ANNUAL GROUNDWATER MONITORING REPORT

(INCLUDES FOURTH QUARTER 2013 SEMIANNUAL GROUNDWATER MONITORING REPORT)

HAZARDOUS WASTE MANAGEMENT UNITS
5, 10, AND 16
CALENDAR YEAR 2013

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Submitted to:

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ORGANIZATION OF REPORT

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EXECUTIVE SUMMARY

This document presents the Annual Groundwater Monitoring Report for calendar year 2013 for Hazardous Waste Management Units (HWMUs) 5, 10, and 16 located at the Radford Army Ammunition Plant (Radford AAP) in Radford, Virginia. The Annual Groundwater Monitoring Report was compiled in accordance with the requirements specified in the Final Hazardous Waste Post-Closure Care Permit dated October 4, 2002, for HWMUs 5, 7, 10, and 16. This Annual Groundwater Monitoring Report evaluates the analytical data from Second Quarter 2013 and Fourth Quarter 2013 for each Unit.

In correspondence dated June 26, 2013, the Virginia Department of Environmental Quality (VDEQ) issued approval of clean closure for groundwater at HWMU-7. As a result, groundwater monitoring is no longer required for HWMU-7; therefore, Radford AAP did not conduct semiannual groundwater monitoring for HWMU-7 during calendar year 2013.

HWMU-5

The calendar year 2013 groundwater monitoring events served as the seventh and eighth semiannual Corrective Action (CA) groundwater monitoring events for HWMU-5 conducted in accordance with Permit Module VI – *Groundwater Corrective Action & Monitoring Program for Unit 5*, which was approved by the Virginia Department of Environmental Quality (VDEQ) in the *Final Class 3 Hazardous Waste Permit Modification* dated November 5, 2009.

During Second Quarter 2013 and Fourth Quarter 2013, TCE was detected in point of compliance well 5WC21 at concentrations greater than the GPS of 5 µg/l, and in point of compliance wells 5W5B, 5WC22, and 5WC23 at concentrations less than the GPS of 5 µg/l. However, no daughter products of TCE were detected in any of the wells comprising the CA monitoring network during the 2013 monitoring events. The TCE concentrations observed in the point of compliance wells during calendar year 2013 are consistent with historical TCE concentrations observed in those wells. TCE was not detected at concentrations greater than the QL in any other wells comprising the CA monitoring network during the calendar year 2013 monitoring events, and no daughter products of TCE were detected in the wells comprising the CA monitoring network. In accordance with the Permit, a long-term concentration plot of the natural-log concentrations of TCE in well 5WC21 versus time was constructed. A linear regression line shows a decreasing trend in TCE concentration in well 5WC21 over time. Based on the data collected to date, the current calculated compliance timeframe for corrective action (monitored natural attenuation [MNA]) is mid-2014 which is less than the MNA remedial timeframe goal of 2019 as presented in the Permit, and less than the 2026 MNA ineffective date as specified in the Permit. Therefore, the current remedial measure (MNA) is performing effectively in addressing the TCE concentrations in groundwater at the Unit, and no additional action is required.

Total cobalt was detected at concentrations greater than the revised GPS of 7 µg/l in point of compliance well 5WC21 during Second Quarter 2013 and Fourth Quarter 2013. However, total cobalt was not detected at concentrations greater than the GPS in the other wells comprising the CA monitoring network.

Overall, evaluation of calendar year 2013 data for the CA Targeted Constituents and comparison with historical data indicates effective progress of groundwater CA through natural attenuation. No changes to the continuation of the groundwater CA program are anticipated at this time.

HWMU-10

Based on an evaluation of the groundwater analytical data and additional information for HWMU-10, no constituents were detected at concentration greater than their respective GPSs during Second Quarter 2013. Additionally, initial detections of additional Permit Attachment 1, Appendix I constituents during Second Quarter 2013 were refuted by subsequent verification sampling; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit were required.

In correspondence dated July 30, 2013, a teleconference on September 5, 2013, and subsequent correspondence dated November 15, 2013, Radford AAP presented information to the VDEQ to support clean closure for groundwater at HWMU-10 (Radford AAP previously received VDEQ approval for clean closure for soils at HWMU-10 in December 1998). In correspondence dated December 4, 2013, Radford AAP requested a 60-day extension to the semiannual groundwater monitoring deadline for HWMU-10 (December 31, 2013, extended to March 1, 2014) and reporting deadline (March 1, 2014, extended to April 30, 2014) for HWMUs 5, 10 and 16. The 60-day extension request was based on the discussion between Radford AAP and VDEQ during the September 5, 2013 teleconference and in anticipation of the pending approval for termination of post closure care groundwater monitoring at HWMU-10. The VDEQ granted approval of the 60-day extension in correspondence dated January 6, 2014. In correspondence dated April 2, 2014, the VDEQ granted approval for clean closure for groundwater at HWMU-10 with immediate cessation of groundwater post-closure related activities at the Unit. As a result, Radford AAP did not conduct semiannual groundwater monitoring for HWMU-10 during Fourth Quarter 2013.

HWMU-16

Based on an evaluation of the groundwater analytical data and additional information for HWMU-16, total cobalt was detected at a concentration greater than the GPS of 5 µg/l during Fourth Quarter 2013. In accordance with Permit Condition V.J.4.i.(3)(c) and as directed in VDEQ correspondence dated January 21, 2014, Radford AAP will conduct an Alternate Source Demonstration (ASD) to evaluate whether the total cobalt concentration detected in well 16WC1B was due to 1) a source other than the Unit; 2) errors in sampling, analysis, and evaluation; or 3) natural variation in groundwater. The ASD will consist of collecting four (4) independent samples from point of compliance well 16WC1B at a frequency of one sample per calendar quarter to evaluate the effect of seasonal variation upon the total cobalt concentrations in groundwater. If the total cobalt concentrations detected in the independent samples remain above the GPS, Radford AAP will evaluate additional monitoring wells in the Horseshoe Area of the Facility (the area containing HWMU-16) for natural variability of total cobalt within the aquifer. The ASD data results will be submitted to the VDEQ within 90 days following completion of the collection of the quarterly independent samples.

Second Quarter 2013 verification sampling confirmed the presence of the additional Appendix IX constituent diethyl phthalate in HWMU-16 point of compliance well 16MW9 and diethyl phthalate was added to the Groundwater Compliance Monitoring List for the Unit . No additional Permit Attachment 1, Appendix I constituents were confirmed in the point of compliance wells during Second Quarter 2013; therefore, no other changes to the Groundwater Compliance Monitoring List for the Unit are required. The permit requires collection of four quarters of monitoring data from a Unit's upgradient well(s) to establish background values for newly detected Appendix IX constituents. However, Radford AAP has collected diethyl phthalate data from HWMW-16 upgradient monitoring well 16C1 during the previous 11 annual Appendix IX groundwater monitoring events (2003-2013). Diethyl phthalate has never been detected at or above the LOQ in upgradient well 16C1; therefore, in lieu of quarterly background monitoring, Radford AAP proposes to use these data to set the background value for diethyl phthalate at the LOQ of 5 µg/l and the GPS at the VDEQ alternate concentration limit (ACL) of 12,480 µg/l."

Evaluation of the plume monitoring well data indicated that the concentrations of total barium in upgradient well 16C1 and in plume monitoring wells 16-1, 16-2, and 16-3 and in spring sampling location 16SPRING were greater than the site-specific background concentration. As stated previously, higher total barium concentrations in downgradient plume monitoring wells relative to background are likely due to natural variations in trace element distribution in groundwater. Upgradient well 16C1 is screened in limestone while downgradient plume monitoring wells 16-1, 16-2, 16-3, and 16-5 are screened in shale and fault breccia. Such differing lithologic formations would be expected to contain very different trace element distributions. Therefore, no further action regarding the 2013 total barium concentrations detected in plume monitoring wells 16-1, 16-2, and 16-3 and in spring sampling location 16SPRING is recommended at this time.

1.0 INTRODUCTION

This document presents the Annual Groundwater Monitoring Report for calendar year 2013 for Hazardous Waste Management Units (HWMUs) 5, 10, and 16 located at the Radford Army Ammunition Plant (Radford AAP) in Radford, Virginia. The Annual Groundwater Monitoring Report was compiled in accordance with the requirements specified in the Final Hazardous Waste Post-Closure Care Permit dated October 4, 2002, for HWMUs 5, 7, 10, and 16.

In correspondence dated June 26, 2013, the Virginia Department of Environmental Quality (VDEQ) issued approval of clean closure for groundwater at HWMU-7. As a result, groundwater monitoring is no longer required for HWMU-7; therefore, Radford AAP did not conduct semiannual groundwater monitoring for HWMU-7 during calendar year 2013.

The Annual Groundwater Monitoring Report presents the following set of information for each Unit: basic information and unit identification, a description of the groundwater monitoring plan, a discussion of groundwater movement, potentiometric surface maps, a table of groundwater elevations, and detailed statistical evaluations of the analytical data.

Please note that the sampling frequency for the Units was changed from quarterly to semiannual in the VDEQ-approved Class 1 Permit Modification dated June 14, 2007. Therefore, this Annual Groundwater Monitoring Report evaluates the analytical data from Second Quarter 2013 and Fourth Quarter 2013 for each Unit. Additionally, the Compliance Monitoring Constituent Lists and Groundwater Protection Standards (GPS) for HWMUs 10 and 16 were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; the groundwater samples collected at HWMUs 10 and 16 during the calendar year 2013 semiannual monitoring events were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification. Copies of correspondence relating to groundwater monitoring activities conducted at HWMUs 5, 7, 10, and 16 during calendar year 2013 are included (on CD-ROM) in **Appendix G**.

1.1 HWMU-5

HWMU-5 is a closed lined neutralization pond. The Unit received certification for closure in 1989. As stated in Permit Condition I.K.1 of the Final Post-Closure Care Permit, the Compliance Period during which the Groundwater Protection Standard applies to HWMU-5 is 19 years, beginning on the effective date of the original Post-Closure Care Permit for HWMU-5 (October 28, 2001) and continuing until October 28, 2020. The Second Quarter 2010 groundwater monitoring event served as the first semiannual Corrective Action (CA) groundwater monitoring event for HWMU-5 conducted in accordance with Permit Module VI – Groundwater Corrective Action & Monitoring Program for Unit 5, which was approved by the VDEQ in the Final Class 3 Hazardous Waste Permit Modification dated November 5, 2009. This report is the twelfth complete Annual Groundwater Monitoring Report submitted to the Virginia Department of Environmental Quality (VDEQ) for this Unit during the Compliance Period, and the fourth complete Annual Groundwater Monitoring Report submitted to the VDEQ under the Groundwater Corrective Action & Monitoring Program.

1.2 HWMU-10

HWMU-10 is a closed equalization basin for the biological treatment system. The Unit received certification for closure in 1998. As stated in Permit Condition I.K.3, the Compliance Period during which the Groundwater Protection Standard applies to HWMU-10 is 18 years, beginning on the effective date of the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7, 10, and 16 (October 4, 2002) and continuing until October 4, 2020. This report is the twelfth Annual Groundwater Monitoring Report submitted to the VDEQ for this Unit during the Compliance Period.

1.3 HWMU-16

HWMU-16 is a closed hazardous waste landfill. The Unit received certification for closure in 1993. As stated in Permit Condition I.K.4, the Compliance Period during which the Groundwater Protection Standard applies to HWMU-16 is 13 years, beginning on the effective date of the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7, 10, and 16 (October 4, 2002) and continuing until October 4, 2015. This report is the twelfth Annual Groundwater Monitoring Report submitted to the VDEQ for this Unit during the Compliance Period.

2.0 HWMU-5 ANNUAL GROUNDWATER MONITORING REPORT

2.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 5 (HWMU-5)
Owner/Operator: United States Army/BAE Systems, Ordnance Systems Inc.

Unit Location: Radford AAP Main Plant Area, Radford, Virginia

Class: Hazardous Waste Management Unit
Type: Closed Lined Neutralization Pond

2.2 Groundwater Monitoring Plan

Monitoring Network:

Upgradient Well:	5W8B
Point of Compliance Wells:	5W5B, 5W7B, 5WC21, 5WC22, 5WC23
Plume Monitoring Wells:	5W12A
Observation Wells:	S5W5, S5W7, 5W9A, 5W10A, 5W11A, 5WCA, S5W6, S5W8, 5WC11, 5WC22

Monitoring Status: Corrective Action Monitoring Program

CY 2013 Monitoring Events:

Second Quarter 2013:	April 29-30, 2013
Fourth Quarter 2013:	October 28-29, 2013

The calendar year 2013 groundwater monitoring events served as the seventh and eighth semiannual Corrective Action (CA) groundwater monitoring events for HWMU-5 conducted in accordance with Permit Module VI – *Groundwater Corrective Action & Monitoring Program for Unit 5*, which was approved by the Virginia Department of Environmental Quality (VDEQ) in the *Final Class 3 Hazardous Waste Permit Modification* dated November 5, 2009.

2.3 Groundwater Movement

The monitoring wells at HWMU-5 are screened entirely within either weathered carbonate bedrock residuum or alluvium or across the weathered residuum/carbonate bedrock interface. The static water level measurements gathered during the 2013 semiannual monitoring events are summarized in **Table 1**. Groundwater fluctuations ranged from 0.12 to 4.41 feet during the 2013 groundwater monitoring events. As shown on the HWMU-5 Potentiometric Surface Maps (**Appendix A-1**), groundwater movement beneath the site is generally to the northeast.

Darcian flow conditions were assumed for the alluvium, residuum, and carbonate bedrock beneath HWMU-5. As a result, the groundwater velocities were calculated by multiplying the hydraulic conductivity (determined from previously conducted slug tests) by the

average hydraulic gradient across the site and dividing by an assumed effective porosity for the aquifer. The average hydraulic gradient was determined by superimposing three evenly spaced flow line vectors over the potentiometric surface map, measuring their lengths, calculating the head differential over the distances measured, and dividing the head differential by the length of the flow line vectors. The three calculated gradients were then averaged to a single value. Using this method, the average groundwater hydraulic gradient across the site based on Fourth Quarter 2013 groundwater elevations was calculated to be 0.031 ft/ft. Historical slug test data for the site yielded an average hydraulic conductivity of 5.25×10^{-5} ft/second. This value is consistent with literature values for carbonate rock and for clayey, silty sand and gravel alluvium and residuum (Domenico and Schwartz, 1990).

The estimated groundwater velocity across the site was calculated to be approximately 0.35 ft/day or 128 ft/year based on the following:

- Average hydraulic conductivity of 5.25×10^{-5} ft/second.
- Average hydraulic gradient of 0.031 ft/ft.
- Assumed effective porosity of 0.40, based on a representative range of porosities for carbonate rock, weathered residuum, and clayey, silty sand and gravel alluvium (Domenico and Schwartz, 1990).

The actual groundwater flow velocities in the carbonate bedrock may vary as much as one to two orders of magnitude from the velocity presented above depending on water level conditions and the distribution of solution features.

2.4 Groundwater Analytical Data Evaluation

The calendar year 2013 groundwater monitoring events served as the seventh and eighth semiannual Corrective Action (CA) groundwater monitoring events for HWMU-5 conducted in accordance with Permit Module VI – *Groundwater Corrective Action & Monitoring Program for Unit 5*, which was approved by the VDEQ in the *Final Class 3 Hazardous Waste Permit Modification* dated November 5, 2009. Specifically, the Second Quarter 2013 and Fourth Quarter 2013 events served as the seventh and eighth semiannual monitoring events in which all of the wells in the CA groundwater monitoring network were sampled for the constituents listed in Appendix J to Permit Attachment 2 (Groundwater Corrective Action Targeted Constituents - GPS and Semiannual Monitoring List for HWMU-5). The Second Quarter 2013 event also served as the annual monitoring event in which the point of compliance wells at HWMU-5 were sampled for the constituents listed in Appendix K to Permit Attachment 2 (Groundwater Corrective Action Annual Monitoring List).

The laboratory analytical results for the 2013 monitoring events are summarized in **Appendix A-2** (Groundwater Corrective Action Targeted Constituents - GPS and Semiannual Monitoring List) and in **Appendix A-3** (Groundwater Corrective Action Annual Monitoring List). The laboratory analytical results for the 2013 monitoring events are included on CD-ROM in **Appendix D**. The analytical data were validated in accordance with SW-846, *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

Data validation reports are included in **Appendix D**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix E**.

2.4.1 Semiannual Monitoring for Corrective Action Targeted Constituents

During the Second Quarter 2013 and Fourth Quarter 2013 monitoring events, groundwater samples collected from all of the wells in the CA groundwater monitoring network were analyzed for the CA Targeted Constituents listed in Appendix J to Permit Attachment 2. The CA Targeted Constituents consist of TCE and its daughter products: 1,1-dichloroethene (1,1-DCE), *cis*-1,2-dichloroethene (*c*DCE), *trans*-1,2-dichloroethene (*t*DCE), and vinyl chloride (VC). In addition, the VDEQ added total cobalt to the list of CA Targeted Constituents during a meeting with Radford AAP on May 4, 2011. The laboratory analytical results for the CA Targeted Constituents are summarized in **Appendix A-2**.

During Second Quarter 2013, TCE was detected in point of compliance well 5WC21 at a concentration of 6.8 µg/l, which is greater than the GPS of 5 µg/l (**Appendix A-2**). TCE was detected in point of compliance well 5WC22 at a concentration of 3.2 µg/l, which is less than the GPS of 5 µg/l, and in point of compliance well 5WC23 at a concentration of 5.0 µg/l, which is equal to the GPS of 5 µg/l. TCE was detected in point of compliance well 5W5B at a concentration less than the quantitation limit (QL) of 1 µg/l (**Appendix A-2**). TCE was not detected in any of the other wells in the CA groundwater monitoring network. Additionally, the TCE daughter products were not detected in any of the wells comprising the CA groundwater monitoring network.

During Fourth Quarter 2013, TCE was detected in point of compliance well 5WC21 at a concentration of 5.9 µg/l, which is greater than the GPS of 5 µg/l (**Appendix A-2**). TCE was detected in point of compliance wells 5WC22 and 5WC23 at concentrations of 3.7 µg/l and 3.7 µg/l, respectively, which are less than the GPS of 5 µg/l. TCE was detected in point of compliance well 5W5B at a concentration less than the quantitation limit (QL) of 1 µg/l (**Appendix A-2**). TCE was not detected in any of the other wells in the CA groundwater monitoring network. Additionally, the TCE daughter products were not detected in any of the wells comprising the CA groundwater monitoring network.

During Second Quarter 2013, total cobalt was detected in point of compliance well 5WC21 at a concentration of 70.3 µg/l, which is greater than the GPS of 7 µg/l (**Appendix A-2**). Total cobalt was not detected at concentrations greater than the GPS in the other wells comprising the CA monitoring network during Second Quarter 2013.

During Fourth Quarter 2013, total cobalt was detected in point of compliance well 5WC21 at a concentration of 90.5 µg/l, which is greater than the GPS of 7 µg/l (**Appendix A-2**). Total cobalt was not detected at concentrations greater than the GPS in the other wells comprising the CA monitoring network during Fourth Quarter 2013.

2.4.2 Annual Monitoring List - Comparison to Groundwater Protection Standards

During Second Quarter 2013, groundwater samples collected from the point of compliance wells for HWMU-5 were analyzed for the constituents listed in Appendix K to Permit Attachment 2 (Groundwater Corrective Action Annual Monitoring List). Annual monitoring for the constituents listed in Appendix K is required in order to evaluate whether additional hazardous constituents that are not the targets for the current Corrective Action (e.g., TCE and its daughter products, total cobalt) are present at concentrations greater than the Groundwater Protection Standards (GPS) for the Unit. No additional hazardous constituents that are not targets for the current Corrective Action for the Unit were detected at concentrations greater than their respective GPS during Second Quarter 2013 (**Appendix A-3**).

2.4.3 Annual Monitoring List – Verification of Estimated Values

A footnote presented in Appendix K to Permit Attachment 2 indicates that verification is required for constituents detected at concentrations less than the QL if their associated GPSs are 1) based on background values equal to the QL, and 2) are greater than the applicable risk-based concentrations (i.e., ACL or RSL). In these instances, verification must be conducted using an alternate low-level analytical method in order to confirm or refute the observed initial detections if the QL achievable by that method is less than, or equal to, the ACL or RSL for the subject constitutent. If a concentration greater than the low-level analytical method QL is observed, then the GPS for that constituent will be updated, if warranted.

During Second Quarter 2013, nitrobenzene (which has a GPS based on a background value equal to the QL) was initially detected in point of compliance well 5WC21 at a concentration less than the QL of 10 µg/l. As a result, a sample aliquot for point of compliance well 5WC21 which had been collected during the original Second Quarter 2013 sampling event, prepared by the laboratory, and held pending the initial analytical results was analyzed by the laboratory using an alternate low-level analytical method to confirm or refute the observed initial detection. Using the alternate low-level analytical method, nitrobenzene was detected in the sample collected from point of compliance well 5WC21 at a concentration of 1.2 µg/l, which is greater than the low-level analytical method QL of 1 µg/l. Therefore, on June 18, 2013, Radford AAP collected a verification sample from point of compliance well 5WC21 for analysis for nitrobenzene using a low-level analytical method. Nitrobenzene was not detected at a concentration greater than the low-level analytical method QL of 1 µg/l in the verification sample from point of compliance well 5WC21; therefore, no further action is warranted.

2.5 Annual Evaluation of Effectiveness of Corrective Action

In accordance with Sections VI.B.6, VI.J.4.f and VI.J.4.g and other applicable sections of the *Final Class 3 Hazardous Waste Permit Modification* dated November 5, 2009, Radford AAP performed an annual evaluation of the effectiveness of the Corrective Action Program (CAP) (monitored natural attenuation [MNA] program) for calendar year 2013. MNA is the current remedial measure implemented at the Unit to address TCE in groundwater at concentrations greater than the GPS. In accordance with the applicable sections of the Permit, the evaluation includes the following:

- Construction of long-term concentration plots of constituents of concern (COCs) detected at concentrations greater than their respective GPS.
- Calculation of a Point Attenuation Rate for each detected COC and determination of an updated compliance (MNA remedial) timeframe prediction based on revised point attenuation rates determined from concentration versus time graphs using the principles and methods presented in Section 7.4 of Permit Attachment 2, Appendix I (CAP).
- Comparison of updated MNA remedial timeframe to the 2019 MNA remedial timeframe (MNA goal per CAP).
- Determination of the effectiveness of the Current Remedial Measure.

2.5.1 Construction of Long-term Concentration Plots of COCs

In accordance with the Permit, graphs of natural-log concentration versus time for monitoring wells exhibiting current detections of TCE and degradation products at concentrations greater than their respective GPS values were constructed (**Appendix A-4**). During Second Quarter 2013 and Fourth Quarter 2013, TCE was detected in point of compliance well 5WC21 at concentrations greater than the GPS of 5 µg/l. TCE was not detected at concentrations greater than the GPS in any other wells comprising the CA monitoring network during the calendar year 2013 monitoring events. The TCE concentrations observed in point of compliance well 5WC21 are consistent with historical TCE concentrations observed in that well. In accordance with the Permit, a long-term concentration plot of the natural-log concentrations of TCE in well 5WC21 versus time was constructed. A linear regression line shows a decreasing trend in TCE concentration in well 5WC21 over time (**Appendix A-4**). An isoconcentration map illustrating TCE concentrations detected in groundwater during the Fourth Quarter 2013 event is included in **Appendix A-4**.

TCE was detected in point of compliance wells 5W5B, 5WC22, and 5WC23 during both 2013 monitoring events at concentrations equal to or less than the GPS of 5 µg/l. Therefore, concentration plots were not required for TCE in those wells. The TCE concentrations in 5W5B, 5WC22, and 5WC23 continue to show consistent decreases in comparison with historical data (**Appendix A-4**).

To date no daughter products of TCE (i.e., other COCs) have been detected in the groundwater samples collected at from the wells comprising the CA monitoring network at HWMU-5.

Overall, the above evaluation shows that concentrations of TCE are decreasing in the groundwater at the Unit. Therefore, the current remedial measure (MNA) is performing effectively in addressing the TCE concentrations in groundwater at the Unit.

2.5.2 Calculation of Point Attenuation Rates and Updated Compliance (MNA Remedial) Timeframe

TCE is the only current COC detected at concentrations greater than its GPS at the Unit (specifically, in well 5WC21). Therefore an updated point attenuation rate was calculated for TCE concentration in well 5WC21. The updated point attenuation rate is 0.0006, which is based on a linear regression, where the slope of the regression represents the attenuation rate, k_{point} (see

attached MNA Effectiveness Evaluation Concentration Trend Graph and Point Attenuation Rate Constant Calculation for TCE in Well 5WC21; **Appendix A-4**). The data set used to calculate the point attenuation rate encompasses TCE concentrations detected in well 5WC21 from the last 20 monitoring events beginning with November 18, 2005 to the present (October 28, 2013).

The updated MNA Compliance timeframe was calculated using the following equation:

$$t = -[\ln(C_{goal}/C_{start})]/k_{point}$$

whereas:

t = predicted GPS remedial time frame
C_{goal} = GPS concentration (5 µg/l)
C_{start} = current constituent concentration (5.9 µg/l)
k_{point} = natural attenuation rate (0.0006)

$$t = -[\ln(5/5.9)]/0.0006$$
$$t = 0.76 \text{ years}$$

The calculated current MNA timeframe (date) is mid-2014.

The current MNA timeframe is less than the 2019 MNA goal (MNA remedial timeframe presented in the CAP) and less than the 2026 MNA ineffective date (as specified in the CAP). Therefore, the current remedy is considered effective and no additional action is required.

2.6 Recommendations

During Second Quarter 2013 and Fourth Quarter 2013, TCE was detected in point of compliance well 5WC21 at concentrations greater than the GPS of 5 µg/l, and in point of compliance wells 5W5B, 5WC22, and 5WC23 at concentrations less than the GPS of 5 µg/l. However, no daughter products of TCE were detected in any of the wells comprising the CA monitoring network during the 2013 monitoring events. The TCE concentrations observed in the point of compliance wells during calendar year 2013 are consistent with historical TCE concentrations observed in those wells. TCE was not detected at concentrations greater than the QL in any other wells comprising the CA monitoring network during the calendar year 2013 monitoring events, and no daughter products of TCE were detected in the wells comprising the CA monitoring network. In accordance with the Permit, a long-term concentration plot of the natural-log concentrations of TCE in well 5WC21 versus time was constructed. A linear regression line shows a decreasing trend in TCE concentration in well 5WC21over time. Based on the data collected to date, the current calculated compliance timeframe for corrective action (monitored natural attenuation [MNA]) is mid-2014, which is less than the MNA remedial timeframe goal of 2019 as presented in the Permit, and less than the 2026 MNA ineffective date as specified in the Permit. Therefore, the current remedial measure (MNA) is performing effectively in addressing the TCE concentrations in groundwater at the Unit, and no additional action is required.

Total cobalt was detected at concentrations greater than the revised GPS of 7 μg/l in point of compliance well 5WC21 during Second Quarter 2013 and Fourth Quarter 2013. However, total cobalt was not detected at concentrations greater than the GPS in the other wells comprising the CA monitoring network.

Overall, evaluation of calendar year 2013 data for the CA Targeted Constituents and comparison with historical data indicates effective progress of groundwater CA through natural attenuation. No changes to the continuation of the groundwater CA program are anticipated at this time.

3.0 HWMU-10 ANNUAL GROUNDWATER MONITORING REPORT

3.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 10 (HWMU-10)
Owner/Operator: United States Army/BAE Systems, Ordnance Systems Inc.

Unit Location: Radford AAP Main Plant Area, Radford, Virginia

Class: Hazardous Waste Management Unit
Type: Closed Equalization Basin for the Biological Treatment System

3.2 Groundwater Monitoring Plan

Monitoring Network:

Upgradient Well:	10D4
Point of Compliance Wells:	10MW1, 10DDH2R, 10D3, 10D3D
Plume Monitoring Wells:	none
Observation Wells:	none

Monitoring Status: Compliance Monitoring Program (Second Quarter 2013)
Clean Closure for Groundwater Approved April 2, 2014, with immediate cessation of post-closure activities.

CY 2013 Monitoring Events:

Second Quarter 2013: April 25, 2013

The Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-10 were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. Therefore, the groundwater samples collected at HWMU-10 during the Second Quarter 2013 semiannual monitoring event were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification.

In correspondence dated July 30, 2013, a teleconference on September 5, 2013, and subsequent correspondence dated November 15, 2013, Radford AAP presented information to the VDEQ to support clean closure for groundwater at HWMU-10 (Radford AAP previously received VDEQ approval for clean closure for soils at HWMU-10 in December 1998). In correspondence dated December 4, 2013, Radford AAP requested a 60-day extension to the semiannual groundwater monitoring deadline for HWMU-10 (December 31, 2013, extended to March 1, 2014) and reporting deadline (March 1, 2014, extended to April 30, 2014) for HWMUs 5, 10 and 16. The 60-day extension request was based on the discussion between Radford AAP and VDEQ during the September 5, 2013 teleconference and in anticipation of the pending approval for termination of post closure care groundwater monitoring at HWMU-10. The VDEQ granted approval of the 60-day extension in correspondence dated January 6, 2014 (**Appendix F**). In correspondence dated April 2, 2014, the VDEQ granted approval for clean closure for groundwater at HWMU-10 with immediate cessation of groundwater post-closure related

activities at the Unit. As a result, Radford AAP did not conduct semiannual groundwater monitoring for HWMU-10 during Fourth Quarter 2013.

3.3 Groundwater Movement

The monitoring wells at HWMU-10 are screened either across the alluvium/limestone bedrock interface or entirely within bedrock. The static water level measurements gathered during the Second Quarter 2013 semiannual monitoring event are summarized in **Table 2**. As shown on the HWMU-10 Potentiometric Surface Map (**Appendix B-1**), groundwater movement beneath the site is generally to the north towards the New River.

Darcian flow conditions were assumed for the alluvium and limestone bedrock beneath HWMU-10. As a result, the groundwater velocities were calculated by multiplying the hydraulic conductivity (determined from previously conducted slug tests) by the average hydraulic gradient across the site and dividing by an assumed effective porosity for the aquifer materials. The average hydraulic gradient was determined by superimposing three evenly spaced flow line vectors over the potentiometric surface map, measuring their lengths, calculating the head differential over the distances measured, and dividing the head differential by the length of the flow line vectors. The three calculated gradients were then averaged to a single value. Using this method, the average groundwater hydraulic gradient across the site based on Second Quarter 2013 groundwater elevations was calculated to be 0.010 ft/ft. Historical slug test data for the site yielded an average hydraulic conductivity of 4.9×10^{-4} ft/second. This value is consistent with literature values for limestone and for clayey, silty sand and gravel alluvium (Domenico and Schwartz, 1990).

The estimated groundwater velocity across the site was calculated to be approximately 1.06 ft/day or 387 ft/year, based on the following:

- Average hydraulic conductivity of 4.9×10^{-4} ft/second.
- Average hydraulic gradient of 0.010 ft/ft.
- Assumed effective porosity of 0.40, based on a representative range of porosities for limestone and for clayey, silty sand and gravel alluvium (Domenico and Schwartz, 1990).

The actual groundwater flow velocities in the carbonate bedrock may vary as much as one to two orders of magnitude from the velocity presented above depending on water level conditions and the distribution of solution features.

3.4 Groundwater Analytical Data Evaluation

The groundwater samples collected from the compliance monitoring network during the Second Quarter 2013 semiannual monitoring event were analyzed for the constituents listed in Appendix E to Attachment 4 of the Final Post-Closure Care Permit, as revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. In addition, groundwater samples were collected from the upgradient well and the point of compliance wells for the annual monitoring for the constituents listed in Permit Attachment 1, Appendix I. The laboratory

analytical results for the Second Quarter 2013 monitoring event are included in **Appendix B-2**. The laboratory analytical results for the Second Quarter 2013 monitoring event also are included in electronic format in **Appendix D**. The analytical data were validated in accordance with SW-846, *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. Data validation reports are included in **Appendix D**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix E**.

3.4.1 Comparison to Groundwater Protection Standards

As specified in Permit Condition V.J.3.i, the Second Quarter 2013 groundwater analytical data for the upgradient well and the point of compliance wells were compared to GPS for HWMU-10 listed in Appendix G of Permit Attachment 4, as revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. In accordance with Permit Condition V.I.2, Radford AAP performed a simple empirical comparison of the upgradient well and the point of compliance well data to the GPS (**Appendix B-2**). No constituents were detected at concentrations greater than their respective GPSs in the upgradient well and the point of compliance wells during Second Quarter 2013.

3.4.2 Comparison to Background Concentrations

Only the analytical data from plume monitoring wells are compared to background concentrations. However, the compliance monitoring network at HWMU-10 is composed entirely of point of compliance wells. Therefore, the analytical data from HWMU-10 is not compared to background concentrations.

3.4.3 Annual Monitoring for Constituents Listed in Permit Attachment 1, Appendix I

Upon receipt of the Second Quarter 2013 analytical data, Radford AAP notified the VDEQ of the detection of one additional Appendix IX constituents (bis(2-ethylhexyl) phthalate) that is not listed in Appendix E of Permit Attachment 4 (Unit 10 – Groundwater Compliance Monitoring Constituent List). Bis(2-ethylhexyl)phthalate was initially detected in point of compliance well 10MW1. In accordance with the Permit, Radford AAP resampled point of compliance well 10MW1 for bis(2-ethylhexyl)phthalate in order to confirm or refute the additional Appendix IX constituent detection in the point of compliance well.

Bis(2-ethylhexyl)phthalate was not confirmed in point of compliance well 10MW1 at a concentration greater than the detection limit; as a result, no changes to the Groundwater Compliance Monitoring List for the Unit were required.

3.5 Recommendations

Based on an evaluation of the groundwater analytical data and additional information for HWMU-10, no constituents were detected at concentration greater than their respective GPSs during Second Quarter 2013. Additionally, initial detections of additional Permit Attachment 1, Appendix I constituents during Second Quarter 2013 were refuted by subsequent verification

sampling; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit were required.

In correspondence dated July 30, 2013, a teleconference on September 5, 2013, and subsequent correspondence dated November 15, 2013, Radford AAP presented information to the VDEQ to support clean closure for groundwater at HWMU-10 (Radford AAP previously received VDEQ approval for clean closure for soils at HWMU-10 in December 1998). In correspondence dated December 4, 2013, Radford AAP requested a 60-day extension to the semiannual groundwater monitoring deadline for HWMU-10 (December 31, 2013, extended to March 1, 2014) and reporting deadline (March 1, 2014, extended to April 30, 2014) for HWMUs 5, 10 and 16. The 60-day extension request was based on the discussion between Radford AAP and VDEQ during the September 5, 2013 teleconference and in anticipation of the pending approval for termination of post closure care groundwater monitoring at HWMU-10. The VDEQ granted approval of the 60-day extension in correspondence dated January 6, 2014. In correspondence dated April 2, 2014, the VDEQ granted approval for clean closure for groundwater at HWMU-10 with immediate cessation of groundwater post-closure related activities at the Unit. As a result, Radford AAP did not conduct semiannual groundwater monitoring for HWMU-10 during Fourth Quarter 2013.

4.0 HWMU-16 ANNUAL GROUNDWATER MONITORING REPORT

4.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 16 (HWMU-16)
Owner/Operator: United States Army/BAE Systems, Ordnance Systems Inc.

Unit Location: Radford AAP Main Plant Area, Radford, Virginia

Class: Hazardous Waste Management Unit
Type: Closed Hazardous Waste Landfill

4.2 Groundwater Monitoring Plan

Monitoring Network:

Upgradient Well:	16C1
Point of Compliance Wells:	16WC1A, 16WC1B, 16MW8, 16MW9
Plume Monitoring Wells:	16-1, 16-2, 16-3, 16-5, 16WC2B, 16SPRING
Observation Wells:	16WC2A, 16C3, 16CDH3

Monitoring Status: Compliance Monitoring Program

CY 2013 Monitoring Events:

Second Quarter 2013:	April 23-24, 2013
Fourth Quarter 2013:	October 21-23, 2013

The Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-16 were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. Therefore, the groundwater samples collected at HWMU-16 during the calendar year 2013 semiannual monitoring events were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification.

4.3 Groundwater Movement

The monitoring wells at HWMU-16 are screened entirely within either carbonate bedrock or weathered carbonate bedrock residuum, or across the residuum/bedrock interface. The static water level measurements gathered during the 2013 semiannual monitoring events are summarized in **Table 3**. Groundwater fluctuations ranged from 0.01 to 9.63 feet annually. As shown on the HWMU-16 Potentiometric Surface Maps (**Appendix C-1**), groundwater movement beneath the site is generally to the northeast.

Darcian flow conditions were assumed for the weathered residuum and carbonate bedrock beneath HWMU-16. As a result, the groundwater velocities were calculated by multiplying the hydraulic conductivity (determined from previously conducted slug tests) by the average hydraulic gradient across the site and dividing by an assumed effective porosity for the aquifer materials. The average hydraulic gradient was determined by superimposing three

evenly spaced flow line vectors over the potentiometric surface map, measuring their lengths, calculating the head differential over the distances measured, and dividing the head differential by the length of the flow line vectors. The three calculated gradients were then averaged to a single value. Using this method, the average groundwater hydraulic gradient across the site based on Fourth Quarter 2013 groundwater elevations was calculated to be 0.091 ft/ft. Historical slug test data for the site yielded an average hydraulic conductivity of 7.87×10^{-5} ft/second. This value is consistent with literature values for carbonate rock and for clay and silt residuum (Domenico and Schwartz, 1990).

The estimated groundwater velocity across the site was calculated to be approximately 1.55 ft/day or 565 ft/year based on the following:

- Average hydraulic conductivity of 7.87×10^{-5} ft/second.
- Average hydraulic gradient of 0.091 ft/ft.
- Assumed effective porosity of 0.40, based on a representative range of porosities for carbonate rock and clay and silt residuum (Domenico and Schwartz, 1990).

The actual groundwater flow velocities in the carbonate bedrock may vary as much as one to two orders of magnitude from the velocity presented above depending on water level conditions and the distribution of solution features.

4.4 Groundwater Analytical Data Evaluation

The groundwater samples collected from the compliance monitoring network during the 2013 semiannual monitoring events were analyzed for the constituents listed in Appendix E to Attachment 5 of the Final Post-Closure Care Permit, as revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. In addition, groundwater samples were collected from the upgradient well and the point of compliance wells for the annual monitoring for the constituents listed in Permit Attachment 1, Appendix I. The laboratory analytical results for the 2013 monitoring events are included in **Appendix C-2** (point of compliance wells) and in **Appendix C-3** (plume monitoring wells). The laboratory analytical results for the 2013 monitoring events also are included in electronic format in **Appendix D**. The analytical data were validated in accordance with SW-846, *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. Data validation reports are included in **Appendix D**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix E**.

4.4.1 Comparison to Groundwater Protection Standards

As specified in Permit Condition V.J.4.i, the 2013 groundwater analytical data for the upgradient well and the point of compliance wells were compared to GPS for HWMU-16 listed in Appendix G of Permit Attachment 5, as revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. In accordance with Permit Condition V.I.2, Radford

AAP performed a simple empirical comparison of the upgradient well and the point of compliance well data to the GPS (**Appendix C-2**).

Upon receipt of the Second Quarter 2013 analytical data, Radford AAP notified the VDEQ of the initial detection of total cobalt at a concentration greater than the GPS in point of compliance well 16WC1A, and of 1,1-dichloroethane (1,1-DCA) at a concentration greater than the GPS in upgradient well 16C1. On June 18, 2013, verification samples were collected from wells 16WC1A and 16C1 to confirm or refute these initial detections. Total cobalt and 1,1-DCA were not detected at concentrations greater than their respective GPS in the verification samples collected from point of compliance well 16WC1A and upgradient well 16C1; therefore, no further action was required. No other constituents were detected in the upgradient well or in the point of compliance wells at concentrations greater than their respective GPSs during Second Quarter 2013 (**Appendix C-2**).

During Fourth Quarter 2013, total cobalt was detected in point of compliance well 16WC1B at a concentration greater than the GPS of 5 µg/l (**Appendix C-2**); Radford AAP confirmed the total cobalt concentration in subsequent verification samples collected on December 5, 2013 (total cobalt) and on December 20, 2013 (total and dissolved cobalt). In accordance with Permit Condition V.J.4.i.(3)(c) and as directed in VDEQ correspondence dated January 21, 2014 (**Appendix F**), Radford AAP will conduct an Alternate Source Demonstration (ASD) to evaluate whether the total cobalt concentration detected in well 16WC1B was due to 1) a source other than the Unit; 2) errors in sampling, analysis, and evaluation; or 3) natural variation in groundwater.

4.4.2 Comparison to Background Concentrations

As specified in Permit Condition V.O, the 2013 groundwater analytical data for the plume monitoring wells were compared to the background concentrations for HWMU-16 listed in Appendix F of Permit Attachment 5. In accordance with Permit Condition V.I.2, Radford AAP performed a simple empirical comparison of the plume monitoring well data to the background concentrations (**Appendix C-3**).

As shown in **Appendix C-3**, total barium concentrations detected in upgradient well 16C1 and plume monitoring wells 16-2 and 16-3 and in spring sampling location 16SPRING during both 2013 semiannual monitoring events as well as in plume monitoring well 16-1 duirng Second Quarter 2013 were greater than the background concentration of 175.4 µg/l. However, all of the total barium concentrations detected in the plume monitoring wells were well below the USEPA MCL for barium of 2,000 µg/l. Furthermore, higher barium concentrations in downgradient plume monitoring wells relative to background may be the result of natural variations in trace element distribution in groundwater. As illustrated in the boring logs for the compliance network monitoring wells (Appendix H of Permit Attachment 5), upgradient well 16C1 is screened in limestone while downgradient plume monitoring wells 16-1, 16-2, 16-3, and 16-5 are screened in shale and fault breccia. Such differing lithologic formations would be expected to contain very different trace element distributions.

No other constituent concentrations detected in the plume monitoring wells were greater than their respective background concentrations. In accordance with the requirements of Permit

Condition V.K.3, the established background values and the computations used to determine the background values are included in **Appendix C-4**. The background values and associated computations are taken from the Groundwater Quality Assessment Report for HWMU-16 dated August 1999.

4.4.3 Annual Monitoring for Constituents Listed in Permit Attachment 1, Appendix I

Upon receipt of the Second Quarter 2013 analytical data, Radford AAP notified the VDEQ of the detection of seven additional Appendix IX constituents (acetone, delta-BHC, 1,1-dichloroethene, diethyl phthalate, gamma-BHC, heptachlor, and tetrahydrofuran) that were not listed in Appendix E of Permit Attachment 5 (Unit 16 – Groundwater Compliance Monitoring Constituent List). 1,1-Dichloroethene, alpha-BHC, gamma-BHC, heptachlor, and tetrahydrofuran were detected in upgradient well 16C1. Additionally, tetrahydrofuran was initially detected in point of compliance well 16WC1B. Acetone and diethyl phthalate were initially detected in point of compliance wells 16MW8 and 16MW9, respectively. In accordance with the Permit, Radford AAP resampled well 16MW8 for acetone, well 16MW9 for diethyl phthalate, and well 16WC1B for tetrahydrofuran in order to confirm or refute the additional Appendix IX constituent detections in the point of compliance wells.

Sampling of well 16C1 for Appendix IX constituents is not required per the Post-Closure Care Permit for the Unit; therefore, 1,1-dichloroethene, delta-BHC, gamma-BHC, and heptachlor will not be added to the Groundwater Monitoring List for the Unit. Acetone was not confirmed in point of compliance well 16MW8, and tetrahydrofuran was not confirmed in point of compliance well 16WC1B; as a result, acetone and tetrahydrofuran will not be added to the Groundwater Monitoring List for the Unit.

