendum to Ecology on August 11, 2015, for review. This review has been held up due to Ecology's concerns over the groundwater model proposed in the RI reports. RL received an Ecology letter dated December 28, 2016, accepting the Central Plateau model for 200-BP-5 and 200-PO-1 OUs with stipulations. RL's response (sent March 20, 2017) to the Ecology letter requested that comments be provided within 45 days. This delay impacts completion of TPA milestone M-015-21A to *Submit 200-BP-5 and 200-PO-1 OU FS Report and PP(s) to Ecology* by June 30, 2018.
- Completed the Rev 0 Groundwater Sampling and Analysis Plan for the 200-BP-5 Groundwater Operable Unit (DOE/RL-2014-33). Regulator approvals were completed on April 21, 2017. The SAP is undergoing the clearance process and being prepped for transmittal.
- On schedule to transmit the Draft A 200-BP-5 Remedial Action Work Plan by May 31st to Ecology for review.

Regulatory Agency Comments: Ecology is planning on providing comments for the 200-BP-5 RI and 200-PO-1 addendum by July 31, 2017.

200-PW-1/3/6 and CW-5 EPA Lead (RL- Robert Long, CHPRC – Patrick Baynes)

- Nothing new to report
- DOE anticipates completing its acquisition process in date in accordance with the RD/RA workplan.

Regulatory Agency Comments:

200-UP-1 EPA Lead (RL – Kate Amrhein, CHPRC – Curtis Wittreich, PNNL-D. Wellman [I-129])

- Completed construction of the initial six groundwater monitoring wells supporting characterization of the southeast chromium plume. The collection of quarterly groundwater continued for all six wells. Initiated the planning for installing the four additional chromium plume wells in CY2017.
- Completed the drilling of one (299 W19-125) of two 8-inch uranium plume wells.
- Completed an initial design for an extension of the uranium extraction system to a third extraction well (299 W19-125) to improve capture of the uranium plume.
- Completed Revision 2 to the drilling SAP to include all 24 wells to be installed in support of TPA Milestone M-016-193. EPA approved the SAP on April 7, 2017.

M-016-193: Complete the remedial design investigation of the SE chromium plume, including the installation of new wells and evaluation of the GW monitoring data and install monitoring wells needed for remedy performance monitoring as defined in the UP-1 RD/RA WP, 9/30/2018.

- Status: TPA Change Package (M-16-16-05) extending TPA Milestone M-016-193 out one year to September 30, 2018 was approved.

Regulatory Agency Comments:

200-ZP-1 EPA Lead (RL – Kate Amrhein, CHPRC – Mark Byrnes)

- TPA change notice TPA-CN-0776 was approved March 1, 2017. This change notice updated the 200 West P&T Operations and Maintenance Plan to add four injection wells and three monitoring wells being drilled in FY2017.
- Refining the annotated outline for Rev. 1 to the 200-ZP-1 RD/RAWP. A meeting was held with EPA March 14, 2017, to discuss the draft annotated outline.
- Completed the groundwater monitoring redundancy analysis for the 200-ZP-1 groundwater monitoring network. A meeting will be scheduled in late-May to walk EPA through the conclusions and recommendations from this evaluation.

Regulatory Agency Comments:

200 Area Groundwater/200 West P&T Facility

- Treated 519M gallons of water in FY2017 as of the end of April, which included the removal of:
  - 38,259 kgs of nitrate
  - 1,023 kgs of carbon tetrachloride
  - 44 kgs of chromium
  - 56 kgs of uranium
  - 1.18 Ci of Tc-99

M-024 Well Installation Ecology Lead (RL-Kathy Higgins, CHPRC-Dave Capelle)

- Nothing new to report. There are five CY2018 M-024 wells planned for drilling in FY2017. Cultural and ecological (C&E) is statused below, however, drilling has not been initiated on any of these wells.
  - C9616 299-E26-80 216-A-29 C&E complete - PO-1 OU
  - C9617 299-E25-238 216-A-29 C&E complete - PO-1 OU
  - C9618 299-E25-239 216-A-29 C&E complete - PO-1 OU
  - C9615 699-44-43C 216-B-3 Pond C&E complete - BP-5

- C9630 299-E25-95 216-A37-1 C&E issued - PO-1 OU

M-024-58J: Initiate discussions of well commitments.
- Status: Meeting scheduled for May 22, 2017. Due 6/1/2017.

M-024-68-T01: Conclude discussions of well commitments initiated under M-024-58.
- Status: On Schedule. Due 8/1/2017.

M-024-68: Complete Construction of all wells listed for CY2017 and before identified in TPA Change Package M-024-14-01.
- Status: Completed 09/01/2016. Due 12/31/2017.

Regulatory Agency Comments:

200 Area RCRA TSD Closures Ecology Lead (RL – Mostafa Kamal, CHPRC – Bert Day)
- Initiating discussions with Ecology regarding the 216-A-29 ditch, 216-A-36B crib, 216-A-37-1 crib, and 216-B-63 trench waste site scoping information and waste designations in support of Closure Plan preparation.
- Initiating 216-A-37-1 crib closure strategy in preparation for Closure Plan kick-off and storyboard discussion with Ecology.

Regulatory Agency Comments: Ecology has accepted the closure certification package for 207-A SRB as complete. A letter will be sent beginning of the week of May 22, 2017.

U Plant Canyon EPA Lead (RL – Robert Long, CHPRC – TBD)
- Nothing to report.

Regulatory Agency Comments:

Canyon Facilities EPA/Ecology Lead (RL – Robert Long, CHPRC –George Jackson)
- Completed REDOX SAP Draft A (DOE/RL-2017-05).
- Completed 200 Area Tier 2 Miscellaenous Faciilities RAWP Draft A (DOE/RL-2016-50).
- Awaiting comments on the Tier 2 B Plant RAWP (DOE/RL-2016-46) which was sent to Ecology on August 2, 2016.
- Awaiting response on the 276-BA RCRA Closure Plan (DOE/RL-2015-70) and proposal, which were sent to Ecology on October 20, 2016.
- Awaiting comments on the Tier 2 PUREX RAWP (DOE/RL-2016-47), which was sent to Ecology on November 14, 2016.
- Awaiting response on proposal for B Plant EE/CA actions submitted to Ecology on November 17, 2016, (M-085-074).
- Continued development of RAWP for REDOX.
- Started development of 224B SAP (DOE/RL-2017-34) and RAWP (DOE/RL-2017-33) in March 2017..

M-085-80A: Submit a DQO report to assess the structural integrity of the PUREX storage tunnels 1 and 2, 9/30/2017
- Status: On Schedule.

Regulatory Agency Comments: Meet before the next PMM to assess what will be provided as part of this milestone.

Waste Site Removal Ecology Lead (RL- Al Farabee, CHPRC – Darren Corriel)

- Nothing to report.

M-016-250: Submit to Ecology for approval a three year rolling prioritized schedule consistent with site-wide clean-up priorities to implement waste site removal actions per Action Memoranda (DOE/RL-2009-37, DOE/RL-2009-48 and DOE/RL-2009-86), 3/31/2016 and annually thereafter.

- Status: Completed M-016-250B, approved on March 30, 2017.

Regulatory Agency Comments:

Monthly Performance Report Assessment

FPD has not identified any significant issues with the contractors' previous monthly report.

Central Plateau Milestones due post 9/30/2017

MS#	Title	Due Date
	Fiscal Year 2018	
M-085-82	Submit proposals for expedited response actions for one or more of the Tier 1 or Tier 2 facilities in the PUREX geographic area	12/31/2017
M-024-58K	Initiate Discussions of Well Commitments	6/1/2018
M-015-21A	Submit BP-5/PO-1 FS/PP	6/30/2018
M-085-74	Submit proposals for expedited response actions for one or more of the Tier 1 and Tier 2 facilities in the B Plant geographic area	6/30/2018
M-024-69-T01	Conclude discussions of well commitments initiated under M-024-58	8/1/2018
M-015-93C	Initiate characterization field work for the 200-SW-2 OU	9/30/2018
M-016-255	DOE shall complete the removal of all waste sites for FY2018 as identified in TPA Change Package M-16-16-01.	9/30/2018
	Fiscal Year 2019	
M-024-69	Complete construction of all wells listed for CY18 and before as listed in M-24-15-01	12/31/2018
M-015-98	Complete remedial investigation of U Plant related waste sites located in 200-WA-1 in accordance with the WA-1 RI/FS Work Plan	6/30/2019
M-085-70	Submit RI/FS Work Plan for 200-CB-1	9/30/2019
	Fiscal Year 2020	
M-015-99	Complete remedial investigation of PFP related waste sites located in 200-WA-1 in accordance with the 200-WA-1 and 200-BC-1 RI/FS Work Plan.	12/31/2019
M-085-72	Submit RAWP to implement the approved Action Memorandum for 224-B	9/30/2020
M-085-80	Submit RI/FS Work Plan for 200-CP-1	9/30/2020
M-085-100	Submit a RAWP to implement the approved Action Memorandum for 224-T	9/30/2020
M-037-10	Complete Unit-Specific closure requirements for six TSD units	9/30/2020
	Fiscal Year 2021	

M-016-86	Complete remedial actions for 618-11 Burial Ground	9/30/2021
M-085-90	Submit RI/FS Work Plan for 200-CR-1	9/30/2021
M-015-84	Complete RI of 200-WA-1 and 200-BC-1 Waste Sites in Accordance with RI/FS Work Plan	12/31/2021
Fiscal Year 2022		
M-037-13	Complete unit-specific closure requirements for 241-CX Tank System	9/30/2022
Fiscal Year 2023		
M-015-92B	Submit RFI/CMS, RI/FS, and Proposed CA Decision proposed plan for 200-EA-1	11/30/2022
M-015-93B	Submit RFI/CMS & RI/FS Study Report and proposed CAD/PP for 200-SW-2 OU	1/31/2023
M-015-92C	Submit RFI/CMS & RI/FS Study report and proposed CAD/PP for the 200-IS-1 OU to Ecology	3/31/2023
M-015-38B	Submit FS/PP for 200-CW-1, 200-CW-3 and 200-OA-1 OUs	7/31/2023
M-015-91B	Submit FS/PP for 200-BC-1 and200-WA-1 OUs	7/31/2023
M-015-110B	Submit CMS & FS and Proposed CAD/PP for 200-DV-1 OU	9/30/2023
Fiscal Year 2024		
M-016-200A	Complete U Plant canyon demolition	9/30/2024
M-037-11	Complete unit-specific closure requirements for 216-B-3 Main Pond System and 216-S-10 Pond and Ditch	9/30/2024
Fiscal Year 2025-2027		
M-085-76	Initiate response actions for the B Plant geographic area	9/30/2025
M-085-84	Initiate response actions for the PUREX geographic work	9/30/2025
M-085-01	Submit change package to establish a date for major milestone M-085-00	6/30/2026
M-016-200B	Complete U Plant barrier construction	9/30/2027

Project Managers Meeting – May 2017 (March and April Data)

Hanford's overall Site groundwater monitoring program managed by CHPRC (River Corridor and Central Plateau) coordinates collection of groundwater samples from wells and aquifer tubes, as well as surface water samples from springs. Sample trips are scheduled by target month and prioritized based on project needs. Target sample dates (months) are chosen to minimize the number of sample trips by temporally aligning requests from multiple activities for a single location into a single trip where practical.

