ANNUAL GROUNDWATER MONITORING REPORT

Hazardous Waste Management Units
5, 7, 10 and 16
CALENDAR YEAR 2011

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Submitted to:

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DAA PROJECT NO. B03204-09

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EXECUTIVE SUMMARY

This document presents the Annual Groundwater Monitoring Report for calendar year 2011 for Hazardous Waste Management Units (HWMUs) 5, 7, 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 2011 and Fourth Quarter 2011 for each Unit.

HWMU-5

The calendar year 2011 groundwater monitoring events served as the third and fourth 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 2011, trichloroethene (TCE) was detected in point of compliance wells 5WC22 and 5WC23 at concentrations greater than the GPS of 5 µg/l. During Fourth Quarter 2011, TCE was detected in point of compliance wells 5WC22 and 5WC23 at concentrations less than the GPS of 5 µg/l; however, TCE was detected in point of compliance well 5WC21 at a concentration greater than the GPS of 5 µg/l during Fourth Quarter 2011. No daughter products of TCE were detected in any wells during the 2011 monitoring events. The observed concentration fluctuations of TCE in point of compliance wells 5WC21, 5WC22, and 5WC23 are consistent with typical historical concentration fluctuations of TCE in those wells. TCE was not detected at concentrations greater than the GPS in any other wells comprising the CA monitoring network during the calendar year 2011 monitoring events, and no daughter products of TCE were detected in the wells comprising the CA monitoring network. In accordance with the Permit, the effectiveness of the corrective action (monitored natural attenuation [MNA]) was assessed, found to be effective, and no additional action is required.

During Second Quarter 2011, total cobalt was detected in point of compliance wells 5WC21 and 5WC22 at concentrations greater than the revised GPS of 7 µg/l. As directed by the VDEQ during a meeting with Radford AAP on May 4, 2011, total cobalt was added to the list of CA Targeted Constituents for HWMU-5. During Fourth Quarter 2011, total cobalt was detected in point of compliance well 5WC21 at a concentration greater than the GPS of 7 µg/l; 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 2011 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-7

Based on an evaluation of the groundwater analytical data and additional information for HWMU-7, no constituents were detected in the point of compliance wells at concentrations greater than their respective GPSs during calendar year 2011. Therefore, no further action is recommended at this time.

Initial detections of additional Permit Attachment 1, Appendix I constituents during Second Quarter 2011 were refuted by subsequent verification sampling; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit are required.

An evaluation of the plume monitoring well data indicates that the concentrations of total barium in plume monitoring wells 7W10B and 7W10C were greater than the site-specific background concentration. Additionally, the concentration of total zinc in plume monitoring well 7W10B during Fourth Quarter 2011 was greater than the site-specific background concentration. Higher total barium and total zinc concentrations in downgradient plume monitoring wells relative to background at HWMU-7 may be the result of natural variations in trace element distribution in groundwater. In addition, these concentrations are consistent with previous barium and zinc concentrations detected these wells. Therefore, no further action regarding the total barium concentrations detected in plume monitoring wells 7W10B and 7W10C or the total zinc concentration detected in plume monitoring well 7W10B is recommended at this time.

Total cobalt was detected in plume monitoring well 7W13 during both 2011 monitoring events at concentrations greater than the site-specific background concentration of 5 µg/l. Additionally, the total cobalt concentration detected in plume monitoring well 7W13 during Fourth Quarter 2011 was greater than the revised GPS of 5 µg/l specified in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. On December 15, 2011, Radford AAP submitted an ASD for total cobalt in groundwater at HWMU-7 as recommended by the VDEQ. 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 VDEQ approved the ASD in correspondence dated January 5, 2012, stating that the facility is not required to remediate cobalt in groundwater at HWMU-7. Therefore, no further action regarding total cobalt in plume monitoring well 7W13 is recommended at this time.