The verification sample results confirmed the presence of diethyl phthalate in point of compliance well 16MW9; as a result, diethyl phthalate will be added to the Groundwater Monitoring List for HWMU-16. The permit requires collection of four quarters of monitoring data from a Unit's upgradient well(s) to establish background values for newly detected Appendix IX constituents. However, Radford AAP has collected diethyl phthalate data from HWMW-16 upgradient monitoring well 16C1 during the previous 11 annual Appendix IX groundwater monitoring events (2003-2013). Diethyl phthalate has never been detected at or above the LOQ in upgradient well 16C1; therefore, in lieu of quarterly background monitoring, Radford AAP proposes to use these data to set the background value for diethyl phthalate at the LOQ of 5 µg/l and the GPS at the VDEQ alternate concentration limit (ACL) of 12,480 µg/l.

4.5 Recommendations

Based on an evaluation of the groundwater analytical data and additional information for HWMU-16, total cobalt was detected at a concentration greater than the GPS of 5 µg/l during Fourth Quarter 2013. In accordance with Permit Condition V.J.4.i.(3)(c) and as directed in VDEQ correspondence dated January 21, 2014 (**Appendix F**), Radford AAP will conduct an ASD to evaluate whether the total cobalt concentration detected in well 16WC1B was due to 1) a source other than the Unit; 2) errors in sampling, analysis, and evaluation; or 3) natural variation in groundwater. The ASD will consist of collecting four (4) independent samples from point of compliance well 16WC1B at a frequency of one sample per calendar quarter to evaluate the

effect of seasonal variation upon the total cobalt concentrations in groundwater. If the total cobalt concentrations detected in the independent samples remain above the GPS, Radford AAP will evaluate additional monitoring wells in the Horseshoe Area of the Facility (the area containing HWMU-16) for natural variability of total cobalt within the aquifer. The ASD data results will be submitted to the VDEQ within 90 days following completion of the collection of the quarterly independent samples.

Second Quarter 2013 verification sampling confirmed the presence of the additional Appendix IX constituent diethyl phthalate in HWMU-16 point of compliance well 16MW9 and diethyl phthalate was added to the Groundwater Compliance Monitoring List for the Unit . No additional Permit Attachment 1, Appendix I constituents were confirmed in the point of compliance wells during Second Quarter 2013; therefore, no other changes to the Groundwater Compliance Monitoring List for the Unit are required. The permit requires collection of four quarters of monitoring data from a Unit's upgradient well(s) to establish background values for newly detected Appendix IX constituents. However, Radford AAP has collected diethyl phthalate data from HWMW-16 upgradient monitoring well 16C1 during the previous 11 annual Appendix IX groundwater monitoring events (2003-2013). Diethyl phthalate has never been detected at or above the LOQ in upgradient well 16C1; therefore, in lieu of quarterly background monitoring, Radford AAP proposes to use these data to set the background value for diethyl phthalate at the LOQ of 5 µg/l and the GPS at the VDEQ alternate concentration limit (ACL) of 12,480 µg/l."

Evaluation of the plume monitoring well data indicated that the concentrations of total barium in upgradient well 16C1 and in plume monitoring wells 16-1, 16-2, and 16-3 and in spring sampling location 16SPRING were greater than the site-specific background concentration. As stated previously, higher total barium concentrations in downgradient plume monitoring wells relative to background are likely due to natural variations in trace element distribution in groundwater. Upgradient well 16C1 is screened in limestone while downgradient plume monitoring wells 16-1, 16-2, 16-3, and 16-5 are screened in shale and fault breccia. Such differing lithologic formations would be expected to contain very different trace element distributions. Therefore, no further action regarding the 2013 total barium concentrations detected in plume monitoring wells 16-1, 16-2, and 16-3 and in spring sampling location 16SPRING is recommended at this time.

SIGNATURE/CERTIFICATION

Prepared by:

Name: Ross G. Miller, Senior Project Geologist

Signature: 

Company: Draper Aden Associates

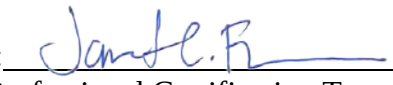
Address: 2206 South Main Street

City/State/Zip: Blacksburg, Virginia 24060-6600

Virginia Professional Certification:

I certify that I have prepared or supervised preparation of the attached report, that it has been prepared in accordance with industry standards and practices, and that the information contained herein is truthful and accurate to the best of my knowledge.

Name: Michael D. Lawless, Environmental Program Manager

Signature: 

Virginia Professional Certification Type and Number: PG 832

Company: Draper Aden Associates

Address: 2206 South Main Street

City/State/Zip: Blacksburg, Virginia 24060-6600

TABLES

TABLE 1
HWMU-5
GROUNDWATER ELEVATIONS - 2013
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	APRIL 29, 2013		OCTOBER 28, 2013	
		DTW	GW ELEV	DTW	GW ELEV
5W8B	1789.58	13.90	1775.68	14.02	1775.56
5W5B	1775.13	8.42	1766.71	9.36	1765.77
5W7B	1774.78	8.61	1766.17	9.08	1765.70
5WC21	1774.43	8.77	1765.66	9.32	1765.11
5WC22	1774.45	8.70	1765.75	9.19	1765.26
5WC23	1773.84	8.10	1765.74	8.62	1765.22
5W12A	1772.46	10.28	1762.18	11.65	1760.81
S5W5	1772.31	7.56	1764.75	8.26	1764.05
S5W7	1776.08	10.90	1765.18	11.07	1765.01
5W9A	1762.20	0.85	1761.35	2.48	1759.72
5W10A	1771.40	12.27	1759.13	14.88	1756.52
5W11A	1766.20	8.87	1757.33	13.28	1752.92
5WC11	1788.92	15.42	1773.50	15.85	1773.07
5WC12	1788.96	15.13	1773.83	15.40	1773.56
5WCA	1779.05	12.27	1766.78	13.22	1765.83
S5W6	1771.43	6.40	1765.03	7.15	1764.28
S5W8	1783.68	11.35	1772.33	10.97	1772.71

NOTES:
DTW: Depth to water from top of casing.
GW ELEV: Groundwater elevation.
All elevations in feet above mean sea level.

TABLE 2
HWMU-10
GROUNDWATER ELEVATIONS - 2013
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	APRIL 25, 2013	
		DTW	GW ELEV
10D4	1714.38	22.61	1691.77
10DDH2R	1704.38	17.66	1686.72
10D3	1702.95	16.24	1686.71
10D3D	1702.64	16.40	1686.24
10MW1	1703.62	16.33	1687.29

NOTES:
DTW: Depth to water from top of casing.
GW ELEV: Groundwater elevation.
All elevations in feet above mean sea level.

TABLE 3
HWMU-16
GROUNDWATER ELEVATIONS - 2013
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	APRIL 23, 2013		OCTOBER 22, 2013	
		DTW	GW ELEV	DTW	GW ELEV
16C1	1840.14	49.55	1790.59	48.31	1791.83
16MW8	1815.82	71.22	1744.60	73.41	1742.41
16MW9	1808.88	61.79	1747.09	65.51	1743.37
16WC1A	1812.61	64.66	1747.95	67.86	1744.75
16WC1B	1812.95	64.96	1747.99	68.08	1744.87
16-1	1815.82	52.58	1763.24	42.95	1772.87
16-2	1810.99	55.81	1755.18	55.80	1755.19
16-3	1824.77	57.37	1767.40	55.95	1768.82
16-5	1742.60	4.02	1738.58	3.00	1739.60
16WC2B	1818.71	53.60	1765.11	52.89	1765.82
16WC2A	1820.05	DRY	DRY	DRY	DRY
16C3	1822.22	64.59	1757.63	67.13	1755.09
16CDH3	1825.60	DRY	DRY	DRY	DRY
SPRING	na	na	na	na	na

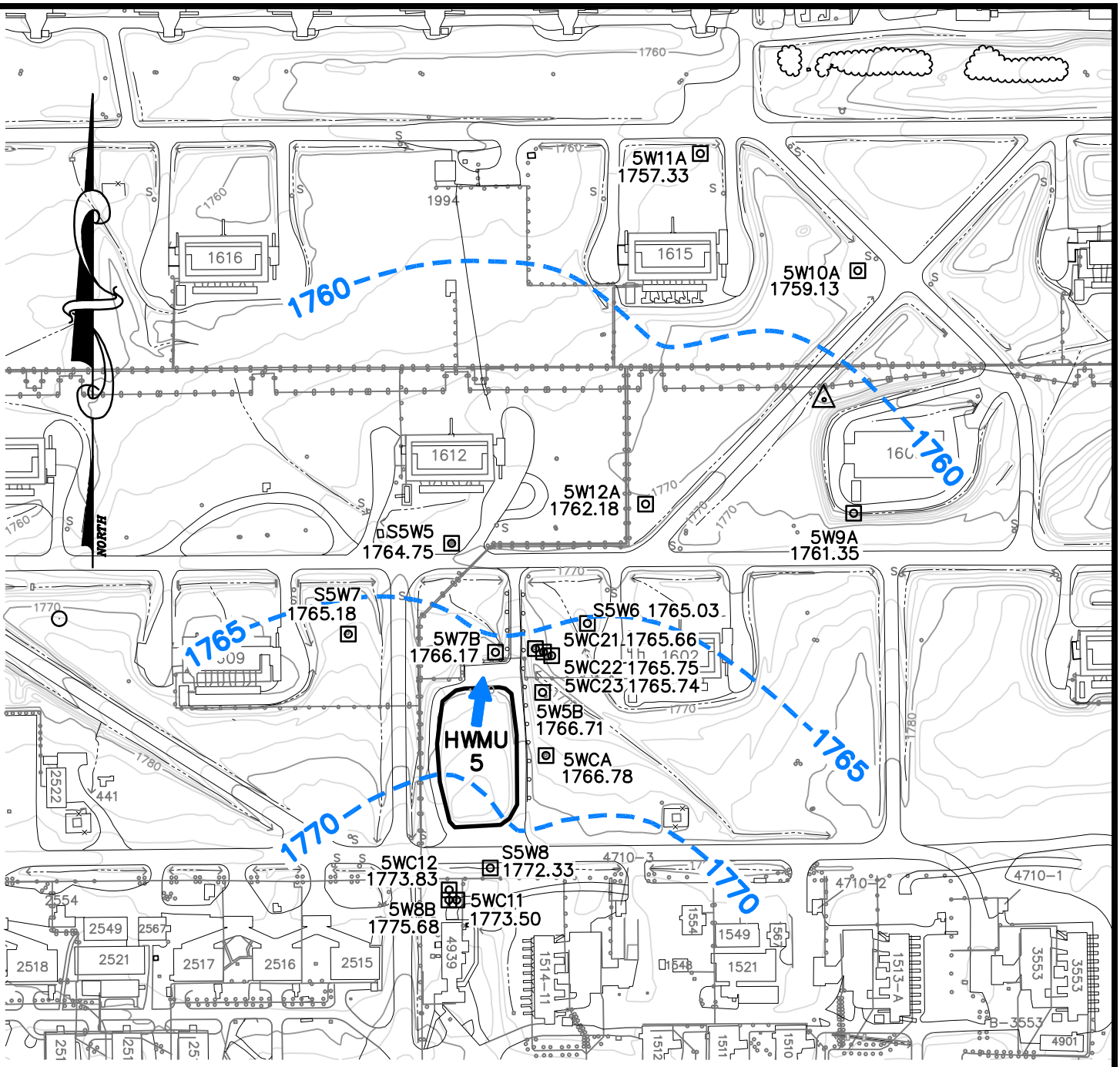
NOTES:
DTW: Depth to water from top of casing.
GW ELEV: Groundwater elevation.
All elevations in feet above mean sea level.
na: Not applicable.

APPENDIX A

HWMU-5

APPENDIX A-1

HWMU-5 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2013
FOURTH QUARTER 2013



GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

LEGEND

5W7B 1766.17 — MONITORING WELL; GROUNDWATER ELEVATION (feet above mean sea level)

--1770-- GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

HWMU-5 POTENTIOMETRIC SURFACE MAP (APRIL 29, 2013)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-11

Draper Aden Associates

Engineering ◆ Surveying ◆ Environmental Services

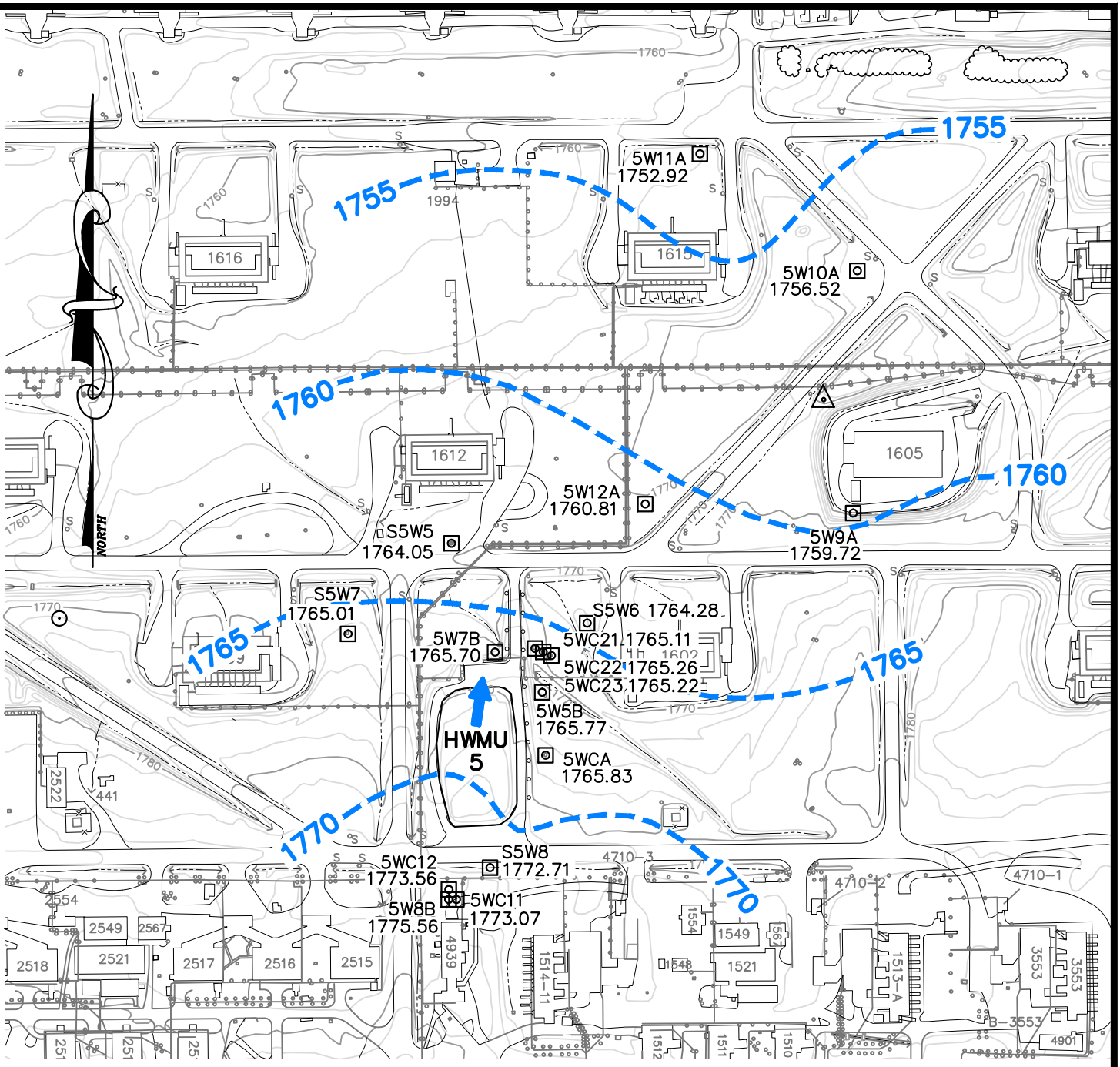
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291

Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	SN
DRAWN	DLD
CHECKED	MDL
DATE	07-22-13

FIGURE 1

P:\B03200\B03204\B03204-11\CAD\B03204-11_HWMU-5.dwg Jul 25, 2013 1:15pm



GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

LEGEND

5W7B 1765.70 — MONITORING WELL GROUNDWATER ELEVATION (feet above mean sea level)

1770 — GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

HWMU-5 POTENTIOMETRIC SURFACE MAP (OCTOBER 28, 2013)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-11

Draper Aden Associates

Engineering ✦ Surveying ✦ Environmental Services

2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291

Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	SN
DRAWN	DLD
CHECKED	MDL
DATE	04/21/14

FIGURE 1

P:\B03200\B03204\B03204-12P\CAD\B03204-12_HWMU-5.dwg Apr 22, 2014 11:42am

APPENDIX A-2

HWMU-5 2013 LABORATORY ANALYTICAL RESULTS
GROUNDWATER CORRECTIVE ACTION TARGETED CONSTITUENTS
GPS AND SEMIANNUAL MONITORING LIST

Summary of Semiannual Target Analyte Monitoring Results Appendix J
Corrective Action Monitoring Plan - Targeted Constituents
Hazardous Waste Management Unit 5
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 5W8B

Analyte/Quarter	*5W8B Q*	*5W5B Q*	*5W7B Q*	*5WC21 Q*	*5WC22 Q*	*5WC23 Q*	*5W12A Q*	*QL*	*Permit QL*	*GPS*	*DL*	*Permit DL*	*UNIT*	*Method*
Cobalt						*CAS #* 7440-48-4								
Second Quarter 2013	U	U	2.94 J	70.3	4.52 J	2.38 J	U	5	5	7	1	1	UG/L	6020A
Fourth Quarter 2013	1.01 J	U	2.23 J	90.5	6.87	2.13 J	U	5	5	7	1	1	ug/l	6020A
1,1-Dichloroethene						*CAS #* 75-35-4								
Second Quarter 2013	U	U	U	U	U	U	U	1	1	7	0.4	0.44	ug/l	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	1	7	0.4	0.44	ug/l	8260C
cis-1,2-Dichloroethene						*CAS #* 156-59-2								
Second Quarter 2013	U	U	U	U	U	U	U	1	1	70	0.1	0.1	ug/l	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	1	70	0.1	0.1	ug/l	8260C
trans-1,2-Dichloroethene						*CAS #* 156-60-5								
Second Quarter 2013	U	U	U	U	U	U	U	1	1	100	0.8	0.8	ug/l	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	1	100	0.8	0.8	ug/l	8260C
Trichloroethene						*CAS #* 79-01-6								
Second Quarter 2013	U	0.5 J	U	6.8	3.2	5.0	U	1	1	5	0.2	0.177	ug/l	8260C
Fourth Quarter 2013	U	0.5 J	U	5.9	3.7	3.7	U	1	1	5	0.2	0.177	ug/l	8260C
Vinyl chloride						*CAS #* 75-01-4								
Second Quarter 2013	U J	U J	U J	U J	U J	U J	U J	1	1	2	0.1	0.1	ug/l	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	1	2	0.1	0.1	ug/l	8260C

See last page of this report for definitions.

Summary of Semiannual Target Analyte Monitoring Results Appendix J
Corrective Action Monitoring Plan - Targeted Constituents
Hazardous Waste Management Unit 5
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 5W8B

Analyte/Quarter	*5W8B Q*	*5W5B Q*	*5W7B Q*	*5WC21 Q*	*5WC22 Q*	*5WC23 Q*	*5W12A Q*	*QL*	*Permit QL*	*GPS*	*DL*	*Permit DL*	*UNIT*	*Method*

Definitions:

Results are reported to the permit detection limit.

QL Denotes laboratory quantitation limit.
Permit QL Denotes permit quantitation limit.
DL Denotes laboratory detection limit.
Permit DL Denotes permit detection limit.
U denotes not detected at or above the permit detection limit or QL.
UA denotes not detected at or above the adjusted detection limit or adjusted QL.
J Denotes result is estimated. When used with "U" (i.e., "UJ"), denotes analyte not detected at or above the detection limit or QL and detection limit and QL are estimated. When used with "UA" (i.e., "UAJ"), denotes analyte not detected at or above adjusted detection limit and adjusted detection limit and QL are estimated.
UN Denotes analyte concentration is less than the QL and/or five times the blank concentration. Not reliably detected due to blank contamination.
R Denotes result rejected.
Q Denotes data validation qualifier. **X** Denotes mass spectral confirmation not obtained-result suspect.

CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes Groundwater Protection Standards listed in Appendix J of Module VI-Groundwater Corrective Action & Monitoring Program for Unit 5 (approved by the VDEQ in the Final Class 3 Hazardous Waste Permit Modification dated November 5, 2009 and modified Sept 27, 2011) which was incorporated into the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002). The first Corrective Action Monitoring Event occurred Second Quarter 2010.
"–" denotes not sampled.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-5 Monitoring Event: Fourth Quarter 2013

Draper Aden Associates
Engineering ◆ Surveying ◆ Environmental Services

Analyte	Sample ID	Laboratory Result (ug/L)	Q	Validated Result (ug/L)	Q	QL (ug/L)	Validation Notes
Method: 6020A							
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC							
Cobalt	5WC21	90.5		90.5		5	No action taken.
	5WDUP	86.3		86.3		5	No action taken. Field duplicate of 5WC21. RPD 4.8.
Method: 8260C							
Laboratory: Eurofins Lancaster Labortories Environmental, Lancaster, PA							
Trichloroethene	5WC21	5.9		5.9		1	No action taken.
	5WDUP	5.8		5.8		1	No action taken. Field duplicate of 5WC21. RPD 1.7.

Definitions:

Data Validation Qualifiers:

QL Denotes permit quantitation limit. **Q** Denotes data qualifier.

J Denotes analyte reported at or above quantitation limit and associated result is estimated.

APPENDIX A-3

HWMU-5 2013 LABORATORY ANALYTICAL RESULTS
GROUNDWATER CORRECTIVE ACTION ANNUAL MONITORING LIST

Comprehensive Data Validation Report

Draper Aden Associates
Engineering ♦ Surveying ♦ Environmental Services

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-5 Monitoring Event: Second Quarter 2013

Analyte	Sample ID	Laboratory Result (ug/L)	Q	Validated Result (ug/L)	Q	QL (ug/L)	Validation Notes
Method: 6020A							
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC							
Barium	5WC21	13.1		13.1		10	No action taken.
	5WDUP	13		13		10	Analyte not detected at or above DL or QL. Field duplicate of 5WC21.
Beryllium	5WC21	1.09		1.09		1	No action taken.
	5WDUP	1.02		1.02		1	Analyte not detected at or above DL or QL. Field duplicate of 5WC21.
Cobalt	5WC21	70.3		70.3		5	No action taken.
	5WDUP	70.3		70.3		5	Analyte not detected at or above DL or QL. Field duplicate of 5WC21.
Copper	5WC21	5.18		5.18		5	No action taken.
Nickel	5WC21	33.2		33.2		10	No action taken.
	5WDUP	33.2		33.2		10	Analyte not detected at or above DL or QL. Field duplicate of 5WC21.
Zinc	5WC21	31		31		10	No action taken.
	5WDUP	32.2		32.2		10	Analyte not detected at or above DL or QL. Field duplicate of 5WC21.
Method: 8260C							
Laboratory: Eurofins Lancaster Laboratories, Lancaster, PA							
Trichloroethene	5WC21	6.8		6.8		1	No action taken.
	5WDUP	6.6		6.6		1	No action taken. Field duplicate of 5WC21. RPD < 10.

Definitions:

Data Validation Qualifiers:

QL Denotes permit quantitation limit. **Q** Denotes data qualifier.

J Denotes analyte reported at or above quantitation limit and associated result is estimated.

Summary of Annual Target Analyte Monitoring Results - Appendix K
Corrective Action Monitoring Plan - Targeted Constituents
Hazardous Waste Management Unit 5
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 5W8B

Analyte/Quarter	*5W8B Q*	*5W5B Q*	*5W7B Q*	*5WC21 Q*	*5WC22 Q*	*5WC23 Q*	*QL*	*Permit QL*	*GPS*	*DL*	*Permit DL*	*UNIT*	*Method*
Antimony						*CAS # 7440-36-0*							
Second Quarter 2013	-	U	U	U	U	U	2	1	6	0.4	0.4	UG/L	6020A
Arsenic						*CAS # 7440-38-2*							
Second Quarter 2013	-	U	U	U	U	U	10	10	10	2	2	UG/L	6020A
Barium						*CAS # 7440-39-3*							
Second Quarter 2013	-	29.8	29	13.1	26.4	22.7	10	10	2,000	1	1	UG/L	6020A
Beryllium						*CAS # 7440-41-7*							
Second Quarter 2013	-	U	U	1.09	U	U	1	1	4	0.2	0.2	UG/L	6020A
Cadmium						*CAS # 7440-43-9*							
Second Quarter 2013	-	U	U	0.583 J	0.244 J	U	1	1	5	0.2	0.2	UG/L	6020A
Chromium						*CAS # 7440-47-3*							
Second Quarter 2013	-	U	U	3.86 J	U	U	5	5	100	1	1	UG/L	6020A
Cobalt						*CAS # 7440-48-4*							
Second Quarter 2013	U	U	2.94 J	70.3	4.52 J	2.38 J	5	5	7	1	1	UG/L	6020A
Copper						*CAS # 7440-50-8*							
Second Quarter 2013	-	1.99 J	3.02 J	5.18	U	U	5	5	1,300	1	1	UG/L	6020A
Lead						*CAS # 7439-92-1*							
Second Quarter 2013	-	0.24 J	0.884 J	U	U	U	1	1	15	0.2	0.2	UG/L	6020A
Mercury						*CAS # 7439-97-6*							
Second Quarter 2013	-	U	U	U	U	U	2	2	2	0.2	0.2	UG/L	7470A
Nickel						*CAS # 7440-02-0*							
Second Quarter 2013	-	U	2.32 J	33.2	5.88 J	4.24 J	10	10	313	2	2	UG/L	6020A
Selenium						*CAS # 7782-49-2*							
Second Quarter 2013	-	3.85 J	U	U	U	U	10	10	50	3	3	UG/L	6020A
Silver						*CAS # 7440-22-4*							
Second Quarter 2013	-	U	U	U	U	U	2	2	78.25	0.2	0.2	UG/L	6020A
Thallium						*CAS # 7440-28-0*							
Second Quarter 2013	-	U	U	U	U	U	1	1	2	0.2	0.2	UG/L	6020A
Vanadium						*CAS # 7440-62-2*							
Second Quarter 2013	-	U	U	U	U	U	10	10	109.55	1	1	UG/L	6020A

See last page of this report for definitions.

Summary of Annual Target Analyte Monitoring Results - Appendix K
Corrective Action Monitoring Plan - Targeted Constituents
Hazardous Waste Management Unit 5
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 5W8B

Analyte/Quarter	*5W8B Q*	*5W5B Q*	*5W7B Q*	*5WC21 Q*	*5WC22 Q*	*5WC23 Q*	*QL*	*Permit QL*	*GPS*	*DL*	*Permit DL*	*UNIT*	*Method*
Zinc						*CAS # 7440-66-6*							
Second Quarter 2013	-	7.38 J	8.98 J	31	U	U	10	10	4,695	3	3	UG/L	6020A
Acetone						*CAS # 67-64-1*							
Second Quarter 2013	-	U	U	U	U	U	10	10	8,750.2	3	3	ug/l	8260C
bis(2-Ethylhexyl)phthalate						*CAS # 117-81-7*							
Second Quarter 2013	-	U	U	U	U	U	5	6	10	0.57	1.5	UG/L	8270D
2-Butanone						*CAS # 78-93-3*							
Second Quarter 2013	-	U	U	U	U	U	10	10	2,667.6	1	1	ug/l	8260C
Chloroform						*CAS # 67-66-3*							
Second Quarter 2013	-	0.7 J	6.1	0.8 J	0.6 J	0.9 J	1	1	80	0.1	0.1	ug/l	8260C
Dichlorodifluoromethane						*CAS # 75-71-8*							
Second Quarter 2013	-	U J	U J	U J	U J	U J	1	1	142.27	0.3	0.28	ug/l	8260C
1,2-Dichloroethane						*CAS # 107-06-2*							
Second Quarter 2013	-	U	U	U	U	U	1	1	5	0.1	0.147	ug/l	8260C
Diethyl ether						*CAS # 60-29-7*							
Second Quarter 2013	-	U J	U J	4.4 J	4.8 J	16 J	12	12	7,300	0.4	0.39	ug/l	8260C
Diethyl phthalate						*CAS # 84-66-2*							
Second Quarter 2013	-	U	U	U	U	U	5	10	12,520	0.52	0.5	UG/L	8270D
2,4-Dinitrotoluene						*CAS # 121-14-2*							
Second Quarter 2013	-	U	U	0.98 J	U	U	5	10	31.3	0.84	0.6	UG/L	8270D
2,6-Dinitrotoluene						*CAS # 606-20-2*							
Second Quarter 2013	-	U	U	U	U	U	5	10	15.65	0.75	0.7	UG/L	8270D
Methylene chloride						*CAS # 75-09-2*							
Second Quarter 2013	-	U	U	U	U	U	1	1	5	0.2	0.182	ug/l	8260C
o-Nitroaniline						*CAS # 88-74-4*							
Second Quarter 2013	-	U	U	U	U	U	10	10	110	1.5	0.7	UG/L	8270D
p-Nitroaniline						*CAS # 100-01-6*							
Second Quarter 2013	-	U J	U J	U J	U J	U J	10	20	20	2.7	1.3	UG/L	8270D
Nitrobenzene						*CAS # 98-95-3*							
Second Quarter 2013	-	-	-	1	-	-	1	10	10	1	0.8	UG/L	8270D
Second Quarter 2013	-	U	U	-	U	U	5	10	10	1.3	0.8	UG/L	8270D

See last page of this report for definitions.

Summary of Annual Target Analyte Monitoring Results - Appendix K
Corrective Action Monitoring Plan - Targeted Constituents
Hazardous Waste Management Unit 5
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 5W8B

Analyte/Quarter	*5W8B Q*	*5W5B Q*	*5W7B Q*	*5WC21 Q*	*5WC22 Q*	*5WC23 Q*	*QL*	*Permit QL*	*GPS*	*DL*	*Permit DL*	*UNIT*	*Method*
Toluene						*CAS #* 108-88-3							
Second Quarter 2013	-	U	U	U	U	U	1	1	1,000	0.1	0.1	ug/l	8260C
Xylenes (Total)						*CAS #* 1330-20-7							
Second Quarter 2013	-	U	U	U	U	U	3	3	10,000	0.2	0.208	ug/l	8260C

Definitions:

Results are reported to the Permit Detection Limit.
First Corrective Action Monitoring Event Second Quarter 2010:

QL: Denotes laboratory quantitation limit.
Permit QL: Denotes permit quantitation limit.
DL: Denotes laboratory detection limit.
Permit DL: Denotes permit detection limit.
U: Denotes not detected at or above the permit detection limit or QL.
UA: Denotes not detected at or above the adjusted detection limit or adjusted QL.
J: Denotes result is estimated. When used with "U" (i.e., "UJ"), denotes analyte not detected at or above the detection limit or QL and detection limit and QL are estimated. When used with "UA" (i.e., "UAJ"), denotes analyte not detected at or above adjusted detection limit and adjusted detection limit and QL are estimated.
UN: Denotes analyte concentration is less than the QL and/or five times the blank concentration. Not reliably detected due to blank contamination.
R: Denotes result rejected.
Q: Denotes data validation qualifier.
X: Denotes mass spectral confirmation not obtained - result suspect.

CAS#: Denotes Chemical Abstract Services registration number.
GPS: Denotes Groundwater Protection Standards listed in Appendix K of Module VI-Groundwater Corrective Action & Monitoring Program for Unit 5 (approved by the VDEQ in the Final Class 3 Hazardous Waste Permit Modification dated November 5, 2009) which was incorporated into the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002).
"–": Denotes not sampled.

APPENDIX A-4

MNA EFFECTIVENESS EVALUATION
(CONCENTRATION TREND GRAPH, POINT ATTENUATION RATE CALCULATION, DATA TREND GRAPHS, TCE ISOCONCENTRATION MAP)

TCE Detections in Groundwater, Radford Army Ammunition Plant HWMU 5 (RAAP-042)

Date	5W8B	5W5B	5WC21	5WC22	5WC23	5W7B	S5WS	S5W7	5W9A	5W10A	5W11A
1st Qtr 1996	~	2.3	~	2.2	2.9	~	~	~	0.6 J	~	~
2nd Qtr 1996	~	5.7	0.4 J	3.8	4.5	~	~	~	0.7 J	~	~
3rd Qtr 1996	TC	4.3	0.4 J	5	5.8	~	~	~	0.8 J	~	~
4th Qtr 1996	~	2.4	0.9J	6.2	5.3	~	~	~	0.6 J	~	~
1st Qtr 1997	~	2.5	1.8	7.4	6.6	0.2 J	~	0.1 J	0.3 J	~	~
2nd Qtr 1997	0.3 J	7.8	2.7	7.4	6.8	0.1 J	0.4 J	~	0.8 J	0.1 J	~
3rd Qtr 1997	~	6	2.4	8.4	8.7	~	0.2 J	~	0.5 J	~	~
4th Qtr 1997	0.8 J	9.4	1.2	8.9	2.8	0.3 J	0.3 J	~	0.3 J	~	~
1st Qtr 1998	~	3.2	0.5	4.5	5.6	~	~	~	0.2 J	~	~
2nd Qtr 1998	~	12.8	1.3	4.7	4.7	~	0.2 J	~	0.2 J	~	~
3rd Qtr 1998	~	12.8	2	4.7	5.1	~	~	~	0.5 J	~	~
4di Qtr 1998	~	7.5	4.6	5.4	5.6	~	~	~	~	~	~
1st Qtr 1999	~	9.5	6.7	7.5	7.5	~	~	~	~	7.4	~
2nd Qtr 1999	~	15.9	5.6	6.7	6	~	~	~	0.2 J	~	~
3rd Qtr 1999	~	20.5	7.8	9.9	7.8	~	~	~	0.5 J	~	~
4th Qtr 1999	~	19.5	4.06	6.68	6.98	~	~	~	~	~	~
1st Qtr 2000	~	15.8	3.1	6.3	6.3	~	~	~	~	~	~
2nd Qtr 2000	~	13.2	3.9	5.7	5.5	~	~	~	~	~	~
3rd Qtr 2000	~	16.3	5.42	DRY	DRY	~	~	~	~	~	~
4th Qtr 2000	~	14.9	6.55	5.33	5.41	~	~	~	~	~	~
1st Qtr 2001	~	18.8	7.32	5.81	4.98	~	~	~	~	~	~
2nd Qtr 2001	~	1.67	12.1	9.33	9.11	~	~	~	~	~	~
3rd Qtr 2001	~	6.06	20.4	13.2	11.8	~	~	~	~	~	~
4th Qtr 2001	~	9.91	19.2	7.78	7.83	~	~	~	~	~	~
1st Qtr 2002	9.13	~	19.1	6.63	6.33	~	~	~	~	~	~
2nd Qtr 2002	~	9.84	16.6	7.03	6.25	~	~	~	~	~	~
3rd Qtr 2002	~	6.36	8.46	1.94	2.13	~	~	~	~	~	~
4th Qtr 2002	~	5.84	11.3	2.54	2.69	~	~	~	~	~	~
2nd Qtr 2003	~	4.2	26	7.4	7.6	~	~	~	~	~	~
3rd Qtr 2003	~	1.9	22	8	7.9	~	~	~	~	~	~
4th Qtr 2003	~	6	23	7.1	7.1	~	~	~	~	~	~
1st Qtr 2004	~	7.4	23	7.4	6.8	~	~	~	~	~	~
2nd Qtr 2004	~	8	22	6.2	6.8	~	~	~	~	~	~
3rd Qtr 2004	~	7	17	4.8	4.9	~	~	~	~	~	~
4st Qtr 2004	~	9.4	20	6.2	6.6	~	~	~	~	~	~
1st Qtr 2005	~	7.9	24	5.9	5.9	~	~	~	~	~	~
2nd Qtr 2005	~	13	16	5.5	5.8	~	~	~	~	~	~
3rd Qtr 2005	~	12	10	4.2	5.1	~	~	~	~	~	~
4th Qtr 2005	~	12	6.8	4.4	4.3	~	~	~	~	~	~
1st Qtr 2006	~	8.5	3.9	3.7	4.5	~	~	~	~	~	~
2nd Qtr 2006	~	17	4	4	4	~	~	~	~	~	~
3rd Qtr 2006	~	11	3.7	3.3	3.7	~	~	~	~	~	~
4th Qtr 2006	~	9.4	3.5	4.7	3.5	~	~	~	~	~	~
1st Qtr 2007	~	9	5.6	3.3	3.6	~	~	~	~	~	~
2nd Qtr 2007	~	10	5.5	3.5	3.5	~	~	~	~	~	~
4th Qtr 2007	~	8.9	2.5	3.4	3.5	~	~	~	~	~	~
2nd Qtr 2008	~	7.8	~	~	2.9	~	~	~	~	~	~
4th Qtr 2008	~	14	1.3	3	3	~	~	~	~	~	~
2nd Qtr 2009	~	1.3	~	2.5	2.5	~	~	~	~	~	~
4th Qtr 2009	~	7	1.9	3.3	3.3	~	~	~	~	~	~
2nd Qtr 2010	~	2.6	4.2	4.4	4.3	~					
4th Qtr 2010	~	7.3	4	4	3.9	~					
2nd Qtr 2011	~	0.9 J	4.9	5.2	5.3	~					
4th Qtr 2011	~	0.9 J	7.3	4.9	4.9	~					
2nd Qtr 2012	~	0.3 J	5.8	4.3	4.6	~					
4th Qtr 2012	~	2.4	6.2	3.7	3.8	~					
2nd Qtr 2013	~	0.5 J	6.8	3.2	5	~					
4th Qtr 2013	~	0.5 J	5.9	3.7	3.7	~					

Notes:

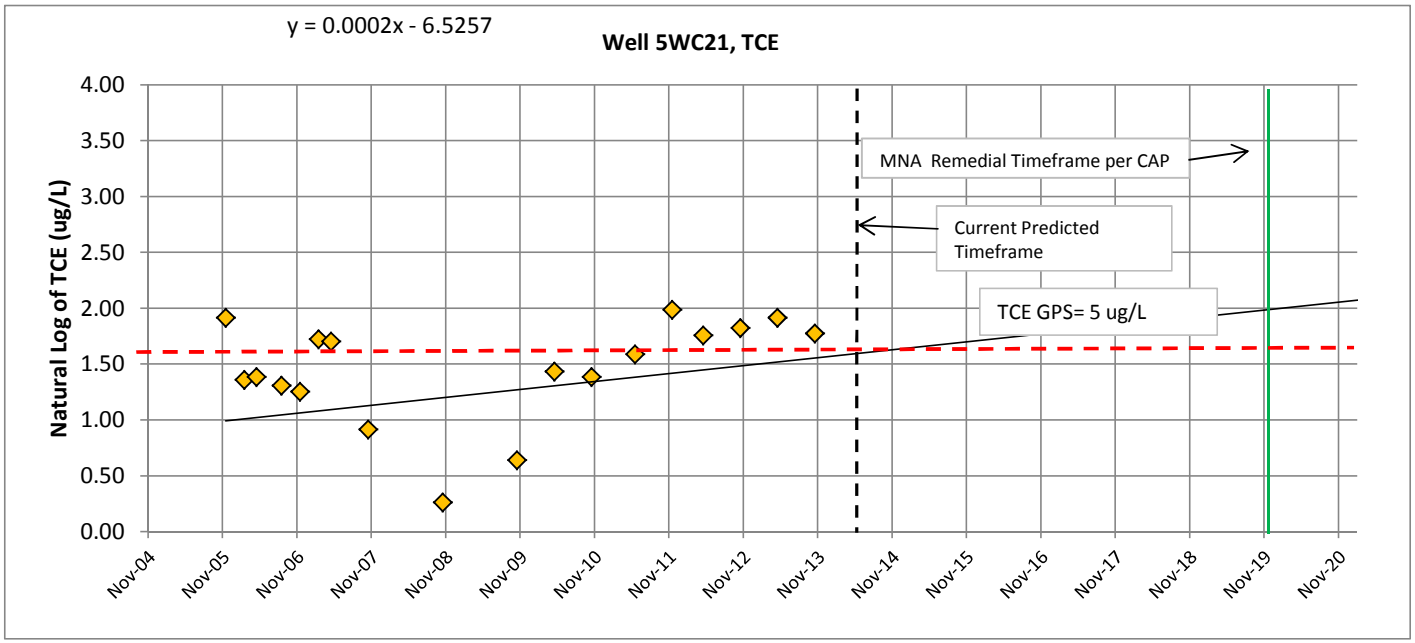
~ - TCE not detected above laboratory detection limit

J - Trichloroethene was detected at a concentration greater than the detection limit but less than the quantitation limit. These results are estimates only.

DRY - Monitoring wells 5WC22 and 5WC23 were dry during 3rd Quarter 2000. No samples were collected.

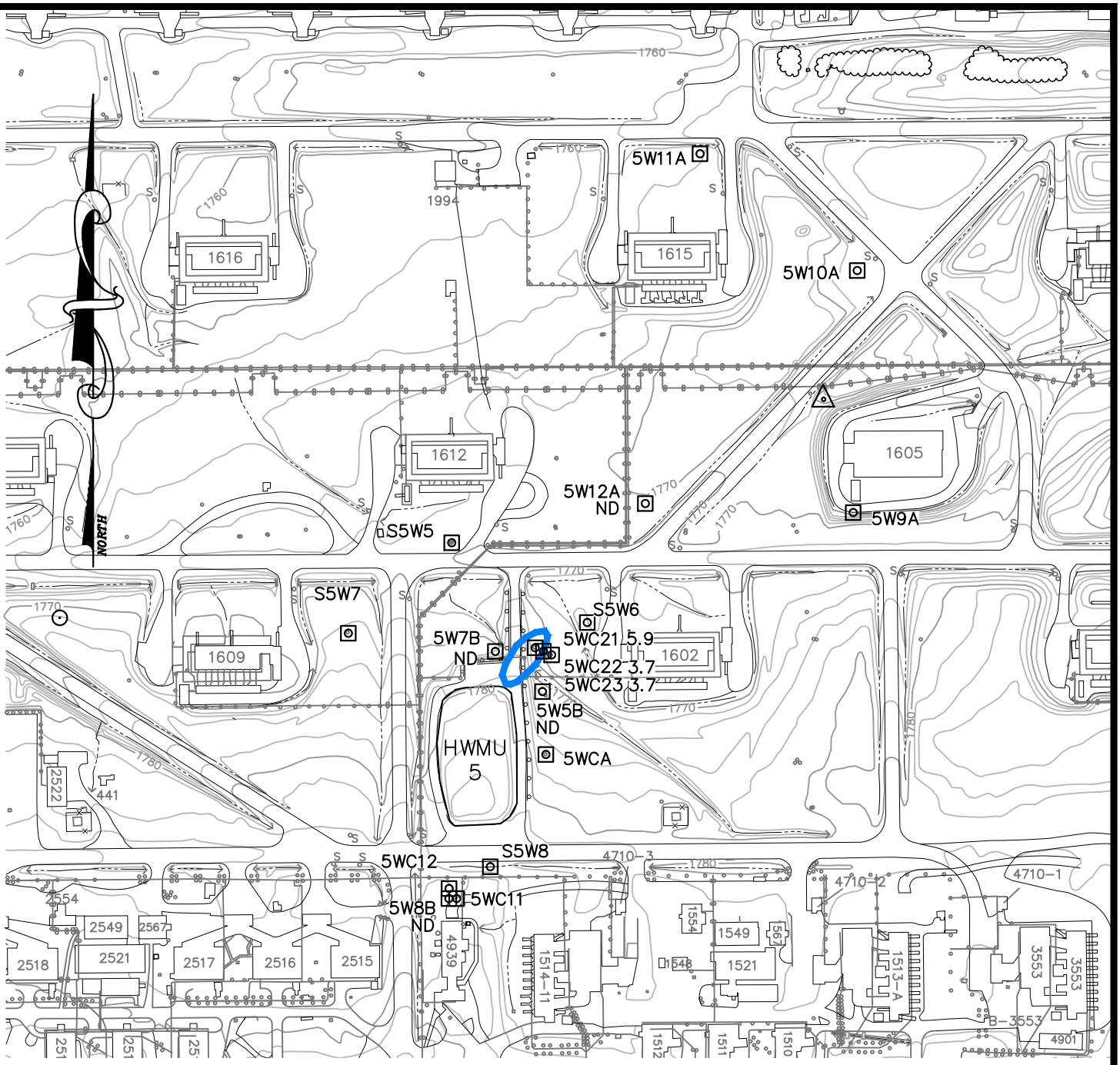
MNA Effectiveness Evaluation - Concentration Trend Graph and Point Attenuation Rate Calculation

Sample Date	TCE (ug/L)	ln TCE (ug/L)
11/18/2005	6.80	1.92
2/14/2006	3.90	1.36
4/18/2006	4.00	1.39
8/18/2006	3.70	1.31
11/18/2006	3.50	1.25
2/14/2007	5.60	1.72
4/18/2007	5.50	1.70
10/30/2007	2.50	0.92
4/28/2008	0.50	-0.69
10/27/2008	1.30	0.26
4/20/2009	0.50	-0.69
10/26/2009	1.90	0.64
4/21/2010	4.20	1.44
10/26/2010	4.00	1.39
5/4/2011	4.90	1.59
11/1/2011	7.30	1.99
4/24/2012	5.80	1.76
10/29/2012	6.20	1.82
4/29/2013	6.80	1.92
10/28/2013	5.90	1.77
		#NUM!