FY 2016 Sample Trip Status by Month Scheduled

For Fiscal Year 2016 Hanford's overall Site groundwater monitoring program has 2,804 sample trips scheduled for collection. Prior to March 2017 the program had successfully completed 2798 of the FY 2016 sample trips. No additional FY 2016 sample trips were collected in March or April 2017.

FY 2017 Sample Trip Status by Month Scheduled (March and April 2017)

For Fiscal Year 2017 Hanford's overall Site groundwater monitoring program has 2,657 sample trips scheduled for collection.

During March 2017 (FY 2017, month six) the program successfully completed 3 sample trips scheduled for November 2016, 1 sample trip scheduled for December 2016, 14 sample trips scheduled for January 2017, 24 sample trips scheduled for February and 159 sample trips scheduled for March 2017. This brings the total number of Fiscal Year 2017 sample trips scheduled through February 2017 completed to 1,255 of 1,318 scheduled. And the total number of sample trips scheduled for March 2017 completed to 159 of 172 scheduled.

During April 2017 (FY 2017, month seven) the program successfully completed 6 sample trips scheduled for October 2016, 1 sample trip scheduled for November 2016, 2 sample trips scheduled for December 2016, 1 sample trip scheduled for February 2017, 6 sample trips scheduled for March 2017, and 138 sample trips scheduled for April 2017. This brings the total number of Fiscal Year 2017 sample trips scheduled through March 2017 completed to 1,430 of 1,490 scheduled. And the total number of sample trips scheduled for April 2017 completed to 138 of 152 scheduled.

The total number of Fiscal Year 2017 sample trips completed at the end of April 2017 is 1,568.

FY 2017 Sample Trip Status by Month Collected (March and April 2017)

During March 2017, 201 Fiscal Year 2017 sample trips were successfully completed of which 42 were scheduled prior to March 2017 and 159 were scheduled for March 2017.

During April 2017, 154 Fiscal Year 2017 sample trips were successfully completed of which 16 were scheduled prior to April 2017 and 138 were scheduled for April 2017.

The specific wells, aquifer tubes, and springs sampled in the river corridor areas during March 2017 are listed in Table 1. The specific wells, aquifer tubes, and springs sampled in the central plateau areas during April 2017 are listed in Table 2.

Awaiting Sample Trips

Of the Fiscal Year 2016 and 2017 sample trips scheduled for April 2017 and prior, there are 83 that are awaiting collection. Of these, 3 are being reviewed for cancellation, 13 were unsuccessful, 2 are awaiting drilling, and 65 are awaiting collection at the month end.

Table 3 presents the sample trips for only the central plateau that were not successfully completed as of April. Sample trips in Table 2 are grouped by fiscal month scheduled and groundwater interest area. This table clearly shows that the number of awaiting well trips decreases with time from the schedule date. Reasons for sample trips to be awaiting include but are not limited to issues such as well maintenance, weather conditions, access restrictions, and resource limitations.

Upcoming Sample Trips

Sample trips for the river corridor only, scheduled for collection in May 2017 and June 2017 (and not collected before the target sample month) are listed in Table 4 and Table 5 respectively.

WMA C Tank Farm

WMA C Tank Farm samples for the second quarter were collected on March 24, 27, and 29. WMA C Tank Farm sample for the third quarter of FY-2017 are scheduled to be collected in June. WMA C Tank Farm monitoring wells are listed in Table 6

Data Access

The sampling results are available in HEIS and can be accessed from the Environmental Dashboard Application which can be accessed from the HLAN at https://ehs.chprc.rl.gov/eda/ or from the internet at https://ehs.hanford.gov/eda/.

Table 1 Wells, Aquifer Tubes, and Springs in the Central Plateau Areas Successfully Sampled In March 2017

200-BP	200-PO	200-UP	200-ZP
299-E27-12	299-E17-1	299-W19-115	299-W10-14
299-E27-13	299-E17-12	299-W21-3	299-W10-26
299-E27-14	299-E17-13	299-W22-115	299-W10-27
299-E27-15	299-E17-14	299-W22-116	299-W10-29
299-E27-155	299-E17-15	299-W22-47	299-W10-30
299-E27-21	299-E17-16	299-W22-93	299-W10-31
299-E27-22	299-E17-18	299-W23-19	299-W11-41
299-E27-23	299-E17-19	699-19-88	299-W14-11
299-E27-24	299-E24-20	699-26-89	299-W14-13
299-E27-25	299-E24-22	699-29-66	299-W14-18
299-E27-26	299-E24-33	699-31-68	299-W15-46
299-E27-5	299-E25-2	699-32-64	299-W15-49
299-E27-7	299-E25-23	699-34-61	299-W15-50
299-E28-30	299-E25-237	699-35-66A	299-W15-7
299-E33-12	299-E25-36	699-36-66B	299-W18-1
299-E33-341	299-E25-40	699-36-70A	299-W18-16
299-E33-342	299-E25-41	699-37-66	299-W6-3

200-BP	200-PO	200-UP	200-ZP
299-E33-360	299-E25-42	699-38-68A	299-W9-2
699-49-57A	299-E25-93		699-47-80AQ
699-49-57B	299-E25-94		699-49-100C
	699-30-57		
	699-31-53B		
	699-34-51		
	699-37-E4		
	699-40-1		
	699-41-1A		
	699-43-3		
	699-43-44		
	699-46-4		
	699-S24-19P		
	699-S8-19		

Table 2 Wells, Aquifer Tubes, and Springs in the Central Plateau Areas Successfully Sampled In April 2017

200-BP	200-PO	200-UP	200-ZP
299-E27-10	299-E13-14	299-W18-260	299-W10-26
299-E27-11	299-E16-1	299-W19-12	299-W10-27
299-E27-16	299-E16-2	299-W19-41	299-W11-41
299-E27-17	299-E17-1	299-W19-42	299-W14-11
299-E27-18	299-E17-1	299-W22-114	299-W14-13
299-E27-19	299-E17-15	699-30-63	299-W14-18
299-E27-8	299-E17-15	699-32-59	699-43-69
299-E27-9	299-E25-18	699-32-62	699-45-69C
299-E33-33	299-E25-2	699-32-70B	699-47-60
299-E33-343	299-E25-22	699-32-72A	699-48-77C
299-E34-10	299-E25-26	699-36-63B	699-48-77D
299-E34-12	299-E25-28	699-36-70B	
299-E34-2	299-E25-32P		
299-E34-8	299-E25-34		
299-E34-9	299-E25-35		
299-E34-9	299-E25-43		
699-42-40C	299-E25-47		
699-43-41F	299-E25-48		
699-48-50B	299-E26-12		
699-49-55A	299-E26-13		
699-50-56	699-10-54A		
699-50-59	699-22-35		

200-BP	200-PO	200-UP	200-ZP
699-52-55	699-23-34B		
699-52-55B	699-24-33		
699-53-47B	699-24-34D		
699-53-48A	699-24-34E		
699-53-55B	699-24-35		
699-53-55C	699-24-36		
699-55-50C	699-25-33A		
699-55-57	699-25-34B		
699-55-60A	699-25-34D		
699-57-59	699-25-34E		
699-59-58	699-25-34F		
699-60-60	699-26-33A		
699-61-62	699-26-34A		
699-61-66	699-26-34B		
699-64-62	699-26-35A		
	699-26-35C		
	699-26-38		
	699-37-47A		
	699-41-23		
	699-43-45		
	699-46-21B		

Table 3 Fiscal Year 2016 and 2017 Sample Trips in the Central Plateau Areas awaiting at the end of April 2017

Qtr Sched	GWIA	SAMP SITE_TYPE	SITE_NAME	SCHEDULE DATE	Frequency	Months Remain	Status	Comment
FY 2016 Q3	200-BP	WELL	299-E28-32	6/1/2016	Annual	2		
	200-PO	WELL	299-E13-16	4/1/2016	Once Every 2 Years	11		
	200-PO	WELL	299-E13-7	4/1/2016	Once Every 2 Years	11		
FY 2016 Q4	200-BP	WELL	299-E28-15	7/1/2016	Annual	3		Unsuccessful 7/20/2016
	200-BP	WELL	299-E33-10	8/1/2016	Annual	4		
	200-UP	WELL	299-W19-4	8/1/2016	Annual	4		Unsuccessful 4/14/2017
	200-UP	WELL	699-17-70	7/1/2016	Annual	3		
FY 2017 Q1	200-BP	WELL	299-E28-5	10/1/2016	2 Times Annually	1		Unsuccessful 10/7/2016
	200-BP	WELL	299-E33-205	10/1/2016	2 Times Annually	0	Late	Review for Cancellation
	200-BP	WELL	299-E33-50	12/1/2016	Annual	7		
	200-PO	WELL	299-E24-23	12/1/2016	Annual	7		
	200-PO	WELL	499-S0-7	10/1/2016	Annual	5		
	200-PO	WELL	499-S0-8	10/1/2016	Annual	5		