HWMU-10

Based on an evaluation of the groundwater analytical data and additional information for HWMU-10, acetone and 2-propanol were detected in point of compliance well 10D3D at concentrations greater than their respective GPSs during Fourth Quarter 2011. In accordance with the Permit, Radford AAP will conduct an ASD to evaluate whether the acetone and 2-propanol concentrations detected in point of compliance well 10D3D are derived from a source other than the Unit.

No additional Permit Attachment 1, Appendix I constituents were detected during Second Quarter 2011; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit are required.

HWMU-16

Based on an evaluation of the groundwater analytical data and additional information for HWMU-16, no constituents were detected at concentrations greater than their respective GPS during calendar year 2011. Therefore, no further action is recommended at this time.

The additional Permit Attachment 1, Appendix I constituent benzene was verified at a concentration greater than the detection limit in point of compliance well 16MW9; therefore, benzene will be added to the Groundwater Compliance Monitoring List for the Unit. No other additional Permit Attachment 1, Appendix I constituents were confirmed in the point of compliance wells during Second Quarter 2011.

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, 16-3, and 16SPRING were greater than the site-specific background concentration. 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 2011 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 2011 for Hazardous Waste Management Units (HWMUs) 5, 7, 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.

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 HWMUs 5, 7, 10, and 16 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 2011 and Fourth Quarter 2011 for each Unit. Additionally, the Compliance Monitoring Constituent Lists and Groundwater Protection Standards (GPS) for HWMUs 7, 10, and 16 were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. The groundwater samples collected at HWMUs 7, 10, and 16 during the Fourth Quarter 2011 semiannual monitoring event 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 2011 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 tenth complete Annual Groundwater Monitoring Report submitted to the Virginia Department of Environmental Quality (VDEQ) for this Unit during the Compliance Period, and the second complete Annual Groundwater Monitoring Report submitted to the VDEQ under the Groundwater Corrective Action & Monitoring Program.

1.2 HWMU-7

HWMU-7 is a closed unlined holding and neutralization basin. The Unit received certification for closure in 1990. As stated in Permit Condition I.K.2, the Compliance Period during which the Groundwater Protection Standard applies to HWMU-7 is 18 years, beginning on the effective date of the original Post-Closure Care Permit for HWMU-7 (October 30, 1999)

and continuing until October 30, 2017. This report is the twelfth complete Annual Groundwater Monitoring Report submitted to the VDEQ for this Unit during the Compliance Period.

1.3 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 tenth Annual Groundwater Monitoring Report submitted to the VDEQ for this Unit during the Compliance Period.

1.4 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 tenth 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/Alliant Techsystems 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 2011 Monitoring Events:

Second Quarter 2011:	May 3-4, 2011
Fourth Quarter 2011:	October 31-November 1, 2011

The calendar year 2011 groundwater monitoring events served as the first and second 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 2011 semiannual monitoring events are summarized in **Table 1**. Groundwater fluctuations ranged from 0.03 to 5.09 feet during the 2011 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 2011 groundwater elevations was calculated to be 0.028 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 0.32 ft/day or 116 ft/year based on the following:

- Average hydraulic conductivity of 5.25×10^{-5} ft/second.
- Average hydraulic gradient of 0.028 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 2011 groundwater monitoring events served as the third and fourth 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 2011 and Fourth Quarter 2011 events served as the third and fourth 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 2011 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 2011 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 2011 monitoring events are included on CD-ROM in **Appendix E**. 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 E**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix F**.

2.4.1 Semiannual Monitoring for Corrective Action Targeted Constituents

During the Second Quarter 2011 and Fourth Quarter 2011 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). The laboratory analytical results for the CA Targeted Constituents are summarized in **Appendix A-2**.

During Second Quarter 2011, TCE was detected in point of compliance wells 5W5B and 5WC21 at concentrations of 0.9 µg/l and 4.9 µg/l, respectively, which are less than the GPS of 5 µg/l (**Appendix A-2**). However, TCE was detected in point of compliance wells 5WC22 and 5WC23 at concentrations of 5.2 µg/l and 5.3 µg/l, respectively, which are greater than the GPS of 5 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 2011, TCE was detected in point of compliance well 5W5B at a concentration of 0.9 µg/l and in point of compliance wells 5WC22 and 5WC23 each at a concentration of 4.9 µg/l, which are less than the GPS of 5 µg/l (**Appendix A-2**). However, TCE was detected in point of compliance well 5WC21 at a concentration of 7.3 µg/l, which is greater than the GPS of 5 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.