Last 20 rounds		TCE GPS	Estimated Rate and Time Required			Current MNA Timeframe Prediction	MNA Goal (per CAP)	MNA Ineffective Date (per CAP)
First Event	Last Event	ug/L	Rate (per day)	Rate (per year)	Time (years)			
11/18/2005	10/28/2013	5.000	0.0006	0.219	0.76	July-2014	October-2019	December-2026

Effectiveness Evaluation for MNA Remedy	Status	Condition
1) Is the current MNA remedial timeframe prediction less than the 2019 MNA Goal?	yes	If 'yes', then the remedy is considered effective and no additional action is required. If 'no' for three consecutive years, then contingency measures will be implemented as defined in the CAP.
2) Is the current MNA remedial timeframe prediction less than the 2026 MNA ineffective date?	yes	If 'yes', the remedy will be considered effective. If 'no' for three consecutive monitoring years, then an alternate remedial approach will be implemented as defined in the CAP.



LEGEND

5W5B ⊡	MONITORING WELL
5.9	TCE CONCENTRATION (ug/l)
ND	NOT DETECTED
– –5.0– –	TCE GPS ISOCONCENTRATION CONTOUR

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

HWMU-5 TCE ISOCONCENTRATION MAP (4th QUARTER 2013)
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-11

Draper Aden Associates
Engineering ✦ Surveying ✦ Environmental Services
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	DLD
CHECKED	MDL
DATE	04/21/14

FIGURE 1

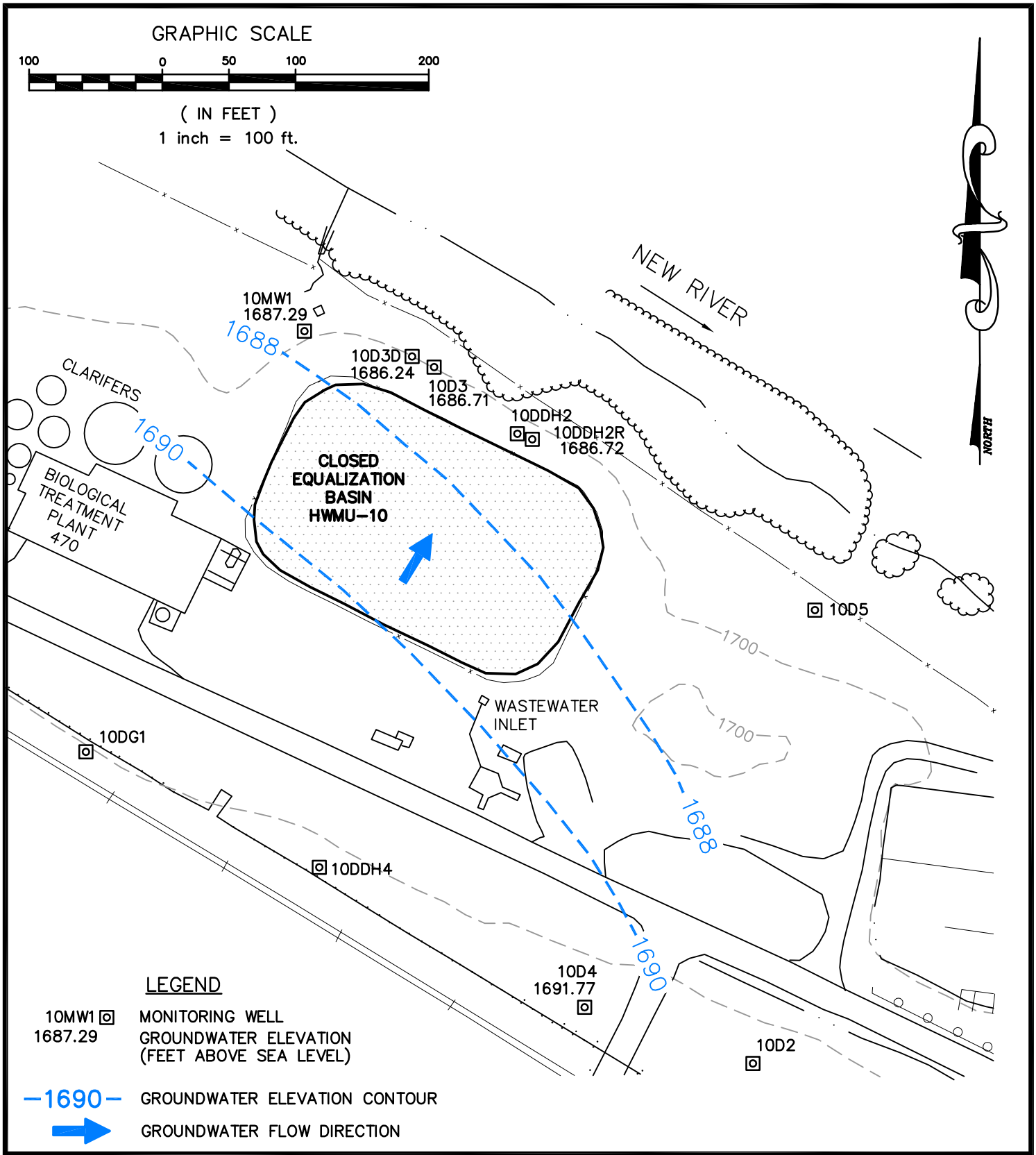
P:\B03\200\B03204\B03204-12P\CAD\B03204-12_4TH QUARTER 2013 FIG1.dwg Apr 22, 2014 10:55am

APPENDIX B

HWMU-10

APPENDIX B-1

HWMU-10 POTENTIOMETRIC SURFACE MAP
SECOND QUARTER 2013



HWMU-10 POTENTIOMETRIC SURFACE MAP (APRIL 25, 2013)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-11

Draper Aden Associates

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Blacksburg, VA 24060
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DESIGNED	RGM
DRAWN	DLD
CHECKED	SN
DATE	07-22-13

FIGURE 2

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APPENDIX B-2

HWMU-10 2013 LABORATORY ANALYTICAL RESULTS
POINT OF COMPLIANCE WELLS

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Antimony				*CAS # 7440-36-0*				
Second Quarter 2013	U	U	U	U	U	1	-	6020A
Arsenic				*CAS # 7440-38-2*				
Second Quarter 2013	U	U	U	U	U	10	10	6020A
Barium				*CAS # 7440-39-3*				
Second Quarter 2013	78.9	105	52.9	63.5	69.9	10	2000	6020A
Beryllium				*CAS # 7440-41-7*				
Second Quarter 2013	U	U	U	U	U	1	-	6020A
Cadmium				*CAS # 7440-43-9*				
Second Quarter 2013	U	U	U	U	U	1	-	6020A
Chromium				*CAS # 7440-47-3*				
Second Quarter 2013	2.68 J	2.04 J	1.08 J	1.47 J	3.12 J	5	100	6020A
Cobalt				*CAS # 7440-48-4*				
Second Quarter 2013	U	U	U	U	U	5	5	6020A
Copper				*CAS # 7440-50-8*				
Second Quarter 2013	1.37 J	U	1.17 J	U	U	5	1300	6020A
Lead				*CAS # 7439-92-1*				
Second Quarter 2013	0.381J	U	U	U	U	1	15	6020A
Mercury				*CAS # 7439-97-6*				
Second Quarter 2013	U	U	U	U	U	2	2	7470A
Nickel				*CAS # 7440-02-0*				
Second Quarter 2013	2.23 J	U	U	U	U	10	313	6020A
Selenium				*CAS # 7782-49-2*				
Second Quarter 2013	U	U	U	U	U	5	50	6020A
Silver				*CAS # 7440-22-4*				
Second Quarter 2013	U	U	U	U	U	1	78.25	6020A
Thallium				*CAS # 7440-28-0*				
Second Quarter 2013	U	U	U	U	U	1	-	6020A
Tin				*CAS # 7440-31-5*				
Second Quarter 2013	U	U	U	U	U	50	-	6010C
Vanadium				*CAS # 7440-62-2*				
Second Quarter 2013	U	U	U	U	U	10	109.55	6020A
Zinc				*CAS # 7440-66-6*				
Second Quarter 2013	9.41 J	U	4.03 J	3.26 J	U	10	4695	6020A
Sulfide				*CAS # 18496-25-8*				
Second Quarter 2013	U	U	U	U	U	3000	-	9034
Cyanide				*CAS # 57-12-5*				
Second Quarter 2013	U	U	U	U	U	20	200	9012B
Total Recoverable Phenolics				*CAS #*				
Second Quarter 2013	U	U	U	U	U	40	-	9066
Acenaphthene				*CAS # 83-32-9*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acenaphthylene				*CAS # 208-96-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acetone				*CAS # 67-64-1*				
Second Quarter 2013	U	U	U	U	U	10	8750.2	8260C
Acetonitrile				*CAS # 75-05-8*				
Second Quarter 2013	U	U	U	U	U	100	-	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Acetophenone				*CAS # 98-86-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Acetylaminofluorene				*CAS # 53-96-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acrolein				*CAS # 107-02-8*				
Second Quarter 2013	U J	U J	U J	U J	U J	25	-	8260C
Acrylonitrile				*CAS # 107-13-1*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Aldrin				*CAS # 309-00-2*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Allyl chloride				*CAS # 107-05-1*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
4-Aminobiphenyl				*CAS # 92-67-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Aniline				*CAS # 62-53-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Anthracene				*CAS # 120-12-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Aramite				*CAS # 140-57-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzene				*CAS # 71-43-2*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Benzo[a]anthracene				*CAS # 56-55-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[b]fluoranthene				*CAS # 205-99-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[k]fluoranthene				*CAS # 207-08-9*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[ghi]perylene				*CAS # 191-24-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo(a)pyrene				*CAS # 50-32-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,4-Benzenediamine				*CAS # 106-50-3*				
Second Quarter 2013	U J	U J	U J	U J	U J	7.5	-	8270D
Benzyl alcohol				*CAS # 100-51-6*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
alpha-BHC				*CAS # 319-84-6*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
beta-BHC				*CAS # 319-85-7*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
delta-BHC				*CAS # 319-86-8*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
gamma-BHC				*CAS # 58-89-9*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
bis(2-Chloroethoxy)methane				*CAS # 111-91-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
bis(2-Chloroethyl)ether				*CAS # 111-44-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
bis(2-Chloro-1-methylethyl)ether				*CAS #*	*108-60-1*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
bis(2-Ethylhexyl)phthalate				*CAS #*	*117-81-7*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Bromobenzene				*CAS #*	*108-86-1*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Bromochloromethane				*CAS #*	*74-97-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Bromodichloromethane				*CAS #*	*75-27-4*			
Second Quarter 2013	U	U	U	U	U	1	80	8260C
Bromoform				*CAS #*	*75-25-2*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
4-Bromophenyl phenyl ether				*CAS #*	*101-55-3*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Butanone				*CAS #*	*78-93-3*			
Second Quarter 2013	U	U	U	U	U	10	2667.6	8260C
n-Butyl alcohol				*CAS #*	*71-36-3*			
Second Quarter 2013	U	U	U	U	U	50	-	8260C
tert-Butyl alcohol				*CAS #*	*75-65-0*			
Second Quarter 2013	U	U	U	U	U	200	-	8260C
n-Butylbenzene				*CAS #*	*104-51-8*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
sec-Butylbenzene				*CAS #*	*135-98-8*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
tert-Butylbenzene				*CAS #*	*98-06-6*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Butyl benzyl phthalate				*CAS #*	*85-68-7*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Carbon disulfide				*CAS #*	*75-15-0*			
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Carbon tetrachloride				*CAS #*	*56-23-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chlordane				*CAS #*	*57-74-9*			
Second Quarter 2013	U	U	U	U	U	0.8	-	8081B
p-Chloroaniline				*CAS #*	*106-47-8*			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Chlorobenzene				*CAS #*	*108-90-7*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chlorobenzilate				*CAS #*	*510-15-6*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
p-Chloro-m-cresol				*CAS #*	*59-50-7*			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Chloroethane				*CAS #*	*75-00-3*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chloroform				*CAS #*	*67-66-3*			
Second Quarter 2013	14	3.4	4.3	U	3.2	1	80	8260C
2-Chloroethyl vinyl ether				*CAS #*	*110-75-8*			
Second Quarter 2013	U J	U J	U J	U J	U J	20	-	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
2-Chloronaphthalene				*CAS # 91-58-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Chlorophenol				*CAS # 95-57-8*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
4-Chlorophenyl phenyl ether				*CAS # 7005-72-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Chloroprene				*CAS # 126-99-8*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
2-Chlorotoluene				*CAS # 95-49-8*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
4-Chlorotoluene				*CAS # 106-43-4*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chrysene				*CAS # 218-01-9*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Cyclohexane				*CAS # 110-82-7*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,4-Dichlorophenoxyacetic acid				*CAS # 94-75-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8151A
4,4'-DDD				*CAS # 72-54-8*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
4,4'-DDE				*CAS # 72-55-9*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
4,4'-DDT				*CAS # 50-29-3*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Diallate				*CAS # 2303-16-4*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Dibenz(a,h)anthracene				*CAS # 53-70-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dibenzofuran				*CAS # 132-64-9*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dibromochloromethane				*CAS # 124-48-1*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2-Dibromo-3-chloropropane				*CAS # 96-12-8*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2-Dibromoethane				*CAS # 106-93-4*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Di-n-butyl phthalate				*CAS # 84-74-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,2-Dichlorobenzene				*CAS # 95-50-1*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3-Dichlorobenzene				*CAS # 541-73-1*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,4-Dichlorobenzene				*CAS # 106-46-7*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
3,3'-Dichlorobenzidine				*CAS # 91-94-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
trans-1,4-Dichloro-2-butene				*CAS # 110-57-6*				
Second Quarter 2013	U J	U	U	U J	U J	10	-	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Dichlorodifluoromethane				*CAS #* 75-71-8				
Second Quarter 2013	U J	U J	U J	U J	U J	1	-	8260C
1,1-Dichloroethane				*CAS #* 75-34-3				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2-Dichloroethane				*CAS #* 107-06-2				
Second Quarter 2013	U J	U J	U J	U J	U J	1	-	8260C
1,1-Dichloroethene				*CAS #* 75-35-4				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
trans-1,2-Dichloroethene				*CAS #* 156-60-5				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,4-Dichlorophenol				*CAS #* 120-83-2				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,6-Dichlorophenol				*CAS #* 87-65-0				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
1,2-Dichloropropane				*CAS #* 78-87-5				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3-Dichloropropane				*CAS #* 142-28-9				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,2-Dichloropropane				*CAS #* 594-20-7				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1-Dichloropropene				*CAS #* 563-58-6				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
cis-1,3-Dichloropropene				*CAS #* 10061-01-5				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
trans-1,3-Dichloropropene				*CAS #* 10061-02-6				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Dieldrin				*CAS #* 60-57-1				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Diethyl ether				*CAS #* 60-29-7				
Second Quarter 2013	U J	U J	U J	U J	U J	13	-	8260C
Diethyl phthalate				*CAS #* 84-66-2				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
O,O-Diethyl O-2-pyrazinyl				*CAS #* 297-97-2				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dimethoate				*CAS #* 60-51-5				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dimethyl ether				*CAS #* 115-10-6				
Second Quarter 2013	U	U	U	U	U	13	-	8260C
p-(Dimethylamino)azobenzene				*CAS #* 60-11-7				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
7,12-Dimethylbenz[a]anthracene				*CAS #* 57-97-6				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
3,3'-Dimethylbenzidine				*CAS #* 119-93-7				
Second Quarter 2013	U J	U J	U J	U J	U J	5	-	8270D
a,a-Dimethylphenethylamine				*CAS #* 122-09-8				
Second Quarter 2013	U J	U J	U J	U J	U J	15	-	8270D
2,4-Dimethylphenol				*CAS #* 105-67-9				
Second Quarter 2013	U J	U J	U J	U J	U J	10	-	8270D

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Dimethyl phthalate				*CAS # 131-11-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
m-Dinitrobenzene				*CAS # 99-65-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
4,6-Dinitro-o-cresol				*CAS # 534-52-1*				
Second Quarter 2013	U J	U J	U J	U J	U J	10	-	8270D
2,4-Dinitrophenol				*CAS # 51-28-5*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,4-Dinitrotoluene				*CAS # 121-14-2*				
Second Quarter 2013	U	U	U	U	U	5	31.3	8270D
2,6-Dinitrotoluene				*CAS # 606-20-2*				
Second Quarter 2013	U	U	U	U	U	5	15.65	8270D
Dinoseb				*CAS # 88-85-7*				
Second Quarter 2013	U	U	U	U	U	2.5	-	8151A
Di-n-octyl phthalate				*CAS # 117-84-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,4-Dioxane				*CAS # 123-91-1*				
Second Quarter 2013	U	U	U	U	U	200	-	8260C
Diphenylamine				*CAS # 122-39-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Disulfoton				*CAS # 298-04-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Endosulfan I				*CAS # 959-98-8*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Endosulfan II				*CAS # 33213-65-9*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Endosulfan sulfate				*CAS # 1031-07-8*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Endrin				*CAS # 72-20-8*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Ethyl acetate				*CAS # 141-78-6*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Endrin aldehyde				*CAS # 7421-93-4*				
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Ethanol				*CAS # 64-17-5*				
Second Quarter 2013	U	U	U	U	U	250	-	8260C
Ethylbenzene				*CAS # 100-41-4*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Ethyl methacrylate				*CAS # 97-63-2*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Ethyl methanesulfonate				*CAS # 62-50-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Ethylene oxide				*CAS # 75-21-8*				
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8260B
Famphur				*CAS # 52-85-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Fluoranthene				*CAS # 206-44-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Fluorene				*CAS # 86-73-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Heptachlor				*CAS # 76-44-8*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Heptachlor epoxide				*CAS # 1024-57-3*				
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Hexachlorobenzene				*CAS # 118-74-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Hexachlorobutadiene				*CAS # 87-68-3*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Hexachlorocyclopentadiene				*CAS # 77-47-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Hexachloroethane				*CAS # 67-72-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Hexachlorophene				*CAS # 70-30-4*				
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8270D
Hexachloropropene				*CAS # 1888-71-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Hexanone				*CAS # 591-78-6*				
Second Quarter 2013	U J	U	U	U J	U J	10	-	8260C
Indeno[1,2,3-cd]pyrene				*CAS # 193-39-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Isobutyl alcohol				*CAS # 78-83-1*				
Second Quarter 2013	U	U	U	U	U	200	-	8260C
Isodrin				*CAS # 465-73-6*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Isophorone				*CAS # 78-59-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Isopropylbenzene				*CAS # 98-82-8*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Isopropylether				*CAS # 108-20-3*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
4-Isopropyltoluene				*CAS # 99-87-6*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Isosafrole				*CAS # 120-58-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Kepone				*CAS # 143-50-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Methacrylonitrile				*CAS # 126-98-7*				
Second Quarter 2013	U	U	U	U	U	100	-	8260C
Methapyrilene				*CAS # 91-80-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Methoxychlor				*CAS # 72-43-5*				
Second Quarter 2013	U	U	U	U	U	0.25	-	8081B
Bromomethane				*CAS # 74-83-9*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chloromethane				*CAS # 74-87-3*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
3-Methylcholanthrene				*CAS # 56-49-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Iodomethane				*CAS # 74-88-4*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Methyl methacrylate				*CAS # 80-62-6*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Methyl methane sulfonate				*CAS # 66-27-3*				
Second Quarter 2013	U J	U J	U J	U J	U J	5	-	8270D
2-Methylnaphthalene				*CAS # 91-57-6*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Methyl parathion				*CAS # 298-00-0*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
4-Methyl-2-pentanone				*CAS # 108-10-1*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
2-Methylphenol				*CAS # 95-48-7*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
3 & 4-Methylphenol				*CAS # 106-44-5*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Methyl tert-butyl ether				*CAS # 1634-04-4*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Dibromomethane				*CAS # 74-95-3*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Methylene chloride				*CAS # 75-09-2*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Naphthalene				*CAS # 91-20-3*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,4-Naphthoquinone				*CAS # 130-15-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1-Naphthylamine				*CAS # 134-32-7*				
Second Quarter 2013	U J	U J	U J	U J	U J	5	-	8270D
2-Naphthylamine				*CAS # 91-59-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
o-Nitroaniline				*CAS # 88-74-4*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
m-Nitroaniline				*CAS # 99-09-2*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
p-Nitroaniline				*CAS # 100-01-6*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Nitrobenzene				*CAS # 98-95-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
o-Nitrophenol				*CAS # 88-75-5*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
p-Nitrophenol				*CAS # 100-02-7*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
4-Nitroquinoline-1-oxide				*CAS # 56-57-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodi-n-butylamine				*CAS # 924-16-3*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
N-Nitrosodiethylamine				*CAS # 55-18-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodimethylamine				*CAS # 62-75-9*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodiphenylamine				*CAS # 86-30-6*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodipropylamine				*CAS # 621-64-7*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosomethylethylamine				*CAS # 10595-95-6*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosomorpholine				*CAS # 59-89-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosopiperidine				*CAS # 100-75-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosopyrrolidine				*CAS # 930-55-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
5-Nitroso-o-toluidine				*CAS # 99-55-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Parathion				*CAS # 56-38-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachlorobenzene				*CAS # 608-93-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachloroethane				*CAS # 76-01-7*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Pentachloronitrobenzene				*CAS # 82-68-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachlorophenol				*CAS # 87-86-5*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Phenacetin				*CAS # 62-44-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Phenanthrene				*CAS # 85-01-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Phenol				*CAS # 108-95-2*				
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Phorate				*CAS # 298-02-2*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Picoline				*CAS # 109-06-8*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pronamide				*CAS # 23950-58-5*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1-Propanol				*CAS # 71-23-8*				
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8260B
2-Propanol				*CAS # 67-63-0*				
Second Quarter 2013	U	U	U	U	U	100	100	8260C
Propionitrile				*CAS # 107-12-0*				
Second Quarter 2013	U	U	U	U	U	100	-	8260C
n-Propylbenzene				*CAS # 103-65-1*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
Pyrene				*CAS #*	*129-00-0*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pyridine				*CAS #*	*110-86-1*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Safrole				*CAS #*	*94-59-7*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Silvex				*CAS #*	*93-72-1*			
Second Quarter 2013	U	U	U	U	U	1	-	8151A
Styrene				*CAS #*	*100-42-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Sulfotep				*CAS #*	*3689-24-5*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2,4,5-Trichlorophenoxyacetic acid				*CAS #*	*93-76-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8151A
1,2,4,5-Tetrachlorobenzene				*CAS #*	*95-94-3*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,1,1,2-Tetrachloroethane				*CAS #*	*630-20-6*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,2,2-Tetrachloroethane				*CAS #*	*79-34-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Tetrachloroethene				*CAS #*	*127-18-4*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Tetrahydrofuran				*CAS #*	*109-99-9*			
Second Quarter 2013	U	U	U	U	U	25	-	8260C
2,3,4,6-Tetrachlorophenol				*CAS #*	*58-90-2*			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Toluene				*CAS #*	*108-88-3*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
o-Toluidine				*CAS #*	*95-53-4*			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Toxaphene				*CAS #*	*8001-35-2*			
Second Quarter 2013	U	U	U	U	U	2.5	-	8081B
1,2,3-Trichlorobenzene				*CAS #*	*87-61-6*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2,4-Trichlorobenzene				*CAS #*	*120-82-1*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,1-Trichloroethane				*CAS #*	*71-55-6*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,2-Trichloroethane				*CAS #*	*79-00-5*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Trichloroethene				*CAS #*	*79-01-6*			
Second Quarter 2013	U	U	U	U	U	1	5	8260C
Trichlorofluoromethane				*CAS #*	*75-69-4*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,4,5-Trichlorophenol				*CAS #*	*95-95-4*			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,4,6-Trichlorophenol				*CAS #*	*88-06-2*			
Second Quarter 2013	U	U	U	U	U	10	-	8270D

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*
1,2,3-Trichloropropane				*CAS # 96-18-4*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane				*CAS # 76-13-1*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
O,O,O-Triethyl phosphorothioate				*CAS # 126-68-1*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,2,4-Trimethylbenzene				*CAS # 95-63-6*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3,5-Trimethylbenzene				*CAS # 108-67-8*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
sym-Trinitrobenzene				*CAS # 99-35-4*				
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Vinyl acetate				*CAS # 108-05-4*				
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Vinyl chloride				*CAS # 75-01-4*				
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Xylenes (Total)				*CAS # 1330-20-7*				
Second Quarter 2013	U	U	U	U	U	3	10000	8260C

Target Analyte Monitoring Results - HWMU-10 Point of Compliance Wells

Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 10D4 ***All Results in ug/L.***

Analyte/Quarter	*10D4 Q*	*10D3 Q*	*10D3D Q*	*10DDH2R Q*	*10MW1 Q*	*QL*	*GPS*	*Method*

Definitions:

QL Denotes permit required quantitation limit.
U Denotes analyte not detected at or above QL.
UA Denotes analyte not detected at or above adjusted sample QL.
J Denotes associated result is estimated. When used with "U" (i.e., "**UJ**"), denotes analyte not detected at or above QL and QL is estimated. When used with "UA" (i.e., "**UAJ**"), denotes analyte not detected at or above adjusted QL and adjusted QL is estimated.
UN Denotes analyte concentration is less than the quantiation limit and five times the blank concentration. Not reliably detected due to blank contamination. This qualifier used only for Appendix IX monitoring event when results are reported to at or above the detection limit.
R Denotes result rejected.
Q Denotes data validation qualifier.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes Groundwater Protection Standards listed in Appendix G to Attachment 4 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002) (revised September 27, 2011)
NS denotes not sampled.
NA denotes not analyzed.
"–" denotes not detected (pre-2nd Quarter 2003) or not available / not sampled (beginning 2nd Quarter 2003).

Appendix IX Monitoring Events:
First Quarter 2003,
Second Quarter: 2004, 2005, 2007, 2008, 2009, 2010, 2011, 2012
Third Quarter 2006

For Appendix IX monitoring, compliance well results reported/evaluated to detection limit. See data validation Qualifier definitions noted below.

The following definitions apply to results reported for Appendix IX monitoring events.
All Appendix IX monitoring results for compliance wells are reported to the detection limit.

QL Denotes permit required quantitation limit.
U denotes not detected at or above the detection limit or QL.
UA denotes not detected at or above the adjusted detection limit or adjusted QL.
J Denotes result is estimated. When used with "U" (i.e., "UJ"), denotes analyte not detected at or above the detection limit or QL and detection limit and QL are estimated. When used with "UA" (i.e., "UAJ"), denotes analyte not detected at or above adjusted detection limit or adjusted QL and adjusted detection limit and adjusted QL are estimated.
UN Denotes analyte concentration is less than the quantitation limit and/or five times the blank concentration. Not reliably detected due to blank contamination. This qualifier used only for Appendix IX monitoring event when compliance well results are reported to at or above the project detection limit.

Verification events: 12/12/03, 06/17/04, 7/25/2005.
6/17/04. Verification event. Acetone: 10D3D was not detected during verification event. Verification event result reported.
7/25/05. Verification event. All wells: ethyl acetate. 10D3D: alpha-BHC, acetone and 2-propanol. All verification results: Not detected except for acetone and 2-propanol. Verification results presented in table.
7/17/2008. Verification event. 10MW1. Technical chlordane, diethyl phthalate. Verification results reported-all not detected.
6/11/2009 – Verification event, 10DDH2R, Diethyl ether, Verification results reported in table-all not detected.
6/27/2012- Verification event, 10MW1, Benzo[ghi]perylene. Verification results reported in table-all not detected.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-10 Monitoring Event: Second Quarter 2013

Draper Aden Associates
Engineering • Surveying • Environmental Services

Analyte	Sample ID	Laboratory Result (ug/L)	Q	Validated Result (ug/L)	Q	QL (ug/L)	Validation Notes
Method: 6020A							
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC							
Barium	10D3	105		105		10	No action taken.
	10DUP	103		103		10	No action taken. Field duplicate for 10D3.
Method: 8260C							
Laboratory: Eurofins Lancaster, Lancaster, PA							
Chloroform	10D3	3.4		3.4		1	No action taken. Field duplicate RPD <10.
	10DUP	3.2		3.2		1	No action taken. Field duplicate for 10D3. RPD <10.

Definitions:
QL Denotes permit quantitation limit.
Q Denotes data qualifier.
J Denotes analyte reported at or above QL and associated result is estimated.

APPENDIX C

HWMU-16

APPENDIX C-1

HWMU-16 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2013
FOURTH QUARTER 2013

SPRING

16-5
1738.58

16-1
1763.24

16WC2A
Dry
16WC2B
1765.11

16-2
1755.18

1929

1928

SWMU
28

16MW8
1744.60

16MW9
1747.09

16WC1A
1747.95

16WC1B
1747.99

HWMU-16

4601-14

SWMU
30

16C1
1790.59

16CDH3
Dry

16C3
1757.63

4601-13

16-3
1767.40

16-4

SWMU
51

SWMU
52

16CDH2

1820
1830
1840
1810
1800
1790
1780
1770
1760
1750
1740

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.

LEGEND

16C1 ⊡ 1790.59 — MONITORING WELL GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

1780 — GROUNDWATER ELEV. CONTOUR

GROUNDWATER FLOW DIRECTION

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

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Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	DLD
CHECKED	SN
DATE	07/22/13

HWMU-16 POTENTIOMETRIC SURFACE MAP (APRIL 23, 2013)

RADFORD ARMY AMMUNITION PLANT

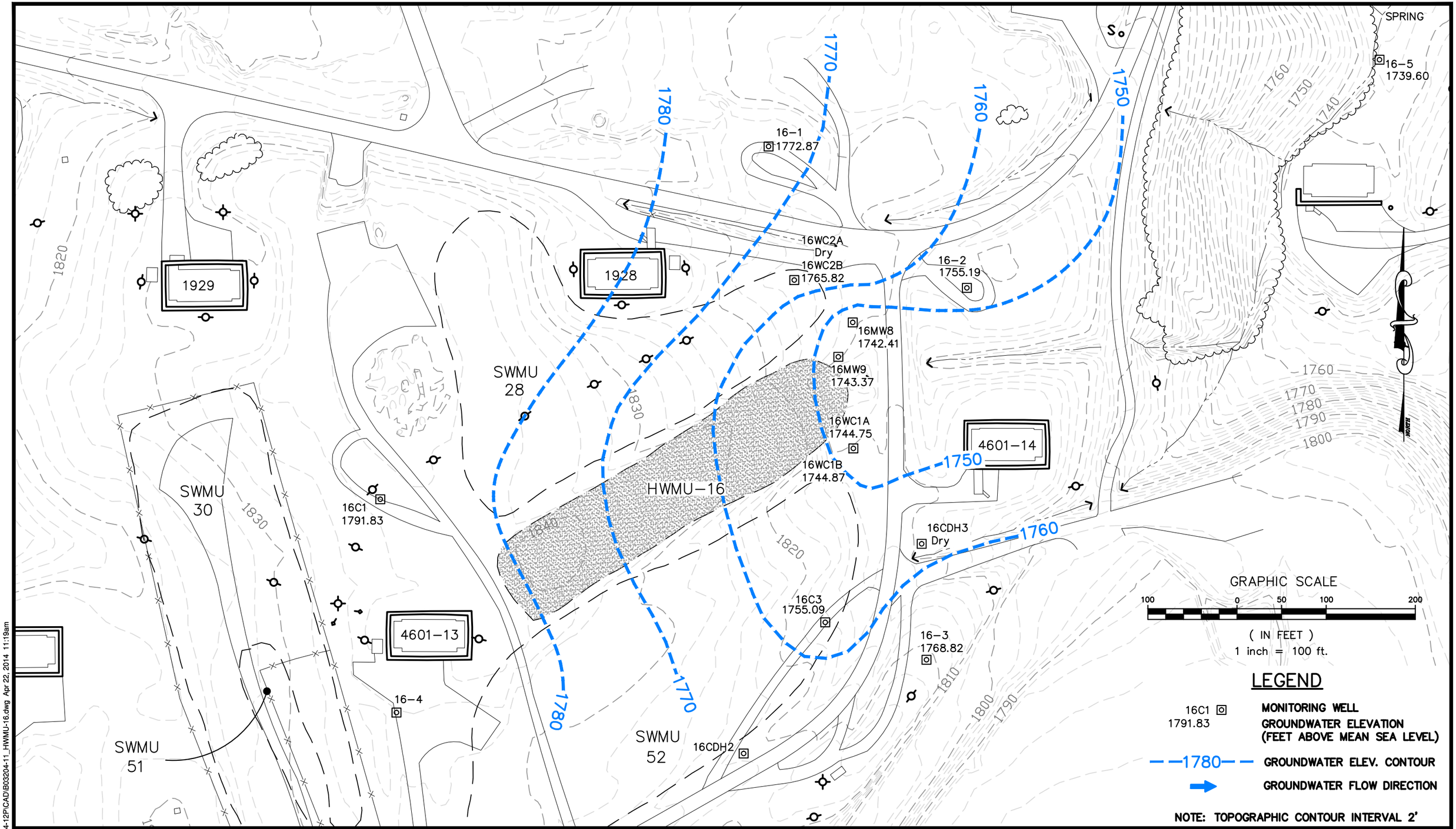
RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-11

FIGURE 3

P:\B03200\B03204\B03204-11\CAD\B03204-11_HWMU-16.dwg Jul 25, 2013 1:10pm



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Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	DLD
CHECKED	SN
DATE	04/21/14

HWMU-16 POTENTIOMETRIC SURFACE MAP (OCTOBER 22, 2013)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-11

FIGURE 3

APPENDIX C-2

HWMU-16 2013 LABORATORY ANALYTICAL RESULTS
POINT OF COMPLIANCE WELLS

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*OL*	*GPS*	*Method*
Antimony					*CAS #*	*7440-36-0*		
Second Quarter 2013	U	U	U	U	U	1	6	6020A
Arsenic					*CAS #*	*7440-38-2*		
Second Quarter 2013	U	U	U	U	U	10	10	6020A
Fourth Quarter 2013	U	U	U	U	U	10	10	6020A
Barium					*CAS #*	*7440-39-3*		
Second Quarter 2013	194	127	536	263	133	10	2000	6020A
Fourth Quarter 2013	171	121	560	262	110	10	2000	6020A
Beryllium					*CAS #*	*7440-41-7*		
Second Quarter 2013	U	0.263 J	U	U	U	1	4	6020A
Fourth Quarter 2013	U	U	U	U	U	1	4	6020A
Cadmium					*CAS #*	*7440-43-9*		
Second Quarter 2013	U	0.245 J	U	U	U	1	5	6020A
Fourth Quarter 2013	U	U	U	U	U	1	5	6020A
Chromium					*CAS #*	*7440-47-3*		
Second Quarter 2013	U	U	U	U	1.54 J	5	100	6020A
Fourth Quarter 2013	U	U	U	U	U	5	100	6020A
Cobalt					*CAS #*	*7440-48-4*		
Second Quarter 2013	U	1.13 J	3.59 J	4.5 J	U	5	5	6020A
Fourth Quarter 2013	U	U	U	U	33.4	5	5	6020A
Copper					*CAS #*	*7440-50-8*		
Second Quarter 2013	U	5.28	U	U	1.52 J	5	1300	6020A
Fourth Quarter 2013	U	10.8	U	U	U	5	1300	6020A
Lead					*CAS #*	*7439-92-1*		
Second Quarter 2013	U	0.522 J	U	U	U	1	15	6020A
Fourth Quarter 2013	U	U	U	U	U	1	15	6020A
Mercury					*CAS #*	*7439-97-6*		
Second Quarter 2013	U	U	U	U	0.6 J	2	2	7470A
Fourth Quarter 2013	U J	U J	U J	U J	U J	2	2	7470A
Nickel					*CAS #*	*7440-02-0*		
Second Quarter 2013	3.25 J	3.66 J	13.6	8.37 J	U	10	313	6020A
Fourth Quarter 2013	U	U	13.8	U	11.6	10	313	6020A
Selenium					*CAS #*	*7782-49-2*		
Second Quarter 2013	U	U	U	U	U	5	50	6020A
Silver					*CAS #*	*7440-22-4*		
Second Quarter 2013	U	U	U	U	U	1	78.25	6020A
Thallium					*CAS #*	*7440-28-0*		
Second Quarter 2013	U	U	U	U	U	1	-	6020A
Tin					*CAS #*	*7440-31-5*		
Second Quarter 2013	U	U	U	U	U	50	-	6010C
Vanadium					*CAS #*	*7440-62-2*		
Second Quarter 2013	U	U	U	U	U	10	151	6020A
Fourth Quarter 2013	U	U	U	U	U	10	151	6020A
Zinc					*CAS #*	*7440-66-6*		
Second Quarter 2013	U	28	U	7.15 J	5.21 J	10	4695	6020A
Fourth Quarter 2013	U	36.2	U	U	U	10	4695	6020A
Sulfide					*CAS #*	*18496-25-8*		
Second Quarter 2013	U	U	U	U	U	3000	-	9034
Cyanide					*CAS #*	*57-12-5*		
Second Quarter 2013	U	U	U	U	U	20	-	9012B
Acenaphthene					*CAS #*	*83-32-9*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acenaphthylene					*CAS #*	*208-96-8*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acetone					*CAS #*	*67-64-1*		
Second Quarter 2013	U	U	U	U	U	10	223.57	8260C

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Acetonitrile					*CAS #* 75-05-8			
Second Quarter 2013	U	U	U	U	U	100	-	8260C
Acetophenone					*CAS #* 98-86-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Acetylaminofluorene					*CAS #* 53-96-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Acrolein					*CAS #* 107-02-8			
Second Quarter 2013	U J	U J	U J	U J	U J	25	-	8260C
Acrylonitrile					*CAS #* 107-13-1			
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Aldrin					*CAS #* 309-00-2			
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Allyl chloride					*CAS #* 107-05-1			
Second Quarter 2013	U	U	U	U	U	10	-	8260C
4-Aminobiphenyl					*CAS #* 92-67-1			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Aniline					*CAS #* 62-53-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Anthracene					*CAS #* 120-12-7			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Aramite					*CAS #* 140-57-8			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzene					*CAS #* 71-43-2			
Second Quarter 2013	0.3 J	U	0.2 J	U	U	1	5	8260C
Fourth Quarter 2013	U	U	U	U	U	1	5	8260C
Benzo[a]anthracene					*CAS #* 56-55-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[b]fluoranthene					*CAS #* 205-99-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[k]fluoranthene					*CAS #* 207-08-9			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo[ghi]perylene					*CAS #* 191-24-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Benzo(a)pyrene					*CAS #* 50-32-8			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,4-Benzenediamine					*CAS #* 106-50-3			
Second Quarter 2013	U J	U J	U J	U J	U J	7.5	-	8270D
Benzyl alcohol					*CAS #* 100-51-6			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
alpha-BHC					*CAS #* 319-84-6			
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
beta-BHC					*CAS #* 319-85-7			
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
delta-BHC					*CAS #* 319-86-8			
Second Quarter 2013	0.0034J	U	U	U	U	0.025	-	8081B
gamma-BHC					*CAS #* 58-89-9			
Second Quarter 2013	0.0020J	U	U	U	U	0.025	-	8081B
bis(2-Chloroethoxy)methane					*CAS #* 111-91-1			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
bis(2-Chloroethyl)ether					*CAS #* 111-44-4			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
bis(2-Chloro-1-methylethyl)ether					*CAS #* 108-60-1			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
bis(2-Ethylhexyl)phthalate					*CAS #* 117-81-7			
Second Quarter 2013	U	U	U	U	U	5	10	8270D
Bromobenzene					*CAS #* 108-86-1			
Second Quarter 2013	U	U	U	U	U	1	-	8260C

