

**DRAFT**  
**FACILITY-WIDE GROUNDWATER MONITORING PROGRAM PLAN**  
**RVAAP-66 FACILITY-WIDE GROUNDWATER**  
**SEMIANNUAL GROUNDWATER MONITORING ADDENDUM FOR 2015**

**FORMER RAVENNA ARMY AMMUNITION PLANT**  
**PORTAGE AND TRUMBULL COUNTIES, OHIO**

**October 10, 2014**

**GSA Contract Number GS-10F-0293K**  
**Delivery Order W912QR-11-F-0266**

*Prepared for*



**U.S. Army Corps of Engineers**  
**600 Martin Luther King Jr. Place**  
**Louisville, Kentucky 40202**

*Prepared by*



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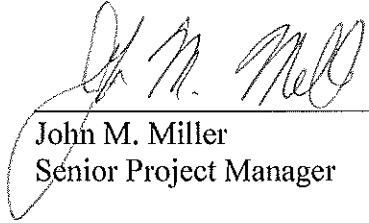
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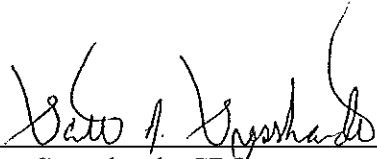
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**CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW**

Environmental Quality Management, Inc. (EQM) has completed the *Draft Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Groundwater Monitoring Addendum for 2015*. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in this project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions, methods, procedures, and materials used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing United States Corps of Engineers policy.

  
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John M. Miller  
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10/5/14  
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10/8/2014  
Date

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Former Ravenna Army Ammunition Plant**

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EQM Project Manager, John Miller	1	1

ARNG – Army National Guard  
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 Environmental Response & Revitalization  
 RVAAP – Ravenna Army Ammunition Plant  
 USACE – U.S. Army Corps of Engineers  
 EQM – Environmental Quality Management, Inc.

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26

1  
2  
3 **EXECUTIVE SUMMARY**

4 The Semiannual Groundwater Monitoring Addendum for 2015 is a supplement to the Facility-  
5 Wide Groundwater Monitoring Program Plan (FWGWMP) and discusses the subset of existing  
6 monitoring wells at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and  
7 Trumbull Counties, Ohio, that will be monitored in January and July 2015 and the contaminants  
8 of potential concern that will be evaluated at each selected well. This document supersedes the  
9 Semiannual Monitoring Addendum for 2014 that was submitted in 2013 (finalized August 1,  
10 2013) for the groundwater sampling that began with the July 2013 event and continued through  
11 the July 2014 sampling event.

12 A total of 42 existing wells at the former RVAAP have been identified for semiannual sampling  
13 in 2015 to evaluate potential offsite migration and potential source area attenuation and temporal  
14 fluctuations. Under this revised addendum, wells DA2mw-114 and LL2mw-265 will not be  
15 sampled in 2015; whereas, wells LL2mw-060 and LL7mw-001 have been added to the 2015  
16 semi-annual well network. In addition, wells LL1mw-088, LL2mw-271, and LL3mw-246 have  
17 been formerly added to the 2015 sampling schedule. (Note that these three wells were installed  
18 in December 2013 and were sampled for four consecutive quarters in 2014.) No other additions  
19 or deletions to the prior 2014 semi-annual well network are proposed.  
20

21 **BACKGROUND**

22  
23 The United States Army Corps of Engineers (USACE), Louisville District, is performing  
24 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) closure  
25 at the former Ravenna Army Ammunition Plant (RVAAP) located in Portage and Trumbull  
26 Counties near Ravenna, Ohio. CERCLA closure is occurring under the Installation Restoration  
27 Program (IRP). Activities include monitoring of an extensive network of groundwater  
28 monitoring wells. During the time period of 2005 through 2007, the USACE developed a  
29 database of groundwater quality information based on the sampling of approximately 36  
30 monitoring wells. Beginning in fiscal year 2008, the USACE expanded the Facility-Wide  
31 Groundwater Monitoring Program (FWGWMP) to include the characterization of groundwater  
32 from 243 existing monitoring wells at the facility.  
33

34 The USACE, under a Government Services Administration (GSA) Performance Based  
35 Acquisition (PBA) contract, retained Environmental Quality Management, Inc. (EQM) (Contract  
36 No. GS-10F-0293K – Delivery Order W912QR-11-F-0266) to obtain a signed Record of  
37 Decision (ROD) for the Facility-Wide groundwater (RVAAP-66) at the former RVAAP. In  
38 support of completion of a Remedial Investigation/Feasibility Study (RI/FS) necessary to  
39 supplement the ROD, EQM reviewed the currently available groundwater data. Based on this  
40 review, EQM determined that additional monitoring wells were needed at the facility to complete  
41 the RI/FS and eventual ROD. EQM believed that additional wells were necessary to complete  
42 hydrogeologic system modeling and to conduct contaminant fate-and-transport modeling for a  
43 Facility-Wide groundwater approach. The approach for installing these wells was described in  
44 the approved *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-*  
45 *Wide Groundwater Addendum* dated January 6, 2012 and supplemented by the *Final Facility-*  
46 *Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Additional*



1 *Well Installation Addendum* dated September 4, 2013. In accordance with these two addendums,  
2 EQM has installed 41 groundwater monitoring wells to determine nature and extent of  
3 groundwater impacts, provide additional information in support of hydrogeologic and fate-and-  
4 transport models, evaluate potential exit pathways, evaluate vertical contaminant distribution  
5 and/or particle inflow/outflow through the central portion of the facility, and assess potential  
6 groundwater impacts from Compliance Restoration (CR) sites. A description of the initial 38  
7 wells is presented in the approved *Final Facility-Wide Groundwater Monitoring Program*  
8 *RVAAP-66 Facility-Wide Groundwater Monitoring Well Installation Report* dated December 18,  
9 2012. Information regarding installation of the three additional RI wells is included in Appendix  
10 B of the *Draft Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide*  
11 *Groundwater Monitoring Report on the January 2014 Sampling Event* dated May 9, 2014.