Qtr Sched	GWIA	SAMP SITE_TYPE	SITE_NAME	SCHEDULE DATE	Frequency	Months Remain	Status	Comment
	200-PO	WELL	499-S1-8J	10/1/2016	Annual	5		
	200-PO	AQUIFER TUBE	C6384	10/1/2016	Annual	5		Unsuccessful 9/27/2016
	200-UP	WELL	299-W13-2	11/1/2016	Annual	6		
	200-ZP	WELL	299-W18-7	11/1/2016	Annual	6		
	200-ZP	WELL	299-W5-2	11/1/2016	Annual	6		
	200-ZP	WELL	699-48-96	12/1/2016	Annual	7		
FY 2017 Q2	200-BP	WELL	299-E28-33	1/1/2017	Semi-annual	2		Awaiting drilling
	200-BP	WELL	699-42-40A	1/1/2017	Annual	8		Unsuccessful 2/27/2017
	200-BP	AQUIFER TUBE	C6236	1/30/2017	Other	5		
	200-BP	AQUIFER TUBE	C6237	1/30/2017	Other	5		
	200-BP	AQUIFER TUBE	C6238	1/30/2017	Other	5		
	200-PO	WELL	299-E17-21	1/1/2017	Annual	8		Unsuccessful 1/27/2017
	200-PO	WELL	299-E24-4	3/1/2017	Annual	10		Unsuccessful 3/17/2017
	200-PO	WELL	299-E25-9	3/1/2017	Annual	10		
	200-PO	WELL	699-20-E12O	1/1/2017	Annual	8		
	200-PO	WELL	699-20-E12S	1/1/2017	Annual	8		
	200-PO	WELL	699-36-58B	1/1/2017	Annual	8		
	200-PO	WELL	699-43-43	1/1/2017	Annual	8		
	200-PO	WELL	699-S2-34B	3/1/2017	Annual	10		
	200-UP	WELL	299-W17-3	1/1/2017	Annual	8		
	200-UP	WELL	699-35-59	2/1/2017	Annual	9		
	200-UP	WELL	699-35-78A	3/1/2017	3 Times Annually	1		
	200-ZP	WELL	299-W11-22	1/1/2017	Annual	8		
	200-ZP	WELL	299-W11-90	1/1/2017	Annual	8		
	200-ZP	WELL	299-W15-225	1/1/2017	Annual	8		
	200-ZP	WELL	299-W15-36	2/1/2017	Annual	9		
	200-ZP	WELL	299-W17-2	1/1/2017	Annual	8		
FY 2017 Q3	200-BP	WELL	299-E33-205	4/1/2017	2 Times Annually	0	Late	Review for Cancellation
	200-BP	WELL	299-E33-9	4/1/2017	Annual	11		
	200-PO	WELL	299-E13-13	4/1/2017	Annual	11		
	200-PO	WELL	299-E13-15	4/1/2017	Annual	11		
	200-PO	WELL	299-E13-4	4/1/2017	Annual	11		
	200-PO	WELL	299-E13-5	4/1/2017	Annual	11		
	200-PO	WELL	299-E17-9	4/1/2017	Annual	11		Unsuccessful 4/14/2017
	200-PO	WELL	299-E25-21	4/1/2017	Annual	11		Unsuccessful 4/6/2017
	200-UP	WELL	699-19-88	4/1/2017	Quarterly	2		

Qtr Sched	GWIA	SAMP SITE_TYPE	SITE_NAME	SCHEDULE DATE	Frequency	Months Remain	Status	Comment
	200-ZP	WELL	299-W14-74	4/1/2017	Annual	11		
	200-ZP	WELL	699-45-69A	4/1/2017	Annual	11		Unsuccessful 4/17/2017
	200-ZP	WELL	699-49-100C	4/1/2017	Quarterly	2		

Table 4 Groundwater Sampling Locations in the Central Plateau Areas Scheduled to be sampled in May 2017

200-BP	200-PO	200-UP	200-ZP
199-K-183		299-W19-115	299-W10-26
199-K-31		299-W19-116	299-W10-27
299-E33-20		299-W19-123	299-W11-40
299-E33-31		299-W19-125	299-W11-41
299-E33-32		299-W26-13	299-W11-42
299-E33-334		299-W26-14	299-W11-45
299-E33-335		299-W27-2	299-W11-47
299-E33-337		699-32-76	299-W14-11
299-E33-338		699-33-74	299-W14-13
299-E33-339		699-33-75	299-W14-14
299-E33-38		699-33-76	299-W14-15
299-E33-41		699-38-70B	299-W14-18
299-E33-42		699-38-70C	299-W14-19
299-E33-44		699-40-65	299-W15-44
299-E33-47			299-W15-763
299-E33-48			
299-E33-49			

Table 5 Groundwater Sampling Locations in the Central Plateau Areas Scheduled to be sampled in June 2017

200-BP	200-PO	200-UP	200-ZP
299-E26-8	299-E24-20	299-W21-2	299-W10-26
299-E27-12	299-E24-22	299-W21-3	299-W10-27
299-E27-13	299-E24-33	299-W22-10	299-W11-41
299-E27-14	299-E24-5	299-W22-113	299-W14-11
299-E27-15	299-E25-2	299-W22-114	299-W14-13
299-E27-155	299-E25-237	299-W22-115	299-W14-18
299-E27-21	299-E25-40	299-W22-116	699-50-74
299-E27-22	299-E25-41	299-W22-24P	699-51-63
299-E27-23	299-E25-93	299-W22-47	
299-E27-24	299-E25-94	299-W22-69	
299-E27-25	699-30-57	299-W22-72	

200-BP	200-PO	200-UP	200-ZP
299-E27-26	699-31-53B	299-W22-80	
299-E27-7	699-34-51	299-W22-81	
299-E28-11		299-W22-82	
299-E28-2		299-W22-83	
299-E28-21		299-W22-84	
299-E28-23		299-W22-85	
299-E28-24		299-W22-86	
299-E28-25		299-W22-87	
299-E28-3		299-W22-88	
299-E28-31		299-W22-89	
299-E28-32		299-W22-90	
299-E28-5		299-W22-92	
299-E28-6		299-W22-93	
299-E28-7		299-W22-94	
299-E28-8		299-W22-95	
299-E28-9		299-W22-96	
		299-W23-19	
		299-W23-20	
		299-W23-21	
		299-W23-236	
		699-29-66	
		699-30-63	
		699-31-68	
		699-32-59	
		699-32-64	
		699-36-61A	
		699-36-63B	
		699-38-65	

Table 6. WMA C Quarterly Monitoring Wells

SITE_NAME
299-E27-12
299-E27-13
299-E27-14
299-E27-15
299-E27-155
299-E27-21
299-E27-22
299-E27-23
299-E27-24
299-E27-25

SITE_NAME
299-E27-26
299-E27-7

TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0759	TPA CHANGE NOTICE FORM	Date: 11/08/16
Document Number, Title, and Revision: DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan, Rev. 5		Date Document Last Issued: April 2016
Approved Change Notices Against this Document: TPA-CN-0725		
Originator: Bill Barrett		Phone: 373-3985

Description of Change:
Appendix B, in Waste Management Plan for the 200 West Pump and Treat, DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan, Rev. 5, is revised to add the location identified in Figure B-3 for storage of investigation derived waste (IDW).

M.W. Cline (**DOE**) and E. Laija (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement*.

Page B-10, Paragraph 1, of Appendix B, Waste Management Plan for the 200 West Pump and Treat, in DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan, Rev. 5, is revised to add the location identified in Figure B-3 for storage of IDW. Previously, only the location shown in Figure B-4 was identified. Figure B-4, Page B-11, was revised to clarify the waste storage location and to be consistent with Figure B-1 in the 200-UP-1 Waste Management Plan.

Added text is shown in <u>double underline</u> on page B-10. Figure B-4 is replaced in its entirety.

Note: Include affected page number(s): B-10 & B-11

Justification and Impacts of Change:
The addition of another IDW waste storage area will add efficiency to management of waste that is generated pursuant to the 200-ZP-1 Record of Decision and the 200-UP-1 Interim Record of Decision. Figure B-4 has been changed to match Figure 1 in the 200-UP-1 Waste Management Plan.

Approvals:

M.W. Cline DOE Project Manager	11/17/2016 Date	[X] Approved [ ] Disapproved
Ernest Laija EPA Project Manager	11/17/16 Date	[X] Approved [ ] Disapproved
N/A Ecology Project Manager	Date	[ ] Approved [ ] Disapproved

Figure B-3. 200 West P&T Waste Storage Location

The IDW waste (e.g., drill cuttings) may be accumulated near the point of generation while awaiting analytical laboratory test results. IDW also may be accumulated at the 200-ZP-1 *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) waste storage area (Figure B-4) or at the 200-ZP-1 waste storage location at the 200 West P&T waste storage location (Figure B-3). Waste from 200-UP-1 and 200-PW-1 OUs may also be stored at these locations; however, the waste is kept segregated by operable unit and will not be co-mingled. If IDW must be stored for longer than 6 months after designation, concurrence from the lead regulatory agency will be obtained on storage, treatment, and disposal options of the waste, along with the disposition schedule.