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Bromochloromethane					*CAS #*	*74-97-5*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Bromodichloromethane					*CAS #*	*75-27-4*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Bromoform					*CAS #*	*75-25-2*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
4-Bromophenyl phenyl ether					*CAS #*	*101-55-3*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Butanone					*CAS #*	*78-93-3*		
Second Quarter 2013	U	U	U	U	U	10	2667.6	8260C
Fourth Quarter 2013	U	U	U	U	U	10	2667.6	8260C
n-Butyl alcohol					*CAS #*	*71-36-3*		
Second Quarter 2013	U	U	U	U	U	50	-	8260C
tert-Butyl alcohol					*CAS #*	*75-65-0*		
Second Quarter 2013	U	U	U	U	U	200	-	8260C
n-Butylbenzene					*CAS #*	*104-51-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
sec-Butylbenzene					*CAS #*	*135-98-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
tert-Butylbenzene					*CAS #*	*98-06-6*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Butyl benzyl phthalate					*CAS #*	*85-68-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Carbon disulfide					*CAS #*	*75-15-0*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Carbon tetrachloride					*CAS #*	*56-23-5*		
Second Quarter 2013	U	U	U	U	U	1	5	8260C
Fourth Quarter 2013	U	U	U	U	U	1	5	8260C
Chlordane					*CAS #*	*57-74-9*		
Second Quarter 2013	U	U	U	U	U	0.8	-	8081B
p-Chloroaniline					*CAS #*	*106-47-8*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Chlorobenzene					*CAS #*	*108-90-7*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chlorobenzilate					*CAS #*	*510-15-6*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
p-Chloro-m-cresol					*CAS #*	*59-50-7*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Chloroethane					*CAS #*	*75-00-3*		
Second Quarter 2013	5	U	2.4	0.7 J	U	1	1293.39	8260C
Fourth Quarter 2013	4.9	U	2.9	1	U	1	1293.39	8260C
Chloroform					*CAS #*	*67-66-3*		
Second Quarter 2013	U	U	U	U	U	1	80	8260C
2-Chloroethyl vinyl ether					*CAS #*	*110-75-8*		
Second Quarter 2013	U J	U J	U J	U J	U J	20	-	8260C
2-Chloronaphthalene					*CAS #*	*91-58-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Chlorophenol					*CAS #*	*95-57-8*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
4-Chlorophenyl phenyl ether					*CAS #*	*7005-72-3*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Chloroprene					*CAS #*	*126-99-8*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
2-Chlorotoluene					*CAS #*	*95-49-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
4-Chlorotoluene					*CAS #*	*106-43-4*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Chrysene					*CAS #*	*218-01-9*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Cyclohexane					*CAS #*			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,4-Dichlorophenoxyacetic acid					*CAS #*	*94-75-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8151A
4,4'-DDD					*CAS #*	*72-54-8*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
4,4'-DDE					*CAS #*	*72-55-9*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
4,4'-DDT					*CAS #*	*50-29-3*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Diallate					*CAS #*	*2303-16-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Dibenz(a,h)anthracene					*CAS #*	*53-70-3*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dibenzofuran					*CAS #*	*132-64-9*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dibromochloromethane					*CAS #*	*124-48-1*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2-Dibromo-3-chloropropane					*CAS #*	*96-12-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2-Dibromoethane					*CAS #*	*106-93-4*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Di-n-butyl phthalate					*CAS #*	*84-74-2*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,2-Dichlorobenzene					*CAS #*	*95-50-1*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3-Dichlorobenzene					*CAS #*	*541-73-1*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,4-Dichlorobenzene					*CAS #*	*106-46-7*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
3,3'-Dichlorobenzidine					*CAS #*	*91-94-1*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
trans-1,4-Dichloro-2-butene					*CAS #*	*110-57-6*		
Second Quarter 2013	U J	U J	U J	U	U	10	-	8260C
Dichlorodifluoromethane					*CAS #*	*75-71-8*		
Second Quarter 2013	0.3 J	U J	U J	U J	U J	1	142.3	8260C
Fourth Quarter 2013	U J	U J	U J	U J	U J	1	142.3	8260C
1,1-Dichloroethane					*CAS #*	*75-34-3*		
Second Quarter 2013	8.6	0.3 J	8	2.3	0.2 J	1	9.5	8260C
Fourth Quarter 2013	8.9	U	8.8	3.1	U	1	9.5	8260C
1,2-Dichloroethane					*CAS #*	*107-06-2*		
Second Quarter 2013	U J	U J	U J	U	U	1	5	8260C
1,1-Dichloroethene					*CAS #*	*75-35-4*		
Second Quarter 2013	0.4 J	U	U	U	U	1	-	8260C
trans-1,2-Dichloroethene					*CAS #*	*156-60-5*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
2,4-Dichlorophenol					*CAS #*	*120-83-2*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,6-Dichlorophenol					*CAS #*	*87-65-0*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
1,2-Dichloropropane					*CAS #*	*78-87-5*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3-Dichloropropane					*CAS #*	*142-28-9*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*OL*	*GPS*	*Method*
2,2-Dichloropropane					*CAS #*	*594-20-7*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1-Dichloropropene					*CAS #*	*563-58-6*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
cis-1,3-Dichloropropene					*CAS #*	*10061-01-5*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
trans-1,3-Dichloropropene					*CAS #*	*10061-02-6*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Dieldrin					*CAS #*	*60-57-1*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Diethyl ether					*CAS #*	*60-29-7*		
Second Quarter 2013	48 J	8.3 J	39 J	11 J	1.5 J	13	7300	8260C
Fourth Quarter 2013	39	U	48	13	U	12.5	7300	8260C
Diethyl phthalate					*CAS #*	*84-66-2*		
Second Quarter 2013	U	U	0.62 J	U	U	5	11000	8270D
Fourth Quarter 2013	U	U	U	U	U	5	11000	8270D
O,O-Diethyl O-2-pyrazinyl					*CAS #*	*297-97-2*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dimethoate					*CAS #*	*60-51-5*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Dimethyl ether					*CAS #*	*115-10-6*		
Second Quarter 2013	U N	U N	U N	U N	U N	13	17	8260C
Fourth Quarter 2013	U	U	U	U	U	12.5	17	8260C
p-(Dimethylamino)azobenzene					*CAS #*	*60-11-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
7,12-Dimethylbenz[a]anthracene					*CAS #*	*57-97-6*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
3,3'-Dimethylbenzidine					*CAS #*	*119-93-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
a,a-Dimethylphenethylamine					*CAS #*	*122-09-8*		
Second Quarter 2013	U J	U J	U J	U J	U J	15	-	8270D
2,4-Dimethylphenol					*CAS #*	*105-67-9*		
Second Quarter 2013	U J	U J	U J	U J	U J	10	-	8270D
Dimethyl phthalate					*CAS #*	*131-11-3*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
m-Dinitrobenzene					*CAS #*	*99-65-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
4,6-Dinitro-o-cresol					*CAS #*	*534-52-1*		
Second Quarter 2013	U J	U J	U J	U J	U J	10	-	8270D
2,4-Dinitrophenol					*CAS #*	*51-28-5*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,4-Dinitrotoluene					*CAS #*	*121-14-2*		
Second Quarter 2013	U	U	U	U	U	10	31.3	8270D
Fourth Quarter 2013	U	U	U	U	U	10	31.3	8270D
2,6-Dinitrotoluene					*CAS #*	*606-20-2*		
Second Quarter 2013	U	U	U	U	U	10	15.65	8270D
Fourth Quarter 2013	U	U	U	U	U	10	15.65	8270D
Dinoseb					*CAS #*	*88-85-7*		
Second Quarter 2013	U J	U J	U J	U J	U J	2.5	-	8151A
Di-n-octyl phthalate					*CAS #*	*117-84-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,4-Dioxane					*CAS #*	*123-91-1*		
Second Quarter 2013	U	U	U	U J	U J	200	-	8260C
Diphenylamine					*CAS #*	*122-39-4*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Disulfoton					*CAS #*	*298-04-4*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*OL*	*GPS*	*Method*
Endosulfan I					*CAS #*	*959-98-8*		
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Endosulfan II					*CAS #*	*33213-65-9*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Endosulfan sulfate					*CAS #*	*1031-07-8*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Endrin					*CAS #*	*72-20-8*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Ethyl acetate					*CAS #*	*141-78-6*		
Second Quarter 2013	U J	U J	U J	U J	U J	10	-	8260C
Endrin aldehyde					*CAS #*	*7421-93-4*		
Second Quarter 2013	U	U	U	U	U	0.05	-	8081B
Ethanol					*CAS #*	*64-17-5*		
Second Quarter 2013	U	U	U	U	U	250	-	8260C
Ethylbenzene					*CAS #*	*100-41-4*		
Second Quarter 2013	U	U	U	U	U	1	700	8260C
Fourth Quarter 2013	U	U	U	U	U	1	700	8260C
Ethyl methacrylate					*CAS #*	*97-63-2*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Ethyl methanesulfonate					*CAS #*	*62-50-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Ethylene oxide					*CAS #*	*75-21-8*		
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8260B
Famphur					*CAS #*	*52-85-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Fluoranthene					*CAS #*	*206-44-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Fluorene					*CAS #*	*86-73-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Heptachlor					*CAS #*	*76-44-8*		
Second Quarter 2013	0.0029J	U	U	U	U	0.025	-	8081B
Heptachlor epoxide					*CAS #*	*1024-57-3*		
Second Quarter 2013	U	U	U	U	U	0.025	-	8081B
Hexachlorobenzene					*CAS #*	*118-74-1*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Hexachlorobutadiene					*CAS #*	*87-68-3*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Hexachlorocyclopentadiene					*CAS #*	*77-47-4*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Hexachloroethane					*CAS #*	*67-72-1*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Hexachlorophene					*CAS #*	*70-30-4*		
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8270D
Hexachloropropene					*CAS #*	*1888-71-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Hexanone					*CAS #*	*591-78-6*		
Second Quarter 2013	U J	U J	U J	U	U	10	-	8260C
Indeno[1,2,3-cd]pyrene					*CAS #*	*193-39-5*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Isobutyl alcohol					*CAS #*	*78-83-1*		
Second Quarter 2013	U	U	U	U	U	200	-	8260C
Isodrin					*CAS #*	*465-73-6*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Isophorone					*CAS #*	*78-59-1*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Isopropylbenzene					*CAS #*	*98-82-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Isopropylether					*CAS #*	*108-20-3*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
4-Isopropyltoluene					*CAS #*	*99-87-6*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Isosafrole					*CAS #*	*120-58-1*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Kepone					*CAS #*	*143-50-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Methacrylonitrile					*CAS #*	*126-98-7*		
Second Quarter 2013	U	U	U	U	U	100	-	8260C
Methapyrilene					*CAS #*	*91-80-5*		
Second Quarter 2013	U J	U J	U J	U J	U J	5	-	8270D
Methoxychlor					*CAS #*	*72-43-5*		
Second Quarter 2013	U	U	U	U	U	0.25	-	8081B
Bromomethane					*CAS #*	*74-83-9*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Chloromethane					*CAS #*	*74-87-3*		
Second Quarter 2013	U	U	U	U	U	1	1.4	8260C
Fourth Quarter 2013	U	U	U	U	U	1	1.4	8260C
3-Methylcholanthrene					*CAS #*	*56-49-5*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Iodomethane					*CAS #*	*74-88-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Methyl methacrylate					*CAS #*	*80-62-6*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Methyl methane sulfonate					*CAS #*	*66-27-3*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Methylnaphthalene					*CAS #*	*91-57-6*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Methyl parathion					*CAS #*	*298-00-0*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
4-Methyl-2-pentanone					*CAS #*	*108-10-1*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
2-Methylphenol					*CAS #*	*95-48-7*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
3 & 4-Methylphenol					*CAS #*	*m 108-39-4*	*p 106-44-5*	
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Methyl tert-butyl ether					*CAS #*	*1634-04-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Dibromomethane					*CAS #*	*74-95-3*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Methylene chloride					*CAS #*	*75-09-2*		
Second Quarter 2013	4.7	U	U	U	U	1	13.95	8260C
Fourth Quarter 2013	4.2	U	U	U	U	1	13.95	8260C
Naphthalene					*CAS #*	*91-20-3*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,4-Naphthoquinone					*CAS #*	*130-15-4*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1-Naphthylamine					*CAS #*	*134-32-7*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Naphthylamine					*CAS #*	*91-59-8*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
o-Nitroaniline					*CAS #*	*88-74-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1 *All Results in ug/L.*

Analtye/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
m-Nitroaniline					CAS # 99-09-2			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
p-Nitroaniline					CAS # 100-01-6			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Nitrobenzene					CAS # 98-95-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
o-Nitrophenol					CAS # 88-75-5			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
p-Nitrophenol					CAS # 100-02-7			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
4-Nitroquinoline-1-oxide					CAS # 56-57-5			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodi-n-butylamine					CAS # 924-16-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodiethylamine					CAS # 55-18-5			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodimethylamine					CAS # 62-75-9			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodiphenylamine					CAS # 86-30-6			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosodipropylamine					CAS # 621-64-7			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosomethylethylamine					CAS # 10595-95-6			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosomorpholine					CAS # 59-89-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosopiperidine					CAS # 100-75-4			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
N-Nitrosopyrrolidine					CAS # 930-55-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
5-Nitroso-o-toluidine					CAS # 99-55-8			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Parathion					CAS # 56-38-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachlorobenzene					CAS # 608-93-5			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachloroethane					CAS # 76-01-7			
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Pentachloronitrobenzene					CAS # 82-68-8			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pentachlorophenol					CAS # 87-86-5			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Phenacetin					CAS # 62-44-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Phenanthrene					CAS # 85-01-8			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Phenol					CAS # 108-95-2			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Total Recoverable Phenolics					CAS #			
Second Quarter 2013	U	U	U	U	U	40	-	9066
Phorate					CAS # 298-02-2			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2-Picoline					CAS # 931-19-1			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pronamide					CAS # 23950-58-5			
Second Quarter 2013	U	U	U	U	U	5	-	8270D

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1 *All Results in ug/L.*

Analtye/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
1-Propanol					CAS # 71-23-8			
Second Quarter 2013	U J	U J	U J	U J	U J	100	-	8260B
2-Propanol					CAS # 67-63-0			
Second Quarter 2013	U	U	U	U	U	100	-	8260C
Propionitrile					CAS # 107-12-0			
Second Quarter 2013	U	U	U	U	U	100	-	8260C
n-Propylbenzene					CAS # 103-65-1			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Pyrene					CAS # 129-00-0			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Pyridine					CAS # 110-86-1			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Safrole					CAS # 94-59-7			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Silvex					CAS # 93-72-1			
Second Quarter 2013	U	U	U	U	U	1	-	8151A
Styrene					CAS # 100-42-5			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Sulfotep					CAS # 3689-24-5			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
2,4,5-Trichlorophenoxyacetic acid					CAS # 93-76-5			
Second Quarter 2013	U	U	U	U	U	1	-	8151A
1,2,4,5-Tetrachlorobenzene					CAS # 95-94-3			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,1,1,2-Tetrachloroethane					CAS # 630-20-6			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,2,2-Tetrachloroethane					CAS # 79-34-5			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Tetrachloroethene					CAS # 127-18-4			
Second Quarter 2013	0.4 J	U	U	U	U	1	5	8260C
Fourth Quarter 2013	U	U	U	U	U	1	5	8260C
Tetrahydrofuran					CAS # 109-99-9			
Second Quarter 2013	18 J	U	U	U	U	25	-	8260C
2,3,4,6-Tetrachlorophenol					CAS # 58-90-2			
Second Quarter 2013	U	U	U	U	U	10	-	8270D
Toluene					CAS # 108-88-3			
Second Quarter 2013	U	U	U	U	U	1	1000	8260C
Fourth Quarter 2013	U	U	U	U	U	1	1000	8260C
o-Toluidine					CAS # 95-53-4			
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Toxaphene					CAS # 8001-35-2			
Second Quarter 2013	U	U	U	U	U	2.5	-	8081B
1,2,3-Trichlorobenzene					CAS # 87-61-6			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,2,4-Trichlorobenzene					CAS # 120-82-1			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,1-Trichloroethane					CAS # 71-55-6			
Second Quarter 2013	0.8 J	U	U	U	U	1	200	8260C
Fourth Quarter 2013	U	U	U	U	U	1	200	8260C
1,1,2-Trichloroethane					CAS # 79-00-5			
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Trichloroethene					CAS # 79-01-6			
Second Quarter 2013	0.3 J	U	U	U	U	1	5	8260C
Fourth Quarter 2013	U	U	U	U	U	1	5	8260C
Trichlorofluoromethane					CAS # 75-69-4			
Second Quarter 2013	U	U	U	U	U	1	469.5	8260C
Fourth Quarter 2013	U	U	U	U	U	1	469.5	8260C

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1 *All Results in ug/L.*

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
2,4,5-Trichlorophenol					*CAS #*	*95-95-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
2,4,6-Trichlorophenol					*CAS #*	*88-06-2*		
Second Quarter 2013	U	U	U	U	U	10	-	8270D
1,2,3-Trichloropropane					*CAS #*	*96-18-4*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane					*CAS #*	*76-13-1*		
Second Quarter 2013	U	U	U	U	U	1	59000	8260C
Fourth Quarter 2013	U	U	U	U	U	1	59000	8260C
O,O,O-Triethyl phosphorothioate					*CAS #*	*126-68-1*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
1,2,4-Trimethylbenzene					*CAS #*	*95-63-6*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
1,3,5-Trimethylbenzene					*CAS #*	*108-67-8*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
sym-Trinitrobenzene					*CAS #*	*99-35-4*		
Second Quarter 2013	U	U	U	U	U	5	-	8270D
Vinyl acetate					*CAS #*	*108-05-4*		
Second Quarter 2013	U	U	U	U	U	10	-	8260C
Vinyl chloride					*CAS #*	*75-01-4*		
Second Quarter 2013	U	U	U	U	U	1	-	8260C
Xylenes (Total)					*CAS #*	*1330-20-7*		
Second Quarter 2013	U	U	U	U	U	3	10000	8260C
Fourth Quarter 2013	U	U	U	U	U	3	10000	8260C

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 16C1 ***All Results in ug/L.***

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*

Definitions:

The following definitions apply to results reported for Appendix IX monitoring events. All Appendix IX monitoring results for compliance wells are reported to the detection limit.

Appendix IX Monitoring Events: 3Q2003, 2Q-2004, 2Q-2005, 3Q2006, 2Q2007, 2Q2008, 2Q2009, 2Q 2010, 2Q 2011, 2Q 2012, 2Q2013

QL Denotes permit required quantitation limit.
U denotes not detected at or above the detection limit.
UA denotes not detected at or above the adjusted detection limit.
J Denotes result is estimated. When used with "U" (i.e., "UJ"), denotes analyte not detected at or above the detection limit and detection limit and QL are estimated. When used with "UA" (i.e., "UAJ"), denotes analyte not detected at or above adjusted detection limit and adjusted detection limit and QL are estimated.
UN Denotes analyte concentration is less than the quantitation limit and/or five times the blank concentration. Not reliably detected due to blank contamination. This qualifier used only for Appendix IX monitoring event when compliance well results are reported to at or above the project detection limit.
R Denotes result rejected.
Q Denotes data validation qualifier. **X** Denotes mass spectral confirmation not obtained-result suspect.
Background Denotes background concentrations listed in Appendix F to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002), where applicable.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes Groundwater Protection Standards listed in Appendix G to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002) (revised September 27, 2011).
NS denotes not sampled. **NA** denotes not analyzed.
"–" denotes not detected (pre-2nd Quarter 2003) or not available / not sampled (beginning 2nd Quarter 2003).

The following definitions apply to results reported for non-Appendix IX monitoring events. All non-Appendix IX monitoring results for compliance wells are reported at or above the quantitation limit.

QL Denotes permit required quantitation limit.
U Denotes analyte not detected at or above QL.
UA Denotes analyte not detected at or above adjusted sample QL.
J Denotes result is estimated. When used with "U" (i.e., "**UJ**"), denotes analyte not detected at or above QL and QL is estimated. When used with "UA" (i.e., "**UAJ**"), denotes analyte not detected at or above adjusted QL and adjusted QL is estimated.
R Denotes result rejected.
Q Denotes data validation qualifier.
Background Denotes background concentrations listed in Appendix F to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002), (revised September 27, 2011), where applicable.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes Groundwater Protection Standards listed in Appendix G to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002) (revised September 27, 2011).

NOTE:

Fourth Quarter 2008:
Due to laboratory error all HWMU 16 samples were analyzed using Method 8260B 5 ml purge instead of a 25 ml purge which resulted in a higher QL. For these samples, all results were evaluated to the detection limit, which is comparable to the permit QL. Results below the laboratory QL but at or above the permit QL are reported and qualified as estimated.
Second Quarter 2009:
Verification event 6/11/2009 - 16MW8 for acetone. Verification result reported as not detected.
4/ 2010 event -Per DEQ, tin analyzed by Method 6010B instead of Method 6020. Verification event: 16MW9 1,1-dichloroethene and benzene. 16WC1B 4,4-DDD. Verification result reported as not detected.
Verification event 6/27/2012 – 16WC1A for cobalt. Verification result reported.

See last page of this report for definitions.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-16 Monitoring Event: Fourth Quarter 2013

Draper Aden Associates
Engineering ◆ Surveying ◆ Environmental Services

Analyte	Sample ID	Laboratory Result (ug/L)	Q	Validated Result (ug/L)	Q	QL (ug/L)	Validation Notes
Method: 6020A							
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC							
Barium	16WC1A	262		262		10	No action taken.
	16WDUP	263		263		10	No action taken. Field duplicate of 16WC1A. RPD <10.
Method: 8260C							
Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA							
Chloroethane	16WC1A	1		1		1	No action taken.
	16WDUP	1		1		1	No action taken. Field duplicate of 16WC1A. RPD <10.
1,1-Dichloroethane	16WC1A	3.1		3.1		1	No action taken.
	16WDUP	3.2		3.2		1	No action taken. Field duplicate of 16WC1A. RPD <10.
Diethyl ether	16WC1A	13		13		12.5	No action taken.
	16WDUP	14		14		12.5	No action taken. Field duplicate of 16WC1A. RPD <10.

Definitions:

Data Validation Qualifiers:

QL Denotes permit quantitation limit. **Q** Denotes data qualifier.

J Denotes analyte reported at or above quantitation limit and associated result is estimated.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-16 Monitoring Event: Second Quarter 2013

Draper Aden Associates
Engineering • Surveying • Environmental Services

Analyte	Sample ID	Laboratory Result (ug/L)	Q	Validated Result (ug/L)	Q	QL (ug/L)	Validation Notes
Method: 6020A							
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC							
Barium	16WC1A	263		263		10	No action taken.
	16WDUP	278		278		10	No action taken. Field duplicate of 16C1A. RPD <10.
Method: 8260C							
Laboratory: Eurofins Lancaster, Lancaster, PA							
1,1-Dichloroethane	16WC1A	2.3		2.3		1	No action taken.
	16WDUP	2.5		2.5		1	No action taken. Field duplicate of 16C1A. RPD <10.

Definitions:
Data Validation Qualifiers:
QL Denotes permit quantitation limit. Q Denotes data qualifier.
J Denotes analyte reported at or above quantitation limit and associated result is estimated.

APPENDIX C-3

HWMU-16 2013 LABORATORY ANALYTICAL RESULTS
PLUME MONITORING WELLS

Target Analyte Monitoring Results At Or Above Permit Quantitation Limit
HWMU-16 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L.

Upgradient well = 16C1

Analtye/Quarter	*16C1 Q*	*16-1 Q*	*16-2 Q*	*16-3 Q*	*16-5 Q*	*16WC2B Q*	*16SPRING Q*	*QL*	*Background*	*Method*
Arsenic						*CAS # 7440-38-2*				
Second Quarter 2013	U	U	U	U	U	U	U	10	1	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	10	1	6020A
Barium						*CAS # 7440-39-3*				
Second Quarter 2013	194	220	240	728	165	114	234	10	175.4	6020A
Fourth Quarter 2013	171	167	232	763	174	117	208	10	175.4	6020A
Beryllium						*CAS # 7440-41-7*				
Second Quarter 2013	U	U	U	U	U	U	U	1	0.7	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	1	0.7	6020A
Cadmium						*CAS # 7440-43-9*				
Second Quarter 2013	U	U	U	U	U	U	U	1	0.2	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	1	0.2	6020A
Chromium						*CAS # 7440-47-3*				
Second Quarter 2013	U	U	U	U	U	U	U	5	6.2	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	5	6.2	6020A
Cobalt						*CAS # 7440-48-4*				
Second Quarter 2013	U	U	U	U	U	U	U	5	5	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	5	5	6020A
Copper						*CAS # 7440-50-8*				
Second Quarter 2013	U	U	U	U	U	U	U	5	13	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	5	13	6020A
Lead						*CAS # 7439-92-1*				
Second Quarter 2013	U	U	U	U	U	U	U	1	10	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	1	10	6020A
Mercury						*CAS # 7439-97-6*				
Second Quarter 2013	U	U	U	U	U	U	U	2	0.2	7470A
Fourth Quarter 2013	U J	U J	U J	U J	U J	U J	U J	2	0.2	7470A
Nickel						*CAS # 7440-02-0*				
Second Quarter 2013	3.25 J	U	U	U	U	U	U	10	16	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	10	16	6020A
Vanadium						*CAS # 7440-62-2*				
Second Quarter 2013	U	U	U	U	U	U	U	10	151	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	10	151	6020A
Zinc						*CAS # 7440-66-6*				
Second Quarter 2013	U	U	U	U	U	U	U	10	51	6020A
Fourth Quarter 2013	U	U	U	U	U	U	U	10	51	6020A
Benzene						*CAS # 71-43-2*				
Second Quarter 2013	0.3 J	U	U	U	U	U	U	1	1	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	1	8260C
2-Butanone						*CAS # 78-93-3*				
Second Quarter 2013	U	U	U	U	U	U	U	10	1.1	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	10	1.1	8260C
Carbon tetrachloride						*CAS # 56-23-5*				
Second Quarter 2013	U	U	U	U	U	U	U	1	0.2	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	1	0.2	8260C
Chloroethane						*CAS # 75-00-3*				
Second Quarter 2013	5	U	U	U	U	U	U	1	20.7	8260C
Fourth Quarter 2013	4.9	U	U	U	U	U	U	1	20.7	8260C

See last page of this report for definitions.

Target Analyte Monitoring Results At Or Above Permit Quantitation Limit
HWMU-16 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L.

Upgradient well = 16C1

Analtye/Quarter	*16C1*	*Q*	*16-1*	*Q*	*16-2*	*Q*	*16-3*	*Q*	*16-5*	*Q*	*16WC2B*	*Q*	*16SPRING*	*Q*	*QL*	*Background*	*Method*
Dichlorodifluoromethane											*CAS # 75-71-8*						
Second Quarter 2013	0.3	J	U	J	U	J	U	J	U	J	U	J	U	J	1	46.5	8260C
Fourth Quarter 2013	U	J	U	J	U	J	U	J	U	J	U	J	U	J	1	46.5	8260C
1,1-Dichloroethane											*CAS # 75-34-3*						
Second Quarter 2013	8.6		U		U		U		U		U		U		1	9.5	8260C
Fourth Quarter 2013	8.9		U		U		U		U		U		U		1	9.5	8260C
Diethyl ether											*CAS # 60-29-7*						
Second Quarter 2013	48	J	U	J	U	J	U	J	U	J	U	J	U	J	13	75.5	8260C
Fourth Quarter 2013	39		U		U		U		U		U		U		12.5	75.5	8260C
Diethyl phthalate											*CAS # 84-66-2*						
Second Quarter 2013	U		-		-		-		-		-		-		5	5	8270D
Fourth Quarter 2013	U		U		U		U		U		U		U		5	5	8270D
Dimethyl ether											*CAS # 115-10-6*						
Second Quarter 2013	U	N	U		U		U		U		U		U		13	17.0	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		12.5	17.0	8260C
2,4-Dinitrotoluene											*CAS # 121-14-2*						
Second Quarter 2013	U		U		U		U		U		U		U		10	10	8270D
Fourth Quarter 2013	U		U		U		U		U		U		U		10	10	8270D
2,6-Dinitrotoluene											*CAS # 606-20-2*						
Second Quarter 2013	U		U		U		U		U		U		U		10	10	8270D
Fourth Quarter 2013	U		U		U		U		U		U		U		10	10	8270D
Ethylbenzene											*CAS # 100-41-4*						
Second Quarter 2013	U		U		U		U		U		U		U		1	0.1	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	0.1	8260C
Chloromethane											*CAS # 74-87-3*						
Second Quarter 2013	U		U		U		U		U		U		U		1	0.3	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	0.3	8260C
Methylene chloride											*CAS # 75-09-2*						
Second Quarter 2013	4.7		U		U		U		U		U		U		1	13.95	8260C
Fourth Quarter 2013	4.2		U		U		U		U		U		U		1	13.95	8260C
Tetrachloroethene											*CAS # 127-18-4*						
Second Quarter 2013	0.4	J	U		U		U		U		U		U		1	0.7	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	0.7	8260C
Toluene											*CAS # 108-88-3*						
Second Quarter 2013	U		U		U		U		U		U		U		1	0.1	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	0.1	8260C
1,1,1-Trichloroethane											*CAS # 71-55-6*						
Second Quarter 2013	0.8	J	U		U		U		U		U		U		1	9.2	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	9.2	8260C
Trichloroethene											*CAS # 79-01-6*						
Second Quarter 2013	0.3	J	U		U		U		U		U		U		1	0.1	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	0.1	8260C
Trichlorofluoromethane											*CAS # 75-69-4*						
Second Quarter 2013	U		U		U		U		U		U		U		1	11.3	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	11.3	8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane											*CAS # 76-13-1*						
Second Quarter 2013	U		U		U		U		U		U		U		1	1.2	8260C
Fourth Quarter 2013	U		U		U		U		U		U		U		1	1.2	8260C

Target Analyte Monitoring Results At Or Above Permit Quantitation Limit
HWMU-16 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L.

Upgradient well = 16C1

Analtye/Quarter	*16C1 Q*	*16-1 Q*	*16-2 Q*	*16-3 Q*	*16-5 Q*	*16WC2B Q*	*16SPRING Q*	*QL*	*Background*	*Method*
Xylenes (Total)						*CAS # 1330-20-7*				
Second Quarter 2013	U	U	U	U	U	U	U	3	0.2	8260C
Fourth Quarter 2013	U	U	U	U	U	U	U	3	0.2	8260C

Definitions:

All plume monitoring well results reported to at or above the permit quantitation limit except for the upgradient well during the Appendix IX monitoring Event. During this event, results for the upgradient well are reported to the detection limit.

Q Denotes data validation qualifier.
QL Denotes permit required quantitation limit.
U Denotes analyte not detected at or above QL.
UA Denotes analyte not detected at or above adjusted sample QL.
J Denotes result is estimated. When used with "U" (i.e., "**UJ**"), denotes analyte not detected at or above QL and QL is estimated. When used with "UA" (i.e., "**UAJ**"), denotes analyte not detected at or above adjusted QL and adjusted QL is estimated.
UN Denotes analyte concentration is less than the quantiation limit and five times the blank concentration. Not reliably detected due to blank contamination. This qualifier used only for Appendix IX monitoring event when compliance well results are reported to at or above the project detection limit.
R Denotes result rejected.
Background Denotes background concentrations listed in Appendix F to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002), revised September 27, 2011.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes groundwater protection standard.

NS denotes not sampled. **NA** denotes not analyzed. "–"denotes not detected (pre-2nd Quarter 2003) or not available / not sampled (beginning 2nd Quarter 2003).

Notes:
4Q2004. No data for 16-1 8270C-semivolatiles. Well dry-insufficient sample volume.
4Q2006 - No data for 16-1; well dry.
4Q2008- No data for 16-1; well dry.
2Q2009- No data for 16-1; well dry.

NOTE:
Fourth Quarter 2008
Due to laboratory error all HWMU 16 samples were analyzed using Method 8260B 5 ml purge instead of a 25 ml purge which resulted in a higher QL. For these samples, all results were evaluated to the detection limit, which is comparable to the permit QL. Results below the laboratory QL but at or above the permit QL are reported and qualified as estimated.

APPENDIX C-4

ESTABLISHED BACKGROUND VALUES AND COMPUTATIONS FOR HWMU-16

- It was not understood why the majority of fluorescein detections were considered false positive detections. The basis of this observation is unclear considering a lack of background and laboratory confirmation results.

- It was not apparent why certain samples were selected for laboratory confirmation and others were not. There was no apparent consistency in the selection of samples for laboratory confirmation.

- Samples were submitted for confirmation laboratory analyses three months or more following the collection of the samples in the field. No information was provided regarding the custody and/or storage of the samples. The samples were submitted to the analytical laboratory with incomplete chain-of-custody (COC), and the COC documentation was not completed by the laboratory.

In summary, the data from the study do not provide the basis for meaningful interpretation. Any attempt to formulate conclusions from the data as presented regarding the presence of preferred or predominant groundwater flow patterns is not warranted or recommended.

3.3 HWMU-16 GROUNDWATER MONITORING ANALYTE LIST

The groundwater monitoring analyte list for HWMU-16 is presented in **Table 1 (Appendix B)**. The list represents the subset of the constituents listed in Appendix III of 40 CFR Part 261 that previously have been detected in the groundwater and/or that are reasonably expected to be in or derived from waste contained in HWMU-16. As discussed in Section 3.5.2 below, 12 inorganic constituents and two explosive/propellant constituents have been detected in the groundwater monitoring network for HWMU-16 at statistically significant concentrations above the Unit's calculated background concentrations. The inorganic constituents may be derived from the aquifer formation materials; however, the two explosive/propellant constituents (2,4-Dinitrotoluene and 2,6-Dinitrotoluene) are byproducts of wastes derived from explosives. Therefore, the two explosive/propellant constituents detected could only be from HWMU-16.

The concentration limits established for the hazardous constituents also are listed in **Table 1**. The concentration limits represent either background concentrations calculated for the constituents in this GWQAR, Maximum Concentrations of Constituents for Ground-water Protection listed in Table 1 of 40 CFR 264.94, USEPA Drinking Water Standard Maximum Contaminant Levels (MCLs), or alternate concentration limits (ACLs) established by the VDEQ (July 1998). Certain organic constituents on the list do not have USEPA MCLs or VDEQ ACLs; they also do not have calculated background concentrations because they have not been detected in the Unit's upgradient well. Therefore, the concentration limits for these constituents are equal to their respective method detection limits.

As Alliant discussed with the VDEQ in the past, the reliability of previous laboratory analytical data - particularly dissolved metals data - appeared to be questionable in some cases. In an April 9, 1996 letter to C. Jake (Alliant), the VDEQ agreed that only total metals concentrations in groundwater would be measured, as described in a USEPA Region III guidance on groundwater sampling in karst terrain. Therefore, all references to metals concentrations in this GWQAR refer to <u>total</u> metals concentrations.

3.4 HWMU-16 GROUNDWATER BACKGROUND CONCENTRATIONS

Background concentrations were calculated for each constituent in the groundwater monitoring program using the analytical data from 1996 through 1998 for upgradient well 16C1.

The background concentration calculations were based on site wide 95% confidence, 95% coverage upper prediction intervals. The calculated background concentrations are listed in **Table 2 (Appendix B)**. The background concentrations were used to construct the outermost closing contours on the Isoconcentration Maps **(Appendix A)**.

3.5 HWMU-16 STATISTICAL ANALYSIS

Statistical evaluations for HWMU-16 are performed annually and submitted to the VDEQ in accordance with the annual reporting requirements specified in 40 CFR 265.94. As part of this GWQAR, statistical evaluations were performed on Fourth Quarter 1998 analytical data in accordance with the procedures and guidance provided in the following documents:

- Title 40 of the Code of Federal Regulations, 40 CFR 264.97 and 264.98;
- VDEQ Guidance for statistical analysis titled "Data Analysis Plan," undated;
- Interim Final Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, USEPA, April 1989;
- Addendum to Interim Final Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, USEPA, July 1992; and
- Statistical Methods for Groundwater Monitoring, Gibbons, R.D., 1994.

Statistical threshold values were computed for the 54 constituents for which HWMU-16 is currently monitored based on the concentrations of those constituents in upgradient (background) well 16C1. All data starting with First Quarter 1996 to Fourth Quarter 1998 were used for this purpose. The 1996 through 1998 monitoring data have been submitted previously to the VDEQ by Alliant in quarterly monitoring reports; therefore, the data are not listed in this GWQAR. Statistical comparisons were performed for the Fourth Quarter 1998 data set. Comparison statistical analyses were performed for all constituents which were detected in any downgradient well during that event.

3.5.1 Background Data and Statistical Comparisons

Statistical analyses were performed using the analytical results from upgradient well 16C1 data as background data. Based on the percentage of non-detects and the distribution of the background data, methods of statistical comparisons varied. Background average, standard deviation and other descriptive statistical data were computed for all constituents and are presented in **Appendix C**.

The constituents listed below were 100% non-detected in the background data. The background threshold levels (BTLs) for these constituents were established as equal to their detection limits (DL). Detections of these constituents in the downgradient wells during Fourth Quarter 1998 were compared to these BTLs.

Background Threshold Level (BTL) = Detection Limit (DL)				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Antimony	12	100	3	3
Arsenic	12	100	1	1
Bromoform	12	100	0.3	0.3
Carbon tetrachloride	12	100	0.2	0.2
Chlorobenzene	12	100	0.1	0.1
Chloromethane	12	100	0.3	0.3
Cyanide	12	100	10	10

Background Threshold Level (BTL) = Detection Limit (DL)				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Di-n-butyl phthalate	12	100	5	5
1,2-Dichloroethane	12	100	0.1	0.1
trans-1,2-Dichloroethene	12	100	0.1	0.1
1,4-Dichlorobenzene	12	100	0.1	0.1
Ethylbenzene	12	100	0.1	0.1
Mercury	12	100	0.2	0.2
Methyl ethyl ketone	12	100	1.1	1.1
Selenium	12	100	1	1
1,1,2,2-Tetrachloroethane	12	100	0.3	0.3
1,1,2-Trichloroethane	12	100	0.5	0.5
Trichloroethene	12	100	0.1	0.1
Toluene	12	100	0.1	0.1
2378-TCDF	12	100	0.0485 ppt	0.0485 ppt
12378-PECDF	12	100	0.0439 ppt	0.0439 ppt
23478-PECDF	12	100	0.0417 ppt	0.0417 ppt
123478-HXCDF	12	100	0.0390 ppt	0.0390 ppt
123678-HXCDF	12	100	0.0377 ppt	0.0377 ppt
234678-HXCDF	12	100	0.0428 ppt	0.0428 ppt
123789-HXCDF	12	100	0.0415 ppt	0.0415 ppt
1234678-HPCDF	12	100	0.0615 ppt	0.0615 ppt
1234789-HPCDF	12	100	0.0709 ppt	0.0709 ppt
OCDF	12	100	0.1307 ppt	0.1307 ppt

Non-parametric prediction intervals were computed for all of the constituents for which the data from background well 16C1 satisfied one of the following two criteria, per VDEQ regulations and guidance as well as USEPA guidance:

- Percentage of non-detects was greater than or equal to 50 and less than 100; or
- Percentage of non-detects was less than 50, but data was not normally distributed in original or log-transformed mode.

The background threshold levels for these constituents were set as equal to their upper prediction limits (UPLs). The background and relevant statistical data for these constituents are summarized below. The confidence level and false positive rate were calculated based on the number of background data points available and number of future comparisons. For all constituents, the confidence level was determined to be equal to 0.933, and the false positive rate was equal to 0.067. Since the upper control limit of a non-parametric interval cannot be adjusted for multiple comparisons and inadequate number of background data, the number of resampling events required was adjusted to account for the high error rates inherent in those situations. The number of confirmation resamples required for all constituents is 2. The background and relevant statistical data for these constituents are summarized below. Associated statistical computations are presented in **Appendix C**.

BTL = Upper Prediction Limit of Non-parametric Prediction Interval w/false positive rate=0.067				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Beryllium	12	75	0.2	0.7
Cadmium	12	75	0.1	0.2
Cobalt	12	75	1	5
Copper	12	50	1	13
1,1-Dichloroethane	12	0	0.2	9.5
2,4-Dinitrotoluene	12	92	0.08	0.10

BTL = Upper Prediction Limit of Non-parametric Prediction Interval w/false positive rate=0.067				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
2,6-Dinitrotoluene	12	75	0.08	0.11
Lead	12	42	1	10
Nickel	12	92	15	16
Silver	12	75	0.2	0.5
Thallium	12	67	1	6
TOC	12	75	1000	7000
1,1,1-Trichloroethane	12	17	0.3	9.2
Vanadium	12	83	4	151
Vinyl Chloride	12	92	0.1	0.1
Xylene (total)	12	92	0.1	0.2
Zinc	12	50	5	51

Chromium exhibited normally distributed data (excluding non-detects) with between 25% and 50% non-detects in the background well. The mean and standard deviation of the background data for chromium were adjusted using Cohen's Maximum Likelihood Estimator Method (1959, 1961). A one-sided parametric prediction interval was then computed for chromium based on the adjusted mean and standard deviation. The Upper Prediction Limit was set as the BTL for chromium. The background and relevant statistical data for chromium are summarized below. Cohen's adjustment computations and prediction interval computations are presented in **Appendix C**.

BTL = Upper Prediction Limit of Prediction Interval w/false positive rate=0.05 Original Mean = 3.54, Original SD = 1.933 Adjusted Mean = 3.642. Adjusted SD = 1.95				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Chromium	12	25	1	6.2

The following constituents exhibited normally distributed background data with less than 25% non-detects. One sided parametric prediction intervals were computed on the background data for all of these constituents. The UPLs for these constituents were set as their respective BTLs, with one exception. For pH, a two-sided parametric prediction interval was computed; therefore, the BTL for pH consisted of a range between the lower prediction limit (LPL) and the upper prediction limit. The background concentration calculations were based on a site wide 95% confidence, 95% coverage upper prediction intervals. When adjusted for multiple comparisons of the background data, the minimum required false positive rate was below 1% (0.01). A 99% confidence level (0.01 false positive rate) was used for all individual comparisons, which with the most conservative assumptions provided a site-wide false positive rate of >0.05 for all constituents. The background and relevant statistical data for these constituents are summarized below. The prediction interval computations for these constituents are presented in **Appendix C**.

BTL = UPL of one-sided Prediction Interval (exception pH) w/site-wide false positive rate>0.05 (individual comparisons false positive rate=0.01) BTL for pH = LPL – UPL of two-sided Prediction Interval				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Barium	12	0	2	175.4
Dichlorodifluoromethane	12	8	0.3	46.5
Tetrachloroethene	12	17	0.1	0.7
TOX	12	17	5	42.2

BTL = UPL of one-sided Prediction Interval (exception pH) w/site-wide false positive rate>0.05 (individual comparisons false positive rate=0.01) BTL for pH = LPL – UPL of two-sided Prediction Interval				
Parameter	Sample Size	% Non-Detects	DL (µg/l)	BTL (µg/l)
Trichlorofluoromethane	12	0	0.5	11.3
Specific Conductivity	8	0	1 µS/cm	672 µS/cm
pH	8	0	0.1 pH units	5.7 to 7.9 pH units

3.5.2 Results of Statistical Comparisons

The following table lists the constituents which were detected during the Fourth Quarter 1998 event at concentrations exceeding their respective background threshold levels (BTLs), and the downgradient wells in which they were detected.

Parameter	Monitoring Well(s)
Arsenic	16-5, 16WC2B
Barium	16-2, 16-3, 16-5, 16WC1A, 16WC1B, 16WC2B, 16SPRING
Beryllium	16WC1B, 16WC2B
Cadmium	16WC1B
Chromium	16-3, 16-5, 16WC1B, 16WC2B
Cobalt	16-5, 16WC1B, 16WC2B
Copper	16-5, 16WC1B, 16WC2B
Lead	16WC1B
Mercury	16WC1B
Nickel	16-5, 16WC1A, 16WC2B
Selenium	16-5, 16WC1B, 16WC2B
Zinc	16WC1B
2,4-Dinitrotoluene	16-3, 16-5, 16WC1B, 16WC2B, 16SPRING
2,6-Dinitrotoluene	16WC1A, 16WC1B

Any HWMU-16 target constituents not listed above were not detected in the downgradient monitoring wells at concentrations exceeding their respective BTLs.

3.6 HWMU-16 PLUME DELINEATIONS

In accordance with VDEQ instructions presented during the May 19, 1999 meeting between Alliant and the VDEQ, Isoconcentration Maps were produced to depict constituent plumes in the groundwater beneath the site (**Appendix A**). In order to evaluate the shape and position of constituent plumes over time, historical Isoconcentration Maps were developed using the historical maximum concentrations for the constituents monitored at the site for the time periods of 1992 through 1995 and 1996 through 1998. The historical maximum concentrations for these time periods are listed in **Tables 3** and **4**, respectively (**Appendix B**).

Groundwater analytical data collected prior to 1992 were not included in the evaluation of historical maximum concentrations. The data collected prior to 1992 are considered unreliable due to "order-of-magnitude" variations in parameter concentrations from quarter to quarter, as well as a general lack of laboratory QA/QC. Additionally, the groundwater monitoring analyte lists prior to 1992 did not include many of the parameters on the current groundwater monitoring analyte list for HWMU-16.