12  
13 To supplement the RI, EQM prepared the *Facility-Wide Groundwater Monitoring Program Plan*  
14 *RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum* (Semiannual  
15 Monitoring Addendum; January 2012). Under this addendum, the facility-wide groundwater  
16 monitoring schedule was modified from a quarterly to semiannual basis (January and July  
17 events). The new RI wells were not included in the semiannual monitoring network, but these  
18 wells were monitored quarterly beginning in April 2012 and overlapped with the semiannual  
19 sampling events. The semiannual well network eliminated wells that provided redundancy or  
20 minimal information on groundwater quality or fate-and-transport migration. A subset of the  
21 well network was selected in association with or paired with several of the new RI wells to  
22 assess horizontal and/or vertical contaminant distribution; provide up-gradient data for the  
23 various site-wide models; assess potential exit pathway wells that had no direct association with  
24 the new wells; and provide continued monitoring of the five Resource Conservation and  
25 Recovery Act (RCRA) wells at the site. A total of 35 wells were selected as part of the 2012-  
26 2013 semiannual well network. Besides fulfilling the selection criteria, the groundwater quality  
27 information obtained from the semiannual well network was designed for incorporation into the  
28 hydrogeologic system and contaminant fate-and-transport models under the RI.

29  
30 The Semiannual Monitoring Addendum was revised in 2013 (finalized August 1, 2013) to  
31 address semi-annual monitoring beginning with the July 2013 event and continuing through the  
32 July 2014 sampling event. Specifically, EQM re-evaluated the semiannual monitoring well  
33 network to determine if any of the new RI wells should be permanently added to the semiannual  
34 monitoring network. Additionally, since the purpose of several of the semiannual wells was to  
35 provide additional data in support of the hydrogeologic and contaminant fate-and-transport  
36 models, including horizontal and/or vertical contaminant distribution through pairings with new  
37 RI wells, their inclusion in the semiannual well network was also re-evaluated. Consequently,  
38 forty-two (42) wells (including the five RCRA wells and the three new RI wells) were selected  
39 for sampling during the semiannual events in 2013 and 2014.

#### 40 41 **PURPOSE OF ADDENDUM**

42  
43 The 38 original RI wells installed between February and July 2012 have been monitored for four  
44 successive quarters. [Note that one well (FWGmw-009) was frozen during the January 2013  
45 event, so it was only sampled for three consecutive quarters. This well was sampled for a fourth  
46 time during August 2013.] The three additional RI wells installed in December 2013 have been

1 sampled for three consecutive quarters; the fourth quarter event will take place in October 2014.

2  
3 Moving forward, the primary objectives of the facility-wide monitoring well network are to  
4 assess potential exit pathways and monitor contaminant levels strictly tied to historical RVAAP  
5 activities (e.g., explosives/propellants, volatile organic compounds, semivolatile organic  
6 compounds, pesticides, and polychlorinated biphenyls) at selected source area wells for trend  
7 analysis. Metals will also be evaluated in groundwater, but their relationship to historical  
8 activities and/or natural occurrence has not been fully determined. EQM re-evaluated the  
9 semiannual monitoring well network to determine if any of the three new RI wells should be  
10 permanently added to the semiannual monitoring network and whether the current list of  
11 semiannual wells should be revised based on the cumulative historical and recent data.

12  
13 As a result, EQM has identified three new wells (LL1mw-088, LL2mw-271, and LL3mw-246)  
14 and one existing well (LL2mw-060) that should be incorporated into the semiannual monitoring  
15 well network as exit pathway wells; several current semiannual wells (see following section for  
16 list) that should be retained as potential exit pathway or source area wells; and one additional  
17 source area well (LL7mw-001) that should be added to the program to evaluate current levels of  
18 contaminants previously identified at this location that are associated with former RVAAP  
19 operations (specifically, chlorinated solvents and explosives);. Note that LL2mw-060 will  
20 replace LL2mw-265 in the semiannual network as an exit pathway well since the former has  
21 occasionally been found to contain low level explosives; whereas, well LL2mw-265 has not.

22  
23 Several wells selected under the 2013 semiannual monitoring addendum will no longer be  
24 sampled at this time since they have not been found to contain any former operations related  
25 contaminants other than metals during the past several sampling events (i.e., LL2mw-265 and  
26 DA2mw-114). These wells will not be physically removed from the monitoring well network;  
27 they are merely being excluded from the list of wells to be included in the 2015 semiannual  
28 groundwater monitoring well network.