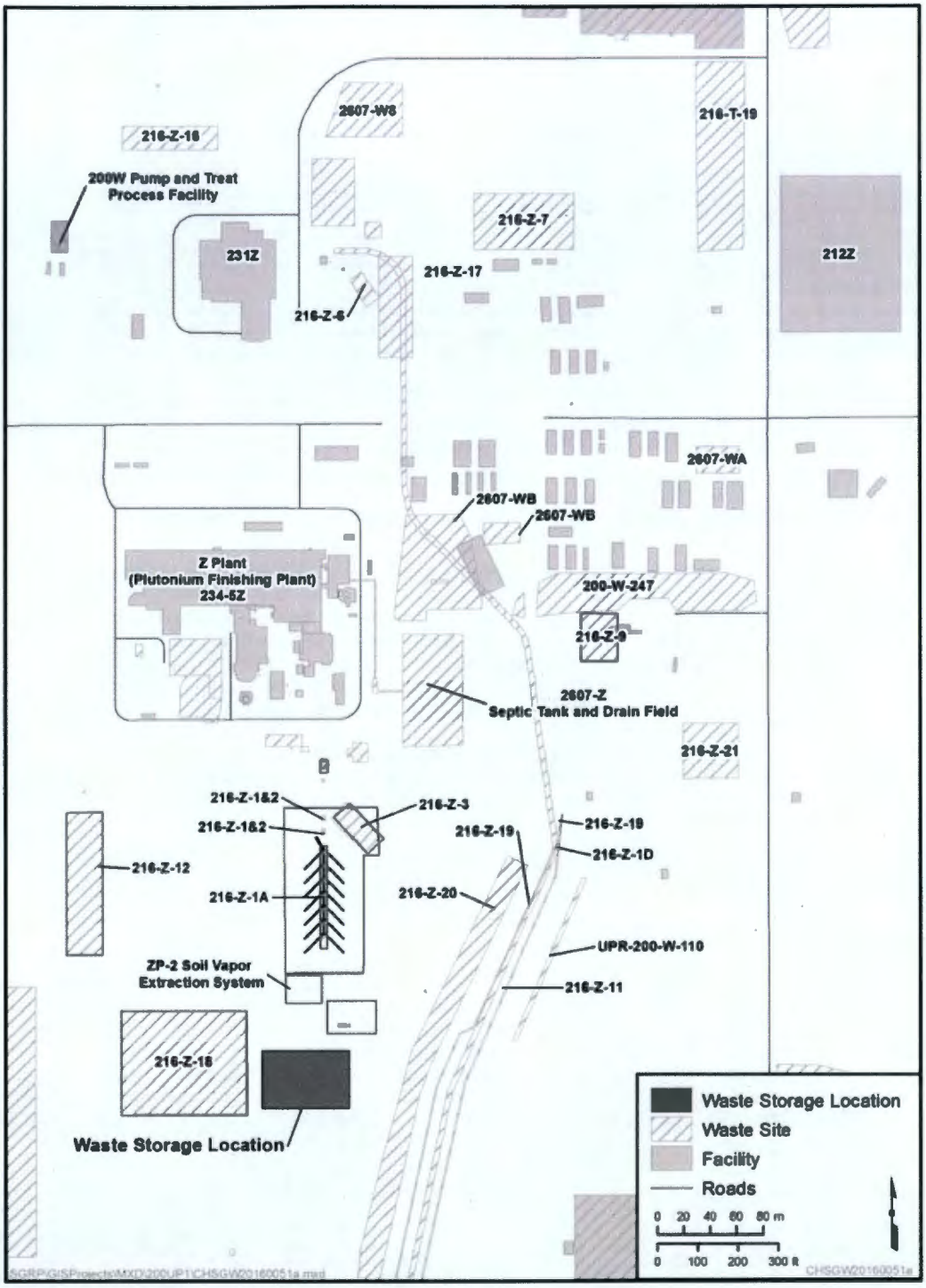


Figure B-4. 200-ZP-1 Waste Storage Location

TRI-PARTY AGREEMENT

Change Notice Number	TPA CHANGE NOTICE FORM	Date:
TPA-CN- 0764		March 9, 2017

Document Number, Title, and Revision:	Date Document Last Issued:
DOE/RL-2010-88 Rev. 0 Sampling and Analysis Plan for Uranium Sequestration Pilot Test	April 2015

Approved Change Notices Against this Document: N/A

Originator: Mark Byrnes | Phone: 509 373-3996

Description of Change:
Changes to this Sample and Analysis Plan are required to address the revised sampling approach, borehole locations, sampling intervals, and associated number and type of sampling to be completed in support of completion of the borehole/well network for the Uranium Reactive Gas Sequestration Pilot Test.

M.W. Cline (DOE) and C.E. Cameron (Lead Regulatory Agency) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement*.

Changes include:
Section 1-1 is revised to include the phased approach that is outlined in Section 3 of this SAP. Table 1-1 is revised to correct a grammatical error.
Section 3-1, page 3-1 revising the third paragraph to address the initial borehole drilling that was completed and outlines the drilling to be completed for conducting and completing the Uranium Reactive Gas Testing. Page 3-2 revised text recognizing that borehole 4 is already installed. Added text to give flexibility to the number of post-treatment boreholes that could be drilled.
Section 3-2, page 3-3, change based on updated well network recognizing that borehole 4 is already installed.
Section 3-3, page 3-4 revised table 3-1 with new borehole numbers and locations. Page 3-4, last paragraph revised text to reflect that numbers and types of analyses may be adjusted based on data reviewed from boreholes 1 through 4. Page 3-5 Table 3-2 corrects borehole number. Table 3-3 page 3-7 and 3-8 corrects borehole numbers.

All deletions are indicated by ~~strikeout~~ and new text indicated by double underline.
Note: Include affected page number(s): 1-1, 1-6, 3-1, 3-2, 3-3, 3-4, 3-6, 3-7, and 3-8

Justification and Impacts of Change:
Changes were made to reflect the situation in the field where the initial well installed could not be completed as the injection well as planned. This initial well is now a monitoring location and the well network was slightly shifted to accommodate this change. The change also recognizes that sediment characterization which was not originally planned at this monitoring well location was already conducted and should be considered in the characterization effort associated with installation of the remaining site wells and monitoring locations. Because there was more than a year delay between the initial well and planned installation of the remainder of the well network, these changes to the Sampling and Analysis Plan will help better document the plan for the remainder of the test.

Approvals:

Mark W. Cline	3/9/2017	[X] Approved [ ] Disapproved
DOE Project Manager	Date	
Craig Cameron	3/9/2017	[X] Approved [ ] Disapproved
EPA Project Manager	Date	
N/A		[ ] Approved [ ] Disapproved
Ecology Project Manager	Date	

1 Introduction

This sampling and analysis plan (SAP) describes the field sampling activities and quality assurance processes for obtaining data of sufficient quality and quantity to support the Uranium Sequestration Pilot Test (USPT) as described by DOE/RL-2010-87, *Field Test Plan for the Uranium Sequestration Pilot Test*. The pilot or treatability test involves injection of a reactive gas (ammonia) into contaminated subsurface sediments in the vadose zone to induce geochemical changes that act to render contaminants, such as uranium, less mobile. Completion of the USPT will provide specific information that will be used to evaluate uranium sequestration via vadose zone ammonia injection as a treatment technology for reducing the mobility of contaminants that have the potential to adversely impact groundwater. It is anticipated the test will provide information that will enable uranium sequestration via ammonia injection to be considered as a remedy in *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) response actions.

1.1 Project Scope and Objective

The USPT test is being implemented to evaluate the effectiveness of injecting ammonia gas into the Hanford Site vadose zone to decrease the mobility of uranium, and other similar contaminants, in order to protect the underlying groundwater. A phased approach for implementation is outlined in detail in Section 3 Field Sampling Plan. Groundwater risk mitigation is derived from reducing the fraction of uranium contamination that is mobile. This process, uranium sequestration via ammonia injection, will be evaluated in a treatability test conducted at the 200-WA-1 Operable Unit (OU), located in the 200 West Area of the Hanford Site. The specific test site selected is adjacent to the 216-U-8 Crib in this OU. Figure 1-1 shows the location of the 216-U-8 Crib (lower center in figure) relative to the U Plant (Building 221-U) located within the 200 West Area of the Hanford Site.

The USPT will require drilling eight boreholes on the south side of the 216-U-8 Crib, one of which will serve as the ammonia injection well. Five surrounding boreholes will be equipped with instrumentation to monitor the ammonia/sediment pore water reaction process and collect data to evaluate ammonia injection as a potential remedy to protect groundwater from mobile contaminants. After the ammonia has been injected into the subsurface sediments, and the ammonia/pore water reaction has been completed, two boreholes will be drilled through the treatment zone to sample and characterize the treated sediments. The sediment results and the data collected during the test from in situ instruments and sensors will be used to evaluate the effectiveness of the treatment technology.

1.2 Background

The U.S. Department of Energy (DOE) Hanford Site is a 1,517 km^2 (586 mi^2) federal facility located in southeastern Washington State along the Columbia River. For administrative purposes, the Hanford Site was divided into four National Priority List (NPL) sites (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List") under CERCLA in 1989, one of which is the 200 Area. In anticipation of the NPL (40 CFR 300, Appendix B) listing, the Washington State Department of Ecology (Ecology), the U.S. Environmental Protection Agency (EPA), and DOE entered into the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a), also known as the Tri-Party Agreement (TPA), in May 1989. This agreement established a procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions and *Resource Conservation and Recovery Act of 1976* (RCRA) compliance and permitting, on the Hanford Site.

Table 1-1. Summary of Problem Statement 1

Problem Statement 1	The vadose zone sediments near the 216-U-8 Crib represent a region of subsurface uranium contamination that has been selected to demonstrate the effectiveness of uranium sequestration using treatment by injection of ammonia.	
Principal Study Question 1	Does the planned test interval contain sufficient mobile uranium and have characteristics suitable to evaluate potential treatment effectiveness?	
Discussion	Data obtained from nearby characterization boreholes indicates two regions of uranium-contaminated sediment that may be suitable to demonstrate uranium sequestration by ammonia injection. The upper region is in the Hanford formation at about 10.6 m (35 ft) bgs. The lower region is in the CCU silt zone at about 58 m (190 ft) bgs. The upper region is ~~been~~ proposed for the treatability test.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**
Vertical profile and distribution of uranium soil concentrations and lithology of the upper region of contaminated sediment (Hanford formation)	Collect continuous geophysical (neutron moisture and spectral gamma) measurements and lithology observations from three boreholes drilled through the upper region of contaminated sediment in the Hanford formation.	This information will be combined with existing data to refine the conceptual site model of uranium soil concentrations in the study area. The geophysical measurements will be used to select vertical profile interval samples for chemical and physical characterization.
Chemical and physical characteristics of contaminated sediment in the upper region of contamination (Hanford formation)	Conduct sequential extraction tests on vertical profile samples obtained from the three boreholes drilled through the upper region of contaminated sediment to determine the amount of labile uranium.	Confirm that sufficient labile uranium (>20%) is present to meet the test objectives. Confirm mobile uranium concentrations are present in concentration conducive for the treatability test (30 µg/L). Confirm that contaminant and sediment characteristics are conducive for the treatability test.
	Conduct grain-size, bulk conductivity, and chemistry analyses on samples selected for the leachability study.	Determine the physical characteristics of the sediments that may affect leachability and the treatability test.
Principal Study Question 2	Does laboratory testing of sediments obtained from the planned test interval show reduction in mobile uranium content due to ammonia treatment?	
Discussion	Vertical profile samples from PSQ 1 will be selected for laboratory exposure to ammonia to simulate the treatability test. Exposed samples will then be characterized in a similar manner as the samples characterized for PSQ 1 to determine the effectiveness of the treatment.	
Data Need	**Measurement/Observation and Location/Frequency**	**Data Use**

3 Field Sampling Plan

The objective of the field sampling plan is to identify project sampling and analysis activities. The field sampling plan uses the sampling design identified during the systematic planning process, and includes defining the number of sample locations, sampling methods, field documentation, field equipment calibration requirements, and specific information on the various data collection technologies.