TABLE 2
HWMU-16
Calculated Background Values

Constituent	Background Concentration (µg/l unless otherwise noted)
Antimony	3
Arsenic	1
Barium	175.4
Beryllium	0.7
Cadmium	0.2
Chromium	6.2
Cobalt	5
Copper	13
Lead	10
Mercury	0.2
Nickel	16
Selenium	1
Silver	0.5
Thallium	6
Vanadium	151
Zinc	51
Bromoform	0.3
Carbon Tetrachloride	0.2
Chlorobenzene	0.1
Chloromethane	0.3
1,4-Dichlorobenzene	0.1
Dichlorodifluoromethane	46.5
1,1-Dichloroethane	9.5
1,2-Dichloroethane	0.1
trans-1,2-Dichloroethene	0.1
Ethylbenzene	0.1
Methyl Ethyl Ketone	1.1
1,1,2,2-Tetrachloroethane	0.3
Tetrachloroethene	0.7
Toluene	0.1
1,1,1-Trichloroethane	9.2
1,1,2-Trichloroethane	0.5
Trichloroethene	0.1
Trichlorofluoromethane	11.3
Vinyl Chloride	0.1
Xylenes (total)	0.2

TABLE 2
HWMU-16
Calculated Background Values

Constituent	Background Concentration (µg/l unless otherwise noted)
Di-n-butylphthalate	5
2,4-Dinitrotoluene	0.10
2,6-Dinitrotoluene	0.11
2378-TCDF	0.0485 ppt
12378-PECDF	0.0439 ppt
23478-PECDF	0.0417 ppt
123478-HXCDF	0.0390 ppt
123678-HXCDF	0.0377 ppt
234678-HXCDF	0.0428 ppt
123789-HXCDF	0.0415 ppt
1234678-HPCDF	0.0615 ppt
1234789-HPCDF	0.0709 ppt
OCDF	0.1307 ppt
Cyanide	10
Total Organic Carbon (x4)	7000
Total Organic Halides (x4)	42.2
Specific Conductivity	672 µS/cm
pH	5.7 to 7.9 pH units

Appendix IX Constituents Detected Since Permit Issuance
HWMUs 5, 7, 10, and 16
Radford Army Ammunition Plant

Unit	Quarter Initially Detected	Constituent	Background--Calculated or QL?	Background (ug/L)	GPS Required? (261 Appendix VIII)	Proposed GPS (ug/L)	Source
HMWU-5	Fourth Quarter 2003	Chromium	QL	5	yes	100	USEPA MCL
		Diethyl Ether	QL	12	no	NA	NA
		2-Nitroaniline	QL	20	no	NA	NA
		4-Nitroaniline	QL	20	yes	20	Background/QL
		Nitrobenzene	QL	10	yes	10	Background/QL
	Third Quarter 2006	Dichlorodifluoromethane	QL	1	yes	125.2	VDEQ ACL
HWMU-7	Third Quarter 2003	Copper	Calculated	49	no	NA	NA
	Second Quarter 2004	Zinc	Calculated	217	no	NA	NA
HWMU-10	First Quarter 2003	Cobalt	QL	5	no	NA	NA
	Second Quarter 2003	Vanadium	QL	10	no	NA	NA
	Second Quarter 2005	Acetone	QL	10	no	NA	NA
		2-Propanol	QL	50	no	NA	NA
HWMU-16	Second Quarter 2003	Chloroethane	Calculated	20.7	yes	20.7	Background/QL
		Diethyl Ether	Calculated	75.5	no	NA	NA
		Dimethyl Ether	Calculated	17.0	no	NA	NA
	Third Quarter 2003	Methylene Chloride	Calculated	13.95	no*	NA	NA
	Second Quarter 2004	1,1,2-Trichloro-1,2,2-trifluoroethane	Calculated	1.2	no*	NA	NA

HWMU-5: The additional Appendix IX constituents detected in the downgradient point of compliance wells were not detected above their respective Quantitation Limits (QLs) in the upgradient well. As a result, background concentrations for those constituents were set as equal to their respective QLs. In accordance with the Permit (Condition V.J.1.g.), GPS are proposed for those additional Appendix IX constituents that are listed in Appendix VIII of 40 CFR Part 261 (chromium, 4-nitroaniline, nitrobenzene, and dichlorodifluoromethane). No GPS are proposed for the additional Appendix IX constituents that are not listed in Appendix VIII of 40 CFR Part 261 (diethyl ether and 2-nitroaniline).

HWMU-7: Background concentrations for the additional Appendix IX constituents detected in the downgradient point of compliance wells (copper and zinc) were previously calculated and submitted to the VDEQ in the August 1998 ***Groundwater Quality Assessment Report for HWMU-7*** prepared by ERM, Inc. In accordance with the Permit (Condition V.J.2.g.), no GPS are proposed for the additional Appendix IX constituents (copper and zinc), as they are not listed in Appendix VIII of 40 CFR Part 261.

HWMU-10: The additional Appendix IX constituents detected in the downgradient point of compliance wells were not detected above their respective Quantitation Limits (QLs) in the upgradient well. As a result, background concentrations for those constituents were set as equal to their respective QLs. In accordance with the Permit (Condition V.J.3.g.), no GPS are proposed for the additional Appendix IX constituents (cobalt, vanadium, acetone, and 2-propanol), as they are not listed in Appendix VIII of 40 CFR Part 261.

HWMU-16: Background concentrations for additional Appendix IX constituents chloroethane, diethyl ether, dimethyl ether, and methylene chloride were calculated using data collected from upgradient well 16C1 during the period from Third Quarter 2003 through Third Quarter 2004. The background concentration for additional Appendix IX constituent 1,1,2-trichloro-1,2,2-trifluoroethane was calculated using data collected from upgradient well 16C1 during the period from Second Quarter 2004 through Third Quarter 2006.
In accordance with the Permit (Condition V.J.4.g.), GPS are proposed for additional Appendix IX constituents that are listed in Appendix VIII of 40 CFR Part 261 (chloroethane). No GPS are proposed for the additional Appendix IX constituents that are not listed in Appendix VIII of 40 CFR Part 261 (diethyl ether and dimethyl ether).
*Methylene chloride and 1,1,2-trichloro-1,2,2-trifluoroethane should not be added to the Groundwater Monitoring List for HWMU-16, as these constituents were only detected in the upgradient well for the Unit, and not in the downgradient point of compliance wells.

Statistical Computations – RAAP HWMU-16 – 1,1,2-Trichloro-1,2,2-Trifluoroethane

In accordance with the facility permit and VHWMR, statistical background concentration is being established for 1,1,1-Trichloro-1,2,2-Trifluoroethane. Inter-well upper prediction limits (UPL) were calculated on the background data for this target parameter in accordance with the facility permit and VHWMR (40 CFR 264.97(h)). Background data for this target parameter consisted of all data for the background well 16C1 collected from 2nd quarter 2004 through 3rd quarter 2006.

Discussion of Tests for Normality

The power of a statistical tool to account for false positive and false negative results, while accurately detecting true statistical variations for a facility under scrutiny depends on numerous factors, one of which is the distribution of the data. A great number of statistical tools are based on the assumption that data are normally distributed. Hence the distribution of the sample population for parameters evaluated under this statistical analysis is first determined. Sample populations are tested for normal distribution using several normality tests. "Groundwater Information Tracking System with Statistical Analysis Capability" (GRITS/STAT) v5.0 was the software used to run these statistical tests. GRITS/STAT is an analytical software package provided by the USEPA. The distributions of the data sets were verified in the original mode as well as in log-transformed mode. The normality of the data set was evaluated using the Shapiro-Wilk test for normality.

Discussion of Prediction Interval Tests

Normality tests are performed prior to running parametric tests (tests that require that the data be normal). Results of the normality tests show that the background data for 1,1,2-Trichloro-1,2,2-Trifluoroethane is non-normally distributed. Non-parametric UPL (NUPL) was constructed on the background data for this parameter. The confidence levels of NUPLs are typically approximate and estimated to be around 91%.

Summary of UPL

Parameter	Background Data Distribution	Type of UPL	Multiple Comparisons/year	UPL (µg/l)
1,1,2-Trichloro-1,2,2-Trifluoroethane	Non-Normal	NUPL	N/A	1.2

Statistical Computations – RAAP HWMU-16

In accordance with the facility permit and VHWMR, statistical background concentrations are being established for the four new target parameters chloroethane, diethyl ether, dimethyl ether and methylene chloride. These four target parameters were added to the facility monitoring program during the 3rd quarter 2003 monitoring event. Inter-well upper prediction limits (UPL) were calculated on the background data for the target parameters in accordance with the facility permit and VHWMR (40 CFR 264.97(h)). Background data for these target parameters consisted of all data for the background well 16C1 collected from 3rd quarter 2003 through 3rd quarter 2004.

Discussion of Tests for Normality

The power of a statistical tool to account for false positive and false negative results, while accurately detecting true statistical variations for a facility under scrutiny depends on numerous factors, one of which is the distribution of the data. A great number of statistical tools are based on the assumption that data are normally distributed. Hence the distribution of the sample population for parameters evaluated under this statistical analysis is first determined. Sample populations were tested for normal distribution using several normality tests. "Groundwater Information Tracking System with Statistical Analysis Capability" (GRITS/STAT) v5.0 was the software used to run these statistical tests. GRITS/STAT is an analytical software package provided by the USEPA. The distributions of the data sets were verified in the original mode as well as in log-transformed mode. The normality of the data sets was evaluated using the Shapiro-Wilk test for normality.

Discussion of Prediction Interval Tests

Normality tests are performed prior to running parametric tests (tests that require that the data be normal). A 99% confidence parametric inter-well UPL was computed for each of the four target parameters that showed normally distributed background data. Results of the normality tests show that the background data for chloroethane, diethyl ether and methylene chloride are normally distributed, and the background data for dimethyl ether is non-normally distributed. Non-parametric UPL (NUPL) was constructed on the background data for dimethyl ether, and parametric UPLs (PUPL) were constructed on the background data for chloroethane, diethyl ether and methylene chloride. No adjustments to the error rates were made to the NUPLs for multiple comparisons. Adjustment for 10 comparisons per year (considering 10 compliance monitoring wells at the facility and 4 quarters of data for each year, and considering historic detects, 10 is considered a representative number for multiple comparisons per year) was made to the PUPLs. The confidence levels of NUPLs are well less than 95%. Any statistically significant increase (SSI) must be confirmed by verification sampling.

Summary of UPLs

Parameter	Background Data Distribution	Type of UPL	Multiple Comparisons/year	UPL (µg/l)
Chloroethane	Normal	PUPL	10	20.7
Diethyl ether	Normal	NUPL	10	75.5
Dimethyl ether	Non-normal	PUPL	N/A	17.0
Methylene Chloride	Normal	PUPL	10	13.95

RAAP-HWMU-16 - Statistical Analysis - Notes

1) Y2K Correction dates are as shown in table below.

Actual Event	Date Used in Stat Software
2000-Qtr1	12/13/1999
2000-Qtr2	12/14/1999
2000-Qtr3	12/15/1999
2000-Qtr4	12/16/1999
2001-Qtr1	12/17/1999
2003-Qtr3	12/18/1999
2003-Qtr4	12/19/1999
2004-Qtr1	12/20/1999
2004-Qtr2	12/21/1999
2004-Qtr3	12/22/1999

Interwell Tests:
2) Background data for target parameters chloroethane, diethyl ether, dimethyl ether and methylene chloride were evaluated using Shapiro-Wilk test. Background data showed normal distribution for chloroethane, diethyl ether and methylene chloride. Parametric interwell 99% confidence upper prediction limits were computed for parameters with normally distributed background data. Dimethyl ether background data was non-normally distributed. Therefore non-parametric Upper Prediction Limit (UPL) was computed for dimethyl ether.

3) No adjustments for multiple comparisons could be made for non-parametric UPLs. Adjustments were made to the parametric UPLs for 10 future comparisons per year to account for multiple compliance monitoring wells and quarterly event data.
Any Statistically significant increase (SSI) must be confirmed by verification sampling.

E:\Ross Work\Radford AAP Archives\HWMU-16\[HWMU16StatDate correction.xls]Sheet1

Normality Tests

Report Printed: 02-02-2005 13:49

Facility:RAAPHWMU16 Haz. Waste Unit 16 - RAAP

Address:

City:Radford ST:VA Zip:24141
County:PULASKI

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:ClEthane Chloroethane

CAS Number: 75-00-3
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 2.000 ppb

Start Date:Mar 31 1996
End Date:Dec 22 1999

Normality Test on Observations for wells listed below:

Well:16C1 Position:Upgradient Observations:5

Scale	Minimum	Maximum	Mean	Std Dev
Original:	1.000	6.400	4.340	2.078
Log:	0.000	1.856	1.303	0.749

Pooled Statistics
Observations: 5

Statistic	Original Scale	Log Scale
Mean:	4.340	1.303
Std Dev:	2.078	0.749
Skewness:	-0.810	-1.296*
Kurtosis:	-0.555	-0.011
Minimum:	1.000	0.000
Maximum:	6.400	1.856
CV:	0.479	0.575

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.9037	0.7620	0.6860

Log:	0.7615*	0.7620	0.6860

* Indicates statistically significant evidence of non-normality.
GRIT/STAT Version 5.0

Parametric Prediction Interval
Report Printed February 2,2005

Facility:Haz. Waste Unit 16 - RAAP
Parameter:Chloroethane(CAS Number:75-00-3)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n):	5
Shapiro-Wilk (W):	0.9037
Critical W,α=0.01:	0.6860
Mean:	4.340 ppb
Std Dev:	2.078 ppb
DF:	4
Conf. Level (1-α):	~~0.9500~~ 0.99
Future Samples (k):	10
$t_{\left[1-\frac{\alpha}{k}\right]}$:	7.1732
Kappa:	7.8579
UL:	20.669 ppb
LL:	-∞

Report Produced by GRITS/STAT 5.01

Normality Tests

Report Printed: 02-02-2005 13:49

Facility:RAAPHWMU16 Haz. Waste Unit 16 - RAAP

Address:

City:Radford ST:VA Zip:24141
County:PULASKI

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:DEthEth Diethyl ether

CAS Number: - -
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 24.000 ppb

Start Date:Mar 31 1996
End Date:Dec 22 1999

Normality Test on Observations for wells listed below:

Well:16C1 Position:Upgradient Observations:5

Scale	Minimum	Maximum	Mean	Std Dev
Original:	12.000	30.000	21.200	6.907
Log:	2.485	3.401	3.007	0.355

Pooled Statistics
Observations: 5

Statistic	Original Scale	Log Scale
Mean:	21.200	3.007
Std Dev:	6.907	0.355
Skewness:	-0.122	-0.491
Kurtosis:	-1.140	-1.024
Minimum:	12.000	2.485
Maximum:	30.000	3.401
CV:	0.326	0.118

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.9768	0.7620	0.6860

Log:	0.9507	0.7620	0.6860

* Indicates statistically significant evidence of non-normality.
GRIT/STAT Version 5.0

Parametric Prediction Interval
Report Printed February 2,2005

Facility:Haz. Waste Unit 16 - RAAP
Parameter:Diethyl ether(CAS Number:- -)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n):	5
Shapiro-Wilk (W):	0.9768
Critical W, α=0.01:	0.6860
Mean:	21.200 ppb
Std Dev:	6.907 ppb
DF:	4
Conf. Level (1-α):	~~0.9500~~ 0.99
Future Samples (k):	10
$t_{\left[1-\frac{\alpha}{k}\right]}$:	7.1732
Kappa:	7.8579
UL:	75.470 ppb
LL:	-∞

Report Produced by GRITS/STAT 5.01

Normality Tests

Report Printed: 02-02-2005 13:53

Facility:RAAPHWMU16 Haz. Waste Unit 16 - RAAP

Address:

City:Radford ST:VA Zip:24141
County:PULASKI

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:DMethEth Dimethyl ether

CAS Number: - -
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 24.000 ppb

Start Date:Mar 31 1996
End Date:Dec 22 1999

Normality Test on Observations for wells listed below:

Well:16C1 Position:Upgradient Observations:5

Scale	Minimum	Maximum	Mean	Std Dev
Original:	12.000	17.000	13.000	2.236
Log:	2.485	2.833	2.555	0.156

Pooled Statistics
Observations: 5

Statistic	Original Scale	Log Scale
Mean:	13.000	2.555
Std Dev:	2.236	0.156
Skewness:	1.500*	1.500*
Kurtosis:	0.250	0.250
Minimum:	12.000	2.485
Maximum:	17.000	2.833
CV:	0.172	0.061

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.5521*	0.7620	0.6860

Log:	0.5521*	0.7620	0.6860

* Indicates statistically significant evidence of non-normality.
GRIT/STAT Version 5.0

Nonparametric Prediction Interval
Report Printed February 2,2005

Facility:Haz. Waste Unit 16 - RAAP
Parameter:Dimethyl ether(CAS Number:- -)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n):	5
Conf. Level (1-α):	33.330%

UL: 17.000 ppb
LL: 0.000

Report Produced by GRITS/STAT 5.01

Normality Tests

Report Printed: 02-02-2005 13:54

Facility:RAAPHWMU16 Haz. Waste Unit 16 - RAAP

Address:

City:Radford ST:VA Zip:24141
County:PULASKI

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:MeCl Dichloromethane (Methylene chloride)

CAS Number: 75-09-2
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 2.000 ppb

Start Date:Mar 31 1996
End Date:Dec 22 1999

Normality Test on Observations for wells listed below:

Well:16C1 Position:Upgradient Observations:5

Scale	Minimum	Maximum	Mean	Std Dev
Original:	4.100	6.800	5.800	1.037
Log:	1.411	1.917	1.743	0.197

Pooled Statistics
Observations: 5

Statistic	Original Scale	Log Scale
Mean:	5.800	1.743
Std Dev:	1.037	0.197
Skewness:	-0.925	-1.088*
Kurtosis:	-0.436	-0.263
Minimum:	4.100	1.411
Maximum:	6.800	1.917
CV:	0.179	0.113

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.8964	0.7620	0.6860

Log:	0.8519	0.7620	0.6860

* Indicates statistically significant evidence of non-normality.
GRIT/STAT Version 5.0

Parametric Prediction Interval
Report Printed February 2,2005

Facility:Haz. Waste Unit 16 - RAAP
Parameter:Dichloromethane (Methylene chloride(CAS Number:75-09-2)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n):	5
Shapiro-Wilk (W):	0.8964
Critical W, α=0.01:	0.6860
Mean:	5.800 ppb
Std Dev:	1.037 ppb
DF:	4
Conf. Level (1-α):	~~0.9500~~ 0.99
Future Samples (k):	10
$t_{\left[1-\frac{\alpha}{k}\right]}$:	7.1732
Kappa:	7.8579
UL:	13.947 ppb
LL:	-∞

Report Produced by GRITS/STAT 5.01

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 16C1

All Results in ug/L.

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Chloroethane					*CAS #*	*75-00-3*		
Third Quarter 2003	6.4	U	4.8	U	U	1	20.7	8260B
Fourth Quarter 2003	5.7	U	2.6	1.1	U	1	20.7	8260B
First Quarter 2004	U J	U J	U J	U J	U J	1	20.7	8260B
Second Quarter 2004	4.4	U	2.4	0.63 J	U	1	20.7	8260B
Third Quarter 2004	4.2	U	2	U	U	1	20.7	8260B
Fourth Quarter 2004	4.9	U	2.5	U	U	1	20.7	8260B
First Quarter 2005	7.6 J	U J	3.7 J	U J	U J	1	20.7	8260B
Second Quarter 2005	U J	U	U J	U	U	1	20.7	8260B
Third Quarter 2005	4.7 J	U J	U	U J	U J	1	20.7	8260B
Fourth Quarter 2005	4.6 J	U	2.6 J	U	U	1	20.7	8260B
First Quarter 2006	5.3	U	U	U	U	1	20.7	8260B
Second Quarter 2006	5 J	U	2 J	U	U	1	20.7	8260B
Third Quarter 2006	5	U	0.7 J	0.7 J	U	1	20.7	8260B
Fourth Quarter 2006	5.8	U	1	U	U	1	20.7	8260B
First Quarter 2007	6.1	U	1	U	U	1	20.7	8260B
Second Quarter 2007	5.2	U	1.4	U	U	1	20.7	8260B
Diethyl ether					*CAS #*	*60-29-7*		
Third Quarter 2003	12 J	U	12 J	U	U	12	-	8260B
Fourth Quarter 2003	30	U	14	U	U	12	-	8260B
First Quarter 2004	24	U	U	U	U	12	-	8260B
Second Quarter 2004	23 J	U J	13 J	U J	U J	12	-	8260B
Third Quarter 2004	17	U	U	U	U	12	-	8260B
Fourth Quarter 2004	24	U J	U	U	U J	12	-	8260B
First Quarter 2005	29	U	14	U	U	12	-	8260B
Second Quarter 2005	20	U J	9.2	U J	U J	12	-	8260B
Third Quarter 2005	30	U	15	U	U	12	-	8260B
Fourth Quarter 2005	25	U	18	U	U	12	-	8260B
First Quarter 2006	19	U	U	U	U	12	-	8260B
Second Quarter 2006	17	U	U	U	U	12.5	-	8260B
Third Quarter 2006	33	1.5 J	4.3 J	4.6 J	U	12.5	-	8260B
Fourth Quarter 2006	20	U	U	U	U	12.5	-	8260B
First Quarter 2007	21	U	U	U	U	12.5	-	8260B
Second Quarter 2007	17 J	1.5 J	5.7 J	2.1 J	U J	12.5	-	8260B
Dimethyl ether					*CAS #*	*115-10-6*		
Third Quarter 2003	6.6 J	U	9.9 J	U	U	12	-	8260B
Fourth Quarter 2003	U	U	U	U	U	12	-	8260B
First Quarter 2004	17 J	U J	13 J	U J	U J	12	-	8260B
Second Quarter 2004	U J	U J	6.6 J	U J	U J	12	-	8260B
Third Quarter 2004	U J	U J	U J	U J	U J	12	-	8260B
Fourth Quarter 2004	16 J	U J	12 J	U	U J	12	-	8260B
First Quarter 2005	26	U	25	U	U	12	-	8260B
Second Quarter 2005	15	U	14	U	U	12	-	8260B
Third Quarter 2005	13	U	U	U	U	12	-	8260B
Fourth Quarter 2005	U	U	U	U	U	12	-	8260B
First Quarter 2006	U	U	U	U	U	12	-	8260B
Second Quarter 2006	U	U	U	U	U	12.5	-	8260B
Third Quarter 2006	11 J	U J	3.2 J	2.8 J	U J	12.5	-	8260B
Fourth Quarter 2006	U	U	U	U	U	12.5	-	8260B
First Quarter 2007	U	U	U	U	U	12.5	-	8260B
Second Quarter 2007	11 J	U	7 J	2.6 J	1.2 J	12.5	-	8260B

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 16C1 *All Results in ug/L.*

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
Methylene chloride					*CAS #* 75-09-2			
Third Quarter 2003	4.1	U	U	U	U	1	13.95	8260B
Fourth Quarter 2003	6.8	U	U	U	U	1	13.95	8260B
First Quarter 2004	6.4	U	U	U	U	1	13.95	8260B
Second Quarter 2004	5.7	U	U	U	U	1	13.95	8260B
Third Quarter 2004	6	U A	U A	U A	U A	1	13.95	8260B
Fourth Quarter 2004	6.4	U	U	U	U	1	13.95	8260B
First Quarter 2005	6.8 J	U	U	U	U	1	13.95	8260B
Second Quarter 2005	6.3	U	U	U	U	1	13.95	8260B
Third Quarter 2005	6.2	U	U	U	U	1	13.95	8260B
Fourth Quarter 2005	4.7	U	U	U	U	1	13.95	8260B
First Quarter 2006	4.9	U	U	U	U	1	13.95	8260B
Second Quarter 2006	7	U	U	U	U	1	13.95	8260B
Third Quarter 2006	U N	U N	U N	U N	U N	1	13.95	8260B
Fourth Quarter 2006	U A	U	U	U A	U	1	13.95	8260B
First Quarter 2007	6.3	U	U	U	U	1	13.95	8260B
Second Quarter 2007	3.4	U	U	U	U	1	13.95	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane					*CAS #* 76-13-1			
Third Quarter 2003	U	U	U	U	U	1	-	8260B
Second Quarter 2004	1.2	U J	U J	U J	U J	1	-	8260B
Third Quarter 2004	U	U	U	U	U	1	-	8260B
Fourth Quarter 2004	U	U	U	U	U	1	-	8260B
First Quarter 2005	1	U	U	U	U	1	-	8260B
Second Quarter 2005	U	U	U	U	U	1	-	8260B
Third Quarter 2005	U	U	U	U	U	1	-	8260B
Fourth Quarter 2005	U	U	U	U	U	1	-	8260B
First Quarter 2006	U	U	U	U	U	1	-	8260B
Second Quarter 2006	U	U	U	U	U	1	-	8260B
Third Quarter 2006	U	U	U	U	U	1	-	8260B
Fourth Quarter 2006	U	U	U	U	U	1	-	8260B
First Quarter 2007	U	U	U	U	U	1	-	8260B
Second Quarter 2007	U	U	U	U	U	1	-	8260B

See last page of this report for definitions.

Target Analyte Monitoring Results - HWMU-16 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia

Upgradient well = 16C1 *All Results in ug/L.*

Analtye/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*

Definitions: **QL** Denotes permit required quantitation limit. **U** Denotes analyte not detected at or above QL. **UA** Denotes analyte not detected at or above adjusted sample QL. **J** Denotes associated result is estimated. When used with "U" (i.e., "**UJ**"), denotes analyte not detected at or above QL and QL is estimated. When used with "UA" (i.e., "**UAJ**"), denotes analyte not detected at or above adjusted QL and adjusted QL is estimated. **UN** Denotes analyte concentration is less than the quantiation limit and five times the blank concentration. Not reliably detected due to blank contamination. This qualifier used only for Appendix IX monitoring event when results are reported to at or above the project detection limit. **R** Denotes result rejected. **Q** Denotes data validation qualifier. **CAS#** Denotes Chemical Abstract Services registration number. **X** Denotes mass spectral confirmation not obtained-result suspect.

GPS Denotes Groundwater Protection Standards listed in Appendix G to Attachment 5 in the Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Units 5, 7, 10, and 16 (October 4, 2002).
NS denotes not sampled. **NA** denotes not analyzed. "–" denotes not detected (pre-2nd Quarter 2003) or not available / not sampled (beginning 2nd Quarter 2003).

Notes:
-Appendix IX Groundwater Monitoring Events:
Third Quarter 2003, Second Quarter 2004, Second Quarter 2005, Third Quarter 2006, Second Quarter 2007
For Appendix IX monitoring events, all results evaluated to detection limit. See laboratory data deliverable for detection limit.

-9/30/2003: Verification sampling event for 16C1 (heptachlor) and 16C1B (Endrin). Verification results: all results reported not detected to detection limit. Original results 0.067 µg/l and 0.39 µg/l, respectively. Confirmation results reported in this table.
-9/30/2003: Verification sampling event for 16C1 (chloroethane, ethyl ether, methyl ether, methylene chloride) and 16MW9 (chloroethane, ethyl ether, methyl ether). Verification results: all results confirmed original analysis. Original results reported in this table.
-June 21, 2004: Verification event for 8260B 16C1 (1,1-dichloroethene and 1,1,2-trichloro-1,2,2-trifluoroethane). Verification results: all not detected except 1,1,2-trichloro-1,2,2-trifluoroethane added to quarterly analyte list beginning 3Q 2004. Due to laboratory error, Appendix IX results for semivolatiles (Method 8270C) will be presented in 3Q 2004. Verification event results for 16WC1B and 16C1 (8081A) – all verification results were not confirmed.
-07/27-28/2005. Verification event for 16WC1B (Mercury Method 7470A.) Not detected in verification sample. Also, verification event for 16C1, 16WC1B-8081A. and 16C1, 16MW9, 16WC1A-ethanol. All verification results not detected. Verification results used.
-06/19/2007. Verification event for 16WC1B and 16MW9 thallium Not detected in verification sample. Verification results used.

Ross Miller

From: Flint, Jeremy <Jeremy.Flint@ATK.COM>
Sent: Friday, January 20, 2012 2:23 PM
To: Powers, Loretta
Cc: Janet Frazier; Kathy Olsen; Mike Lawless; Ross Miller
Subject: FW: VA1210020730, RAAP, Additional App. IX GW Mont Results PCC HWMU 5,7,10,16, Final Notification

Loretta,
Please file the attached e-mail as an answer to ATK letter number 11-815-106

Thank You
Jeremy Flint
Lead Compliance Engineer
Environmental Affairs Department
Alliant Techsystems Inc.
P.O. Box 1
Radford, VA 24143
Phone: 540 - 639 - 7668
Fax: 540 - 639 - 8109
"Together Everyone Accomplishes More." (TEAM)

From: Maiden, Vince (DEQ) [mailto:Vincent.Maiden@deq.virginia.gov]
Sent: Friday, January 20, 2012 10:26 AM
To: Flint, Jeremy
Cc: McKenna, Jim; Schneider, Jutta (DEQ)
Subject: VA1210020730, RAAP, Additional App. IX GW Mont Results PCC HWMU 5,7,10,16, Final Notification

Jeremy:

The Department has received the referenced August 1, 2011 document. The notification indicates the benzene was confirmed in 16MW and recommended that this contituent be added to the compliance monitoring list for HWMU-16. In addition, the facility recommeded that the background for benzene be estalished at the LOQ of 1µg/l and the groundwater protection standard be set at 5µg/l based on the MCL. The Department agrees with the recommedations. It appears that these changes were included in the permit renewal application dated September 15, 2011. The Department will formally address those changes along with others in the permit renewal process. If you have any questions please feel free to contact me.

Vincent Maiden
Corrective Action Project Manager
Virginia Department of Environmental Quality
Office of Remediation Programs
629 East Main Street or P.O. Box 1105
Richmond, VA 23218 Richmond, VA 23219
(276) 676-4867
Vincent.Maiden@deq.virginia.gov

APPENDIX D
LABORATORY ANALYTICAL RESULTS – YEAR 2013

APPENDIX E

FIELD NOTES

4/15/13 RAAP- SWMU 433 BO32 of-11 DAS/TQE FB# 11

General Notes
Weather- Overcast, Rain, 40's
PPE- Eye Protection, Nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 - 9.96
- Conductivity reads 1413 us in 1413 us std
- DO% = 100
HACH 2100 Q Turbidimeter: 0.02 - 1000 ntu
- New tubing and well skirts used at each well
- All equipment decon'ed before/after each use
- All purge water disposed of at dedicated location onsite
- All samples collected, stored and transported on ice in coolers

Static Water Level Table (Permit 433)

WELL	DTW	Post Purge DTW	Notes
74MW1	22.84	22.89	
74MW2	56.36	56.41	
74MW3	19.44	19.81	
74MW4	23.34	23.35	
74MW5	25.43	25.43	
74MW6	24.53	24.53	
74MW7	24.65	25.48	

74MW-DUP
* Collected at monitoring well 74MW3

Sample Time (1200)
Samples Collected: (3)8260, (2)8011, (1)TOM

4/15/13 RAAP FB# 11
SWMU 433
B03204-11
DAS/TQE

74MW3

DTW - 19.44 Begin Purge (1051)
Post Purge DTW - 19.81 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge(gpm)	Desc
(1055)	11.32	575	4.19	6.19	25.4	16.4	0.3 L/min	Clear
(1100)	11.14	579	2.30	6.20	13.7	10.1	"	Clear
(1105)	11.07	582	1.98	6.23	2.3	4.69	"	Clear
(1110)	11.05	581	2.00	6.25	0.1	4.04	"	Clear
(1115)	11.01	569	2.10	6.25	-0.7	3.76	"	Clear
(1120)	11.02	518	2.35	6.20	-1.1	3.12	"	Clear
(1125)	11.03	488	2.53	6.18	-0.3	2.65	"	Clear
(1130)	11.00	467	2.70	6.14	1.0	1.95	"	Clear
(1135)	11.00	461	2.77	6.10	1.9	1.38	"	Clear
(1140)	10.99	454	2.79	6.08	2.3	1.32	"	Clear
(1140)	Readings Stable							
(1209)	11.06	440	3.05	6.05	4.8	1.59	Post Purge Reading	

Sample Time (1145)
Samples Collected: (3)8260C, (2)8011, (1)TM

74MW1

DTW - 22.84 Begin Purge (1228)
Post Purge DTW - 22.89 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge(gpm)	Desc
(1230)	12.13	516	6.98	6.00	23.5	0.96	0.3 L/min	Clear
(1235)	12.29	516	5.69	5.94	22.9	0.80	"	Clear
(1240)	12.30	517	5.65	5.90	22.8	0.51	"	Clear
(1245)	12.28	517	5.42	5.90	23.2	0.28	"	Clear
(1250)	12.31	518	5.30	5.92	23.9	0.28	"	Clear
(1255)	12.34	518	5.21	5.90	22.3	0.25	"	Clear
(1300)	12.35	519	5.18	5.90	21.8	0.21	"	Clear
(1300)	Readings Stable							
(1315)	12.39	520	5.13	5.91	20.9	0.23	Post Purge Reading	

4/15/13 RAAP FB# 11
SWMU 433
B03204-11
DAS/TQE

74MW1 (Continued)

Sample Time (1305)
Samples Collected: (3)8260C, (2)8011, (1)TM

74MW4

DTW - 23.34 Begin Purge (1343)
Post Purge DTW - 23.35 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge(gpm)	Desc
(1345)	12.31	496	7.25	6.28	24.4	3.91	0.3 L/min	Clear
(1350)	12.51	449	6.46	6.28	11.3	4.62	"	Clear
(1355)	12.50	458	5.52	6.36	3.0	4.34	"	Clear
(1400)	12.46	458	5.18	6.25	-0.8	7.52	"	Clear
(1405)	12.45	464	4.76	6.18	3.1	10.7	"	Clear
(1410)	12.42	468	4.71	6.10	7.9	8.19	"	Clear
(1415)	12.42	469	4.80	6.08	10.1	6.75	"	Clear
(1420)	12.43	470	4.91	6.06	12.9	4.64	"	Clear
(1425)	12.40	471	5.02	6.03	15.3	3.85	"	Clear
(1425)	Readings Stable						Post Purge Reading	
(1453)	12.47	472	6.80	6.08	24.7	3.96		

Sample Time (1430)
Samples Collected: (3)8260C, (2)8011, (1)TM

4/16/13 RAAP FB#11
Summa 433
B03204-11
DAS/TOE/TET

General Notes
Weather - Mostly Cloudy 50's
PPE - Eye Protection, Nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 - 4.00, 7.00 = 7.00, 10.00 = 9.98
- Conductivity reads 1413 us in 1413 us std
- DO% 100
HACH 2100Q Turbidimeter: 0.02 - 1000 ntu
* New tubing and well skirts used at each well
* All equipment decon'ed before/after each use
* All purge water disposed of at dedicated location onsite
* All samples collected, stored and transported on ice in coolers

74MW05
DTW - 25.43 Begin Purge (0947)
Post Purge DTW - 25.43 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO%	pH	ORP(mV)	Turb(ntu)	Purge(Lpm)	Desc
(0950)	13.24	458	5.12	5.67	50.3	0.74	0.3 l/min	Clear
(0955)	13.15	454	4.81	5.63	43.6	0.76	"	Clear
(1000)	13.10	455	4.73	5.61	41.4	0.80	"	Clear
(1005)	13.14	457	4.66	5.62	40.6	0.95	"	Clear
(1010)	13.19	458	4.75	5.61	39.8	1.11	"	Clear
(1015)	13.24	458	4.83	5.60	38.4	1.10	"	Clear
(1020)	13.40	460	4.91	5.60	37.5	1.15	"	Clear
(1020)	Readings Stable							
(1033)	13.29	460	5.53	5.63	43.2	1.35	Post Purge Reading	

Sample Time (1025)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

4/16/13 RAAP FB#11
Summa 433
B03204-11
DAS/TOE/TET

74MW06
DTW - 24.55 Begin Purge (1118)
Post Purge DTW - 24.53 Initial Purge -

Time	Temp(C)	Cond(us)	DO%	pH	ORP(mV)	Turb(ntu)	Purge(Lpm)	Desc
(1120)	13.12	642	8.07	5.76	49.1	0.86	0.3 l/min	clear
(1125)	11.03	628	6.51	5.48	48.9	0.72	"	clear
(1130)	11.25	632	6.08	5.41	49.5	0.31	"	clear
(1135)	11.39	631	6.01	5.43	51.3	0.39	"	clear
(1140)	11.37	635	6.00	5.43	52.6	0.41	"	clear
(1145)	11.56	636	5.95	5.42	53.9	0.45	"	clear
(1150)	11.52	639	5.97	5.36	53.1	0.34	"	clear
(1155)	12.05	638	5.95	5.34	54.7	0.37	"	clear
(1200)	11.95	639	5.90	5.28	55.6	0.30	"	clear
(1200)	Readings Stable							
(1212)	11.94	639	5.95	5.35	58.9	0.31	Post Purge Reading	

Sample Time (1205)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

74MW07
DTW - 24.65 Begin Purge (1228)
Post Purge DTW - 25.48 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO%	pH	ORP(mV)	Turb(ntu)	Purge(Lpm)	Desc
(1230)	14.20	390	7.32	6.45	-28.3	0.38	0.3 l/min	Clear
(1235)	13.55	418	1.12	6.82	-34.6	0.42	"	Clear
(1240)	13.65	411	0.86	6.02	-39.5	0.57	"	"
(1245)	13.43	406	0.58	6.04	-47.1	0.45	"	"
(1250)	13.30	405	0.49	6.08	-50.6	0.38	"	"
(1255)	13.35	404	0.47	6.07	-51.7	0.50	"	"
(1300)	13.18	404	0.43	6.05	-53.4	0.48	"	"
(1300)	Readings Stable							
(1313)	13.17	405	0.52	6.08	-54.4	0.53	Post Purge Reading	

4/16/13 RAAP FB#11
Stemilt 433
BO32C4-11
DAS/TQE/TEJ

74MW7 (Continued)

Sample Time (1305)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

74MW2

DTW - 56.36 Begin Purge (1325)
Post Purge DTW - 56.41 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge Kg(gal)	Desc
(1330)	14.94	270	9.25	6.55	22.2	0.55	0.3 L/min	Clear
(1335)	14.89	270	8.93	6.38	30.9	0.41	"	"
(1340)	14.75	268	8.61	6.24	35.8	0.28	"	"
(1345)	14.90	268	8.55	6.25	37.5	0.30	"	"
(1350)	14.84	266	8.55	6.20	40.4	0.38	"	"
(1355)	14.95	266	8.56	6.18	43.6	0.28	"	"
(1355)	Readings Stable							
(1410)	14.91	267	8.78	6.12	49.9	0.30	Post Purge Reading	

Sample Time (1400)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

4/17/13 RAAP FB#11
BO32C4-11
DAS/TQE

General Notes
Weather - Overcast, 60's, Scattered showers
PPE - Eye Protection, Nitrile gloves
- Calibrations - YSI 650 MDS
- pH: 7.00 = 4.00, 7.00 = 7.00, 10.00 = 9.97
- Conductivity reads 1413 us in 1413 us std.
- DO % - 100
HACH 2100Q Turbidimeter: 0.02 - 1000 NTU

Static Water Level Table

WELL	DTW	Post Purge DTW	Notes
FAL 2	34.72	38.85	
FAL 3	66.23	66.92	
WELL 7	25.87	26.08	
16-3	57.50	65.11	

FAL 2

DTW - 34.72 Begin Purge (1001)
Post Purge DTW - 38.85 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge Kg(gal)	Desc
(1005)	12.75	717	8.36	5.70	80.4	256	0.3 L/min	Clear
(1010)	12.74	717	8.58	5.74	82.6	28.2	"	Clear
(1015)	12.71	720	8.37	5.75	81.7	34.1	"	Clear
(1020)	12.77	722	8.24	5.70	77.3	80.8	"	SI Cloudy
(1025)	12.77	724	8.10	5.70	75.4	112	"	SI Milky
(1030)	12.86	726	7.90	5.70	75.1	131	"	"
(1035)	12.93	726	7.90	5.72	75.9	149	"	"
(1040)	12.97	725	7.93	5.73	74.7	143	"	"
(1046)	Readings Stable							
(1057)	13.04	724	8.12	5.76	75.1	45.9	Post Purge Reading	

Sample Time (1045)
Samples Collected: (3) 8260C,

4/17/13 RAAP B03204-11 DAS/TOE FB# 11

FAL-3

DTW - 66.23 Begin Purge (1121)

Post Purge DTW - 66.92 Initial Purge - Clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(Intu)	Purge L	Desc
(1125)	13.21	1020	5.34	5.60	76.3	12.3	0.3 l/min	Clear
(1130)	13.02	1124	1.95	5.50	69.2	39.2	"	Sl. Cloudy
(1135)	13.04	1119	1.45	5.50	63.4	64.1	"	Sl. Cloudy
(1140)	13.02	1126	1.36	5.50	60.6	64.1	"	"
(1145)	13.20	1137	1.27	5.52	54.4	62.3	"	"
(1150)	13.15	1140	1.25	5.48	50.3	42.1	"	"
(1155)	13.20	1158	1.23	5.46	48.7	42.0	"	"
(1155)	Readings Stable							
(1210)	13.34	1157	1.46	5.46	46.8	44.6	Post Purge Reading	

Sample Time (1200)

Samples Collected: (3) 8260C, (2) 8011, (1) TM

WELL 7

DTW - 25.87 Begin Purge (1242)

Post-Purge DTW - 26.08 Initial Purge - Clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(Intu)	Purge L	Desc
(1245)	12.49	738	6.68	5.38	61.5	16.2	0.3 l/min	Clear
(1250)	12.31	744	5.98	5.25	66.4	12.4	"	Clear
(1255)	12.40	692	5.99	5.24	68.0	9.41	"	"
(1300)	12.35	669	6.65	5.22	72.2	6.28	"	"
(1305)	12.32	640	6.95	5.23	74.9	3.62	"	"
(1310)	12.28	616	7.53	5.22	76.6	2.46	"	"
(1315)	12.22	602	7.60	5.20	79.7	1.86	"	"
(1320)	12.21	594	7.62	5.21	81.6	1.29	"	"
(1320)	Readings Stable							
(1334)	12.40	583	7.70	5.19	83.3	0.91	Post Purge Reading	

Sample Time (1325)

Samples Collected: (3) 8260C, (2) 8011, (1) TM

4/17/13 RAAP B03204-11 DAS/TOE FB# 11

16-3

DTW - 57.50 Begin Purge (1355)

Post Purge DTW - 65.11 Initial Purge - Clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(Intu)	Purge L	Desc
(1400)	13.31	220	8.61	6.20	65.2	1.73	0.3 l/min	Clear
(1405)	13.50	220	6.69	6.51	55.7	1.01	"	Clear
(1410)	13.46	223	5.89	6.64	53.2	0.75	"	Clear
(1415)	13.49	223	5.72	6.68	52.7	0.69	"	Clear
(1420)	13.48	223	5.68	6.71	51.1	0.63	"	Clear
(1425)	13.50	222	5.69	6.73	50.8	0.52	"	Clear
(1430)	13.48	221	5.74	6.73	51.9	0.39	"	Clear
(1430)	Readings Stable							
(1445)	13.57	220	5.71	6.68	53.4	0.55	Post Purge Reading	

Sample Time (1435)

Samples Collected: (3) 8260C, (2) 8011, (1) TM

4/23/13 RAAP - Unit 16 FB# 11
BO320[illegible]-11
DAS/TQE

General Notes
Weather - Mostly Sunny, 60's
PE - Eye Protection, Nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
- Conductivity reads 1413 us in 1413 us std
- DO% = 100
HACH 2100Q Turbidimeter: 0.02 - 1000 n/u
- Dedicated tubing and well skirts used at each well.
- All equip. deconed before + after each use.
- All purge water disposed of at dedicated location onsite
- All samples collected, stored + transported in coolers on ice.