## 30 SCOPE OF WORK UNDER THE ADDENDUM

31  
32 In making the transition from an AOC approach to a facility-wide evaluation, it is important to  
33 realize that the proposed monitoring well network is not intended to assess each AOC  
34 individually but rather their composite contributions to groundwater quality in the  
35 unconsolidated and bedrock aquifers. Since there are numerous wells at the site, the approach  
36 used was to select wells that have exhibited contaminants of potential concern (COPCs) and  
37 eliminate wells that provide redundancy or provide minimal information on groundwater quality  
38 or fate-and-transport migration. To this end, forty-two (42) wells (including five RCRA wells  
39 and three new RI wells) have been selected for sampling during the semiannual events in 2015.

### 40 New Wells

41  
42  
43 In order to complete the RI/FS and eventual ROD, three new monitoring wells (LL1mw-088,  
44 LL2mw-271, and LL3mw-246) were installed at the facility in December 2013 to further  
45 characterize the nature and extent of facility-wide groundwater impacts. The locations of the  
46 new wells and well installation and sampling procedures are described in the *"Final Facility-*

1 *Wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-Wide Groundwater*  
2 *Additional Well Installation Addendum,"* dated 4 September 2013.

3  
4 The new wells have been sampled for three successive quarters beginning in January 2014. The  
5 new wells will ultimately be sampled for four consecutive quarters for the analyte list detailed in  
6 the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide*  
7 *Groundwater Addendum* dated January 6, 2012. The last quarterly sampling event for the three  
8 new wells is scheduled for October 2014.

9  
10 Based on the analytical data from these wells, EQM proposes to retain these three wells  
11 (LL1mw-088, LL2mw-271, and LL3mw-246) in the semiannual sampling network. They are  
12 included in the list of existing CERCLA wells described below.

### 13 14 **RCRA Wells**

15  
16 The former RCRA/solid waste wells specified by the Director's Final Findings and Orders  
17 (DFFOs) will be sampled semiannually in conjunction with the proposed semiannual sampling  
18 events for the FWGWMP wells (i.e., January and July). The RCRA wells include the Ramsdell  
19 Quarry Landfill wells (RQLmw-007, RQLmw-008, and RQLmw-009) and the Demolition  
20 Area #2 wells (DET-003 and DET-004). The RCRA wells will be sampled using the same  
21 protocols and procedures used for the FWGWMP wells.

### 22 23 **Existing CERCLA Wells**

24  
25 Selection of existing wells for semiannual site-wide monitoring was made based on  
26 consideration of the following criteria:

- 27
- 28 • Detect/monitor potential groundwater contamination near the downgradient facility  
29 boundary, which is also downgradient of AOCs.
  - 30 • Monitor specific source area wells that have consistently been found to contain  
31 COPCs associated with former RVAAP operations (e.g., explosives/propellants,  
32 nitrate) with the primary objective of monitoring increasing/decreasing trends.
  - 33 • Identify/quantify occurrence of COPCs in the unconsolidated aquifer.
  - 34 • Identify/quantify occurrence of COPCs in the bedrock aquifer(s).
  - 35 • Evaluate potential hydraulic connection between unconsolidated and bedrock  
36 aquifers. Use existing wells paired with or near new wells.
  - 37 • Include all currently monitored RCRA wells for the Ramsdell Quarry Landfill and  
38 Demolition Area #2.
- 39

40 On this basis, the proposed network of existing CERCLA wells will include: 19 potential exit  
41 pathway wells (LL1mw-064, LL1mw-065, LL1mw-086, LL1mw-087, LL1mw-088, LL2mw-  
42 059, LL2mw-060, LL2mw-271, LL3mw-244, LL3mw-246, LL12mw-247, FWGmw-004,  
43 FWGmw-007, FWGmw-011, FWGmw-012, FWGmw-015, FWGmw-016, SCFmw-002, and  
44 SCFmw-004) along the southern and eastern perimeter of former RVAAP; and 18 wells

1 (LL1mw-083, LL1mw-084, LL2mw-267, LL3mw-238, LL3mw-241, LL7mw-001, LL10mw-  
2 003, LL12mw-185, LL12mw-187, LL12mw-242, LL12mw-245, DA2mw-115, FBQ-174,  
3 NTAmw-119, WBGmw-006, WBGmw-009, WBGmw-020, and WBGmw-021) for source  
4 evaluations or to monitor horizontal and/or vertical migration of contaminants from expected  
5 source areas.

6  
7 In total, 42 wells (37 CERCLA and five RCRA wells) will be included as part of the semiannual  
8 monitoring well network for 2015. It is not anticipated that the wells selected for semiannual  
9 monitoring will change between monitoring events in 2015. Table 1 lists the proposed wells and  
10 rationale for their inclusion in the semiannual monitoring program. Figures 1 through 3 show the  
11 wells to be sampled during the semiannual monitoring events.

12  
13 The wells will be sampled in accordance with the *Facility-Wide Sampling and Analysis Plan for*  
14 *Environmental Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio* (SAIC,  
15 February 2011) and the two previous semiannual monitoring addendums. Specifically, samples  
16 will be collected using low-flow sampling procedures (with the exception of RCRA well  
17 DETmw-004, which requires the bailer method due to low yield). Metals samples will be field  
18 filtered. For the selected semiannual wells, the list of analytes reflects the primary constituents  
19 of concern within certain areas of the site or immediately downgradient of potential source areas,  
20 as appropriate. The refined analyte list for the semiannual wells is presented in Table 2. The  
21 analytical methods for these analytes are provided in Table 3. Evaluation of data from all future  
22 groundwater monitoring will be subject, where applicable, to the Risk Assessment and Land Use  
23 Technical Memorandum.