3.1 Sampling Design

The USPT will be conducted at the south end of the 216-U-8 Crib. The vadose zone near this site has been previously characterized, and data indicate the presence of significant levels of mobile uranium contamination. As shown earlier in Figure 1-2, two zones of uranium contamination have been previously identified: one relatively shallow in the Hanford formation and another much deeper in the CCU silt layer. This treatability test will focus on the shallow region of contamination in the Hanford formation.

The treatability test is designed to evaluate uranium sequestration via vadose zone ammonia gas injection as a potential remedy for groundwater protection. The test will consist of a single ammonia injection well screened within an interval of the vadose zone where sufficient mobile uranium contamination exists to test the technology. The target soils will be characterized prior to the test to ensure that uranium contamination is present, and the conditions are suitable for the test. Ammonia gas will then be injected into the vadose zone through the well to interact with the sediment moisture to increase its pH and render it sufficiently corrosive to dissolve a fraction of the aluminosilicate minerals that are present. Ammonia gas concentrations and soil parameters (e.g., temperature and electrical conductivity) will be monitored during the test to evaluate the distribution of ammonia in the subsurface. After ammonia injection is stopped, sediment pore water pH will return to near normal, resulting in precipitation of the aluminosilicate minerals and their entrainment of a significant portion of the mobile uranium. Post-treatment borehole geophysical logging and soil samples will be collected and analyzed to evaluate the effectiveness of the treatment.

The sampling strategy uses a phased approach to define the specific test site, evaluate the test site characteristics, and determine the effectiveness of the treatment. A borehole was drilled and completed as a monitoring well at the site with samples collected and analyzed per the Borehole 1 description below. However, this well could not be completed as an injection well and was, instead, completed as a monitoring well to serve as the Borehole 4 location (Figure 3-1). Data from this borehole confirm the presence of mobile uranium contamination within the 30-to-60-ft depth interval. Five additional boreholes (1, 2, 3, 5, and 6) will be installed to complete the borehole/well network for the test. Borehole 1 will include all of the sampling and analysis described below to assist in selecting the injection well screen interval. Sampling of Boreholes 2 and 3 will proceed as described below. However, the project team will review the data from Boreholes 1 and 4 and determine the number of samples and type of analyses to be conducted in Boreholes 2 and 3 up to the maximum listed below.

The phases of the field test, which are aspects of the treatability test, are described as follows:

- **Phase 1 – Site Characterization.** Three boreholes (Boreholes 1, 2, and 3, Figure 3-1) will be installed at the study site and sampled to characterize the vadose zone soils. The characterization data will be used to (1) validate the test site selection, (2) obtain baseline information for site characterization, (3) determine the effectiveness of ammonia on uranium present at the site, and (4) select a target treatment zone. The boreholes will be drilled in a manner to retain the representativeness of vadose zone soil samples.

- Borehole 1 will be drilled to a depth of approximately 24.3 m (80 ft) bgs. Soil samples will be collected continuously, initiating at approximately 9.1 m (30 ft) bgs. Sampling will be performed using a 10.2 cm (4 in.) diameter, 0.76 m (2.5 ft) long split-spoon sampler equipped with four separate nonconductive plastic liners that are each 15.2 cm (6 in.) long which will be sealed and shipped to the laboratory for analysis. Once final depth is achieved, and all samples have been obtained, Borehole 1 will be geophysically logged using downhole neutron, spectral gamma, total gamma, and temperature technology.
- Based on the data from Borehole 1 showing that the study site is suitable for the treatability test, two additional boreholes will be installed. Boreholes 2 and 3 will be drilled to a depth based on the characterization information determined from Borehole 1. Soil samples will be collected continuously, initiating at approximately 9.1 m (30 ft) bgs. Sampling will be performed using a 10.2 cm (4 in.) diameter, 0.76 m (2.5 ft) long split-spoon sampler equipped with four separate nonconductive plastic liners that are each 15.2 cm (6 in.) long which will be sealed and shipped to the laboratory for analysis. Once final depth is achieved, and all samples have been obtained, the boreholes will be geophysically logged using downhole neutron and spectral gamma technology.

- **Phase 2 – Field Site Test System.** Based on the data from Phase 1 confirming that the study site is suitable for the treatability test, Boreholes 4~~,~~ 5 and 6 will be installed at the site. The boreholes will be drilled to depths based on the characterization information determined from Phase 1. Once final depth is achieved, the boreholes will be geophysically logged using downhole neutron and spectral gamma technology. Borehole 1 will be completed as the injection well, and Boreholes 2, 3, 4, 5, and 6 will be completed as monitoring locations. Post-completion, the well will be logged using downhole neutron, spectral gamma, total gamma, and temperature technology. These same logging processes will also be conducted after in situ instruments indicate that the borehole has reached a suitable equilibration with subsurface conditions. Monitoring will focus on obtaining and field-analyzing gas samples, monitoring temperature at multiple depth intervals, monitoring borehole and surface electrodes for electrical resistivity tomography (ERT) surveys, performing ground penetrating radar surveys, and collecting neutron moisture logging data.

- **Phase 3 – Conduct Field Test.** Pending successful site characterization and installation of the injection well and monitoring system, the field test will be conducted. Permeability and tracer gas testing will provide baseline information about injected gas flow in the treatment zone. Ammonia distribution during injection operations will be evaluated based on ammonia gas concentrations at the gas sampling locations, ERT, and in situ temperature data at discrete locations. Post-treatment sediment samples will be analyzed in the laboratory to evaluate treatment effectiveness.

- **Phase 4 – Post-Treatment Characterization.** In the final phase of the treatability test, post-treatment sediment samples will be collected from the treatment area and used to evaluate treatment effectiveness. Post-treatment sediment samples, obtained from two boreholes drilled after the treatment test, will be paired with pre-treatment sample locations. At least t~~T~~he two post-treatment boreholes will be drilled to a depth selected based the test system boreholes (Phase 1) and data from the field test (Phase 3). Soil samples will be collected continuously, initiating at approximately 9.1 m (30 ft) bgs. Sampling will be performed using a 10.2 cm (4 in.) diameter, 0.76 m (2.5 ft) long split-spoon sampler equipped with four separate nonconductive plastic liners that are each 15.2 cm (6 in.) long which will be sealed and shipped to the laboratory for analysis. Once final depth is achieved, and all samples have been obtained, the post-treatment boreholes will be geophysically logged using downhole neutron and spectral gamma technology.

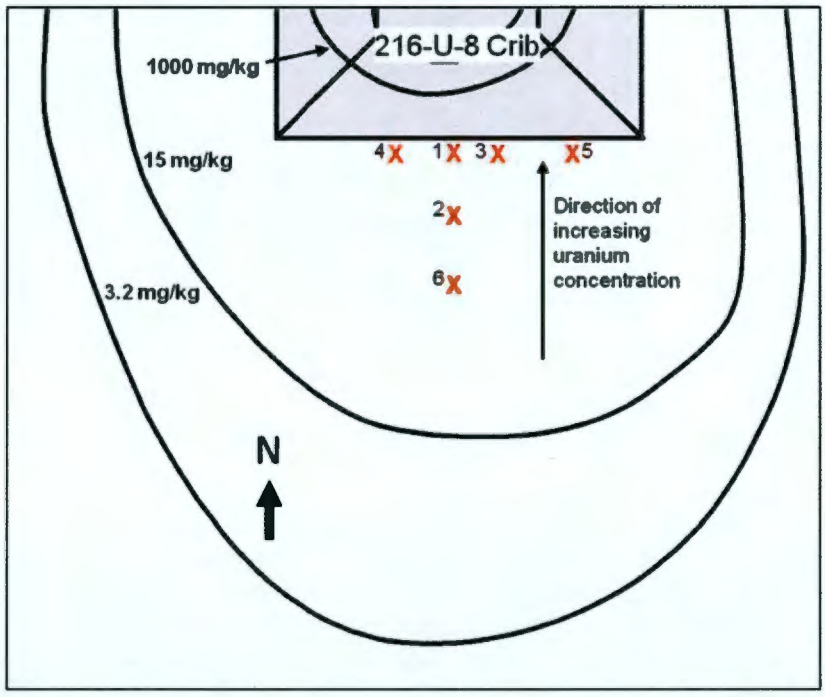
3.2 Borehole Drilling

The borehole drilling method will be approved by the OU project Technical Lead in consultation with the well maintenance and drilling manager. To avoid potential impact to the representativeness of vadose zone soil samples, all efforts must be made to drill without the use of drilling fluids or slurry makeup water. In the event that drilling slurry makeup water is needed, the situation must be discussed with project technical staff before proceeding.

Boreholes will be drilled to approximately 24.3 m (80 ft) bgs (depth does not include additional drilling pad thickness, if any). The final total depth of the boreholes will be determined by the Technical Lead and confirmed by the drilling BTR and site geologist and may change depending on subsurface conditions encountered. In the event that subsurface conditions prevent completion of the borehole to its intended depth, the Project Manager will be consulted to determine the path forward.

All boreholes will be geophysically logged using downhole neutron, temperature, spectral gamma, and total gamma technology, as described in Section 3.1. Sediment samples will be collected in Boreholes 1, 2, and 3 and in the post-treatment boreholes (see Section 3.3). Sediment samples will not be collected in Boreholes 4~~5~~ and 6.

Proposed borehole locations are shown on Figure 3-1, with the estimated NAD83, *North American Datum of 1983*, coordinates provided in Table 3-1.



Note: Uranium concentration data is from D&D-27783, *200-UW-1 Field Summary Report for Fiscal Years 2004 and 2005*. Contours are the estimated uranium sediment concentrations from previous characterization in the upper 25 m (82 ft) of the vadose zone (not to scale).

Figure 3-1. Location of Boreholes

3.3 Sampling Methods

To ensure sample and data usability, the sampling associated with this SAP will be performed in accordance with HASQARD (DOE/RL-96-68), pertaining to sample collection, collection equipment, and sample handling.

Soil samples will be collected throughout the length of the borehole, initiating at approximately 9.1 m (30 ft) bgs to the bottom of the borehole, which is estimated to be at approximately 24.3 m (80 ft) bgs. Sampling will be performed using a 10.2 cm (4 in.) diameter, 0.76 m (2.5 ft) long split-spoon sampler. The split-spoon samplers will be equipped with four separate nonconductive plastic liners that are each 15.2 cm (6 in.) long. If sufficient sample recovery is not achieved, soil from the split-spoon drive shoe may be used to supplement the sample mass of the split-spoon liners. Site personnel will not overdrive the sampling device.