Static water level table

WELL	DTW	Post Purge DTW	Notes
		Below Top of pump	
16-1	52.58	56.12	
16-2	55.81	64.60	
16-3	57.37	7.85	
16-5	4.02	66.28	
16WC2B	53.60	73.33	
16MW8	71.22	65.68	
16WC1B	64.96	69.00	
16WC1A	64.66	63.16	
16MW9	61.79	49.62	
16C1	49.55		
16C3	61.59		
16DDH3	Dry		
16WC2A	Dry		

(24)

4/23/13 RAAP FB#
BO320[illegible]-11
DAS/TQE

16-1
DTW - 52.58 Begin Purge (0937)
Post Purge DTW - [illegible] Below Top of pump Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb	Purge Rate	Desc
0940	12.43	504	7.39	6.85	69.7	0.38	0.3 L/min	Clear
0945	12.88	571	7.10	6.98	65.6	0.38	"	Clear
0950	12.88	570	7.13	7.02	63.4	0.40	"	Clear
0955	12.92	508	7.26	7.03	61.5	0.41	"	Clear
1000	12.92	535	7.30	7.03	60.8	0.40	"	Clear
1005	12.92	502	7.34	7.03	59.2	0.40	"	Clear
1010	12.87	502	7.38	7.02	58.4	0.39	"	Clear
1010	Readings Stable							
1028	12.95	510	7.49	7.00	60.1	0.41	Post Purge Readings	

Sample Time (1015)
Samples Collected: (3) 8260C, (2) 8270D, (1) DTW

16-2
DTW - 55.81 Begin Purge (1050)
Post Purge DTW - 56.12 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(n/u)	Purge Rate	Desc
1100	13.18	591	8.95	7.20	64.4	0.28	0.3 L/min	Clear
1105	13.30	615	6.87	7.25	65.1	0.30	"	Clear
1110	13.28	620	6.76	7.25	65.3	0.30	"	Clear
1115	13.23	620	6.77	7.25	63.3	0.28	"	Clear
1120	13.20	620	6.80	7.15	60.7	0.20	"	Clear
1125	13.19	617	6.85	7.13	61.8	0.25	"	Clear
1130	13.15	615	6.90	7.10	62.2	0.30	"	Clear
1130	Readings Stable							
1147	13.13	620	6.75	7.21	60.3	0.47	Post Purge Readings	

Sample Time (1135)
Samples Collected: (3) 8260C, (2) 8270D, (1) T

(25)

4/23/13 RAAP 130320-11 DAS/TQE FB#11

16-3

DTW - 57.37

Begin Purge (1214)

Post Purge DTW - 64.60 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge L/min	Desc
(1220)	13.30	232	9.63	6.35	38.5	3.31	0.3	Clear
(1225)	13.30	233	7.00	6.40	36.4	2.61	"	Clear
(1230)	13.35	233	6.68	6.37	37.9	1.77	"	Clear
(1235)	13.32	232	6.61	6.42	39.1	1.40	"	Clear
(1240)	13.36	232	6.62	6.42	40.1	1.32	"	Clear
(1245)	13.34	231	6.63	6.44	41.7	1.13	"	Clear
(1246)	Readings Stable							
(1308)	13.19	232	6.84	6.16	42.0	1.20		Post Purge Reading

Sample Time (1250)

Samples Collected: (3) 8260C, (2) 8270D, (1) TM

16-5

DTW - 4.02

Begin Purge (1348)

Post Purge DTW - 7.85 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge L/min	Desc
(1355)	12.40	500	2.54	7.90	58.0	2.71	0.3	Clear
(1400)	12.03	497	1.56	7.88	57.6	1.61	"	Clear
(1405)	11.98	497	1.48	7.83	55.1	0.69	"	Clear
(1410)	11.95	497	1.65	7.80	53.6	0.70	"	Clear
(1415)	12.06	498	1.78	7.75	51.8	0.77	"	Clear
(1420)	12.16	497	1.86	7.78	49.7	0.86	"	Clear
(1425)	12.15	498	1.83	7.78	48.3	0.85	"	Clear
(1444)	Readings Stable 12.36 498 2.66			7.70	45.6	1.66		Post Purge Reading

Sample Time (1430)

Samples Collected: (3) 8260C, (2) 8270D, (1) TM

16 SPRING

Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)
12.22	582	8.97	7.74	52.4	1.39

Sample Time (1515) Samples Collected: (3) 8260C, (2) 8270D, (1) TM

4/23/13 RAAP 130320-11 DAS/TQE FB#1

16WC2B

DTW - 53.60

Begin Purge (1539)

Post Purge DTW - 66.28 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge L/min	Desc
(1545)	14.34	302	4.84	8.10	54.3	0.78	0.3	Clear
(1550)	13.83	308	1.96	8.35	41.4	0.76	"	Clear
(1555)	13.72	308	1.12	8.46	33.1	0.70	"	Clear
(1600)	13.75	308	0.98	8.45	24.4	0.68	"	Clear
(1605)	13.84	309	1.01	8.40	20.3	0.44	"	Clear
(1610)	13.73	308	0.97	8.40	19.5	0.62	"	Clear
(1610)	Readings Stable							
(1626)	14.03	310	1.24	8.32	26.9	0.67		Post Purge Reading

Sample Time (1615)

Samples Collected: (3) 8260C, (2) 8270D, (1) TM

4/24/13 RAAP FB#0
B03207-11
DAS/TEJ/TQE

General Notes
Weather - Sunny, 60's
PPE - Eye Protection, Nitrile gloves, Safety Shoes
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 9.98
- Conductivity reads 1413 us in 1413 us std
- DO % = 100
HACH 2100Q Turbidimeter: 0.02 - 1000 ntu
*All equipment deconed before/after each use
*Dedicated tubing and well skirts used at each location
*All purge water disposed of at dedicated location onsite
*All samples collected - stored and transported in coolers on ice.

16MW8
DTW - 71.22 Begin Purge (1011)
Post Purge DTW - 73.33 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge k	Desc
(1015)	14.00	147	2.64	6.25	143.3	0.92	≤ 0.3 L/min	Clear
(1020)	14.37	135	1.37	5.98	130.4	0.39	"	Clear
(1025)	14.35	131	0.85	5.85	127.8	0.35	"	Clear
(1030)	14.31	131	0.67	5.86	124.1	0.33	"	Clear
(1035)	14.35	131	0.60	5.80	121.2	0.57	"	Clear
(1040)	14.30	132	0.58	5.82	120.8	0.56	"	Clear
(1040)	Readings Stable							
(1111)	14.67	128	0.75	5.90	98.6	0.77	Post Purge Reading	

Sample Time (1045)
Samples Collected: (6) 8260C, (1) 9056, (1) TIM
(2) 8151A, (2) 8270D, (2) 8081A, (1) CN
(2) Sulfide

(28)

4/24/13 RAAP FB#1
B03207-11
DAS/TEJ/TQE

16MW9
DTW - 61.79 Begin Purge (1124)
Post Purge DTW - 63.16 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge k	Desc
(1125)	14.08	813	8.10	7.12	37.8	0.72	0.3 L/min	Cl
(1130)	13.85	881	1.39	7.05	25.4	0.41	"	Cle
(1135)	14.00	884	1.06	7.06	12.8	0.27	"	Cle
(1140)	13.94	895	1.15	7.10	9.5	0.28	"	Clea
(1145)	14.32	896	1.18	7.12	4.2	—	"	Cle
(1150)	13.85	895	0.92	7.13	2.3	0.37	"	Clea
(1155)	13.72	898	0.88	7.13	1.6	—	"	Clear
(1155)	Readings Stable							
(1220)	14.10	900	0.96	6.95	-3.2	0.24	Post Purge Read	

Sample Time (1200)
Samples Collected: (6) 8260C, (1) 9056, (1) TIM
(2) 8151A, (2) 8270D, (2) 8081A
(1) CN, (2) Sulfide

16MW14A
DTW - 64.66 Begin Purge (1233)
Post Purge DTW - 69.00 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge k	Desc
(1235)	13.63	658	5.14	7.45	34.0	0.50	0.3 L/min	Clear
(1240)	13.63	704	2.30	7.43	29.7	0.28	"	Clear
(1245)	13.58	697	1.31	7.40	26.8	0.30	"	Clear
(1250)	13.50	695	0.89	7.34	-3.0	0.30	"	Clear
(1255)	13.51	697	0.71	7.31	-10.7	0.34	"	Clear
(1300)	13.51	697	0.72	7.31	-12.8	0.39	"	Clear
(1305)	13.43	696	0.68	7.31	-15.6	0.34	"	Clear
(1310)	13.39	696	0.65	7.31	-17.8	0.32	"	Clear
(1310)	Readings Stable							
(1425)	14.48	706	0.70	7.38	-31.0	0.24	Post Purge Reading	

Sample Time (1315)
Samples Collected: continued on next page.

(29)

4/24/13 RAAP BO3204-11 DAS/TES/TQE F84/11

16WC1A

Samples Collected: (18) 8260C, (3) 9066, (3) TIM
(4) Sulfide, (3) CN, (6) 8151A, (6) 8270D, (6) 8081A

16WDUP

* Samples collected at 16WC1A
Sample Time (1330)
Samples Collected: (6) 8260C, (1) 9066, (1) TIM, (1) CN
(2) Sulfide, (2) 8151A, (2) 8270D, (2) 8081A

16WC1B ✓

DTW - 64.96 Begin Purge (1435)
Post Purge DTW - 65.68 Initial Purge - Clear

Time	Temp (C)	Cond (us)	DO mg/L	pH	ORP (mv)	Turb (n.t.u)	Purge ℄	Desc
(1440)	14.65	443	5.09	7.01	38.9	0.43	≤ 0.3 L/min	Clear
(1445)	15.38	345	2.63	6.86	47.5	0.28	"	Clear
(1450)	15.21	324	1.52	6.75	58.1	0.31	"	Clear
(1455)	14.85	312	1.00	6.75	40.3	0.31	"	Clear
(1500)	14.80	311	0.85	6.75	41.9	0.44	"	Clear
(1505)	14.70	308	0.72	6.75	43.1	0.42	"	Clear
(1505)	Readings Stable							
(1542)	14.83	320	1.03	6.90	57.1	0.44	Post Purge Reading	

Sample Time (1510)
Samples Collected: (6) 8260C, (1) 9066, (1) TIM
(1) CN, (2) 8151A, (2) 8270D
(2) 8081A, (2) Sulfide, (2) 8081A

4/24/13 RAAP BO3204-11 DAS/TES/TQE FB#11

16C1 ✓

DTW - 49.55 Begin Purge (1557)
Post Purge DTW - 49.62 Initial Purge - Clear

Time	Temp (C)	Cond (us)	DO mg/L	pH	ORP (mv)	Turb (n.t.u)	Purge ℄	Desc
(1600)	14.32	564	8.70	7.90	57.9	0.85	0.3 L/min	Clear
(1605)	14.27	715	4.50	7.35	54.8	0.52	"	Clear
(1610)	14.09	750	2.78	7.35	52.2	0.30	"	Clear
(1615)	13.78	761	1.80	7.30	47.6	0.26	"	Clear
(1620)	14.30	767	1.28	7.24	42.1	0.22	"	Clear
(1625)	14.38	768	1.22	7.25	43.6	0.19	"	Clear
(1625)	Readings Stable							
(1648)	14.47	765	1.19	7.23	36.3	0.23	Post Purge Readin	

Sample Time (1630)
Samples Collected: (4) 8260C, (1) 9066, (1) TIM
(1) CN, (2) 8151A, (2) 8270D
(2) 8081A, (2) Sulfide

4/25/13 RAAP BO32C4-11 DAS/TQL FB#11

General Notes

Weather - Partly Cloudy, 50's
PPE - Eye Protection, Nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
- Conductivity reads 1413 us in 1413 us std
- DO% = 100
HACH 2100Q Turbidimeter: 0.02 - 1000 ntu
* All purge water disposed of at dedicated location onsite
* All equipment decon'd before/after each use
* New tubing and well skirts used at each well location
* All samples collected, stored and transported in coolers on ice.

Static Water Level Table

WELL	DTW	Post Purge DTW	Notes
10DDH2R	17.66	17.85	
10D3	16.24	16.48	
10D3D	16.40	16.61	
10MW1	16.33	17.25	
10D4			

10MW1 ✓

DTW - 16.33 Begin Purge (0922)
Post Purge DTW - 17.25 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(0925)	13.29	372	8.90	7.70	66.3	0.25	0.3 L/min	Clear
(0930)	13.14	373	8.87	7.85	67.8	0.22	"	Clear
(0935)	12.99	373	8.92	7.91	66.8	0.20	"	Clear
(0940)	12.94	373	8.97	7.95	65.7	0.20	"	Clear
(0945)	12.91	373	9.00	7.98	66.1	0.19	"	Clear
(0950)	12.87	374	9.01	7.98	67.7	0.19	"	Clear
(0950)	Readings Stable							
(1056)	13.52	374	8.90	7.92	59.2	0.34		Post Purge Reading

4/25/13 RAAP BO32C4-11 DAS/TQL FB#11

10MW1 (cont.)

Sample Time (0955)
Samples Collected: (18)8260C, (3)9066, (3)TOC, (3)CN
(6)Sulfide, (6)8151A, (6)8270D, (6)8081B, (6)8081B

10D3D ✓

DTW - 16.40 Begin Purge (1114)
Post Purge DTW - 16.61 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(1120)	12.87	571	5.58	7.81	-103.2	2.39	0.3 L/min	Clear
(1125)	13.18	568	4.15	7.92	-31.7	1.82	"	Clear
(1130)	13.29	570	4.16	7.93	-20.8	1.01	"	Clear
(1135)	13.40	570	4.16	7.93	-16.7	0.47	"	Clear
(1140)	13.52	572	4.18	7.91	-9.1	0.46	"	Clear
(1145)	13.52	572	4.19	7.92	-5.8	0.56	"	Clear
(1150)	13.61	572	4.20	7.92	-2.1	0.54	"	Clear
(1150)	Readings Stable							
(1219)	13.88	568	4.83	7.96	13.6	0.65		Post Purge Readings

Sample Time (1155)
Samples Collected: (6)8260C, (1)9066, (1)TOC, (1)CN
(2)Sulfide, (2)8151A, (2)8270D, (2)8081B, (2)8081B

10D3

DTW - 16.24 Begin Purge (1232)
Post Purge DTW - 16.48 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(1235)	13.32	583	5.22	7.90	30.2	0.63	0.3 L/min	Clear
(1240)	13.24	585	4.84	7.85	29.0	0.60	"	Clear
(1245)	13.39	586	4.68	7.83	31.6	0.43	"	Clear
(1250)	13.34	584	4.69	7.85	32.8	0.37	"	Clear
(1255)	13.40	586	4.69	7.83	30.5	0.40	"	Clear
(1300)	13.43	586	4.67	7.80	28.4	0.35	"	Clear
(1305)	13.39	589	4.67	7.75	26.5	0.33	"	Clear
(1310)	13.42	590	4.67	7.80	25.7	0.31	"	Clear

4/25/13 RAAP B03204-11 DAS/TQE

10D3 (Cont.)

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1315)	13.38	586	4.67	7.82	28.5	0.30	0.3 L/min	Clear
(1315)	Readings Stable							
(1407)	14.16	593	6.32	7.84	-22.3	0.28		Post Purge Reading
(1320)	Sample Time							

Samples Collected: (6)8260C, (1)9066, (1)TIC, (1)CN, (2)Sulfide
(2)8151A, (2)8270D, (2)8081B, (2)8081B

10DUP (Collected at Monitoring Well 10D3)
Sample Time (1338)
Samples Collected: (6)8260C, (1)9066, (1)TIC, (1)CN, (2)Sulfide
(2)8151A, (2)8270D, (2)8081B, (2)8081B

10DDH2R

DTW - 17.66 Begin Purge (1425)
Post Purge DTW - 17.85 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1430)	12.85	641	2.05	7.95	-10.7	0.57	0.3 L/min	Clear
(1435)	12.16	419	3.70	7.60	-12.5	0.71	"	Clear
(1440)	11.85	340	5.28	7.39	1.4	0.90	"	Clear
(1445)	11.70	334	5.63	7.35	11.3	0.70	"	Clear
(1450)	11.77	327	5.56	7.10	19.4	0.70	"	Clear
(1455)	11.68	325	5.55	7.08	23.9	0.70	"	Clear
(1500)	11.69	326	5.53	7.06	25.8	0.67	"	Clear
(1505)	11.65	332	5.53	7.06	28.7	0.65	"	Clear
(1505)	Readings Stable							
(1533)	11.36	343	5.97	7.14	34.6	0.94		Post Purge Reading

Sample Time (1510)
Samples Collected: (6)8260C, (1)9066, (1)TIC, (1)CN
(2)Sulfide, (2)8081B, (2)8081B
(2)8151A, (2)8270D

10D4

DTW - 22.61 Begin Purge (1551)
Post Purge DTW - 22.63 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1555)	12.56	645	1.97	7.56	43.3	47.6	0.3 L/min	Cloudy
(1600)	12.36	620	1.39	7.45	39.2	33.7	"	Sl. Cloudy
(1605)	12.22	546	1.35	7.36	37.4	26.8	"	Sl. Cloudy
(1610)	12.04	502	1.64	7.32	36.8	19.7	"	Clear
(1615)	12.01	490	1.70	7.28	37.7	14.2	"	Clear
(1620)	11.96	479	1.75	7.28	38.3	11.6	"	Clear
(1625)	11.88	470	1.80	7.26	39.0	9.78	"	Clear
(1625)	Readings Stable							
(1646)	11.63	421	1.87	7.31	47.3	11.0		Post Purge Reading

Sample Time (1630)
Samples Collected: (6)8260C, (1)9066, (1)TIC
(1)CN, (2)Sulfide, (2)8081B
(2)8151A, (2)8270D, (2)8081B

4/29/13 RAAP B03204-11 DAS/TQE FB#11

General Notes

Weather - Mostly Cloudy, 60s, Scattered Showers
PPE - Eye Protection, Nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
- Conductivity reads 1413 us in 1413 us std
- DO% = 100
HACH 2100Q Turbidimeter: 0.02 - 1000 ntu
* Dedicated tubing and well skirts used at each well
* All equipment deconed before & after each use.
* All purge water disposed of at dedicated location onsite
* All samples collected, stored and transported in coolers on ice

Static Water Level Table

WELL	DTW	Post Purge DTW	Notes
5W8B	13.90	14.38	
5W7B	8.61	8.89	
5W5B	8.42	9.08	
5WC21	8.77	8.83	
5WC22	8.70	8.84	
5WC23	8.10	8.14	
DS [redacted]			
5W12A	10.28	10.41	
S5W7	10.90	SWL ONLY	
S5W5	7.56	"	
5W9A	0.85	"	
5W10A	12.27	"	
5W11A	8.87	"	
5WC1A	12.27	"	
S5W6	6.40	"	Needs new lock
S5W8	11.35	"	
5WC11	15.42	"	
5WC12	15.13	"	

4/29/13 RAAP B03204-11 DAS/TQE FB#11

5W8B

DTW - 13.90 Begin Purge (1214)
Post Purge DTW - 14.38 Initial Purge - Clear

Time	Temp (C)	Cond (us)	DO mg/L	pH	ORP (mV)	Turb (ntu)	Purge R.	Desc
(1220)	13.18	55	4.15	5.83	83.7	0.40	0.3 l/min	Clear
(1225)	13.16	55	3.68	5.79	82.9	0.39	"	Clear
(1230)	13.15	55	3.62	5.80	84.7	0.41	"	Clear
(1235)	13.29	55	3.59	5.78	85.6	0.46	"	Clear
(1240)	13.51	55	3.58	5.80	85.9	0.48	"	Clear
(1245)	13.40	55	3.54	5.78	85.5	0.50	"	Clear
(1245)	Readings Stable							
(1259)	14.27	55	3.83	5.74	89.3	0.68	Post Purge Reading	

Sample Time (1250)
Samples Collected: (3) 8260B, (1) TM

5W5B

DTW - 8.42 Begin Purge (1332)
Post Purge DTW - 9.08 Initial Purge - Clear

Time	Temp (C)	Cond (us)	DO mg/L	pH	ORP (mV)	Turb (ntu)	Purge R.	Desc
(1335)	11.95	544	6.80	6.36	87.0	0.33	0.3 l/min	Clear
(1340)	11.20	521	5.51	6.29	78.4	0.48	"	Clear
(1345)	10.98	518	4.84	6.29	72.3	0.60	"	Clear
(1350)	10.94	518	4.27	6.29	69.4	0.40	"	Clear
(1355)	10.82	518	3.89	6.32	67.3	0.34	"	Clear
(1400)	10.96	517	3.76	6.35	66.9	0.25	"	Clear
(1405)	11.06	517	3.63	6.37	66.2	0.26	"	Clear
(1405)	Readings Stable							
(1424)	11.13	518	3.23	6.40	65.8	0.25	Post Purge Reading	

Sample Time (1410)
Samples Collected: (3) 8260B, (1) TM
(2) 8270D, (2) 8270D

4/29/13 RAAP B03204-11 DAS/TQE FB# 11

SW7B

DTW - 8.61 Begin Purge (1456)

Post Purge DTW - 8.89 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO%	pH	ORP(mV)	Turb(ntu)	Purge K	Desc
(1500)	9.84	131	8.13	5.80	98.4	0.76	0.3 L/min	Clear
(1505)	10.17	127	7.95	5.80	101.0	0.86	"	Clear
(1510)	9.69	127	8.01	5.71	99.5	0.83	"	Clear
(1515)	9.67	130	8.00	5.60	101.9	0.93	"	Clear
(1520)	9.75	130	7.97	5.60	102.3	0.81	"	Clear
(1525)	9.76	130	7.99	5.58	105.1		"	Clear
(1525)	Readings Stable						"	
(1556)	10.18	133	8.19	5.54	111.4	0.48	Post Purge Reading	

Sample Time (1530)

Samples Collected: (9)8260B, (3)TM, (6)8270D (2)8270D

4/30/13 RAAP B03204-11 DAS/TQE/TES FB# 11

General Notes

Weather - Overcast, 60's

PPE - Eye Protection, Nitrile gloves

Calibrations - YSI 650 MDS

- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
- Conductivity reads 1413 us in 1413 us std.
- DO% = 100

HACH 2100Q Turbidimeter: 0.02 - 1000 ntu

* Dedicated tubing and well skirts used at each well.
* All equipment decon'ed before/after each use.
* All purge water disposed of at dedicated location onsite
* All samples collected stored and transported in coolers on ice.

SWC21

DTW - 8.77 Begin Purge (1012)

Post Purge DTW - 8.83 Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO%	pH	ORP(mV)	Turb(ntu)	Purge K	Desc
(1015)	13.21	669	2.12	5.43	133.1	1.32	0.8 L/min	Clear
(1020)	13.29	670	1.55	5.30	132.3	0.91	"	Clear
(1025)	13.35	670	1.30	5.25	132.0	0.80	"	Clear
(1030)	13.38	670	1.15	5.30	131.5	0.71	"	Clear
(1035)	13.50	668	1.21	5.32	129.7	0.75	"	Clear
(1040)	13.50	668	1.29	5.34	128.6	0.89	"	Clear
(1040)	Readings Stable							
(1107)	13.76	673	1.68	5.26	130.4	0.79	Post Purge Reading	

Sample Time (1045)

Samples Collected: (3)8260B, (1)TM, (2)8270D (2)8270D

SWDUP

Collected at monitoring well SWC21

Sample Time (1100)

Samples Collected: (3)8260B, (1)TM, (2)8270D

4/30/13 RAAP BG3204-11 DAS/TQE/TZS FB#11

SWC22

DTW - 8.70

Begin Purge (1121)

Post Purge DTW - 8.84

Initial Purge - Clear/with black particles

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(n/a)	Purge k	Desc
(1125)	13.38	883	3.98	7.62	97.6	2.94	0.3 l/min	Clear
(1130)	13.49	889	3.56	7.60	93.0	2.08	"	clear
(1135)	13.62	891	2.76	7.68	87.1	1.08	"	Clear
(1140)	13.63	891	2.22	7.70	84.6	0.50	"	Clear
(1145)	13.60	893	1.75	7.73	80.2	0.50	"	Clear
(1150)	13.67	893	1.67	7.76	77.8	0.50	"	Clear
(1155)	13.58	893	1.54	7.76	76.0	0.44	"	Clear
(1155)	Readings Stable						"	
(1215)	13.82	895	1.73	7.78	77.5		Post Purge Reading	

Sample Time (1200)

Sample Collected: (3) 8260B, (1) TM, (2) 8270D, (2) 8270D

SWC23

DTW - 8.10

Begin Purge (1230)

Post Purge DTW - 8.14

Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(n/a)	Purge k	Desc
(1235)	12.75	1061	2.78	7.80	74.6	1.76	0.3 l/min	Clear
(1240)	12.75	1144	6.70	7.78	71.3	4.17	"	Clear
(1245)	13.12	1150	6.67	7.80	68.4	3.49	"	Clear
(1250)	12.98	1155	6.41	7.80	67.8	3.26	"	Clear
(1255)	13.06	1161	5.85	7.78	66.7	2.64	"	Clear
(1300)	12.94	1162	5.74	7.78	65.9	2.04	"	Clear
(1305)	12.92	1158	5.62	7.78	64.3	2.06	"	Clear
(1305)	Readings Stable							
(1313)	13.02	1144	6.24	7.82	66.7	2.44	Post Purge Reading	

Sample Time (1310)

Samples Collected: (3) 8260B, (1) TM, (2) 8270D (2) 8270D

(40)

4/30/13 RAAP BG3204-11 DAS/TQE/TZS FB#11

4/30/13 [redacted]

SW12A

DTW - 10.28

Begin Purge (1330)

Post Purge DTW - 10.41

Initial Purge - Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(n/a)	Purge k	Desc
(1335)	14.23	307	6.57	8.32	52.8	2.99	0.3 l/min	Clear
(1340)	14.28	294	6.29	8.12	57.0	2.37	"	Clear
(1345)	14.32	290	6.31	8.07	59.4	2.02	"	Clear
(1350)	14.32	275	6.50	8.03	62.3	1.72	"	Clear
(1355)	14.31	272	6.55	8.04	65.2	1.64	"	Clear
(1400)	14.31	272	6.54	8.02	66.9	1.56	"	Clear
(1405)	14.27	276	6.51	8.00	66.5	1.27	"	Clear
(1405)	Readings Stable							
(1419)	14.36	281	6.32	8.02	67.7	1.43	Post Purge Readings	

Sample Time (1410)

DS 4/30/13

Samples Collected: (3) 8260B, (1) TM, [redacted]

ENTERED MAY 29 2013 BY: [redacted]

(41)

6/17/13 RMAP B0320M-11 TEJ/KLFC F.B.#11

General Notes-
- Weather - cloudy, 70's
- PPE: Eye protection, nitrile gloves, Flame retardant coveralls, steel-toe chemical resistant boots.
- Calibrations: - YSI 650 MDS
  pH = 4.00 = 4.00, 7.00 = 7.00, 10.00 = 9.97
  Conductivity reads 1413 µs in a 1413 µs standard
  DO% = 100 %
  HACH 2100P Turbidimeter: 0.02 - 1000 NTU
- Dedicated tubing & well sticks used at each well.
- All samples collected, stored & transported on ice in coolers.
- All purge water disposed of at dedicated location on-site.
- All equip. decon'ed before and after each use.

STATIC WATER LEVEL TABLE (UNIT-13)

Well	DTW	Post Purge DTW	NOTES
13MW1	19.37	19.52	well sign not attached
13MW2	20.23	21.06	
13MW3	12.42	12.42	
13MW4	15.68	15.77	
13MW5	15.57	15.65	
13MW6	15.16	15.35	
13MW7	14.61		

13MW DUP - (Collected at 13MW4)
Sample Time (1205)
Samples collected: (2) TOC [0.45u filter], (2) DOC, (1) 6010C [0.2u filter], (1) perchlorate
(3) IC300, (1) alkalinity

13 MW DUP2: (Collected at 13MW3)
Sample Time (1105)
Samples collected: (3) 8260C, (2) RSK-175

6/17/13 RMAP B0320M-11 TEJ/KLFC F.B.#11

13MW1
DTW - 19.37 Begin Purge (0837)
Post Purge DTW - 19.52 Initial Purge - clear

Time	Temp(C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(0844)	13.90	516	8.13	6.34	177.4	4.42	0.3 L/min	clea
(0850)	13.42	528	7.23	6.20	177.0	2.93	"	clear
(0855)	14.11	515	7.01	6.11	180.0	2.08	"	clear
(0900)	14.73	512	6.09	5.99	183.0	2.58	"	clear
(0905)	13.63	511	6.80	5.90	187.3	1.90	"	clear
(0910)	13.54	510	6.68	5.97	191.3	1.73	"	clear
(0915)	Readings Stable							
(0930)	13.75	515	6.64	6.15	197.2	1.73	post purge	clear

Sample Time (0920)
Samples Collected: (3) 8260C, (2) RSK-175
(1) perchlorate [0.25u filter]
(2) IC300

13MW2
DTW - 20.23 Begin Purge (0928)
Post Purge DTW - 21.06 Initial Purge -, clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	De
(0933)	14.70	733	6.86	6.55	214.7	2.09	0.3 L/min	cla
(0939)	14.65	733	6.43	6.40	212.3	1.58	"	clea
(0945)	14.62	735	6.34	6.36	213.3	1.65	"	clea
(0950)	14.73	736	6.32	6.27	214.2	2.19	"	clea
(0955)	14.89	734	6.28	6.26	214.5	2.28	"	clear
(0955) (1000)	Readings Stable							
(1005)	14.68	740	6.53	6.29	217.2	1.96	post purge	clear

Sample Time (1010)
Samples Collected: (3) 8260C, (2) RSK-175,
(1) perchlorate [0.25u filter], (2) IC300

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13MW3

DTW - 12.42 Begin Purge (1015)
Post Purge DTW - 12.42 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1017)	15.09	398	6.31	6.46	208.3	17.0	0.3 %/min	clear, sl. cloudy
(1023)	14.94	579	4.99	6.24	211.4	4.93	"	clear
(1029)	15.05	622	4.88	6.17	207.6	3.92	"	clear
(1035)	14.89	631	4.83	6.11	205.5	2.96	"	clear
(1040)	15.04	631	4.80	6.13	203.3	2.32	"	clear
(1045)	15.06	632	4.81	6.07	193.3	1.66	"	clear
(1050)	15.07	634	4.78	5.96	190.6	1.68	"	clear
(1050)	Readings Stable							
(1110)	15.30	638	5.18	6.32	195.5	2.28	post-purge "	clear

Sample Time (1055)
Samples Collected: (3) 8260C, (2) RSK-175, (2) TOC, (2) DOC, (1) 6010C [0.45µ Filter], (1) perchlorate [0.2µ Filter], (3) IC300, (1) alkalinity

13MW4

DTW - 15.68 Begin Purge (1115)
Post Purge DTW - 15.77 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1118)	14.09	430	6.97	6.66	171.1	6.46	0.3 %/min	clear
(1124)	14.44	421	4.59	4.17	170.1	3.45	"	clear
(1130)	14.36	421	4.44	6.03	169.3	4.69	"	clear
(1135)	14.35	420	4.43	6.05	170.8	3.66	"	clear
(1140)	14.94	417	4.40	6.12	171.2	2.95	"	clear
(1145)	15.14	418	4.41	6.12	171.0	2.78	"	clear
(1150)	15.63	419	4.41	6.15	172.6	2.60	"	clear
(1150)	Readings Stable							
(1210)	15.90	408	4.79	6.02	173.3	3.31	post-purge "	clear

Sample Time (1155)
Samples Collected: (3) 8260C, (2) RSK-175, (2) TOC, (2) DOC, (1) 6010C [0.45µ Filter], (1) perchlorate [0.2µ Filter], (3) IC300, (1) alkalinity

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13MW5

DTW - 15.57 Begin Purge (1218)
Post Purge DTW - 15.65 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1220)	15.08	677	5.15	6.32	170.3	1.87	0.3 %/min	clear
(1225)	14.88	694	4.54	6.21	169.6	2.04	"	clear
(1230)	14.76	697	4.42	6.14	170.6	1.58	"	clear
(1235)	15.03	700	4.42	6.12	172.0	1.62	"	clear
(1240)	14.62	692	4.49	6.08	172.7	1.56	"	clear
(1245)	14.46	672	4.63	5.98	172.6	1.58	"	clear
(1245)	Readings Stable							
(1322)	15.13	677	5.00	4.87	35.4	2.22	"	Post Purge clear

Sample Time (1250)
Samples Collected: (9) 8260C, (6) RSK-175, (2) TOC, [(2) DOC, (3) 6010C; 0.45µ Filter], [(3) perchlorate 0.2µ Filter], (9) IC300, (3) alkalinity

13MW6

DTW - 15.16 Begin Purge (1328)
Post Purge DTW - 15.35 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1330)	15.05	812	4.33	5.77	64.5	3.30	0.3 %/min	clear
(1335)	14.51	792	3.44	5.47	83.6	2.88	"	clear
(1340)	14.47	785	3.30	5.49	91.6	2.48	"	clear
(1345)	15.06	781	3.29	5.62	102.2	2.32	"	clear
(1350)	15.16	782	3.28	5.70	93.8	2.20	"	clear
(1355)	14.99	782	3.26	5.75	87.3	2.17	"	clear
(1355)	Readings Stable							
(1410)	14.28	740	3.39	5.78	80.2	1.94	" Post purge	clear

Sample Time (1400)
Samples Collected: (3) 8260C, (2) RSK-175, (2) TOC, [(2) DOC, (1) 6010C 0.45µ Filter], [(1) perchlorate 0.2µ Filter], (3) IC300, (1) alkalinity

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13MW7
DTW- 14.61 Begin Purge (1418)
Post purge DTW- Initial Purge- clear

Time	Temp(°C)	Condus	DO mg/L	pH	ORP(mV)	Turb(ntu)	Purge/L	Desc.
(1420)	13.72	549	5.40	6.65	55.0	1.80	0.3%/min	clear
(1425)	12.75	525	3.65	6.21	48.9	1.61	"	clear
(1430)	12.48	445	4.02	6.02	67.2	1.38	"	clear
(1435)	12.46	432	4.08	5.87	80.2	1.58	"	clear
(1440)	12.36	432	4.05	5.83	87.4	1.65	"	clear
(1445)	12.46	435	4.06	5.89	92.6	2.01	"	clear
(1445)	Readings Stable					~~1.64~~ TJ		ete
(1458)	13.13	444	4.24	6.06	122.6	1.64	Post purge	clear

Sample Time (1450)
Samples Collected: (3) 8260C, (2) RSK-175, (2) TOC, [(2) DOC, (1) 6010C; 0.45µ filter], [(1) perchlorate 0.2µ filter], (3) IC300, (1) alkalinity

6/18/13 RAAP FB#11
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KFC/TEJ Verification

General Notes
- Weather - 60's, rainy
- PPE- Eye protection, nitrile gloves, steel toed boots
- Calibrations - YSI 650 MDS
  pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = ~~10.00~~ 9.97 TJ
  conductivity reads 1413 µs in a 1413 µs standard
  DO% = 100%
  HACH 2100P Turbidimeter: 0.02 - 1000 ntu
- Dedicated tubing and well skirts used at each well.
- All samples collected, stored, and transported on ice in coolers.
- All purge water disposed of at dedicated location onsite.
- All equip. decon'ed before and after each use.

Static Water Level Table

Well	DTW	Post Purge DTW	Notes
5WC21	8.36	8.35	Connector Tubing has a leak
10MW1	15.59	15.98	
16C1	47.23	47.25	
16WC1A	63.95	65.03	
16WC1B	64.08	64.34	
16MW8	70.85		
16MW9	62.97	63.88	

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15WC21

DTW - 8.36 Begin Purge (0816)
Post Purge DTW - 8.35 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(0820)	13.53	730	4.94	4.30	255.4	1.72	0.3%min	clear
(0825)	13.55	727	4.33	4.25	257.1	1.85	"	clear
(0830)	13.63	723	3.86	4.13	258.4	1.83	"	clear
(0835)	13.57	721	3.52	4.10	261.0	1.82	"	clear
(0840)	13.54	719	3.27	4.10	267.7	2.03	"	clear
(0845)	13.48	718	2.93	4.04	268.3	1.81	"	clear
(0850)	13.53	717	2.89	4.06	270.3	1.79	"	clear
(0850)	Readings Stable							
(0930)	13.92	716	3.89	4.16	279.8	2.33	Post Purge	clear

Sample Time (0910)
Samples Collected: (4) 8270D

10MW1

DTW - 15.59 Begin Purge (0951)
Post Purge DTW - 15.98 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc
(0955)	13.67	389	7.13	6.55	272.9	1.57	0.3%min	clear
(1000)	13.53	388	7.09	6.81	275.5	1.37	"	clear
(1005)	13.49	388	7.04	7.01	274.2	1.76	"	clear
(1010)	13.73	388	6.98	7.08	276.1	1.56	"	clear
(1015)	13.84	388	6.88	7.07	271.6	1.59	"	clear
(1020)	13.94	388	6.81	7.12	269.6	1.88	"	clear
(1020)	Readings Stable							
(1030)	13.75	388	6.67	7.18	267.0	1.58	Post Purge	clear

Sample Time (1025)
Samples Collected: (4) 8270D

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16C1

DTW - 47.23 Begin Purge (1048)
Post Purge DTW - 47.25 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1090)	13.30	750	7.83	6.36	264.3	1.58	0.3%min	clear
(1055)	13.11	692	3.21	6.11	262.3	1.62	"	clear
(1100)	13.07	672	2.65	6.08	258.5	1.15	"	clear
(1105)	13.05	657	2.29	6.04	256.0	1.62	"	clear
(1110)	13.06	646	2.24	6.02	252.0	1.49	"	clear
(1115)	13.11	641	2.22	6.03	250.0	1.64	"	clear
(1120)	13.11	637	2.21	6.05	246.1	1.59	"	clear
(1120)	Readings Stable							
(1130)	13.24	635	2.23	6.00	239.7	1.84	Post Purge	clear

Sample Time (1125)
Samples Collected: (9) 8260

16WC1A

DTW - 63.95 Begin Purge (1138)
Post Purge DTW - 65.03 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(1140)	14.24	730	9.62	6.89	245.3	3.36	0.3%min	clear
(1145)	13.96	742	5.19	6.77	240.7	1.70	"	clear
(1150)	13.94	748	3.58	6.68	358.0	1.60	"	clear
(1155)	13.86	751	2.90	6.64	211.2	1.58	"	clear
(1200)	13.87	761	2.75	6.52	155.3	1.43	"	clear
(1205)	14.01	780	2.61	6.48	113.5	1.78	"	clear
(1210)	14.00	788	2.55	6.44	98.6	1.55	"	clear
~~(1210)~~	~~Readings Stable~~							
( )								

~~Sample Time (1215)~~ TEJ 6/18/13
~~Samples Collected: (2) 8021GA~~

6/18/13 RAAP Verification FB#1
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KFC/TES

16WC18A (continued) TES 6/18/13

~~DTW~~ Begin Purge ( )

Post Purge DTW - Initial Purge -

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1215)	14.03	792	2.50	6.40	84.0	1.52	0.3%min	clear
(1220)	14.03	794	2.45	6.39	75.3	1.60	"	clear
(1225)	14.04	794	2.44	6.38	70.7	1.57	"	clear
(1230)	14.06	796	2.41	6.34	61.7	1.61	"	clear
(1235)	Readings Stable							
(1240)	14.47	798	2.61	6.35	55.8	1.57	Post Purge	

Sample Time (1235)

Samples collected: (2) 6020A

√16WC18B

DTW - 64.08 Begin Purge (1243)

Post Purge DTW - 64.34 Initial Purge - clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1245)	14.38	356	6.73	6.20	84.0	1.68	0.3%min	clear
(1250)	14.10	331	3.11	5.81	93.5	1.88	"	clear
(1255)	14.18	327	2.50	5.79	102.7	2.07	"	clear
(1300)	14.16	330	2.37	5.76	106.4	1.58	"	clear
(1305)	14.14	332	2.30	5.73	111.4	1.51	"	clear
(1310)	14.08	334	2.27	5.65	114.3	1.56	"	clear
(1310)	Readings Stable							
(1320)	14.53	336	2.42	5.67	117.5	1.46	Post purge	

Sample Time (1315)

Samples Collected: (9) 8260C

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KFC/TES

√16MW9

DTW - 62.97 Begin Purge (1328)

Post Purge DTW - 63.88 Initial Purge - clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1330)	14.15	947	4.73	6.15	109.7	1.88	0.3%min	clear
(1335)	13.83	980	3.03	6.12	83.9	1.60	"	clear
(1340)	13.71	983	2.75	6.08	70.0	1.63	"	clear
(1345)	13.77	984	2.63	5.94	59.6	1.29	"	clear
(1350)	13.84	987	2.57	5.91	51.4	1.34	"	clear
(1355)	13.88	989	2.52	5.90	44.8	1.36	"	clear
(1400)	13.84	987	2.50	5.91	40.7	1.41	"	clear
(1400)	Readings Stable							
(1410)	14.22	982	2.60	5.95	38.7	1.68	Post Purge	

Sample Time (1405)

Samples Collected: (9) 8270D

√16MW8

DTW - 70.85 Begin Purge (1422)

Post Purge DTW - 73.15 Initial Purge - clear

Time	Temp(°C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Desc.
(1425)	15.13	153	4.35	5.28	107.3	2.09	0.3%min	clear
(1430)	14.44	149	2.50	5.04	115.2	1.88	"	clear
(1435)	14.32	150	2.37	5.06	118.4	2.82	"	clear
(1440)	14.19	148	2.25	4.96	128.2	1.60	"	clear
(1445)	14.22	143	2.18	4.88	131.7	1.64	"	clear
(1450)	14.08	141	2.14	4.87	133.5	1.65	"	clear
(1450)	Readings Stable							
(1500)	14.23	139	2.21	4.84	135.1	1.83	Post Purge	

Sample Time (1455)

Samples Collected: (9) 82[illegible]

General Notes

- Weather: Mostly Cloudy, 60°
- PPE: Eye Protection, Nitrile Gloves
- Calibrations: YSI 650 MDS (rental)
  pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  Conductivity reads 1413 µs in 1413 µs std
  DO% = 95%
  HACH 2100Q Turbidimeter: 0.02 - 1000 NTU
- New tubing and well skirts used at each well
- All equipment decon'ed before/after each use
- All purge water disposed of at dedicated location onsite
- All samples collected, stored, and transported on ice in coolers

✓Static Water Level Table - unit 433

Well	DTW	Post Purge DTW	Notes
74MW3	20.70	23.58	
74MW2	56.34	56.36	
74MW1S	23.35	23.49	
74MW4	23.77	23.77	
74MW5	25.94	25.97	
74MW6	24.60	24.59	
74MW7	24.70	25.30	

74MW-DUP

*collected at monitoring well 74MW3

Sample Time (1305)
Samples Collected: (3)8260c, (2)8011, (1)TM

74MW3 ✓

DTW: 20.70 Begin Purge (1201)
Post Purge DTW: 23.58 Initial Purge: clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge	Desc
(1205)	13.53	635	1.25	6.82	109.6	20.1	0.3L/min	Clear
(1210)	13.24	631	0.75	6.90	104.3	6.24	"	clear
(1215)	13.83	635	0.98	7.13	77.8	7.49	"	clear
(1220)	13.89	637	0.92	7.18	64.0	7.01	"	Clear
(1225)	13.87	637	0.77	7.20	48.0	6.63	"	Clear
(1230)	13.87	638	0.75	7.23	31.1	5.90	"	Clear
(1235)	13.91	640	0.77	7.24	21.4	6.72	"	clear
(1240)	14.81	641	0.81	7.24	11.8	7.01	"	clear
(1245)	13.95	642	0.78	7.23	7.9	8.72	"	clear
(1250)	13.92	642	0.74	7.22	2.9	9.26	"	clear
(1250)	Readings Stable							
(1310)	14.04	644	0.82	7.25	3.2	9.60	Post Purge Reading	