24  
25 **SCHEDULE**  
26

27 EQM will begin semiannual groundwater monitoring activities in January 2015 upon approval of  
28 this addendum.  
29

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**TABLES**

1

**Table 1. Semiannual Monitoring Wells and Rationale**

No.	RVAAP-66 Area	Well Location	Rationale/Comments
1	SE/Load Line 1	LL1mw-064	<b>Overburden</b> monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
2	SE/Load Line 1	LL1mw-065	<b>Overburden</b> monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
3	Load Line 1	LL1mw-083	<b>Upper Sharon</b> source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, and 4-amino-2,6-DNT).
4	Load Line 1	LL1mw-084	<b>Upper Sharon</b> source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, 4-amino-2,6-DNT, and RDX).
5	SE/Load Line 1	LL1mw-086	Second water-bearing zone well ( <b>deep overburden</b> ) downgradient of Load Line 1 for monitoring potential GW exit pathway; pesticide beta-BHC identified in groundwater at this location.
6	SE	LL1mw-087	<b>Overburden</b> well located approximately downgradient of Load Lines 1, 2, 3, 4, and 12, which have been found to contain elevated concentrations of metals, explosives, pesticides, nitrate, and/or PCBs. Monitors potential GW exit pathway.
7	Load Line 1	LL1mw-088	<b>Overburden</b> well located downgradient of Load Line 1 and LL1mw-086, which has had pesticides. Sentinel well for monitoring GW exit pathway outside perimeter fence.
8	S/Load Line 2	LL2mw-059	<b>Upper Sharon</b> well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP; consistently found to contain the explosive 2,4-DNT.
9	S/Load Line 2	LL2mw-060	<b>Upper Sharon</b> well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP.
10	Load Line 2	LL2mw-267	<b>Upper Sharon</b> source area well that has consistently been found to contain explosive constituents (2,4-DNT and RDX).
11	Load Line 2	LL2mw-271	<b>Upper Sharon</b> well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP.
12	Load Line 3	LL3mw-238	<b>Upper Sharon</b> source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 4-amino-2,6-DNT, and RDX).
13	Load Line 3	LL3mw-241	<b>Upper Sharon</b> source area well that has been found to contain explosives (2,4,6-TNT and RDX) in groundwater; also used to evaluate contaminant migration pathway between Load Lines 3 & 12.

2

1

**Table 1 (continued). Semiannual Monitoring Wells and Rationale**

No.	RVAAP-66 Area	Well Location	Rationale/Comments
14	Load Line 3	LL3mw-244	<b>Upper Sharon</b> well located downgradient of Load Lines 3 and 12; consistently found to contain low level explosive constituents (2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) and hexavalent chromium.
15	Load Line 3	LL3mw-246	<b>Upper Sharon</b> well located downgradient of Load Lines 3 and 12 and affected well LL3mw-244; serves as potential GW exit pathway off of former RVAAP; low levels of explosives consistently identified in well.
16	Load Line 7	LL7mw-001	<b>Homewood</b> source area well that has historically been found to contain chlorinated solvents (specifically 1,1-dichloroethane, 1,1-dichloroethene, and 1,1,1-trichloroethane).
17	Load Line 10	LL10mw-003	<b>Homewood</b> well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride and chloroform).
18	Load Line 12	LL12mw-185	<b>Unconsolidated</b> well that has been found to contain elevated levels of nitrate and is downgradient of potential arsenic source.
19	Load Line 12	LL12mw-187	<b>Unconsolidated</b> well that has been found to contain elevated levels of nitrate.
20	Load Line 12	LL12mw-242	<b>Unconsolidated</b> well located downgradient of LL12mw-113, a potential arsenic source.
21	Load Line 12	LL12mw-245	<b>Unconsolidated</b> well located downgradient of potential nitrate source well LL12mw-185.
22	SE	LL12mw-247	<b>Overburden</b> well located approximately downgradient of Load Lines 1, 2, 3, 4, and 12, which have been found to contain elevated concentrations of metals, explosives, pesticides, nitrate, and/or PCBs. Monitors potential GW exit pathway.
23	Fuze and Booster	FBQmw-174	<b>Homewood</b> source area well that has consistently been found to contain explosive constituents (2,4-DNT, 2,4,6-TNT, and 4-amino-2,6-DNT).
24	Admin/George Road	FWGmw-004	<b>Overburden</b> exit pathway well located near the south property line and downgradient of several Compliance Restoration sites.
25	SW	FWGmw-007	<b>Overburden</b> well located in the western portion of former RVAAP. Potential exit pathway well near Hinkley Creek.
26	East Classification Yard	FWGmw-011	<b>Overburden</b> well located east of Ramsdell Quarry and former East Classification Yard. Serves as exit pathway well.
27	East Classification Yard	FWGmw-012	<b>Upper Sharon</b> formation well paired with FWGmw-011; serves as exit pathway well for the Sharon aquifer.