Table 3-1. Estimated Location Coordinates for Proposed Boreholes (NAD83 Washington State Plane South)

Location	Borehole~~/Well Identification~~	Northing (m)	Easting (m)
Borehole 1	C9519~~6/299-W22-118~~	134663~~134669.01~~	567619~~567615.96~~
Borehole 2	C9515~~9/299-W22-121~~	134660~~134666.01~~	567619~~567615.96~~
Borehole 3	C9518~~7/299-W22-119~~	134663~~134669.01~~	567621~~567617.96~~
Borehole 4	~~C9515~~C9520~~/299-W22-117~~	134663~~134669.01~~	567615.93~~567612.96~~
Borehole 5	C9517~~8/299-W22-120~~	134663~~134669.01~~	567624~~561620.96~~
Borehole 6	C9583~~20/299-W22-122~~	134657~~134663.01~~	567619~~567615.96~~
Post-treatment 1	C9522*	TBD	TBD
Post-treatment 2	C9523*	TBD	TBD

Source: NAD83, North America Datum of 1983.
* Borehole only; boring will not be completed as a well.
TBD = to be determined (based on results of the ammonia injection phase of the test)

Upon retrieval of the split-spoon sampler, each split-spoon liner will be labeled at the top and bottom with the appropriate depths (e.g., 9.1 m [30 ft] and 9.2 m [30.5 ft]) and labeled according to borehole number (i.e., C9519~~6~~). Each split-spoon liner will also be labeled regarding its position in the split-spoon (i.e., A, B, C, or D, with the bottom/deepest liner being "A" to the uppermost liner being "D"). A continuous line will be drawn the length of the split-spoon liner, with an arrow pointing to the shallowest end of the liner (i.e., with an "up" arrow indicating core orientation). Figure 3-2 shows the split-spoon liner samples and labeling. Once the split-spoon liners have been appropriately labeled, photos will be taken of the ends of each split-spoon liner to show the sediment.

Table 3-2 shows the borehole information and sample design for Borehole 1. Table 3-3 shows the borehole information and sample design for Boreholes 2 and 3, though numbers and types of analyses may be adjusted by the project team based on review of data from Boreholes 1 and 4. Table 3-4 shows the borehole information and sample design for the post-treatment boreholes.

Table 3-2. Location, Depth, and Sample Design for Borehole 1

Sample Location		C95169	
Estimated Sample Depth		9.1 to 24.3 m (30 to 80 ft) bgs	
Projected Total Depth		Approximately 24.3 m (80 ft) bgs	
Media	**Sample Type[a]**	**Sample Location**	**Analytes**
Soil	All split-spoon liners	Continuous	Lithology description Core photographs Air permeability screening Gamma scan
	Obtain sample material from intact split-spoon liners in positions A, B, or C. Hold split-spoon liner D in reserve for additional sampling if needed.	Select five intervals for characterization. Select sample intervals (split-spoon liners A, B, or C) based on a combination of downhole neutron and spectral gamma geophysical measurements. Hold split-spoon liner D in reserve. For each interval, use one liner for sequential extraction, and use adjacent liners for other physical/ chemical analyses.	Uranium using sequential chemical extraction (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium
			Gamma energy analysis Total uranium (microwave digestion) Uranium mineralogy by fluorescence[b] Sediment mineralogy[b]
			Deionized WE (<4 mm grain-size fractions) pH Electrical conductivity Cations (calcium, sodium, aluminum, silicon, magnesium, iron, potassium, barium, uranium, technetium, strontium, and cesium) Anions (NO_3, NO_2, SO_4, chlorine, and bromine) Carbonate (by total inorganic carbon) Total alpha/beta
			Acid (8 M HNO_3) extraction (<4 mm grain-size fractions) Cations (calcium, sodium, aluminum, silicon, magnesium, iron, potassium, barium, uranium, technetium, strontium, and cesium) Total alpha/beta
			Moisture content Grain size (laboratory analysis) Soil resistivity

Table 3-2. Location, Depth, and Sample Design for Borehole 1

	Select an intact split-spoon liner from the five separate previously characterized intervals.	In the laboratory, expose sample material from the five split-spoon liners selected for sequential extraction to ammonia treatment. After ammonia treatment, conduct analyses.	Uranium using sequential extraction (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium
			Uranium leaching in the soil column with both untreated and treated sediments for these samples (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium in effluent analysis
			pH analysis Electrical conductivity

Note: Depths are approximate; field conditions need to be considered for actual collection depth.

a. Does not include samples for QA/QC.

b. Second-tier analysis may be conducted after review of other analyses at the discretion of the treatability test Project Manager.

bgs = below ground surface
QA = quality assurance
QC = quality control
WE = water extraction

Table 3-3. Location, Depth, and Sample Design for Boreholes 2 and 3

Sample Location		C95178, C95195	
Estimated Sample Depth		9.1 to 24.3 m (30 to 80 ft) bgs (determined by Technical Lead)	
Projected Total Depth		Approximately 24.3 m (80 ft) bgs (determined by Technical Lead)	
Media	**Sample Type[a]**	**Sample Location**	**Analytes**
Soil	All split-spoon liners	Continuous	Lithology description Core photographs Air permeability screening Gamma scan
	Obtain sample material from intact split-spoon liners in positions A, B, or C. Hold split-spoon liner D in reserve for additional sampling if needed.	Select three to five intervals for characterization. Select sample intervals (split-spoon liners A, B, or C) based on a combination of downhole neutron and spectral gamma geophysical measurements. Hold split-spoon liner D in reserve. For each interval, use one liner for sequential extraction, and use adjacent liners for other physical/chemical analyses.	Uranium using sequential chemical extraction (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium
			Gamma energy analysis Total uranium (microwave digestion) Uranium mineralogy by fluorescence[b] Sediment mineralogy[b]
			Deionized WE (<4 mm grain-size fractions) pH

Table 3-3. Location, Depth, and Sample Design for Boreholes 2 and 3

Sample Location		C95178, C95195	
Estimated Sample Depth		9.1 to 24.3 m (30 to 80 ft) bgs (determined by Technical Lead)	
Projected Total Depth		Approximately 24.3 m (80 ft) bgs (determined by Technical Lead)	
Media	**Sample Type[a]**	**Sample Location**	**Analytes**
			Electrical conductivity Cations (calcium, sodium, aluminum, silicon, magnesium, iron, potassium, barium, uranium, technetium, strontium, and cesium) Anions (NO_3, NO_2, SO_4, chlorine, and bromine) Carbonate (by total inorganic carbon) Total alpha/beta
			Acid (8 M HNO_3) extraction (<4 mm grain-size fractions) Cations (calcium, sodium, aluminum, silicon, magnesium, iron, potassium, barium, uranium, technetium, strontium, and cesium) Total alpha/beta
			Moisture content Grain size (laboratory analysis) Soil resistivity
	Select an intact split-spoon liner from the five separate previously characterized intervals.	In the laboratory, expose sample material from the three to five split-spoon liners selected for sequential extraction to ammonia treatment. After ammonia treatment, conduct analyses.	Uranium using sequential extraction (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium
			Uranium leaching in the soil column with both untreated and treated sediments for these samples (<4 mm grain-size fractions) including uranium, technetium, cesium, and strontium in effluent analysis
			pH analysis Electrical conductivity

Note: Depths are approximate; field conditions need to be considered for actual collection depth.

a. Does not include samples for QA/QC.

b. Second-tier analysis may be conducted after review of other analyses at the discretion of the treatability test Project Manager.

bgs = below ground surface
QA = quality assurance
QC = quality control
WE = water extraction

TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0766	TPA CHANGE NOTICE FORM	Date: March 9, 2017
Document Number, Title, and Revision: DOE/RL-2010-87, *Field Test Plan for the Uranium Sequestration Pilot Test*, REV 0		Date Document Last Issued: April 2015
Approved Change Notices Against this Document: N/A		
Originator: Mark Byrnes		Phone: 509 373 3996

Description of Change:
The changes to this Field Test Plan are required to address the revised sampling approach, borehole locations, sampling intervals, and associated number and type of sampling to be completed in support of completion of the borehole/well network for the Uranium Reactive Gas Sequestration Pilot Test.

M.W. Cline (DOE) and C.E. Cameron (Lead Regulatory Agency) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement*.

Section 4.2.1, page 10 - The text was revised to reflect the current status of the initial borehole completed in FY 2015 and the plan to drill the remainder of the boreholes, their new borehole numbers, locations, and how they are to be sampled.
Section 4.2.1.2, page 12 - Minor text revision to accommodate flexibility based on previously collected samples.
Section 4.2.1.3, page 12 - Minor text revision to accommodate flexibility based on previously collected samples.
Section 4.2.2, page 13 - Minor text revision due to Borehole 4 already completed and Table 4-3 update for shift in well locations. Page 14 - Change Figure 4.2 to update locations of post treatment soil sampling location
Section 4.2.4, page 18 - Minor text revision to incorporate flexibility in post characterization borehole locations to be consistent with the Sample and Analysis Plan. Added text to give flexibility to the number of post-treatment boreholes that could be drilled.
All deletions are indicated by ~~strikeout~~ and new text indicated by double underline.

Note: Include affected page number(s) 10, 12, 13, 14, and 18

Justification and Impacts of Change:
Changes were made to reflect the situation in the field where the initial well installed could not be completed as the injection well as planned. This initial well is now a monitoring location and the well network was slightly shifted to accommodate this change. The change also recognizes that sediment characterization which was not originally planned at this monitoring well location was already conducted and should be considered in the characterization effort associated with installation of the remaining site wells and monitoring locations. Because there was more than a year delay between the initial well and planned installation of the remainder of the well network, these changes to the Field Test Plan will help better document the plan for the remainder of the test.