Sample Time (1255)
Samples Collected: (3)8260c, (2)8011, (1)TM

74MW1 ✓

DTW: 23.35 Begin Purge (1324)
Post Purge DTW: 23.49 Initial Purge: clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge	Desc
(1325)	15.76	576	5.33	7.25	99.0	1.19	0.3L/min	clear
(1330)	14.00	554	4.15	6.80	124.0	0.57	"	clear
(1335)	14.12	553	3.93	6.79	126.2	0.29	"	clear
(1340)	14.25	555	3.91	6.87	122.7	0.29	"	clear
(1345)	13.76	555	3.89	6.84	128.5	0.38	"	clear
(1350)	13.73	555	3.89	6.86	128.7	0.31	"	clear
(1355)	13.65	557	3.88	6.86	130.0	0.25	"	Clear
(1400)	13.66	558	3.88	6.87	130.8	0.21	"	Clear
(1400)	Continued on page 56						Readings Stable	

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74MW-1 Cont

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge	Desc
(1410)	13.68	558	3.92	6.91	129.9	0.31		Post Purge Reading

Sample Time (1405)
Samples Collected: (3)8260C, (2)8011, (1)TM

74MW4 ✓

DTW: 23.77
Post Purge DTW: 23.77
Begin Purge (1427)
Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge	Desc
(1430)	13.84	516	2.99	7.29	134.0	8.26	0.3 L/min	Clear
(1435)	13.63	499	1.45	7.22	123.4	8.00	"	Clear
(1440)	13.80	515	2.33	7.14	120.5	8.97	"	Clear
(1445)	13.91	526	2.93	7.06	122.3	9.53	"	clear
(1450)	13.93	533	3.39	6.99	125.4	6.91	"	Clear
(1455)	14.01	538	3.57	6.96	127.9	4.35	"	Clear
(1500)	14.02	542	3.77	6.93	129.3	3.78	"	Clear
(1505)	14.03	541	3.83	6.92	130.3	3.23	"	Clear
(1510)	13.98	543	3.92	6.90	132.1	3.01	"	Clear
(1515)	14.05	544	3.92	6.90	133.0	2.48	"	clear
(1515) Readings Stable								
(1535)	14.01	548	4.01	6.91	133.7	1.51		Post Purge Reading

Sample Time (1520)
Samples Collected: (9)8260C, (6)8011, (3)TM

10/17/13 RFAAP B03204-11 TQE/KFC FB#11

General Notes
- Weather: Overcast 60≤
- PPE: Eye Protection, Nitrile Gloves
- Calibration: YSI 650 MDS (rental)
  pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  Conductivity reads 1413 us in 1413 us std.
  DO% = 94%
  HACH Turbidimeter 2100Q: 0.02 - 1000 NTU
- New tubing and well skirts used at each well.
- All equipment decomed before/after each well
- All purge water disposed of at dedicated location onsite
- All samples collected, stored, and transported on ice in coolers

74MW5 ✓

DTW: 25.94
Post Purge DTW: 25.97
Begin Purge (0916)
Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge	Desc
(0920)	14.07	561	3.68	6.85	104.2	0.86	0.3 L/min	Clear
(0925)	13.89	585	2.29	6.84	117.6	0.87	"	Clear
(0930)	14.02	565	2.85	6.83	121.4	0.91	"	clear
(0935)	14.15	561	2.98	6.83	123.4	1.09	"	Clear
(0940)	14.14	554	3.06	6.84	125.0	1.01	"	Clear
(0945)	14.11	553	3.09	6.83	129.2	1.04	"	Clear
(0950)	14.10	554	3.07	6.83	131.7	0.98	"	Clear
(0955)	14.05	553	3.08	6.82	133.1	0.95	"	clear
(1000)	14.10	553	3.17	6.82	136.1	0.94	"	Clear
(1005)	14.15	555	3.21	6.82	137.0	0.69 ~~0.89~~	"	Clear
(1005) Readings Stable								
(1015)	14.22	558	3.23	6.83	136.6	0.89		Post Purge Reading

Sample Time (1010)
Samples Collected: (3)8260C, (2)8011, (1)TM

10/17/13 RFAAP B03204-11 TQE1RFL FB#11

74MW6 ✓

DTW: 24.60 Begin Purge (1034)
Post Purge DTW: 24.59 Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1035)	15.16	873	4.34	6.55	136.3	0.91	0.3 L/min	Clear
(1040)	14.93	948	3.07	6.43	144.9	0.52	"	Clear
(1045)	14.83	955	3.01	6.44	147.1	0.62	"	Clear
(1050)	14.73	976	2.90	6.44	150.4	0.81	"	Clear
(1055)	14.65	978	2.87	6.44	152.4	0.36	"	clear
(1100)	14.59	984	2.86	6.45	154.4	0.34	"	clear
(1105)	14.66	985	2.85	6.45	157.0	0.29	"	Clear
(1110)	14.64	988	2.79	6.45	158.7	0.27	"	Clear
(1115)	14.69	988	2.81	6.45	160.6	0.21	"	clear
(1115)	Readings Stable							
(1129)	14.71	990	2.99	6.45	161.8	0.27	Post Purge Reading	

Sample Time (1120)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

74MW7 ✓

DTW: 24.70 Begin Purge (1143)
Post Purge DTW: 25.30 Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1145)	14.52	429	3.23	7.60	-14.5	1.53	0.3 L/min	Clear
(1150)	13.97	442	0.20	7.39	-32.9	0.30	"	clear
(1155)	13.94	438	0.04	7.46	-34.2	0.30	"	clear
(1200)	13.91	435	0.11	7.48	-38.9	0.29	"	Clear
(1205)	13.85	434	0.12	7.51	-44.1	0.35	"	Clear
(1210)	13.88	433	0.12	7.51	-42.7	0.31	"	clear
(1215)	13.90	432	0.11	7.52	-44.6	0.29	"	clear
(1215)	Readings Stable							
(1228)	13.94	430	0.15	7.54	-48.0	0.30	Post Purge Reading	

Sample Time (1220)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

10/17/13 RFAAP B03204-11 TQE1RFL FB#11

74MW2 ✓

DTW: 56.34 Begin Purge (1244)
Post Purge DTW: 56.30 Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1245)	14.81	291	9.32	7.85	67.2	1.33	0.3 L/min	clear
(1250)	14.61	287	8.95	7.84	71.5	0.63	"	clear
(1255)	14.38	284	8.72	7.78	79.2	0.57	"	clear
(1300)	14.59	283	8.67	7.80	82.2	0.41	"	Clear
(1305)	14.20	283	8.71	7.78	86.6	0.35	"	clear
(1310)	14.27	283	8.70	7.79	90.1	0.26	"	clear
(1315)	14.30	283	8.68	7.80	91.0	0.29	"	clear
(1315)	Readings Stable							
(1328)	14.45	283	8.75	7.83	89.8	0.31	Post Purge Reading	

Sample Time (1320)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

General Notes

- Weather: Sunny 50s
- PPE: Eye Protection, Nitrile Gloves
- Calibrations: YSI 650 mds (rental)
  pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  Conductivity reads 1413 µs in 1413 µs std
  DO% = 95.1 %
  HACH 2100Q Turbidimeter: 0.02 - 1000 NTU
- New tubing and well skirts used at each well
- All equipment decon'ed before/after each well
- All purge water disposed of at dedicated location onsite
- All Samples collected, stored, and transported on ice in coolers.

Static Water Level Table - Unit 353

Well	DTW	Post Purge DTW	Desc
FAL2	35.02	37.42	
FAL3	65.06	65.90	
WELL 7	28.51	26.58	
16-3	55.95	67.23	

FAL 2

DTW: 35.02
Post Purge DTW: 37.42
Begin Purge (1009)
Initial Purge: clear

Time	Temp(C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1010)	12.37	753	7.56	6.92	128.7	46.9	0.3 L/min	Clear
(1015)	12.33	720	6.81	6.95	129.2	47.1	"	clear
(1020)	12.42	693	6.46	6.98	131.0	46.0	"	clear
(1025)	12.44	695	6.43	6.99	130.6	43.7	"	clear
(1030)	12.44	696	6.40	6.99	132.4	39.4	"	clear
(1035)	12.53	693	6.37	6.99	135.0	33.8	"	Clear
(1040)	12.59	692	6.35	6.99	134.6	40.8	"	Clear

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TOE 10/21/13

FAL2 FAL 2 Cont

Time	Temp(C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1045)	12.67	689	6.34	6.99	135.4	46.1	0.3 L/min	clear
(1050)	12.72	688	6.34	7.00	135.3	52.0	"	sl. milky clear
(1050)	Readings Stable							
(1103)	12.81	685	6.17	7.00	140.2	49.1	Post Purge Reading	

Sample Time (1055)
Samples Collected: (3) 8260C, (2) 8011, (1) TAL

FAL 3 ✓

DTW: 65.06
Post Purge DTW: 65.90
Begin Purge (1117)
Initial Purge: Clear

Time	Temp(C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1120)	13.66	1055	6.78	7.11	147.3	26.6	0.3 L/min	Clear
(1125)	13.31	1164	1.75	6.67	155.4	112	"	sl. cloudy
(1130)	13.35	1162	1.22	6.63	156.6	117	"	sl cloudy
(1135)	13.28	1164	1.07	6.63	157.9	102	"	sl. cloudy
(1140)	13.25	1165	1.01	6.63	158.1	97.1	"	sl. cloudy
(1145)	13.30	1168	1.00	6.63	158.7	116.0	"	sl cloudy
(1150)	13.30	1172	1.01	6.63	159.0	131	"	sl cloudy
(1155)	13.35	1174	0.98	6.63	159.1	123	"	sl cloudy
(1155)	Readings Stable							
(1209)	13.41	1178	0.95	6.63	159.6	120	Post Purge Reading	

Sample Time (1200)
Samples Collected: (3) 8260C, (2) 8011, (1) TAL

WELL 7 ✓

DTW: 26.51 Begin Purge (1250)
Post Purge DTW: 26.58 Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1255)	14.17	481	5.65	6.18	145.7	18.8	0.3 L/min	Clear
(1300)	14.02	482	5.42	6.08	147.6	2.64	"	Clear
(1305)	14.24	484	5.38	6.07	142.1	1.09	"	Clear
(1310)	14.65	477	5.33	6.08	140.6	1.27	"	Clear
(1315)	14.87	480	5.36	6.09	139.7	1.69	"	Clear
(1320)	14.86	483	5.42	6.09	135.8	1.78	"	Clear
(1325)	14.85	489	5.44	6.09	127.1	1.25	"	Clear
(1330)	14.91	491	5.47	6.09	126.0	1.25	"	Clear
(1330)	Readings Stable							
(1343)	15.12	500	5.55	6.12	122.1	1.28	Post Purge Reading	

Sample Time (1335)
Samples Collected: (3) 8260C, (2) 8011, (1) TM

16-3 ✓

DTW: 55.95 Begin Purge (1359)
Post Purge DTW: 67.28 Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1400)	14.85	240	7.03	7.54	93.2	0.83	0.3 L/min	clear
(1405)	14.33	235	6.00	7.84	92.1	1.04	"	Clear
(1410)	14.25	233	5.85	8.02	86.9	0.96	"	clear
(1415)	14.24	232	5.89	8.06	88.2	0.74	"	clear
(1420)	14.29	231	6.02	8.06	87.5	0.77	"	clear
(1425)	14.24	231	6.09	8.05	87.8	0.96	"	clear
(1430)	14.28	231	6.10	8.05	86.1	1.00	"	clear
(1430)	Readings Stable							
(1449)	14.28	231	6.09	8.06	88.2	1.34	Post Purge Reading	

Sample Time (1435)
Samples Collected: (6) 8260, (2) 8011, (2) TM
(2) 8270

General Notes

- Weather: Partly Cloudy 50s
- PPE: Eye Protection, Nitrile Gloves
- Calibrations: YSI 650 MDS (rental)
  pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  Conductivity reads 1413 µs in 1413 µs std
  DO% = 95.7%
  HACH 2100Q Turbidimeter: 0.02 = 1000 NTU
- New tubing and well skirts used at each well
- All equipment decon'ed before/after each well
- All purge water disposed of at dedicated location on site
- All samples collected, stored, and transported on ice in coolers

Static Water Level Table - Cln. 1/6

Well	DTW	Post Purge DTW	Notes
16-1	42.95	49.82	
16-2	55.90	55.91	
16-3	55.95	67.28	Samples collected w/ unit 353 10/21/13
16-5	3.00	3.58	
16WC2B	52.89	68.75	
16MW8	73.41	Below top of pump	
16WC1B	68.08	68.61	
16WC1A	67.86	69.82	
16MW9	65.51	66.38	
16C1	48.31	48.33	
16C3	67.13		
16DH3	DRY		
16WC2A	DRY		

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✓16-1

DTW: 42.95
Post Purge DTW: 49.82

Begin Purge (0843)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge/L	Desc
(0845)	13.06	479	6.56	7.43	125.2	1.05	0.34/min	clear
(0850)	13.15	431	6.50	7.34	124.8	0.91	"	clear
(0855)	13.11	420	6.54	7.34	122.5	0.57	"	clear
(0900)	13.06	410	6.56	7.33	121.3	0.57	"	clear
(0905)	12.99	407	6.59	7.33	121.7	0.54	"	clear
(0910)	13.02	405	6.60	7.32	122.7	0.55	"	clear
(0915)	13.07	401	6.63	7.31	123.3	0.57	"	clear
(0915)	Readings Stable							
(0937)	13.18	396	6.78	7.30	123.6	0.68	Post Purge Reading	

Sample Time (0920)
Samples Collected: (3)8260, (2)8270, (1)TM

✓16-2

DTW: 55.80
Post Purge DTW: 55.91

Begin Purge (1006)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge/L	Desc
(1010)	13.72	615	5.24	7.12	131.4	1.29	0.34/min	clear
(1015)	13.66	618	4.76	7.09	131.6	1.11	"	clear
(1020)	13.51	620	4.09	7.04	132.5	0.97	"	clear
(1025)	13.58	620	4.01	7.03	132.3	0.51	"	clear
(1030)	13.55	619	4.05	7.03	132.2	0.49	"	clear
(1035)	13.57	615	4.13	7.01	132.3	0.43	"	clear
(1040)	13.59	613	4.23	7.00	132.5	0.39	"	clear
(1045)	13.66	609	4.24	6.99	133.2	0.35	"	clear
(1050)	13.59	602	4.27	6.97	133.3	0.24	"	clear
(1050)	Readings Stable							
(1110)	13.71	592	4.50	6.96	133.7	0.50	Post Purge Reading	

Sample Time (1055)
Samples Collected: (3)8260, (2)8270, (1)TM

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✓16-5

DTW: 3.00
Post Purge DTW: 3.58

Begin Purge (1136)
Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge/L	Desc
(1140)	13.93	511	1.38	7.42	124.2	3.03	0.34/min	clear
(1145)	13.86	516	1.00	7.39	122.7	2.02	"	clear
(1150)	13.77	518	0.82	7.38	120.5	0.74	"	clear
(1155)	13.72	519	0.77	7.37	119.5	0.73	"	clear
(1200)	13.61	519	0.72	7.37	115.6	0.71	"	clear
(1205)	13.72	518	0.72	7.37	113.2	0.91	"	clear
(1210)	13.83	518	0.67	7.37	111.2	1.36	"	clear
(1215)	13.71	519	0.58	7.36	108.7	2.02	"	clear
(1220)	13.64	518	0.57	7.36	107.4	2.37	"	clear
(1220)	Readings Stable							
(1239)	13.83	520	0.52	7.37	101.2	4.78	Post Purge Reading	

Sample Time (1225)
Samples Collected: (3)8260, (2)8270, (1)TM

✓16SPRING

Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)
13.65	542	7.03	7.47	55.0	2.43

Sample Time (1250)
Samples Collected: (3)8260, (2)8270, (1)TM

✓16WC2B

DTW: 52.89
Post Purge DTW: 68.75

Begin Purge (1315)
Initial Purge: Clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge/L	Desc
(1320)	14.33	320	2.68	8.00	93.7	0.86	0.34/min	clear
(1325)	14.24	318	1.17	7.97	44.1	0.34	"	clear
(1330)	14.14	316	0.44	7.96	15.7		"	clear

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16WC2B cont

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge#	Desc
(1335)	14.01	316	0.38	7.94	10.4	0.31	0.3%/min	clear
(1340)	13.90	315	0.35	7.93	7.3	0.32	"	Clear
(1345)	13.85	315	0.42	7.91	7.7	0.40	"	clear
(1350)	13.84	315	0.46	7.91	4.3	0.38	"	clear
(1355)	13.81	315	0.50	7.90	2.2	0.37	"	clear
(1400)	13.80	314	0.55	7.90	-0.4	0.35	"	clear
(1400)	Readings Stable							
(1414)	13.87	315	0.61	7.89	1.1	0.35	Post Purge Reading	

Sample Time (1405)

Samples Collected: (3) 8260, (2) 8270, (1) TM

16MW8

DTW: 73.41

Begin Purge (1424)

Post Purge DTW: (water level below pump)

Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge#	Desc
(1425)	14.58	145	2.28	5.72	209.8	2.12	0.3%/min	clear
(1430)	14.40	123	0.35	5.34	210.9	0.77	"	clear
(1435)	14.57	117	0.19	5.27	203.5	0.51	"	clear
(1440)	14.67	119	0.21	5.22	210.4	0.46	"	clear
(1445)	15.12	124	0.14	5.17	228.9	0.55	"	clear
(1450)	15.12	127	0.19	5.17	235.4	0.53	"	clear
(1455)	15.08	127	0.16	5.17	238.6	0.47	"	clear
(1455)	Readings Stable							
(1515)	15.10	129	0.17	5.18	243.7	0.58	Postpurge reading	

Sample Time (1500)

Samples collected: (3) 8260, (2) 8270, (1) TM

General Notes:

- Weather: Partly sunny, 40's
- PPE: Eye protection, Nitrile Gloves
- Calibration: YSI 650 (MDS) - Rental unit
  - pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  - conductivity reads 1413 µs in a 1413 µs standard
  - DO% = 93.0%
- HACH 2100Q Turbidimeter: 0.02 - 1000 NTU
- New tubing and well skirts used at each well.
- All equipment decon'ed before/after each well.
- All purge water disposed of at dedicated location on-site.
- All samples collected, stored & transported on ice in coolers.

16MW9

DTW: 65.51

Begin Purge (0858)

Post purge DTW: 66.38

Initial Purge: clear

TIME	Temp(C)	Cond(µs)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge#	Desc.
(0900)	12.94	873	5.24	6.82	80.4	0.71	0.3%/min	clear
(0905)	13.05	939	1.70	6.55	44.1	0.22	"	clear
(0910)	13.03	956	0.97	6.55	37.7	0.19	"	clear
(0915)	13.19	956	0.71	6.61	32.9	0.18	"	clear
(0920)	13.20	954	0.57	6.64	32.0	0.19	"	clear
(0925)	13.01	946	0.45	6.63	33.8	0.23	"	clear
(0930)	13.04	937	0.45	6.63	33.7	0.37	"	clear
(0930)	Readings Stable							
(0950)	12.99	930	0.57	6.63	34.8	0.46	Postpurge reading	

Sample Time (0935)

Samples Collected: (3) 8260, (2) 8270), (1) TM

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16WC1A

DTW: 67.86 Begin Purge (0959)
Post Purge DTW: 69.82 Initial Purge: clear

TIME	Temp(C°)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc
(1000)	13.77	597	9.25	7.62	61.4	0.35	0.3 L/min	Clear
(1005)	13.30	694	2.81	7.16	70.3	0.34	"	"
(1010)	13.21	714	0.51	7.05	68.1	0.32	"	"
(1015)	13.19	713	0.25	7.04	37.2	0.26	"	"
(1020)	13.19	724	0.19	7.01	29.3	0.34	"	"
(1025)	13.20	740	0.17	6.98	33.4	0.20	"	"
(1030)	13.27	750	0.15	6.95	38.7	0.23	"	"
(1035)	13.28	760	0.14	6.92	39.4	0.20	"	"
(1035)	READINGS STABLE							

SAMPLE TIME (1040)
Samples Collected: (9) 8260, (6) 8270, (3) TM

(1115)	13.18	778	0.18	6.89	35.4	0.20	Post purge reading	

16W Dup

* Samples collected at 16WC1A
Sample Time (1100)
Samples collected: (3) 8260, (2) 8270, (1) TM

10/23/13 RFAAP B03204-11 KFC/TEJ F.B.#11

16WC1B

DTW: 68.08 Begin Purge (1123)
Post purge DTW: 68.61 Initial Purge: Clear

TIME	Temp(C°)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc.
(1125)	13.41	310	6.12	6.73	151.2	0.33	0.3 L/min.	Clear
(1130)	13.25	319	1.43	6.28	158.3	0.71	"	"
(1135)	13.09	322	1.00	6.20	168.6	1.07	"	"
(1140)	13.03	323	0.59	6.18	167.6	0.80	"	"
(1145)	12.81	325	0.31	6.16	163.7	0.58	"	"
(1150)	12.79	325	0.29	6.16	163.5	0.60	"	"
(1155)	12.81	326	0.27	6.16	161.8	0.48	"	"
(1200)	12.83	325	0.23	6.17	160.6	0.37	"	"
(1200)	Readings Stable							
(1215)	13.01	324	0.20	6.17	159.8	0.46	Post Purge Reading	

Sample Time (1205)
Samples collected: (3) 8260, (2) 8270, (1) TM

16C1

DTW: 48.31 Begin Purge (1228)
Postpurge DTW: 48.33 Initial Purge: CLEAR

TIME	Temp(C°)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge(L)	Desc.
(1230)	13.66	581	6.97	6.80	149.7	0.47	0.3 L/min.	CLEAR
(1235)	13.22	664	1.64	6.54	158.4	0.36	"	"
(1240)	13.14	664	0.71	6.49	159.3	0.27	"	"
(1245)	13.35	667	0.27	6.48	159.5	0.23	"	"
(1250)	13.75	664	0.25	6.48	158.5	0.23	"	"
(1255)	13.81	665	0.23	6.48	158.3	0.22	"	"
(1300)	13.68	667	0.22	6.47	156.6	0.20	"	"
(1300)	Readings stable							
(1315)	13.38	661	0.43	6.47	159.2	0.34	Postpurge reading	

Sample Time (1305)
Samples collected: (3) 8260, (2) 8270, (1) TM

10/28/13 RAAP B03204-11 KFC/TEJ FB#11

General Notes

Weather- cloudy, 40's, possible showers
PPE- eye protection, nitrile gloves
Calibrations - YSI 650 MDS
- pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 9.93
- conductivity reads 1413 µs in 1413 µs std.
- DO% = 94.5
HACH 2100Q Turbidimeter: 0.02-1000ntu

* Dedicated tubing and well skirts used at each well
* All equipment decon'ed before and after each use
* All purge water disposed of at dedicated location onsite
* All samples collected-stored-and-transported in coolers on ice

Static Water Level Table

well	DTW	Post purge DTW	Notes
SWSB	14.02	14.95	
SW7B	9.08	9.10	
SW5B	9.36	9.68	
SWC21	9.32	9.36	
SWC22	9.19	9.22	
SWC23	8.62	8.64	
SW12A	11.65	11.66	
SSW7	11.07	SWL ONLY	
SSW5	8.26	"	
SW9A	2.48	"	
SW10A	14.88	"	
SW11A	13.28	"	
SWCA	13.22	"	
SSW6	7.15	"	
SSW8	10.97	"	NO CAP
SWC11	15.85	"	NO CAP
SWC12	15.40	"	NO CAP

10/28/13 RAAP B03204-11 KFC/TEJ FB#11

SW8B

DTW - 14.02 Begin Purge (0903)
Post purge DTW - 14.95 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr
(0905)	14.36	59	4.10	5.47	230.5	0.40	0.3/min	clear
(0910)	14.48	58	3.48	5.04	240.8	0.39	"	clear
(0915)	14.72	57	3.18	4.78	261.8	0.41	"	clear
(0920)	14.67	56	3.09	4.75	275.4	0.29	"	clear
(0925)	14.72	56	3.10	4.74	282.7	0.33	"	clear
(0930)	14.70	56	3.14	4.74	287.4	0.42	"	clear
(0930)	Readings Stable							
(0940)	14.63	55	3.82	4.74	291.7	0.40	Post purge reading	

Sample Time (0935)
Samples Collected: (3) 8260C, (1) TM

SW5B

DTW - 9.36 Begin Purge (0953)
Post Purge DTW - 9.68 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr
(0955)	14.27	538	4.66	5.80	245.0	0.42	0.3/min	clear
(1000)	14.48	537	2.09	5.49	253.4	0.40	"	clear
(1005)	14.89	529	1.15	5.37	262.8	0.39	"	clear
(1010)	14.95	529	1.03	5.35	265.7	0.23	"	clear
(1015)	15.02	532	0.91	5.35	270.3	0.26	"	clear
(1020)	15.03	530	0.99	5.35	275.1	0.30	"	clear
(1025)	15.07	529	1.08	5.35	275.6	0.23	"	clear
(1025)	Readings Stable							
(1035)	15.04	529	1.15	5.36	276.3	0.22	Post purge reading	

Sample Time (1030)
Samples Collected: (3) 8260C, (1) TM

10/28/13 RAAP B03204-11 KFC/TEJ FB#11

SW7B

DTW- 9.08 Begin Purge (1042)

Post purge DTW- 9.10 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr.
(1045)	17.16	126	6.44	4.99	277.5	0.56	0.3%/min	clear
(1050)	18.04	131	4.09	4.77	283.0	0.69	"	"
(1055)	18.00	131	3.95	4.72	291.8	0.79	"	"
(1100)	18.01	132	3.94	4.68	298.8	0.67	"	"
(1105)	18.03	131	3.98	4.68	306.8	0.97	"	"
(1110)	18.04	132	4.10	4.65	311.8	0.59	"	"
(1110)	Readings Stable							
(1125)	18.03	134	4.20	4.61	321.7	0.62	Post Purge readings	

Sample Time (1115)

Samples Collected: (9) 8260C, (3) TM

SWC21

DTW- 9.32 Begin Purge (1248)

Post purge DTW- 9.36 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr.
(1250)	14.18	722	4.16	4.02	273.7	0.53	0.3%/min	clear
(1255)	13.97	727	1.78	3.90	291.0	0.43	"	clear
(1300)	14.08	729	2.12	3.83	317.0	0.75	"	clear
(1305)	14.01	723	2.15	3.84	345.6	0.55	"	clear
(1310)	13.93	722	2.17	3.83	366.3	0.51	"	clear
(1315)	13.61	720	1.86	3.85	377.2	0.85	"	clear
(1320)	13.53	720	2.13	3.85	380.1	0.41	"	clear
(1325)	13.59	718	2.17	3.84	382.6	0.45	"	clear
(1325)	Readings Stable							
(1345)	13.63	715	2.09	3.89	385.7	0.75	Post purge readings	

Sample Time (1330)

Samples Collected: (3) 8260C, (1) TM

10/28/13 RAAP B03204-11 KFC/TEJ FB#11

SW Dup

Collected at monitoring well SWC21

Sample Time (1340)

Samples Collected: (3) 8260C, (1) TM

General Notes

Weather - foggy, 50's
PPE - eye protection, nitrile gloves
calibrations - YSI 650 MDS
- pH 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
- conductivity reads 1413 µs in 1413 µs std
- DO% = 94.9
HACH 2100Q Turbidimeter: 0.02 - 1000 ntu

* Dedicated tubing and well skirts used at each well
* All equipment decon'ed before and after each use.
* All purge water disposed of at dedicated location onsite
* All samples collected-stored-and transported in coolers on ice.

SWC22

DTW - 9.19 Begin Purge (0837)
Post purge DTW - 9.22 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr.
(0840)	14.67	943	3.41	6.68	117.6	8.85	0.3/min	clear
(0845)	14.46	955	0.68	6.61	132.5	6.58	"	clear
(0850)	14.45	958	0.48	6.62	136.6	3.02	"	clear
(0855)	14.44	960	0.32	6.63	139.2	2.57	"	clear
(0900)	14.43	960	0.26	6.64	141.6	1.87	"	clear
(0905)	14.47	960	0.22	6.64	143.4	1.94	"	clear
(0905)	Readings Stable							
(0915)	14.45	959	0.27	6.65	144.5	1.67	Post purge readings	

Sample Time (0910)
Samples Collected: (3) 8260C, (1) TM

SWC23

DTW - 8.62 Begin Purge (0912)
Post purge DTW - 8.64 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr.
(0915)	16.06	942	8.10	7.07	140.9	1.15	0.3/min	clear
(0920)	15.22	1031	1.97	6.82	148.2	1.45	"	clear
(0925)	15.16	1020	1.45	6.74	150.8	1.96	"	clear
(0930)	15.13	1017	1.33	6.73	151.7	1.86	"	clear
(0935)	15.06	1017	1.18	6.73	152.4	1.01	"	clear
(0940)	15.03	1016	0.99	6.74	153.0	0.99	"	
(0940)	Readings Stable							
(0950)	14.95	1014	1.16	6.74	153.7	1.29	Post purge readings	

Sample Time (0945)
Samples Collected: (3) 8260C, (1) TM

SWI2A

DTW - 11.65 Begin Purge (0952)
Post Purge DTW - 11.66 Initial Purge - clear

Time	Temp(°C)	Cond(µs)	DO mg/L	pH	ORP(mv)	Turb(ntu)	Purge/L	Descr.
(0955)	15.19	319	6.86	7.35	136.4	2.14	0.3/min	clear
(1000)	15.15	330	4.37	7.21	138.5	3.72	"	clear
(1005)	15.13	346	3.90	7.09	140.6	4.35	"	clear
(1010)	15.12	348	3.83	7.06	141.3	3.54	"	clear
(1015)	15.15	338	3.92	7.07	140.8	3.06	"	clear
(1020)	15.29	328	3.95	7.07	140.3	3.07	"	clear
(1020)	Readings Stable							
(1030)	15.25	330	3.99	7.05	139.9	3.33	Post purge readings	

Sample Time (1025)
Samples Collected: (3) 8260C, (1) TM

11/27/13 RAAP B03204-137E KFC/SW F.B.#11

General Notes:
- Weather- 30's, overcast, snow flurries
- PPE- Nitrile gloves, eye protection, steel toe boots, white flame retardant coveralls
- All purge water removed & disposed of at dedicated on-site location.
- Dedicated well skirt & tubing used at 13MW8.
- All equipment deconed on-site
- Decon water containerized
- River level is high due to recent heavy rains.

13MW8
TD = 26.21 Post purge/devel. TD = 26.21
DTW = 16.58
Begin Purge: (0840)
End purge (0945)

Used development pump to pump out approx. 28 gallons. Surged pump by hand to rile water and remove as much silt from well as possible. Consistency of purge water was much less cloudy/muddy than previous well-developments. Cleaned pump thoroughly before collecting EB.

EQUIPMENT BLANK
Sample Time (1245)
Samples collected (3) 8260C

12/5/13 RFAAP B03204-11 KFC/TBE F.B.#11

General Notes:
- Weather- Overcast, 50s
- PPE- Eye Protection, Nitrile gloves
- Calibrations- YSI 650 MDS
  - pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 10.00
  - Conductivity reads 1413 µs in 1413 µs std
  - DO% = 100
  - HACH 2100Q Turbidimeter: 0.02 - 1000 NTU
- All purge water disposed of at dedicated location onsite
- Dedicated tubing and well skirts used at each well
- All equipment decontaned before and after each use
- All Samples Collected - Stored - and transported in coolers on ice

10D3D
DTW- 18.03 Begin Purge (1041)
Post purge DTW 17.74 Initial Purge - clear

TIME	Temp (C°)	Cond (µs)	DO mg/L	pH	ORP (mv)	Turb (ntu)	Purge L	Desc.
(1045)	13.91	555	3.81	7.40	155.4	1.37	≥0.3 L/min	clear
(1050)	14.02	535	4.71	7.46	153.9	0.90	"	"
(1055)	14.06	531	5.08	7.46	154.2	0.34	"	"
(1100)	14.00	532	5.42	7.47	153.4	0.41	"	"
(1105)	13.87	531	5.22	7.47	156.3	0.42	"	"
(1110)	13.96	531	5.26	7.46	157.9	0.90	"	"
(1115)	14.09	532	5.33	7.46	157.3	0.17	"	"
(1120)	14.04	532	5.36	7.46	157.8	0.42	"	"
(1125)	14.06	531	5.29	7.46	157.9	0.23	"	"
(1125)	Readings Stable							
(1145)	14.17	530	5.36	7.47	155.9	0.40	Post Purge Reading	

Sample Time (1130)
Samples Collected: (3) 8260C

12/5/13 RAAP B03204-11 TQE1KFC FB#11

10DUP - taken from 10D3D

Sample Time (1140)
Samples Collected: (3) 8260

16WC1B

DTW: 68.95
Post Purge DTW: 69.29

Begin Purge (1203)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge in	Desc
(1205)	13.66	503	8.31	6.42	239.6	0.27	≥0.3%/min	clear
(1210)	13.33	320	1.86	6.18	144.7	0.32	"	clear
(1215)	13.32	323	1.87	6.18	139.4	0.41	"	clear
(1220)	13.31	325	1.73	6.18	126.5	0.59	"	clear
(1225)	13.35	326	1.62	6.18	121.7	0.39	"	clear
(1230)	13.37	326	1.55	6.18	119.5	0.32	"	clear
(1235)	13.45	326	1.48	6.18	118.0	0.25	"	clear
(1240)	13.49	327	1.43	6.17	117.0	0.20	"	clear
(1240)	Readings Stable							
(1300)	13.61	328	1.52	6.18	115.4	0.22	Post Purge Reading	

Sample Time (1245)
Samples Collected: (2) TM

16WDUP - taken from 16WC1B

Sample Time (1255)
Samples Collected: (2) TM

12/6/13 RAAP B03204-11 TQE1KFC FB#11

** For general notes see page 88 below 13MW8

Static Water Level Table

Well	DTW	Post Purge DTW	Notes
13MW1	21.11	DTW only	
13MW2	21.30	23.04	
13MW3	15.38	15.47	
13MW4	16.73	17.54	
13MW5	17.03	16.87	
13MW6	15.97	16.18	
13MW7	15.65	15.86	
13MW8	16.71	17.19	Entered 12/10 EK

13MW3

DTW: 15.38
Post Purge DTW: 15.47

Begin Purge (0735)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge in	Desc
(0740)	15.09	646	7.59	6.93	144.6	11.0	≥0.3%/min	clear
(0745)	15.07	644	7.49	6.90	149.5	1.00	"	clear
(0750)	15.04	638	6.96	6.89	161.1	0.76	"	clear
(0755)	14.99	637	6.98	6.90	163.9	0.40	"	clear
(0800)	15.02	636	6.90	6.90	165.2	0.19	"	clear
(0805)	15.07	633	6.91	6.89	167.8	0.17	"	clear
(0810)	15.10	633	6.95	6.89	168.9	0.15	"	clear
(0810)	Readings Stable							
(0838)	14.98	629	7.08	6.91	173.0	0.34	post purge reading	

Sample Time (0815)
Samples Collected: (3) 8260, (2) RSK175, (1) TOC
(1) TM, (1) DOC, (1) DM, (1) perchlorate, (2) IC300, (1) IC300
(1) Alkalinity, (2) 8270D, (3) 8330B/8332

13MWDUP2 - taken from 13MW3

Sample Time (0825)
Samples Collected: (3) 8260

12/6/13 RAAP B03204-11 TQE/KFC FB#11

13MW8

DTW: 16.71 Begin Purge (0985)

Post Purge DTW: 17.19 Initial Purge:

Time	Temp(°C)	Cond(µS)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(0930)	12.63	1000	7.83	7.31	67.4	10.3	≥0.3 L/min	clear
(0935)	14.98	1023	2.29	7.24	35.5	15.4	"	clear
(0940)	14.80	1025	2.98	7.24	29.3	15.0	"	clear
(0945)	14.86	1025	2.93	7.23	24.5	12.0	"	clear
(0950)	14.90	1025	2.67	7.23	24.2	9.26	"	clear
(0955)	14.92	1009	3.08	7.18	34.8	8.85	"	clear
(1000)	14.92	991	2.88	7.14	42.8	13.3	"	clear
(1000)	Readings Stable							
(1015)	14.89	985	3.07	7.09	55.1	12.6		Post purge reading

Sample Time (1005)

Samples collected: (3) 8260, (2) RSK, (1) TOC, (1) DOC, (1) DM, (1) Perchlorate, (2) IC300, (1) IC300, (1) Alkalinity

GENERAL NOTES:

- Weather - overcast 50s, thunderstorms in area
- PPE - Eye protection, nitrile gloves, flame retardant coveralls, steel-toed chemical resistant boots
- CALIBRATIONS: YSI 650 MDS
  - pH: 4.00 = 4.00, 7.00 = 7.00, 10.00 = 9.98
  - Conductivity reads 1414 µs in a 1413 µs standard
  - DO% = 100 %
  - HACH 2100Q Turbidimeter range: 0.02 - 1000 NTU
- Dedicated tubing & well skirts used at each well.
- All samples collected, stored & transported on ice in coolers.
- All purge water disposed of at designated location on-site.
- All equipment decon'ed before and after each sampling point
- Perchlorate samples filtered w/ 0.2 micron filter.

(89)

12/6/13 RAAP B03204-11 TQE/KFC FB#11

13MW5

DTW: 17.03 Begin Purge (1028)

Post Purge DTW: 16.87 Initial Purge: clear

Time	Temp(°C)	Cond(µS)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc.
(1030)	14.48	718	7.68	7.14	118.7	2.98	≥0.3 L/min	clear
(1035)	14.94	717	6.11	7.02	122.5	1.28	"	clear
(1040)	14.99	705	6.73	6.98	128.2	0.80	"	clear
(1045)	14.93	705	6.47	6.97	132.1	0.55	"	clear
(1050)	14.98	705	6.78	6.97	135.8	0.59	"	clear
(1055)	15.00	706	6.89	6.97	138.6	0.71	"	clear
(1100)	15.01	706	6.57	6.97	140.5	0.62	"	clear
(1100)	Readings Stable							
(1145)	15.06	706	6.60	6.98	140.5	0.76		Post purge reading

Sample Time (1105)

Samples collected: (9) 8260, (6) RSK, (3) TOC, (3) DOC, (3) TIN, (3) DM, (3) Perchlorate (6) IC300, (3) IC300, (3) Alkalinity, (6) 8270D, (12) 8330B/8332

13MW4

DTW: 16.73 Begin Purge (1203)

Post Purge DTW: 18.54 Initial Purge: clear

Time	Temp(°C)	Cond(µS)	DO mg/L	pH	ORP(mV)	Turb(NTU)	Purge L	Desc
(1205)	14.89	562	3.10	7.20	131.8	0.41	≥0.3 L/min	clear
(1210)	14.95	567	2.41	7.23	122.8	0.75	"	clear
(1215)	14.94	578	2.38	7.23	120.5	0.63	"	clear
(1220)	14.96	506	3.92	7.14	121.5	1.98	"	clear
(1225)	14.91	518	4.09	7.10	125.5	2.77	"	clear
(1230)	14.92	510	4.12	7.01	130.1	3.01	"	clear
(1230)	Readings Stable							
(1300)	14.88	501	4.54	6.91	139.6	2.67		Post Purge Reading

Sample Time (1235)

Samples Collected: (3) 8260, (2) RSK 175, (1) TOC, (1) TIN, (1) DOC, (1) DM, (1) Perchlorate, (2) IC300, (1) IC300, (1) Alkalinity, (2) 8270D, (4) 8330/8332

(90)

13MW DUP - taken from 13MW4

Sample Time (1250)
Samples Collected: (2) RSK 175, (1) TOC, (1) TM
(1) DOC, (1) DM, (1) Perchlorate, (2) IC300, (1) IC300
(1) Alkalinity, (2) 8270D, (4) 8330/8332

13MW6
DTW: 15.97
Post Purge DTW: 16.18
Begin Purge (1309)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge k	Desc
(1310)	14.41	854	4.98	6.96	146.1	4.20	≈0.3 L/min	clear
(1315)	14.40	883	4.32	6.96	145.3	2.11	"	clear
(1320)	14.35	885	4.08	6.96	144.5	1.06	"	clear
(1325)	14.40	885	4.14	6.96	144.3	0.57	"	clear
(1330)	14.40	886	4.45	6.96	144.2	0.69	"	clear
(1335)	14.41	886	4.32	6.96	144.6	0.63	"	clear
(1340)	14.43	886	4.27	6.96	144.6	0.58	"	clear
(1340)	Readings Stable							
(1401)	14.51	887	4.44	6.97	140.9	0.37	Post Purge Reading	

Sample Time (1345)
Samples Collected: (3) 8260, (2) RSK 175, (1) TM
(1) TOC, (1) DOC, (1) DM, (1) Perchlorate, (2) IC300, (1) IC300
(1) Alkalinity, (2) 8270D, (3) 8330/8332

13MW7
DTW: 15.65
Post Purge DTW: 15.86
Begin Purge (1417)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge k	Desc
(1420)	15.47	636	3.90	6.91	146.0	0.26	≈0.3 L/min	clear
(1425)	15.45	685	3.39	6.90	143.8	0.19	"	clear
(1430)	15.51	683	3.18	6.91	141.6	0.19	"	clear
(1435)	15.53	678	3.31	6.92	141.3	0.21	"	clear
(1440)	15.54	673	3.70	6.91	141.9	0.26	"	clear
(1445)	15.58	668	3.81	6.91	142.6	0.30	"	clear
(1450)	15.57	667	3.82	6.91	142.8	0.35	"	clear
(1450)	Readings Stable							
(1510)	15.59	660	3.98	6.91	141.0	0.61	Post Purge Reading	

Sample Time (1455)
Samples Collected: (3) 8260, (2) RSK 175, (1) TM, (1) TOC
(1) DOC, (1) DM, (1) Perchlorate, (2) IC300, (1) IC300, (1) Alkalinity
(2) 8270D, (3) 8330/8332

13MW2
DTW: 21.30
Post Purge DTW: 23.04
Begin Purge (1529)
Initial Purge: clear

Time	Temp(C)	Cond(us)	DO mg/L	pH	ORP(mv)	Turb(NTU)	Purge k	Desc
(1530)	14.67	714	8.68	7.00	148.6	0.35	≈0.3 L/min	clear
(1535)	14.58	715	7.25	6.93	156.9	0.25	"	clear
(1540)	14.59	715	7.14	6.93	159.5	0.19	"	clear
(1545)	14.62	715	7.17	6.93	162.9	0.30	"	clear
(1550)	14.66	715	7.21	6.93	164.8	0.45	"	clear
(1555)	14.67	715	7.33	6.93	166.0	0.81	"	clear
(1555)	Readings Stable							
(1607)	14.73	715	7.44	6.94	163.6	0.61	Post Purge Reading	

COMPLETED 1/8/14 - KFC

Sample Time (1600)
Samples Collected: (3) 8260, (2) RSK 175, (1) Perchlorate
(2) IC300, (1) IC<300

APPENDIX F

CORRESPONDENCE

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
TDD (804) 698-4021
www.deq.virginia.gov

Douglas W. Domenech
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

June 26, 2013

VIA ELECTRONIC MAIL
Mr. Jay Stewart
Environmental Manager
Radford Army Ammunition Plant
4050 Pepper's Ferry Road
Radford, Virginia 24141

Re: Radford Army Ammunition Plant, Radford, VA
EPA ID No.VA1210020730, Post-Closure Care Permit (Units 5, 7, 10, and 16)
Approval of Closure of Hazardous Waste Management Unit 7 (former Surface Impoundment)

Dear Mr. Stewart:

The Virginia Department of Environmental Quality (DEQ) is in receipt of the ***Closure Report Addendum*** for Hazardous Waste Management Unit (HWMU) 7 by Draper Aden Associates on behalf of Radford Army Ammunition Plant (RAAP) that was received on February 11, 2013. This February 11, 2013, document presents the results of additional closure activities performed in support of closure of Unit 7 since the DEQ's receipt of the ***Closure Report*** for HWMU 7 on February 15, 2012.