2

1

**Table 1 (continued). Semiannual Monitoring Wells and Rationale**

No.	RVAAP-66 Area	Well Location	Rationale/Comments
28	Admin/George Road	FWGmw-015	<b>Overburden</b> well. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as first-water overburden exit pathway well.
29	Admin/George Road	FWGmw-016	<b>Upper Sharon</b> well paired with FWGmw-015. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as upper Sharon formation exit pathway well.
30	NACA Test	NTAmw-119	<b>Deep overburden</b> well that has been found to contain trace amounts of tetrachloroethene, naphthalene, as well as metals. Monitors second water-bearing zone in buried valley overburden.
31	Demo. Area 2	DA2mw-115	<b>Upper Sharon</b> well paired with well DETmw-003; serves to monitor potential vertical migration in this area of the site.
32	Demo. Area 2	DETMw-003	<b>Unconsolidated RCRA</b> well.
33	Demo. Area 2	DETMw-004	<b>Unconsolidated RCRA</b> well.
34	Ramsdell Quarry	RQLmw-007	<b>Upper Sharon RCRA</b> well.
35	Ramsdell Quarry	RQLmw-008	<b>Upper Sharon RCRA</b> well.
36	Ramsdell Quarry	RQLmw-009	<b>Upper Sharon RCRA</b> well.
37	SE	SCFmw-002	<b>Sharon Conglomerate Member</b> well located downgradient of Atlas Scrap Yard and Load Lines 1, 2, 3, 4, and 12, paired with LL12mw-247, and selected for monitoring the potential GW exit pathway off of former RVAAP in the deeper aquifer.
38	SE	SCFmw-004	<b>Sharon Conglomerate Member</b> well located downgradient of Load Lines 1 and 2, paired with LL1mw-087, and selected for monitoring the potential GW exit pathway off of former RVAAP in the deeper aquifer.
39	Winklepeck	WBGmw-006	<b>Unconsolidated</b> well paired with WBGmw-021; source area well has been found to contain explosives (RDX).
40	Winklepeck	WBGmw-009	<b>Unconsolidated</b> well paired with WBGmw-020; source area well has been found to contain explosive constituents (RDX).
41	Winklepeck	WBGmw-020	<b>Upper Sharon</b> well paired with WBGmw-009; source area well for monitoring potential vertical migration in Sharon aquifer.
42	Winklepeck	WBGmw-021	<b>Upper Sharon</b> well paired with WBGmw-006; source area well for monitoring potential vertical migration in Sharon aquifer.

2 Note – unless otherwise stated, all wells were completed in the first water-bearing zone identified during  
3 well installation.



1

**Table 2. Semiannual Analyte List**

Well Location	Analytes										
	VOCs	SVOCs			Metals <sup>d</sup>	Explosives/ Propellants	Pesticides	PCBs	Nitrate	Cyanide	Hexavalent Chromium <sup>d</sup>
		Nitroaromatics & Phthalates <sup>a</sup>	Phenols <sup>b</sup>	PAHs <sup>c</sup>							
LL1mw-064		x			x	x					
LL1mw-065		x			x	x					
LL1mw-083		x			x	x	x				
LL1mw-084		x			x	x	x				
LL1mw-086		x			x	x	x				
LL1mw-087		x			x	x					
LL1mw-088		x			x	x	x				
LL2mw-059		x			x	x					
LL2mw-060		x			x	x					
LL2mw-267		x			x	x					
LL2mw-271		x			x	x					
LL3mw-238		x			x	x	x				
LL3mw-241		x			x	x	x				
LL3mw-244		x			x	x	x				x
LL3mw-246		x			x	x					
LL7mw-001	x	x			x	x					
LL10mw-003	x	x			x						
LL12mw-185					x (As. only)				x		
LL12mw-187		x			x	x			x		
LL12mw-242		x			x	x			x		
LL12mw-245		x			x	x			x		
LL12mw-247		x			x	x			x		x
FBQmw-174		x			x	x	x				
FWGmw-004		x			x	x					
FWGmw-007		x			x	x					
FWGmw-011		x			x	x					

**Table 2 (continued). Semiannual Analyte List**

Well Location	Analytes										
	VOCs	SVOCs			Metals <sup>d</sup>	Explosives/ Propellants	Pesticides	PCBs	Nitrate	Cyanide	Hexavalent Chromium <sup>d</sup>
		Nitroaromatics & Phthalates <sup>a</sup>	Phenols <sup>b</sup>	PAHs <sup>c</sup>							
FWGmw-012		x			x	x					
FWGmw-015		x			x	x					
FWGmw-016		x			x	x					
NTAmw-119	x	x		x	x	x					
DA2mw-115		x			x	x					
DET-003	x	x	x	x	x	x	x	x		x	
DET-004	x	x	x	x	x	x	x	x		x	
RQLmw-007	x	x	x	x	x	x	x	x		x	
RQLmw-008	x	x	x	x	x	x	x	x		x	
RQLmw-009	x	x	x	x	x	x	x	x		x	
SCFmw-002		x			x	x	x				x
SCFmw-004		x			x	x	x				
WBGmw-006		x			x	x					
WBGmw-009		x			x	x					
WBGmw-020		x			x	x					
WBGmw-021		x			x	x					

<sup>a</sup> Analyte list includes: 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Diethyl phthalate, Dimethyl phthalate, Di-n-butyl phthalate, Di-n-octyl phthalate, and Nitrobenzene

<sup>b</sup> Analyte list includes: 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chlorophenol, 2-Methylphenol, 2-Nitrophenol, 4,6-Dinitro-2-methylphenol, 4-Chloro-3-methylphenol, 3&4 Methylphenol, 4-Nitrophenol, Pentachlorophenol, and Phenol

<sup>c</sup> Analyte list includes: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene.

<sup>d</sup> Analyte list includes: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, and Zinc. Hexavalent chromium will be sampled semiannually in wells LL3mw-244, LL12mw-247, and SCFmw-002.