Approvals:

Michael W. Cline DOE Project Manager	3/9/2017 Date	X Approved [ ] Disapproved
Craig Cameron EPA Project Manager	3/9/2017 Date	X Approved [ ] Disapproved
N/A Ecology Project Manager	Date	[ ] Approved [ ] Disapproved

Table 4-2. Ammonia Gas Partitioning to Water and Resulting pH

% $NH_{3\,(g)}$	NH_3 (aqueous) Total	pH
`5	3.1 mol/L	11.87
1	0.63 mol/L	11.52
0.3	0.19 mol/L	11.26
0.1	6.3×10^{-2} mol/L	11.02
0.01	6.3×10^{-3} mol/L	10.51
10^{-3}	6.3×10^{-4} mol/L	9.99
10^{-4}	6.3×10^{-5} mol/L	9.41
10^{-5}	6.3×10^{-6} mol/L	8.69 (assumes no other aqueous ions)
10^{-6}	6.3×10^{-7} mol/L	7.78 (assumes no other aqueous ions)

NH_3 = nitrate

4.2 Experimental Design

A phased approach to the treatability test will be implemented. The following sections describe the details of the planned field and laboratory testing. Procedures for field operations will be prepared as field test instructions and will cover the activities described as follows.

4.2.1 Phase 1 – Site Characterization

A borehole was drilled and completed as a monitoring well at the site with samples collected and analyzed per the Borehole 1 description below. However, this well could not be completed as an injection well and was, instead, completed as a monitoring well to serve as the Borehole 4 location (Figure 4-1). Data from this borehole confirm the presence of mobile uranium contamination within the 30-to-60-ft depth interval. Five additional boreholes (1, 2, 3, 5, and 6) will be installed to complete the borehole/well network for the test. Borehole 1 will include all of the sampling and analysis described below to assist in selecting the injection well screen interval. Sampling of boreholes 2 and 3 will proceed as described below. However, the project team will review the data from Boreholes 1 and 4 and determine the number of samples and type of analyses to be conducted in Boreholes 2 and 3 up to the maximum listed below.

Three boreholes will be installed at the study site and sampled to characterize the vadose zone soils. The characterization data will be used for the following functions:

- Validate the test site selection.
- Obtain baseline information for site characterization.
- Determine effectiveness of ammonia on uranium present at this site.
- Select a target treatment zone.

The boreholes will be drilled to avoid potential impact to the representativeness of vadose zone soil samples; all efforts must be made to drill without the use of slurry makeup water. In the event that drilling

the suitability of the test site and finalize the drilling targets for the subsequent boreholes. Sequential extraction analysis will require approximately 2 weeks to complete.

The following criteria will be considered to determine whether the full test system should be installed (i.e., is the site appropriate for the test) and select the borehole/well completion configurations:

- Pore water uranium concentration >30 μg/L
- Uranium mobile fraction (aqueous, sorbed, and rind carbonate) >20 percent of total
- Uranium concentration and concentration gradient with preference for a test location with uranium concentrations ranging from 10 to 1,000 mg/kg
- Thickness of uranium contamination and target depth intervals that can be effectively treated and monitored

4.2.1.2 Install, Sample, and Characterize Boreholes 2 and 3

Based on the determination that the study site is suitable for the treatability test, Boreholes 2 and 3 will be installed at the locations shown on Figure 4-1. The boreholes will be drilled to a depth based on the characterization information determined from Borehole 1. Similar to Borehole 1, soil samples will be collected continuously, initiated at approximately 9.1 m (30 ft) bgs. Sampling will be performed using a 10.2 cm (4 in.) diameter, 0.76 m (2.5 ft) long split-spoon sampler. The split-spoon samplers will be equipped with four separate nonconductive plastic liners that are each 15.2 cm (6 in.) long. Once the split-spoon liners have been appropriately labeled and documented in the field logbook, they will be sealed and shipped to the laboratory for analysis. Once final depth is achieved and all samples have been obtained, Boreholes 2 and 3 will be geophysically logged using downhole neutron and spectral gamma technology.

Using the geophysical logging information and data from Boreholes 1 and 4, up to five split-spoon interval samples will be selected from each borehole for characterization at the laboratory. The sampling intervals will be selected based on regions of expected uranium contamination. These samples will be sieved to remove material greater than 4 mm in size. The less than 4 mm fraction of each sample will undergo sequential extraction to determine the pore water uranium and mobile uranium fractions. Adjacent liners from each sample interval will be analyzed for bulk conductivity and for physical and chemical properties.

4.2.1.3 Laboratory Ammonia Testing

In the final step of site characterization, a subsample of the less than 4 mm fraction from liners for each of the intervals characterized for uranium in Boreholes 1, 2, and 3 will be treated with exposure to ammonia in the laboratory and analyzed. This will include five samples from Borehole 1 and ~~three~~ up to five samples each from Boreholes 2 and 3, obtained from the same intervals that were used for sequential extraction analysis in the previous characterization steps. After exposure to ammonia, each sample will undergo sequential extraction to determine the pore water uranium and mobile uranium fractions. Extraction data from the samples exposed to ammonia will be compared to extraction data from untreated samples of the same sampling intervals.

Data from laboratory ammonia treatment will primarily be used to evaluate the geochemical treatment and sequestration processes at the test site. Laboratory data will quantify the increase in pH due to the ammonia exposure, timescale of pH decrease and associated precipitation/sequestration processes following initial ammonia distribution, and change in uranium surface phase distribution (mobility). Laboratory-scale geophysical monitoring on selected samples will provide the geophysical signatures of pH increase and decrease necessary to interpret field-scale geophysical images in terms of spatial and

be assessed in these tests. Results from these tests are anticipated to require about 6 months to 1 year to complete. During that time, Phase 2 of the test will be conducted.

4.2.2 Phase 2 – Field Site Test System

Based on the decision from Phase 1 that the study site is suitable for the treatability test, Boreholes 4,5, and 6 will be installed at the locations shown on Figure 4-1. The boreholes will be drilled to depths based on the characterization information determined from Boreholes 1, 2, and 3. Once final depth is achieved, boreholes will be geophysically logged using downhole neutron and spectral gamma technology.

The ammonia injection well will be completed at the targeted depth interval, and distance from the crib edge will be based on the information obtained in Phase 1. The screened interval is tentatively set at 3 m (9.8 ft) for the test but will be refined based on evaluation of Phase 1 data. Conceptually, the injection well will be located at the borehole location closest to the center of the crib (Borehole 1).

The remaining boreholes (assumed to be Boreholes 2, 3, 4, 5, and 6) will be completed as instrumented monitoring locations with vertically discrete monitoring intervals. Monitoring will focus on obtaining and field analyzing gas samples, monitoring temperature at multiple depth intervals, monitoring borehole and surface electrodes for electrical resistivity tomography (ERT) surveys, collecting neutron moisture logging data, and conducting ground penetrating radar (GPR) surveys. Two sampling and instrumentation tests will be conducted, which include use of sediment coupons in Boreholes 2 and 3 (two per borehole) for field moisture measurements and installing fiber-optic distributed temperature sensing (DTS) cable in all of the boreholes for temperature monitoring. A pressure monitoring system will also be installed at the surface for each gas sampling location. Table 4-3 lists the monitoring techniques and a brief description of their function. Figures 4-2, 4-3, and 4-4 show the conceptual monitoring installation details.

Table 4-3. In Situ Monitoring Techniques

Instrument	Function	Borehole
Gas Sampler	A port for withdrawing soil gas samples.	2, 3, 4, 5, 6
Thermistor	In situ probe that measures temperature. Temperature can be a measure of when the ammonia gas front passes a location.	1, 2, 3, 4, 5, 6
Fiber-Optic DTS Cable	Temperature measurement using DTS technology. Provides temperature measurement along entire cable with a targeted spatial resolution between 25 cm (9.8 in) and 100 cm (39.4 in) and temperature accuracy comparable to thermistors.	1, 2, 3, 4, 5, 6
Resistivity Electrodes	Allows use of cross-borehole/surface electrical resistance tomography (two- or three-dimensional depiction electrical resistivity) that is related to ammonia distribution and induced reactions. These electrodes also enable collection of Spectral Induced Polarization data that may enable imaging of the dissolution/precipitation processes in the field.	1, 2, 3, 4, 5, 6
Access for Logging	A 5.1 cm (2 in.) diameter blank PVC casing will be provided, so that a neutron probe and/or GPR transmitters and receivers can be deployed.	2, 3, 4, 5, 6
Sediment Coupons	Packet of moist sediment deployed at a location such that it can be removed at selected times for analysis (pH, electrical conductivity, pore water cations/anions, uranium surface phases).	2, 3

DTS = distributed temperature sensing
GPR ground penetrating radar
PVC = polyvinyl chloride