The DEQ has determined that Unit 7 meets the criteria for closure of soils and groundwater, This finding is based on reviews by the DEQ staff (groundwater specialist – Vince Maidens (see memorandum attached), risk assessor – Sonal Iyer (see memorandum attached), statistician – Hasan Keceli (see memorandum attached) and Hazardous Waste Permit Writer - Russell McAvoy), of the ***Closure Report***, the ***Closure Report Addendum***, and the hazardous waste Post-Closure Care Permit language inclusive of the ***Closure Plan Amendment***. Closure activity results were compared to the requirements of the ***Closure Plan Amendment*** that became a part of the hazardous waste Post-Closure Care permit as a result of the Class 3 modification to that permit effective October 27, 2011.

The implications of clean closure of Unit 7 for soils and groundwater are as follows:

1. Upon re-issuance, permit conditions addressing HWMU 7 are removed from the hazardous waste Post-Closure Permit – that is currently in the renewal process. The expired permit is continued in accordance with 40 CFR § 270.51, since RAAP submitted a timely renewal permit application.

2. In conjunction with 1, the deed restriction in accordance with 40 CFR § 264.116 (Survey Plat) and 40 CFR § 264.119 (Post-Closure Notices) and currently in force addressing Unit 7 may be disregarded and voided.

3. Groundwater monitoring addressing Unit 7 may be discontinued immediately upon your receipt of this letter, and specifically; the compliance period is discontinued in accordance with the hazardous waste Post-Closure Permit – Module I, Section I.K.2 and Module V, Section V.F.2.c which state:

   "… . The compliance period (for Unit 7) during which the GPS (**Appendix G of Permit Attachment 3**) applies is eighteen (18) years. The original permit for unit 7 was issued on October 30, 1999, and became effective on November 30, 1999. The compliance period, therefore, continues until November 30, 2017 or until the Director approves clean closure in accordance with the closure plan amendment."

4. Non-Groundwater, Post-Closure related activities involving Unit 7 may be discontinued immediately upon your receipt of this letter, and specifically; these may be discontinued in accordance with the hazardous waste Post-Closure Permit – Module I, Section I.I.2 which states:

   "… . The hazardous waste surface impoundment (Unit 7) was closed in accordance with the closure plan on January 4, 1990, the post-closure care period shall extend to January 4, 2020, and the facility is required to manage this unit under a Post-Closure Permit until January 4, 2020 or until the Director approves clean closure in accordance with the closure plan amendment."

A closure verification inspection is not required by the Closure Plan Addendum under the hazardous waste Post-Closure Permit and, therefore, one was not performed. The DEQ's Blue Ridge regional Office did not have any comments with respect to the ***Closure Report*** and ***Closure Report Addendum*** as noted in correspondence dated June 20, 2013.

The ***Closure Plan Amendment*** is contained within the hazardous waste management permit that was issued to US Army Radford Army Ammunition Plant Facility for the post-closure care of four hazardous waste management units of one hazardous waste disposal facility located in Montgomery and Pulaski Counties, Virginia. HWMU 7 is located in Montgomery County, Virginia at north latitude 37° 11' 12'' and west longitude 80° 33' 21''. The permit became effective on November 4, 2002.

Based upon the Department's administrative and technical reviews of the above ***Closure Report***, ***Closure Report Addendum***, the Closure Certifications, and the supplemental information submitted, the Department has determined the information submitted demonstrates closure for the HWMU 7. The demonstration of closure is in accordance with the closure performance standards in the DEQ approved ***Closure Plan Amendment***, the VHWMR, and the RCRA Regulations under 40 CFR § 264.111. The Department approves the Closure Certifications, the above the ***Closure Report***, and the ***Closure Report Addendum***, for the US Army Radford Army Ammunition Plant, Radford facility under EPA ID No. VA1210020730. Please note, however, that the Environmental Protection Agency retains the authority to address possible corrective action of continuing releases pursuant to the Hazardous and Solid Waste Amendments of 1984.

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have 30 days from the date of service of this decision to initiate a legal appeal by filing a notice of appeal with:

David K. Paylor, Director
Department of Environmental Quality
629 East Main Street
PO Box 10009
Richmond VA 23240-0009

In the event that this decision is served to you by mail, the date of service will be calculated as three days after the postmark date. Please refer to Part 2A of the Rules of the Supreme Court of Virginia, which describes the required content of the Notice of Appeal, including specifications of the Circuit Court to which the appeal is taken, and additional requirements concerning appeals from decisions of administrative agencies.

If you have any questions or comments concerning this matter, please contact Russell L. McAvoy, P.E., of my staff at (804) 698-4194 or by e-mail at russell.mcavoy@deq.virginia.gov.

Sincerely,

Leslie A. Romanchik

Leslie A. Romanchik
Hazardous Waste Program Manager
Office of Waste Permitting and Compliance

Enclosures: DEQ Staff Memorandums - 3

cc: Andrea Barbieri, EPA, Region III (3LC50)
Aziz Farahmand, DEQ, Blue Ridge Regional Office
Beth Lohman, DEQ, Blue Ridge Regional Office
Ann Regn, DEQ, CO
Sonal Iyer, DEQ, CO
Pat McMurray, DEQ, CO
Hasan Keceli, DEQ, CO
Jutta Schneider, DEQ, CO
Vince Maiden, DEQ, CO
Julia King–Collins, DEQ, CO
Central Hazardous Waste Files

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

OFFICE OF REMEDIATION PROGRAMS

Via Electronic mail

MEMO

TO: Russ McAvoy

Thru: Pat McMurray PM

FROM: Sonal Iyer SI

DATE: June 08, 2012

SUBJECT: Technical Risk Assessment Review: Closure Report for HWMU 7 at Radford Army Ammunition Plant. Dated February 9, 2012
EPA ID: VA1210020730

Per our internal meeting on May 24, 2012, this memorandum provides review comments for risk assessment portion of the closure report mentioned above. This review does not include comparing protocols and approaches for evaluating the unit against those in approved closure plan. The review also does not include list of HCOCs analyzed in soils and groundwater, facility-wide background concentrations, Laboratory data validation, statistical evaluation, groundwater data and evaluation, permit conditions and/or exemptions, and any other information besides risk assessment calculations. Furthermore, the method detection limits for soil and groundwater samples is assumed to be below applicable risk based levels. If such is not the case, the risk assessment outcomes may be different than discussed herein and may need to be revisited. The risk assessment is carried out to demonstrate that 'the unit no longer meets the definition of waste.'

Comments:

1. Section 3.3.2. Soil Sample Collection and Analytical Results, page 13: The 2004 samples show Aroclor in a few samples and the facility has provided some rationale about possibility of overestimation. However, in absence of confirmatory samples DEQ will consider the results as reported for risk assessment. Over/underestimation of potential risk due

to data limitation may be discussed qualitatively in the uncertainties section.

2. It is noted that the chromium analysis in soils is only for total chromium and data for hexavalent chromium is not available.

3. Section 4.3.2.1. Comparison to Risk-Based Concentrations (residential Screen), page 17: DEQ does not understand the purpose of including this section, corresponding tables, and any conclusions because risk based screening is not considered to demonstrate closure. All detected chemicals above the background must be included in quantitative risk assessment for residential receptor and for fate-and-transport evaluation. The facility has included all detected chemicals in risk assessment. To avoid confusion, please remove this section and corresponding table.

4. Table 6: This table uses maximum detected concentration for all chemicals, except Aroclor. Only for this chemical, average concentration is used. If 95% UCL of the mean cannot be calculated due to data set limitation, maximum detected concentrations must be used. The facility is advised to either exclude this table or recalculate using 95% UCL of the mean for Aroclor-1254.

5. Section 4.3.2.5. Uncertainty Analysis, page 19: Please remove the statements relating to Radford's intention to leave the soil 'in-place' unless Radford AAP is willing to develop a deed restriction that will prohibit any surface disturbance of the soil in future.

6. Section 4.4. Results of Clean Closure Evaluation for Residual Material and Soil, page 20: This evaluation does not include fate-and-transport assessment. However, please see comment # 7 below.

7. Section 5.0. Clean Closure Evaluation for Groundwater, pages 22 through 26: For a land based unit with interrupted bottom liner, ideally, the groundwater data would be included in quantitative risk assessment for residential receptor using same protocols as described in REAMS user's manual and cumulative risk would be calculated from soil and groundwater. Also, all the detected HCOCs in soils must be evaluated via fate-and-transport modeling. However, the unit has had a post-closure groundwater monitoring permit for many years and based on internal DEQ discussion, this review takes the position that groundwater water data evaluation per permit conditions may be sufficient to meet clean closure requirements for groundwater as well as fate-and-transport

evaluation. Therefore current review does not include this entire section and potential for impact to surface water or vapor intrusion and Groundwater/ Permitting Staff may provide comments/decisions regarding groundwater condition, monitoring requirements, and clean closure status.

8. Appendix E. Chronic Daily Intake Calculations, Toxicity Factors: The facility has not used REAMS software to calculate risk and hazard even though the closure plan clearly required the use of it. However, the information provided by the facility reflects REAMS methodology, assumptions, default values, and calculation protocols. Therefore these calculations are deemed acceptable. The facility needs to add carcinogenic risk-adults and carcinogenic risk-child to obtain life-time cancer risk (in line with REAMS methodology). Please add the risk for each chemical, each pathway, and cumulative risk. For non-carcinogenic hazard index, please use assessment results for child receptor. Please provide a summary table showing these calculations.

Based on the information provided in the above submittal and review conducted as specified in the opening paragraph, the soil/stabilized waste mass, bottom clay liner and soils beneath the HWMU 7:

- Fail current individual risk based performance criteria-residential receptor for Aroclor 1254;
- Pass current risk based performance criteria-residential receptor of cumulative risk within 1E-4 to1E-6 and hazard index at or below 1.

This report and review did not include results of fate-and transport evaluation.

If there are any questions pertaining to this memorandum, I can be contacted at 698-4259.

DEQ
Department of Environmental Quality

OFFICE OF REMEDIATION PROGRAMS

MEMO

TO: Russ McAvoy

THROUGH: Pat McMurray PM

FROM: Hasan Keceli H.K

DATE: July 24, 2012

CC: Leslie Romanchik

SUBJECT: Background Development for for Radford AAP Permit # VA12100270730

The facility has developed background for the site as suggested by the Department in 2001. The background limits are acceptable. Please let me know if you have any questions.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND PROTECTION & REVITALIZATION DIVISION
OFFICE OF REMEDIATION PROGRAMS

MEMORANDUM

TO: Russ McAvoy
Office of Waste Permitting and Compliance

THROUGH: Jutta Schneider
Office of Remediation Programs

FROM: Vincent Maiden
Office of Remediation Programs

DATE: March 5, 2013

SUBJECT: Radford Army Ammunition Plant, Radford, VA – EPA ID No. VA1210020730
Closure Report & Addendum for HWMU-7 – Post Closure Care Permit
Clean Closure Evaluation of Groundwater – Technical Review Comments

---

The purpose of this memorandum is to document the review of the groundwater related sections of the Closure Report for HWMU-7 dated February 2012, Closure Report Addendum for HWMU-7 dated January 2013, and Closure Plan approved September 27, 2011. Please accept the following observations and comments.

Closure Report for HWMU-7 (February 2012)

1. **Section 5.0 Clean Closure of Groundwater**

   - The report indicates that the clean closure evaluation for groundwater was carried out as stipulated in the approved Closure Plan Amendment for HWMU-7 dated July 2010, which was incorporated in to the permit on September 27, 2011 as part of a Class 3 permit modification.

   - A review of the approved Closure Plan Amendment for HWMU-7 was conducted to confirm. The Closure Plan Amendment states in Section 2.2 that "In the event that the residual material and underlying soils at HWMU-7 meet the clean closure standards specified by the VDEQ, Radford AAP will attempt to demonstrate clean closure for groundwater at HWMU-7 as well. Clean closure for groundwater at HWMU-7 will be demonstrated by comparing the most recent groundwater sample analytical results at the time that the Closure Report is prepared to the Groundwater Protection Standards (GPSs) for the Unit." This was also described in Section 7.0 and Section 8.3 of the Closure Plan Amendment.

- The groundwater clean closure evaluation focused on data collected during the 4th Quarter 2011 Semi-Annual Compliance Monitoring Event and the 2nd Quarter 2011 Annual Groundwater Monitoring Event. This would be the most recent data and is acceptable for this evaluation.

- For the purpose of this evaluation the groundwater data was compared to the current Groundwater Protection Standards (GPS) for the facility, last revised September 27, 2011, and presented in Appendix H of the report.

2. **Section 5.2 Constituents Detected Above Quantitation Limits & Section 5.3 Comparison to Groundwater Protection Standards.**

   - The report indicated that no organic Hazardous Constituent of Concern (HCOC) were detected and concentrations equal to or greater than their respective QLs in the groundwater at HWMU-7 during the Second Quarter 2011 and Fourth Quarter 2011 monitoring events. Please note that Chloroform was observed but this exceedance was resolved by a June, 2007 ASD approval (details provided in item 3).

   - The report did reveal that five inorganic HCOC were detected at concentrations above their respective QLs in the Second Quarter 2011 and Fourth Quarter 2011 monitoring events. These detections include barium, chromium, cobalt, nickel, and zinc.

   - The facility compared the monitoring results, as discussed above, against the approved GPS (Appendix H) for the unit. This comparison is consistent with the approved Closure Plan.

   - Cobalt was the only detected constituent observed at concentrations above its approved GPS. The cobalt GPS for the Unit is a site-specific background GPS of 5µg/l. Cobalt was detected in plume well 7W13 at a concentration of 11.7µg/l during the events evaluated. This concentration is consistent with the historical cobalt concentrations in this well (5.3µg/l to 16.4µg/l).

   - Radford AAP submitted an Alternate Source Demonstration (ASD) for Cobalt to the Department on December 15, 2011. The results of the ASD concluded that the total cobalt concentrations observed in groundwater at HWMU-7 are derived from ambient, naturally-occurring and naturally variable sources. The Department approved the ASD in correspondence dated January 5, 2012. Based on the ASD approval the facility was not required to remediate cobalt in groundwater at HWMU-7 and no additional action was required in response to the observed exceedance.

3. **Section 5.4 Alternate Source Demonstration for Additional Detected Constituents**

   - Chloroform, which is not an HCOC for HWMU-7, was detected during the Second Quarter 2011 monitoring event and in historical monitoring events at concentrations ranging from below the QL of 1µg/l to a maximum of 3µg/l. These detections are orders of magnitude below the drinking water MCLG of 70µg/l for Chloroform and the Total Trihalomethanes MCL of 80µg/l.

- Radford AAP prepared an ASD for chloroform at HWMU-7 which was received by the on January 31, 2007 and approved by the Department in a letter dated June 14, 2007.

- Chloroform is not a HCOC for HWMU-7 and the Department approved an ASD resolving the noted exceedances. Therefore, the detection of chloroform does not impact the eligibility for groundwater clean closure at this unit.

4. **Section 5.5 Evaluation of Potential for Aroclor-1254 Migration to Groundwater**

- The Post Closure Care Permit for HWMU-7 did not require that the facility analyze groundwater for Aroclor-1254. Therefore, this constituent is not a listed as a groundwater HCOC and groundwater data was not collected or submitted for consideration in the closure report. In subsequent discussions with the Department the facility agreed to further evaluate Aroclor-1254 with additional soil and groundwater sampling and present information in a closure report addendum.

5. **Section 5.6 Results of Clean Closure Evaluation for Groundwater**

- The report concludes that the results of the clean closure evaluation reveal that HCOCs are not currently present in groundwater at HWMU-7 at concentrations greater than their respective GPS or the exceedances have been demonstrated (through ASD approval) to be consistent with site-wide background (cobalt) or derived from a source other than HWMU-7 (chloroform).

- The report states that Radford AAP has met the criteria, detailed in the approved Closure Plan Amendment, for clean closure of groundwater at HWMU-7.

Closure Report Addendum for HWMU-7 (January 2013)

6. Section 5.0 Clean Closure Evaluation For Groundwater & Section 5.1 Aroclor Evaluation

- Verification soil samples confirmed the presence of Aroclor 1254 in the soils underlying HWMU-7. In lieu of fate-and-transport modeling the facility collected one round of groundwater samples for Aroclor 1254. On November 28-29, Draper Aden Associates collected groundwater samples for analysis for Aroclor 1254 from the permit specified Compliance Monitoring wells for HWMU-7. The laboratory analytical results indicated that Aroclor 1254 was not detected in any of the groundwater samples at concentration greater than the laboratory MDL.

7. Section 5.2 Calendar Year 2012 Groundwater Compliance Monitoring

- The Closure Report Addendum updated the clean closure evaluation for groundwater presented in the February 2012 report. The semi-annual groundwater compliance monitoring date for 2012 was presented and evaluated.

- Based on the data presented, hazardous waste constituents are not present in groundwater at HWMU-7 at concentrations greater than their respective GPS or have been demonstrated to

be derived from a source other than the Unit as approved by the Department.

In conclusion, a review of the Closure Report for HWMU-7 (February 2012) and Closure Report Addendum (January 2013) revealed that the facility appears to have met the groundwater clean closure standards set forth in the Amended Closure Plan dated July 2010. However, please note that as described in Section 2.2 of the Closure Plan, the clean closure of groundwater is contingent on the facility meeting clean closure requirements for the residual material and the underlying soils at HWMU-7.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
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Douglas W. Domenech
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1 (800) 592-5492

January 6, 2014

Mr. Jay Stewart
Environmental Manager
BAE Systems
Ordnance Systems Inc.
4050 Pepper's Ferry Road
Radford, Virginia 24141

VIA ELECTRONIC MAIL

Re: Extension Request for HWMU-10
Radford Army Ammunitions Plant
4050 Pepper's Ferry Road, Radford, Virginia 24141
EPA ID#: VA1210020730

Dear Mr. Stewart:

The Department of Environmental Quality, Office of Remediation Programs (the Department) has reviewed the extension request for the Radford Army Ammunitions Plant (Facility) located in Radford, Virginia. The Department understands that BAE Systems, Ordnance Systems Inc. (BAE), in a letter dated December 5, 2013 is requesting a60-day extension to the semiannual groundwater monitoring deadline for Hazardous Waste Management Unity (HWMU) 10 (currently December 31, 2013) and reporting deadline (currently March 1, 2014) for HWMUs 5, 10 and 16. The Department further understands that this extension request is based on previous conversations with the Department in regard to a request for clean closure on HWMU-10. Based upon a review of the letter and file for the Facility, this extension request is approved.

The new reporting deadline will now be April 30, 2014. Please note that the Department is currently reviewing the clean closure request for HWMU-10. If, as indicated in your letter, the approval is received by January 14, 2014, then the Department would expect the report to be submitted by March 1, 2014 as proposed.

The Department also notes that the total cobalt detection at Point of Compliance well 16WC1B (33.9 ug/L) was greater than the revised Groundwater Protection Standard for total cobalt (5 ug/L). The Department understands that verification sampling has been conducted. Please contact the Department when the results of the verification sampling are received from the laboratory.

You may contact me to discuss any questions or issues that arise. I can be reached at 703-583-3825 or by email at Kurt.Kochan@deq.virginia.gov.

Respectfully,

Kurt W. Kochan
Corrective Action Project Manager

cc: RAAP Correspondence File
Jutta Schneider, VDEQ-CO
Aziz Farahmand, VDEQ-BRRO
Matt Albers, BAE
Jim McKenna, ACO Staff

ORDNANCE SYSTEMS INC.
Radford Army Ammunition Plant
4050 Pepper's Ferry Road
Radford Virginia 24141

January 14, 2014

Jutta Schneider
Program Manager
Office of Remediation Programs
Virginia Department of Environmental Quality
629 East Main Street
Richmond, Virginia 23219

Subject: Notification of Groundwater Verification Sample Results and Extension Request for Alternate Source Demonstration
Post Closure Care Permit HWMUs 5, 10, & 16
Radford Army Ammunition Plant, Radford, Virginia
EPA ID#: VA1210020730

Dear Ms. Schneider:

During Fourth Quarter 2013, BAE Systems, Ordnance Systems Inc., completed semiannual groundwater monitoring for Hazardous Waste Management Units (HWMUs) 5 and 16 located at the Radford Army Ammunition Plant (Radford AAP) in Radford, Virginia. On December 5, 2013, Radford AAP collected a verification sample from HWMU-16 point of compliance well 16WC1B to confirm or refute an initial detection of total cobalt at a concentration greater than the Groundwater Protection Standard (GPS) of 5 µg/l. Total cobalt was detected in the verification sample at a concentration of 36 µg/l, which is greater than the GPS of 5 µg/l. On December 20, 2013, Radford AAP collected a subsequent verification sample for analysis of total and dissolved cobalt; the results of the December 20, 2013 samples confirmed those of the December 5, 2013 verification sample. A map of HWMU-16 illustrating the distribution of total cobalt concentrations in groundwater at the Unit is attached.

In accordance with Permit Condition V.J.4.i.(3), Radford AAP will conduct an Alternate Source Demonstration (ASD) to evaluate whether the total cobalt concentration detected in well 16WC1B was due to 1) a source other than the Unit; 2) errors in sampling, analysis, and evaluation; or 3) natural variation in groundwater. Please note that total cobalt has never been detected in well 16WC1B at concentrations greater than 5 µg/l during previous groundwater monitoring events conducted at HWMU-16. Additionally, based on previous semiannual monitoring events, the groundwater elevation within well 16WC1B fluctuates by as much as 5 feet between Second Quarter and Fourth Quarter calendar year monitoring events. Therefore, as specified in Permit Condition V.J.4.i.(3)(c) Radford AAP proposes to collect four (4) independent samples at a frequency of one sample per calendar quarter to evaluate the effect of seasonal variation upon the total cobalt concentrations in groundwater. Due to the age of well 16WC1B (installed in 1987), Radford AAP will re-develop the well prior to collection of the first independent sample.

If the total cobalt concentrations detected in the independent samples remain above the GPS, Radford AAP will evaluate additional monitoring wells in the Horseshoe Area of the Facility (the area containing HWMU-16) for natural variability of total cobalt within the aquifer. Please note that in correspondence dated January 5, 2012, Radford AAP received VDEQ approval for a similar type of ASD for total cobalt at another Unit (HWMU-7) – the results of that ASD concluded that the total cobalt concentrations observed in groundwater at HWMU-7 above the GPS of 5 µg/l were derived from ambient, naturally occurring and naturally variable source, and the Facility was not required to take any further action.

Permit Condition V.J.4.i.(3)(c) states that the results of the ASD must be submitted to the VDEQ within 90 days of this notification letter. However, a component of this ASD is the collection of independent samples over the span of four calendar quarters in order to evaluate the effect of seasonal variation. Therefore, Radford AAP requests an extension to

the 90-day deadline for the ASD specified in the Permit. Radford AAP proposes to submit the results of the ASD to the VDEQ within 90 days following completion of the quarterly collection of the independent samples.

Complete details regarding the Fourth Quarter 2013 monitoring event (field data, laboratory data, and data validation reports) will be forwarded to the VDEQ in the forthcoming *Annual Groundwater Monitoring Report for Hazardous Waste Management Units 5, 10, and 16, Calendar Year 2013*, which is due to the VDEQ by April 30, 2014, as specified in VDEQ correspondence dated January 6, 2014.

If you have any questions or concerns, please contact Mr. Matt Alberts at 540/639-8722 (matt.alberts@baesystems.com).

Sincerely,

Jay Stewart, Environmental Manager
BAE Systems, Ordnance Systems Inc.

c: w/ enclosures
Aziz Farahmand, VDEQ-BRRO
Vince Maiden, VDEQ-SWRO

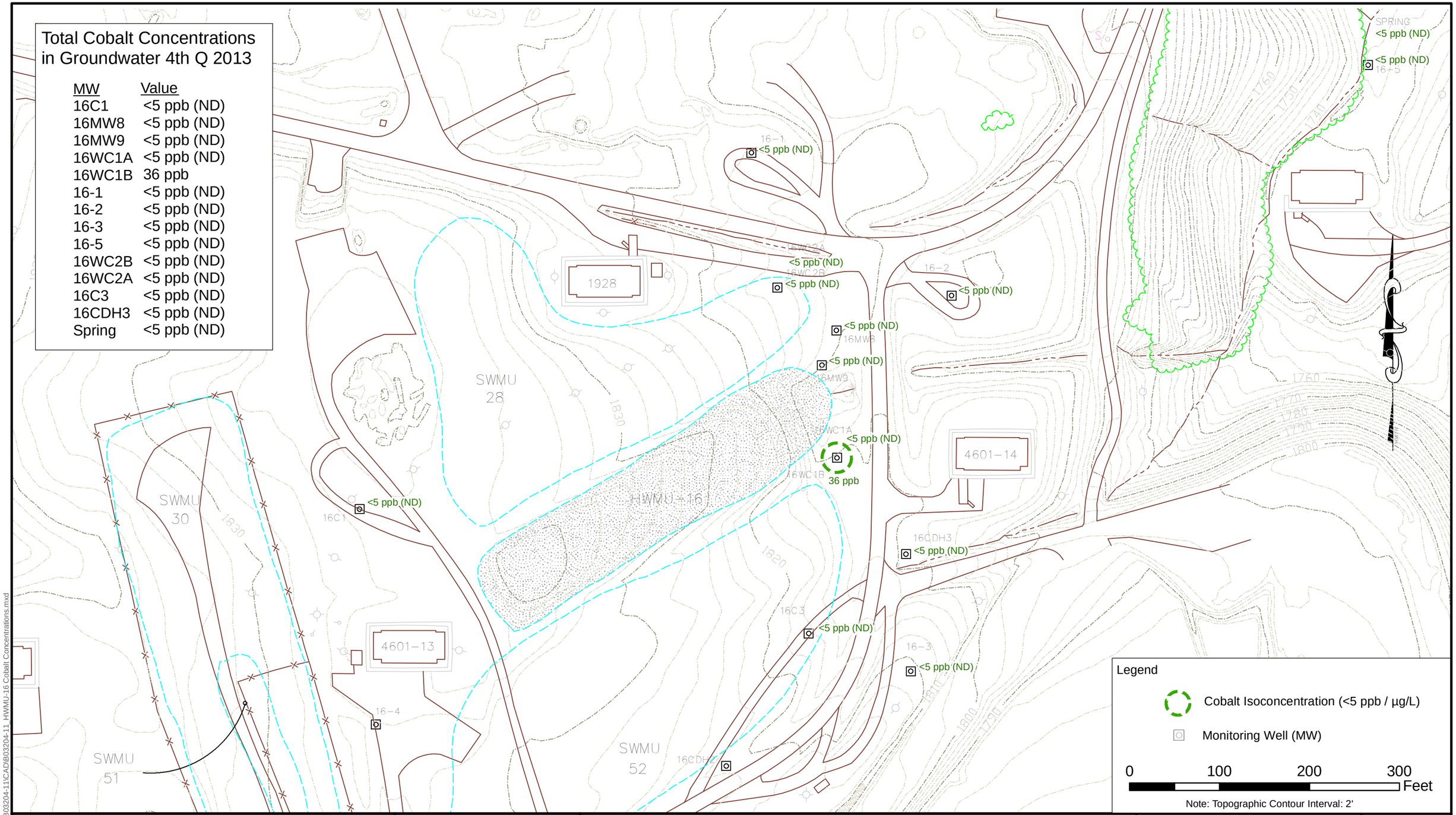
bc: BAE Administrative File
J. McKenna, ACO Staff
Matt Alberts, BAE Staff
Mike Lawless, Draper Aden Associates
Env. File

Coordination: J. McKenna

Attachments: 14-0900-014-A HWMU 16 Cobalt Concentrations

Total Cobalt Concentrations in Groundwater 4th Q 2013

MW	Value
16C1	<5 ppb (ND)
16MW8	<5 ppb (ND)
16MW9	<5 ppb (ND)
16WC1A	<5 ppb (ND)
16WC1B	36 ppb
16-1	<5 ppb (ND)
16-2	<5 ppb (ND)
16-3	<5 ppb (ND)
16-5	<5 ppb (ND)
16WC2B	<5 ppb (ND)
16WC2A	<5 ppb (ND)
16C3	<5 ppb (ND)
16CDH3	<5 ppb (ND)
Spring	<5 ppb (ND)



Draper Aden Associates
Engineering ◆ Surveying ◆ Environmental Services
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	DLD/SMF
CHECKED	SN
DATE	01-14-14

HWMU-16 Total Cobalt Concentrations in Groundwater 4th Q 2013

RADFORD ARMY AMUNITION PLANT

Radford, Virginia

SCALE: 1" = 100'

PLAN NO. B03204-11

FIGURE 1

Path: P:\B03\200\B03204\B03204-11\CAD\B03204-11_HWMU-16 Cobalt Concentrations.mxd

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
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www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4020
1-800-592-5482

January 21, 2014

Mr. Jay Stewart
Environmental Manager
BAE Systems
Ordnance Systems Inc.
4050 Pepper's Ferry Road
Radford, Virginia 24141

VIA ELECTRONIC MAIL

Re: Extension Request for Alternate Source Demonstration
Radford Army Ammunitions Plant
4050 Pepper's Ferry Road, Radford, Virginia 24141
EPA ID#: VA1210020730

Dear Mr. Stewart:

The Department of Environmental Quality, Office of Remediation Programs (the Department) has reviewed the extension request for the Radford Army Ammunitions Plant (Facility) located in Radford, Virginia. The Department understands that BAE Systems, Ordnance Systems Inc. (BAE), in a letter dated January 14, 2014 is requesting an extension for the submittal of the Alternate Source Demonstration (ASD) for total Cobalt, which was verified in well 16WC1B in December 2013.

Based on Permit Condition V.J.4.i.(3)(c), the Facility must collect four independent samples at a frequency of one per calendar quarter,. Therefore, the submittal of the ASD data results within 90 days following completion of the collection of the quarterly samples in approved.

EPA ID#: VA1210020730
Radford Army Ammunitions Plant
Radford, Virginia
January 21, 2014

The Department would request that the Facility provide a schedule for the required sampling. You may contact me to discuss any questions or issues that arise. I can be reached at 703-583-3825 or by email at Kurt.Kochan@deq.virginia.gov.

Respectfully,

Kurt W. Kochan
Corrective Action Project Manager

cc: RAAP Correspondence File
Jutta Schneider, VDEQ-CO
Aziz Farahmand, VDEQ-BRRO
Matt Albers, BAE
Jim McKenna, ACO Staff
Janet Frazier, DAA
Mike Lawless, DAA

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
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Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4020
1-800-592-5482

February 27, 2014

Mr. Jay Stewart
Environmental Manager
BAE Systems, Ordnance Systems Inc.
4050 Pepper's Ferry Road
Radford, Virginia 24141

VIA ELECTRONIC MAIL

Re: Proposed Additional Monitoring
Radford Army Ammunitions Plant
4050 Pepper's Ferry Road, Radford, Virginia 24141
EPA ID#: VA1210020730

Dear Mr. Stewart:

The Department of Environmental Quality, Office of Remediation Programs (the Department) has reviewed the proposed evaluation of the 906-17 Bio lift station outlined in a letter dated November 7, 2013 at the Radford Army Ammunitions Plant located in Radford, Virginia (Facility). In addition, the Department is providing additional comments on the proposed groundwater monitoring at 10D3D.

The Facility had previously submitted an Alternate Source Demonstration (ASD) for the detections of 2-propanol and acetone in monitoring well 10D3D above their respective Groundwater Protection Standards. However, the Department approved an ASD for each of these recognizing that the impacts were not caused by the unit.

As a condition of this approval, the Facility agreed to provide a report on the Bio Lift Station inspection that is scheduled to occur in July 2014 and to continue groundwater monitoring at 10D3D for 2-propanol and acetone independent of the requirements of the post closure care permit issued to the Facility to assure that groundwater conditions do not deteriorate and require further investigation in the future.

EPA ID#: VA1210020730
Radford Army Ammunitions Plant
Radford, Virginia
February 27, 2014

The implementation of the above-mentioned activities are sufficient to remove the groundwater post closure care requirements for HWMU-10 from the Post Closure Care Permit.

The Department approves the implementation of the evaluation and monitoring as proposed by the Facility. You may contact me to discuss any questions or issues that arise during implementation. I can be reached at 703-583-3825 or by email at Kurt.Kochan@deq.virginia.gov.

Respectfully,

Kurt W. Kochan
Corrective Action Project Manager

cc: RAAP Correspondence File
Andrea Barbieri, EPA Region 3
Jutta Schneider, VDEQ-CO
Russ McAvoy, VDEQ-CO
Aziz Farahmand, VDEQ-BRRO
Matt Albers, BAE
Jim McKenna, ACO Staff

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
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Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

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April 2, 2014

VIA ELECTRONIC MAIL
Mr. Jay Stewart
Environmental Manager
Radford Army Ammunition Plant
4050 Pepper's Ferry Road
Radford, Virginia 24141

Re: Radford Army Ammunition Plant (RAAP), Radford, VA
EPA ID No.VA1210020730, Post-Closure Care Permit (Units 5, 7, 10, and 16)
Approval of Closure of Hazardous Waste Management Unit 10 (former Equalization Basin)

Dear Mr. Stewart:

The Virginia Department of Environmental Quality (DEQ) approved the clean closure of soils associated with the RAAP's Equalization Basin for the Biological Treatment System, Hazardous Waste Management Unit (HWMU) 10, on December 8, 1998. The required closure PE and Owner/Operator certifications and closure report addressing HWMU 10 soils were submitted by the RAAP and approved by the DEQ under the soils clean closure approval.

The DEQ has determined, based on information submitted by the RAAP on July 30, 2013 and November 15, 2013, that RAAP meets the groundwater clean closure standards for HWMU 10 (see attached memorandum dated November 18, 2013). In addition, in correspondence to the RAAP dated September 10, 2012 (see Attachment), the DEQ approved an alternate source demonstration (ASD) which concluded that the observed acetone and 2-propanol concentrations in groundwater not associated with HWMU 10 were not derived from HWMU 10. The ASD concluded that acetone and 2-propanol concentrations observed in groundwater at HWMU-10 are derived from propellant production wastewater flowing through the Bioplant lift station and associated pressurized sewer lines located upgradient from point of compliance well 10D3D, and are not originating from HWMU-10. With the exception of acetone and 2-propanol, no constituents of concern have been detected in groundwater at concentrations greater than their

respective GPSs during the course of the Compliance groundwater monitoring program under the auspices of the Hazardous Waste Post-Closure Care Permit.

The implications of clean closure of Unit 10 for soils and groundwater are as follows:

1. Upon re-issuance, permit conditions addressing HWMU 10 are removed from the Hazardous Waste Post-Closure Care Permit – that is currently in the renewal process. The expired permit is continued in accordance with 40 CFR § 270.51, since RAAP submitted a timely renewal permit application.

2. In conjunction with 1, the deed restriction in accordance with 40 CFR § 264.116 (Survey Plat) and 40 CFR § 264.119 (Post-Closure Notices) and currently in force addressing HWMU 10 may be disregarded and voided.

3. Groundwater and non-groundwater, Post-Closure related activities involving HWMU 10 may be discontinued immediately upon your receipt of this letter, and specifically; these may be discontinued in accordance with the continued Hazardous Waste Post-Closure Care Permit – Module I, Section I.I. which states:

   I.I. PERMIT DURATION AND POST-CLOSURE CARE PERIOD

   *This Permit shall be in effect for ten (10) years from the date of issuance (**270.50(a)**). The post-closure period for each hazardous waste management unit shall begin after completion of closure of the unit and continue for 30 years after that date (**264.117(a)**), **or for a reduced period if the Director approves clean closure of the unit and the reduced period is sufficient to protect human health and the environment (264.117(a)(2)(i))**. The date of final closure certification for each unit is different; therefore, the final date of post-closure care is different for each unit.*

4. As a result of the ASD approval by the DEQ on September 10, 2012, (see Attachment), and the DEQ's Clean Closure Evaluation of Groundwater Memorandum dated November 18, 2013 (see Attachment), RAAP is required to provide a report on the Bio Lift Station inspection that is scheduled to occur in July 2014 and to continue groundwater monitoring at well 10D3D for 2-propanol and acetone independent of the requirements of the continued or the to-be issued Hazardous Waste Post-Closure Care Permit to assure that groundwater conditions do not deteriorate and require further investigation in the future. Please contact Kurt Kochan, the DEQ's hazardous waste groundwater specialist at kurt.kochan@deq.virginia.gov or (703) 583-3825 for submission requirements and evaluation criteria.

A closure verification inspection is not required in accordance with 40 CFR Section 264.120 and Post-Closure Care Permit Section II.E.2 because closure is not occurring after completion of the established Post-Closure Care Period for an individual hazardous waste disposal unit. In addition, as stated previously, a final closure inspection and PE and Owner/Operator Certifications were provided in supported of the soils closure of HWMU 10 in 1998.

Based upon the Department's administrative and technical reviews of the above referenced previously submitted groundwater data, the attached memorandums (2), the closure report and Closure Certifications for the HWMU 10 soils, and the supplemental information submitted, the Department has determined the information submitted demonstrates closure for the HWMU 10. The demonstration of closure is in accordance with the closure performance standards in the DEQ approved, continued Hazardous Waste Management Post-Closure Care Permit addressing HWMUs 5, 7, 10, and 16, the VHWMR, and the RCRA Regulations under 40 CFR § 264.111. The Department approves the cited above documentation and Closure Certifications for the US Army Radford Army Ammunition Plant, Radford facility under EPA ID No. VA1210020730. Please note, however, that the Environmental Protection Agency retains the authority to address possible corrective action of continuing releases pursuant to the Hazardous and Solid Waste Amendments of 1984.

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have 30 days from the date of service of this decision to initiate a legal appeal by filing a notice of appeal with:

David K. Paylor, Director
Department of Environmental Quality
629 East Main Street
PO Box 1105
Richmond, VA 23218

In the event that this decision is served to you by mail, the date of service will be calculated as three days after the postmark date. Please refer to Part 2A of the Rules of the Supreme Court of Virginia, which describes the required content of the Notice of Appeal, including specifications of the Circuit Court to which the appeal is taken, and additional requirements concerning appeals from decisions of administrative agencies.

If you have any questions or comments concerning this matter, please contact Russell L. McAvoy, P.E., of my staff at (804) 698-4194 or by e-mail at russell.mcavoy@deq.virginia.gov.

Sincerely,

Leslie A. Romanchik

Leslie A. Romanchik
Hazardous Waste Program Manager
Office of Waste Permitting and Compliance

Attachments (2):
The DEQ's Memorandum dated November 18, 2013 - Groundwater Clean Closure Approval, and
The DEQ's Letter dated September 10, 2012 - Groundwater Alternate Source Demonstration Approval

cc: Andrea Barbieri, EPA, Region III (3LC50)
Aziz Farahmand, DEQ, Blue Ridge Regional Office
Beth Lohman, DEQ, Blue Ridge Regional Office
Jutta Schneider, DEQ, CO
Kurt Kochan, DEQ, CO
Julia King-Collins, DEQ, CO
Central Hazardous Waste Files

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND PROTECTION & REVITALIZATION DIVISION
OFFICE OF REMEDIATION PROGRAMS

MEMORANDUM

TO: Russ McAvoy
Office of Waste Permitting and Compliance

THROUGH: Jutta Schneider
Office of Remediation Programs

FROM: Vincent Maiden
Office of Remediation Programs

DATE: November 18, 2013

SUBJECT: Radford Army Ammunition Plant, Radford, VA – EPA ID No. VA1210020730
HWMU – 10 Clean Closure Information – Post Closure Care Permit
Clean Closure Evaluation of Groundwater – Technical Review

The purpose of this memorandum is to document the review of the groundwater related information that was presented to the Department by the facility in a request to for approval of clean closure of HWMU-10 and ultimately the removal of the monitoring requirements from the HWMU 5,7,10 & 16 Post Closure Care (PCC) permit. This information was submitted on July 30, 2013 with a follow up letter submitted on November 15, 2013. It is noted that the Department granted clean closure of soils at HWMU-10 in 1998.

A review of the information provided and facility file revealed that the facility appears to have met the groundwater clean closure standards. Historically 2-propanol and acetone have been noted above their respective Groundwater Protection Standard (GPS) in monitoring well 10D3D. However, the Department approved an Alternate Source Demonstration (ASD) for each of these recognizing that the impacts were not caused by the unit.

Based on the information received and a review of the file, the groundwater post closure care requirements for HWMU-10 may be removed from the PCC permit. However, as conditions of this approval the facility should be required to provide a report on the Bio Lift Station inspection that is scheduled to occur in July 2014 and to continue groundwater monitoring at 10D3D for 2-propanol and acetone independent of the requirements of this post closure care permit to assure that groundwater conditions do not deteriorate and require further investigation in the future.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

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Douglas W. Domenech
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
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September 10, 2012

Mr. Bob Winstead
BAE Systems
Ordnance Systems Inc.
6580 Valley Center Drive, Suite 333
Radford, VA 24141
VIA ELECTRONIC MAIL

RE: Alternate Source Demonstration for acetone & 2-propanol in monitoring well 10D3D
HWMU #10, Radford Army Ammunition Plant, Radford, VA
EPA ID# VA1210020730

Dear Mr. Winstead:

The above-noted Alternate Source Demonstration (ASD) investigation, submitted on behalf of Radford Army Ammunition Plant, by BAE Systems, Ordinance Systems Inc., dated July 6, 2012, has been reviewed for technical content and consistency with the requirements of 40 CFR 264.99.(i). The need to submit an ASD was triggered by an exceedance of the acetone and 2-propanol Groundwater Protection Standard during the fourth quarter of 2011 for monitoring well 10D3D. The exceedance was reported by the facility and a 90-day extension of the ASD due date was granted by the Department on April 4, 2012.

As defined under 40 CFR 264.99.(i), the ASD report must show one of the following in order to obtain approval:

1) A source other than a regulated unit caused the contamination.
2) The contamination was caused by natural variation in groundwater.
3) The contamination was a result of an error in field sampling.
4) The contamination was the result of an error in lab analysis.
5) The SSI contamination was result of an error in statistical analysis.

The ASD report focused on proving the applicability of item #1 by presenting information regarding the clean closure for soils at HWMU-10, discussion of groundwater flow rates, evidence of a source other than the HWMU-10 (Bioplant lift station and pressurized lines),

and a trend analysis for this historically detected contaminants of concern. The report concludes that acetone and 2-propanol concentrations observed are not derived from the closed HWMU-10, but are derived from the propellant production wastewater flowing through the Bioplant lift station and associated pressurized sewer lines leading to the Bioplant equalization basins, which are located upgradient from monitoring well 10D3D.

Based on the above discussion and the body of evidence presented to the Department, the content of the ASD is determined to be sufficient to meet the regulatory criteria for approval and as a result, the facility does not have to remediate the acetone and 2-propanol GPS exceedances observed in well 10D3D. Please note that future exceedances of the GPS for acetone and 2-propanol noted in 10D3D will not require the submittal of a separate ASD unless the monitoring results reveal a change in site conditions that may indicate a release from HWMU-10. Please make sure that this approval is reflected in future correspondence to the Department where appropriate.

The facility is advised to evaluate the Bioplant lift station and pressurized sewer lines to assure that an ongoing release of wastewater is not occurring. This evaluation should be documented and retained in the facility file record.

If you have any additional technical questions, you may contact me at 276-676-4867 or by email at Vincent.Maiden@deq.virginia.gov.

Sincerely,

Vincent Maiden

Vincent A. Maiden
Office of Remediation Programs

cc: Jutta Schneider, Russ McAvoy, File – DEQ CO
Aziz Farahmand, DEQ-BRRO
Andrea Barbieri, EPA Region II (3LC50)
Jim McKenna, US Army