1

**Table 3. Current Analytical Suite of Chemicals**

<b>Constituents</b>	<b>Method<sup>1</sup></b>
Polychlorinated biphenyls (PCBs)	Gas Chromatograph (GC) – Semivolatile Organics (SVOCs) (8082)
Pesticides	GC Semivolatile Organics (8081A)
Base/Neutrals and Acids (SVOCs)	GC/Mass Spectrograph (MS) Semivolatile Organics (8270C)
Volatile Organic Compounds (VOCs)	GC/MS Volatile Organics (8260B)
Nitroguanidine (Propellant)	Organic compounds by UV/HPLC (8330 modified)
Nitroaromatics & Nitramines (Explosives)	GC Semivolatile Organics Explosives (8330)
Nitrocellulose (Propellant)	General Chemistry (WS-WC-0050)
Nitrate/Nitrites	General Chemistry (353.2) <sup>2</sup>
Cyanide (Total)	General Chemistry (9012A)
Metals (Magnesium, Manganese, Barium, Nickel, Potassium, Silver, Sodium, Vanadium, Chromium, Calcium, Cobalt, Copper, Arsenic, Lead, Selenium)	Inductively Coupled Plasma (6010B)
Metals (Antimony, Iron, Beryllium, Thallium, Zinc, Cadmium, Aluminum)	Inductively Coupled Plasma Mass Spectrometry (6020)
Hexavalent Chromium	Method 218.6 <sup>2</sup>
Mercury	Liquid Waste Cold Vapor Technique (7470A)

2

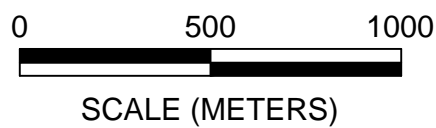
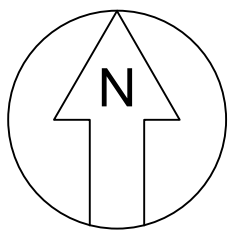
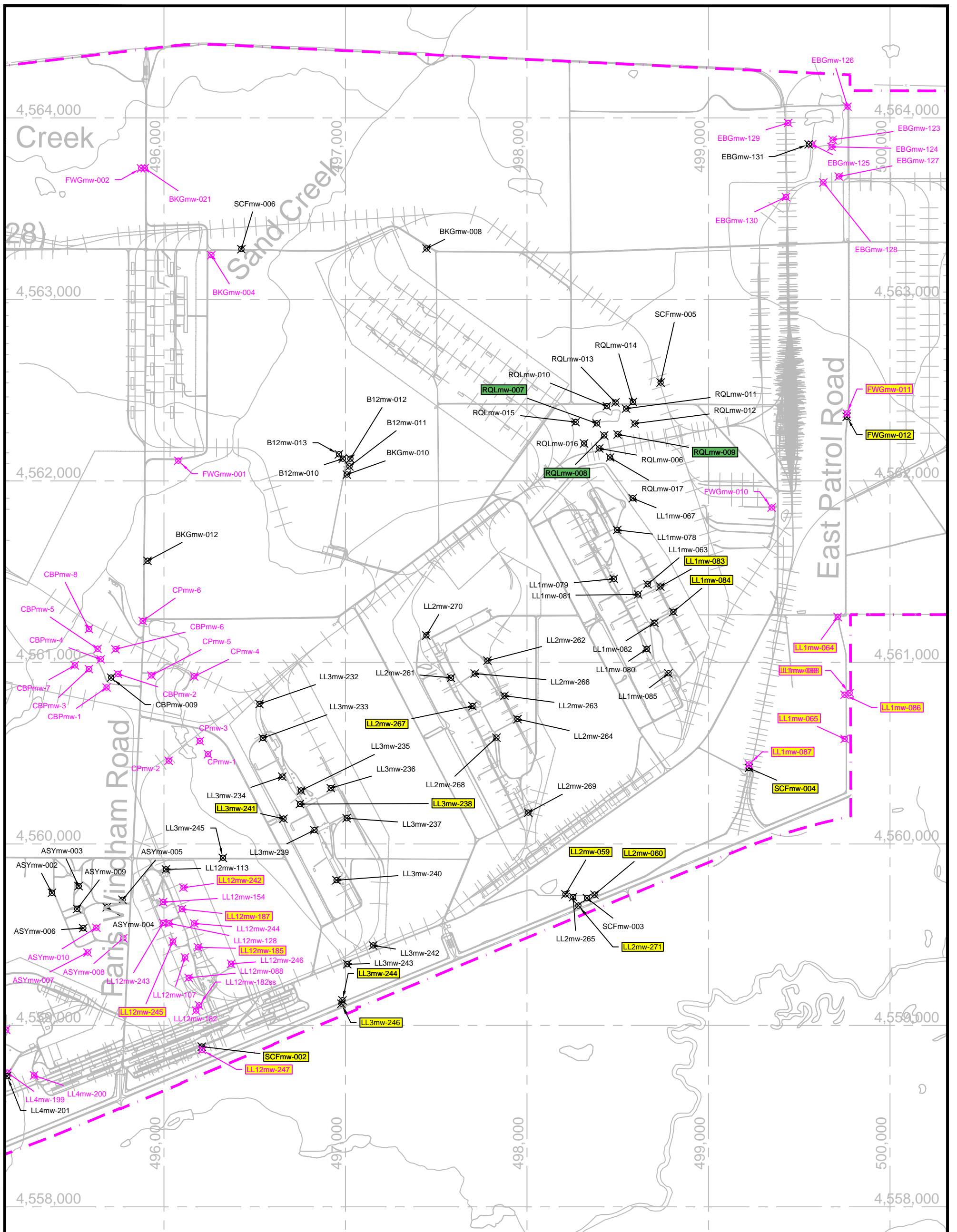
1 = USEPA SW846