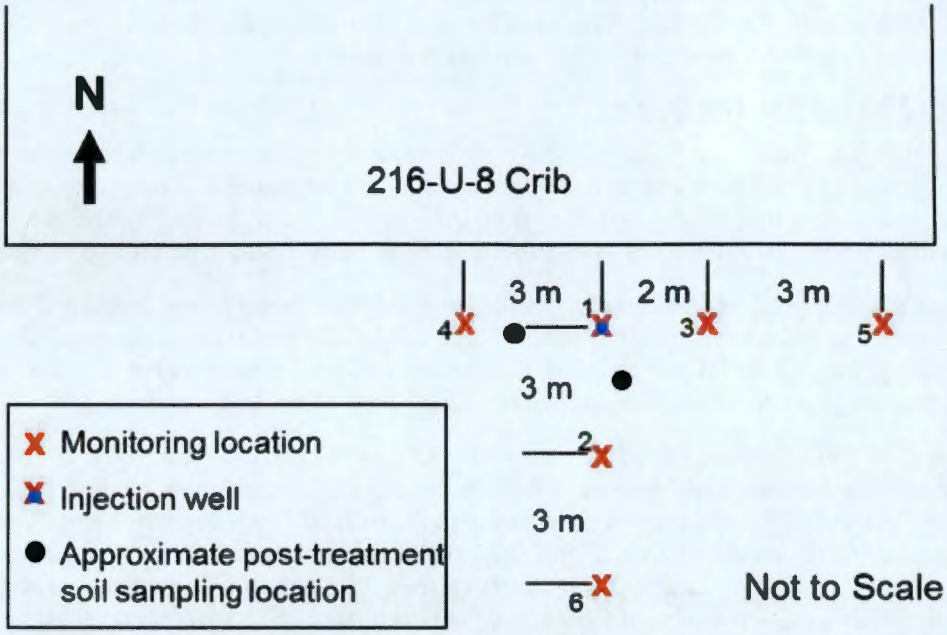


Figure 4-2. Proposed Test Layout

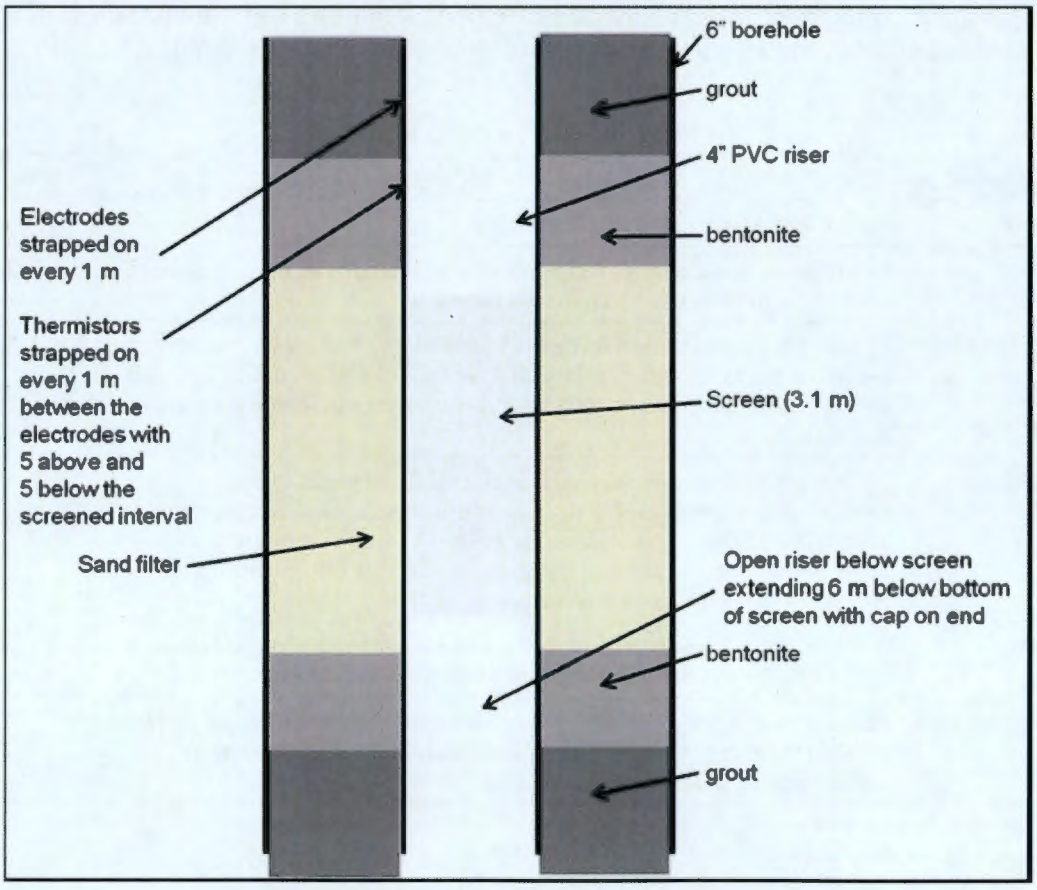


Figure 4-3. Proposed Injection Well Completion Configuration

4.2.3.2 Ammonia Distribution Monitoring

Primary ammonia distribution monitoring will be achieved through collection and field analysis of gas samples at sampling ports located at different radial and vertical positions with respect to the injection well. Because the gas phase and pore water phase ammonia concentrations are expected to be directly related, ammonia gas phase concentration can be a primary indicator of ammonia distribution to the pore water. Based on laboratory experiments, ammonia partitions rapidly to the pore water such that a relatively sharp front will develop between the zone where ammonia has partitioned into the pore water to the target concentration compared to locations beyond this front. Within this treated zone, the gas phase ammonia concentration will be near the injected concentration. Outside the treated zone, the gas phase ammonia concentration will be substantially lower. The frequency of soil gas sampling during injection will be determined based on the site characterization data collected in Phases 1 and 2. ERT will also be used to monitor ammonia injection based on the change in pore water resistivity caused by ammonia partitioning into the pore water. Using both borehole and surface electrodes, ERT is intended to provide detailed ammonia distribution in cross sections between the monitoring boreholes and a less resolved three-dimensional image of ammonia distribution. In situ temperature monitoring will also be used as an indicator for when the ammonia partitioning front passes a monitoring location. At the end of ammonia injection, a neutron moisture and GPR survey will be conducted. The neutron moisture data will used to evaluate the extent of desiccation that may occur near the injection well and to assess potential moisture changes induced by ammonia partitioning into the pore water. The GPR survey will provide a mapping of changes in pore water ionic strength to augment the ERT data and will also help quantify the small desiccation zone expected near the injection well.

4.2.3.3 Reaction Monitoring

Natural buffering will reduce the pH over time after the ammonia injection is completed. Results from laboratory ammonia treatment and monitoring will be used to estimate the time required for uranium treatment. In situ ERT monitoring will be continued after the ammonia injection where resistivity changes are correlated with pore water precipitation reactions as a field indicator of the reaction process. Based on these ERT data and the laboratory study estimate, an appropriate time for post-treatment sampling will be determined.

4.2.4 Phase 4 – Post-treatment Characterization

In the final phase of the treatability test, post-treatment sediment samples will be collected from the treatment area and used to evaluate treatment effectiveness. Post-treatment sediment samples, obtained from two boreholes drilled after the treatment test, will be paired with pre-treatment sample locations. Post-treatment field test sediments will be analyzed using the same type of sequential extraction and leaching studies conducted on the laboratory-treated sediments. The data will be used to assess whether the reaction processes and associated uranium sequestration expected, based on the laboratory tests, were induced in the field test. The time frame for collection of post-treatment samples will be based on the observed geochemical process time frame in the laboratory. ERT will also provide supporting data to monitor the treatment process during the field test. Once the test is deemed complete and ready for post-treatment boreholes, a final round of gas samples and sensor and ERT data will be collected. Neutron moisture logging and GPR surveys will be conducted to evaluate changes in moisture and pore water ionic strength distribution after the ammonia injection period.

At least, t~~T~~wo post-treatment boreholes will be installed at ~~the~~ locations selected based on the ammonia distribution data obtained during the Phase 3 injection portion of the test (estimated approximate locations shown on Figure 4-2~~1~~). The boreholes will be drilled to a depth selected based on the test system boreholes (Boreholes 1, 2, and 3) and data from the field test. Similar to the pretreatment boreholes, soil

Documents Submitted to the Administrative Record
March – April 2017

All documents identified in Table 9-3 of the TPA are including in the Administrative Record. The following documents, which may include:

- Validated sampling and analysis results
- Supporting technical studies and analyses
- Inspection reports and follow up responses

Documents Submitted to the Administrative Record
March – April 2017

Number	Title	Referencing Document
SGW-60338, R0	Historical Changes in Water Table Elevation and Groundwater Flow Direction at Hanford: 1944 to 2014	cleared Feb. 2017, request sent to RL for approval by Brouillard
CHPRC-00189, Rev. 12	CH2M HILL Plateau Remediation Company Environmental Quality Assurance Program Plan	DOE/RL-2016-67
RPP-ENV-59215, R0A	Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site	DOE/RL-2016-67
RPP-RPT-47502, R0	Hanford BX-Farm Leak Assessment Report	DOE/RL-2016-67
RPP-RPT-47562, R0	Hanford BX-Farm Leak Assessment Report	DOE/RL-2016-67
RPP-RPT-59750, R0	Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2016	DOE/RL-2016-67
RPP-RPT-58908, 2016, R0	Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2015, Rev. 0	DOE/RL-2016-67
SGW- 59914	WMA C January Through March 2016 Quarterly Groundwater Monitoring Report	DOE/RL-2016-67; sent by RL to AR via transmittal
SGW-60442	WMA C April Through June 2016 Quarterly Groundwater Monitoring Report	DOE/RL-2016-67; sent by RL to AR via transmittal
SGW-60466	Post-Closure Corrective Action Groundwater Monitoring Report for the 300 Area Process Trenches: July – December 2016	DOE/RL-2016-67; sent by RL to AR via transmittal
SGW-60494	WMA C July Through September 2016 Quarterly Groundwater Monitoring Report	DOE/RL-2016-67; sent by RL to AR via transmittal
RPP-ENV-33418, R4	HANFORD C FARM LEAK INVENTORY ASSESSMENTS REPORT	DOE/RL-2014-33
ECF-HANFORD- 12-0061	Groundwater Hydraulic Gradient and Velocity Calculations for 200 East Area RCRA Sites in 2011	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
SGW-52162	Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
SGW-59346	Borehole Summary Report for the Installation of Eight M-24 Tri-Party Agreement Groundwater Monitoring Wells FY 2015	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)

Documents Submitted to the Administrative Record
March – April 2017

ECF-HANFORD-16-0139	Hydraulic Gradients and Velocity Calculations for RCRA Sites in 2016	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
01-GWVZ-009	Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
WHC-SD-EN-TI-009	Calculation of the Rapid or Large Leak Rate for LERF Basins in the 200 East Area	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
WHC-SD-WM-TI-T30	Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
HNF-3172	Liquid Waste Processing Facilities Waste Acceptance Criteria	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
PNNL, 1999	Groundwater Assessment Plan and Report for the 200 East Area Liquid Effluent Retention Facility	HNF-3172 R8, Groundwater Monitoring Program at the Liquid Effluent retention Facility (LERF)
RHO-CD-798	Current Status of the 200 Area Ponds	
RHO-CD-977	Isolation of Auxiliary Tank Farms Facilities Project B-231	

OPEN ACTION ITEM TRACKING

Action #	Action/Subject	Assigned To	Owed To	Assigned Date	Original Due Date	Adjusted Due Date	Status
174	Ecology will respond with a path forward for BP-5 PO-1 SAP	Ecology/Nina Menard	RL	5/19/2016	6/10/2016	8/5/2016	Closed
178	Discuss with Ecology the status of the Action Memo Work Plan associated with Milestone M-016-250	Al Farabee	Ecology	7/21/2016	9/15/2016		Closed
179	Respond to Ecology justification to add 207A SRB to Appendix C	Ben Vannah/Mostafa Kamal	Ecology	7/21/2016	8/31/2016	10/31/2016	Closed
180	DOE to status PW-1/3/6 progress in 6 months	Al Farabee	EPA	9/15/2016	Mar-17	every Sept	
181	PNNL documents will be transmitted to (Dib Goswami) DOE and put into the AR	Marty Doornbos					
182	Include UP-1 chromium concentrations from the recently sampled wells on next PMM	Marty Doornbos		5/18/2017	7/20/2017		