3

2 = EPA Methods for Chemical Analysis of Water and Waste

4

**FIGURES**



**LEGEND**

- ⊗ SHARON WELL
- ⊗ UNCONSOLIDATED WELL
- ⊗ HOMEWOOD WELL
- RCRA WELL
- SEMI-ANNUAL MONITORING WELL

COORDINATE SYSTEM UTM NAD 83 ZONE 17

REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER
REVISIONS			

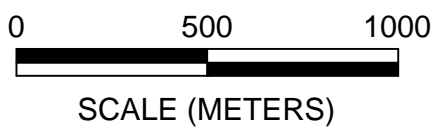
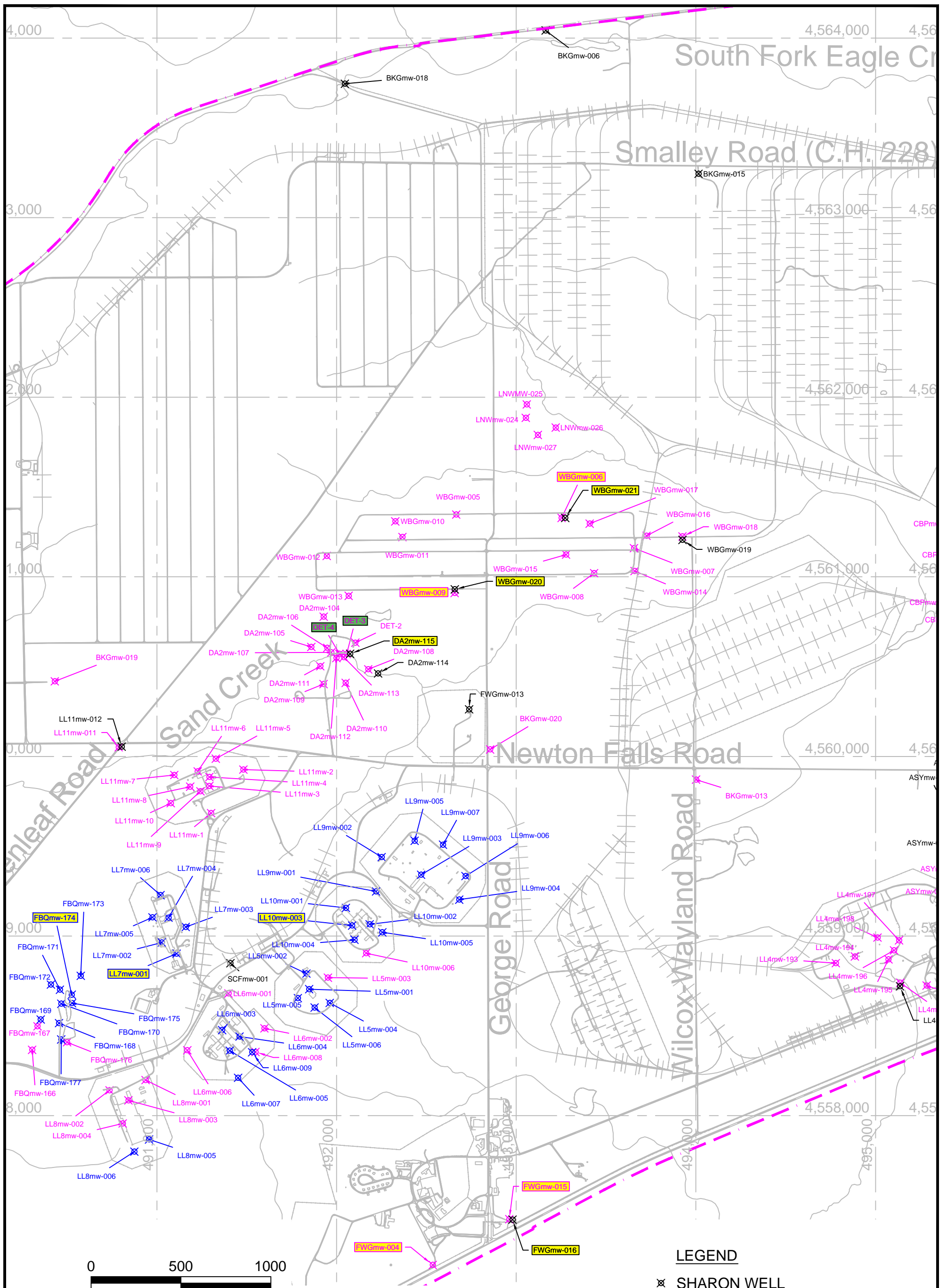


**ENVIRONMENTAL QUALITY  
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DRAWN	R. RUSSELL	05-03-2013
CHECKED	S. SPESSHARDT	05-06-2013
APPROVED	J. MILLER	05-06-2013
SCALE: AS SHOWN		

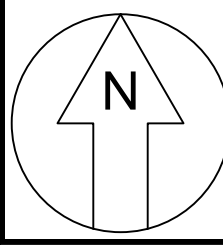
2015 SEMI-ANNUAL WELLS IN EASTERN PORTION RVAAP			
SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 1	2



**LEGEND**

- SHARON WELL
- UNCONSOLIDATED WELL
- HOMEWOOD WELL
- RCRA WELL
- SEMI-ANNUAL MONITORING WELL

COORDINATE SYSTEM UTM NAD 83 ZONE 17



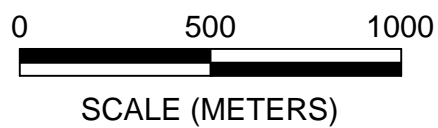
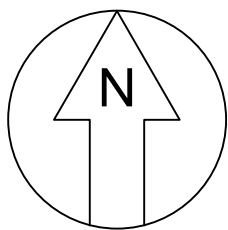
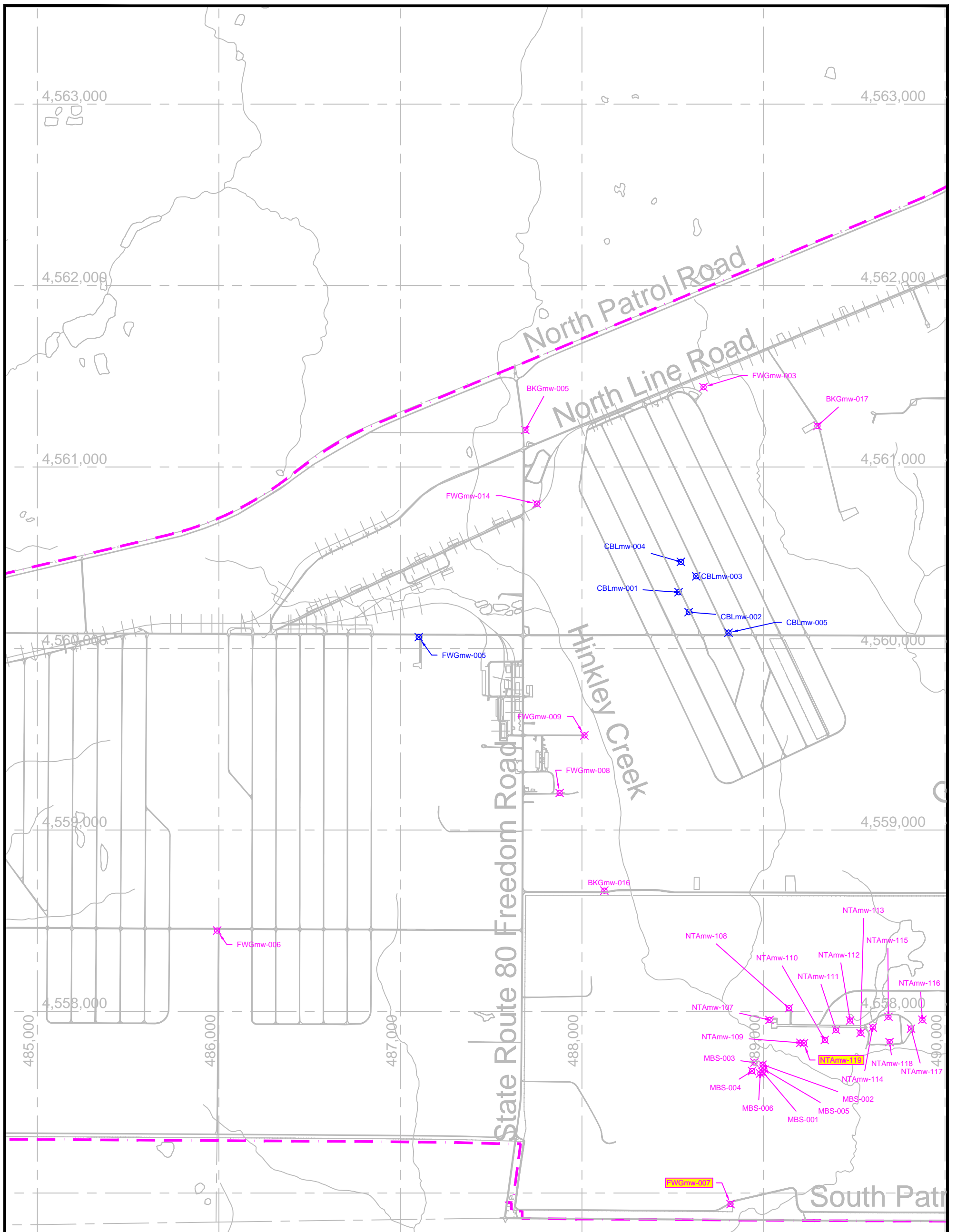
REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER
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APPROVED	J. MILLER	05-06-2013
SCALE:	AS SHOWN	

2015 SEMI-ANNUAL WELLS IN CENTRAL PORTION RVAAP			
SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 2	2





**LEGEND**

- ⊗ SHARON WELL
- ⊗ UNCONSOLIDATED WELL
- ⊗ HOMEWOOD WELL
- RCRA WELL
- SEMI-ANNUAL MONITORING WELL

COORDINATE SYSTEM UTM NAD 83 ZONE 17

REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER
REVISIONS			

  
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APPROVED	J. MILLER	05-06-2013
SCALE:	AS SHOWN	

2015 SEMI-ANNUAL WELLS IN WESTERN PORTION RVAAP			
SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 3	2