As directed by the VDEQ during a meeting with Radford AAP on May 4, 2011, total cobalt was added to the list of CA Targeted Constituents for HWMU-5. During Fourth Quarter 2011, total cobalt was detected in point of compliance wells 5W7B, 5WC22, and 5WC23 at concentrations less than the QL of 5 µg/l and less than the GPS of 7 µg/l. Total cobalt was detected in point of compliance well 5WC21 at a concentration of 55.4 µg/l, which is greater than the GPS of 7 µg/l. Total cobalt was not detected at concentrations greater than the GPS in the other wells comprising the CA monitoring network.

2.4.2 Annual Monitoring List - Comparison to Groundwater Protection Standards

During Second Quarter 2011, 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) are present at concentrations greater than the GPS for the Unit.

As part of the November 5, 2009 *Final Class 3 Hazardous Waste Permit Modification*, the GPS for HWMU-5 were revised to incorporate the January 2009 VDEQ Alternate Concentration Limits (ACLs). As a result, the GPS for total cobalt was reduced from the previous VDEQ ACL used in the original Permit (313 µg/l) to the HWMU-5 background concentration of 7 µg/l. During Second Quarter 2011, total cobalt was detected in point of compliance wells 5WC21 and 5WC22 at concentrations of 61.9 µg/l and 24.5 µg/l, respectively, which are greater than the revised GPS of 7 µg/l (**Appendix A-3**). During a meeting between VDEQ and Radford AAP on May 4, 2011, the VDEQ indicated that the ongoing Corrective Action monitoring program at HWMU-5 is sufficient to address the total cobalt concentrations which are greater than the new GPS, and that total cobalt should be added to the list of CA Targeted Constituents presented in Appendix J to Permit Attachment 2.

On June 29-30, 2011, Radford AAP re-developed wells 5WC21 and 5WC22 in an effort to reduce turbidity and collected groundwater samples for laboratory analysis in order to evaluate the influence of sediment on total cobalt concentrations in groundwater in the wells. Following re-development, the June 2011 groundwater sample collected from well 5WC21 exhibited a total cobalt concentration of 62.9 µg/l, which was comparable with the Second Quarter 2011 concentration of 61.9 µg/l. However, the June 2011 groundwater sample collected from well 5WC22 exhibited a total cobalt concentration of 2.11 µg/l following re-development, which was an order of magnitude less than the Second Quarter 2011 concentration of 24.5 µg/l. On July 27, 2011, Radford AAP collected additional groundwater samples from wells 5WC21 and 5WC22 to evaluate the effectiveness of re-development of the wells; groundwater samples collected from the wells in July 2011 were analyzed for total and dissolved cobalt. The July 2011 groundwater sample from well 5WC21 exhibited a total cobalt concentration of 76.9 µg/l and a dissolved cobalt concentration of 70.1 µg/l (again, comparable to the Second Quarter 2011 total cobalt concentration of 61.9 µg/l). The July 2011 groundwater sample from well 5WC22 exhibited a total cobalt concentration of 4.79 µg/l and a dissolved cobalt concentration of 4.60 µg/l, which were significantly less than the Second Quarter 2011 concentration of 24.5 µg/l. Based on these results, it appeared that the re-development efforts significantly reduced the total cobalt concentration in well 5WC22, but did not significantly affect the total cobalt concentration in well 5WC21. Therefore, as directed by the VDEQ during the May 4, 2011 meeting with Radford AAP, total cobalt was added to the list of CA Targeted Constituents for HWMU-5.

No other 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 2011.

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 Quantitation Limit (QL) if their associated GPS are 1) based on background values equal to the QL, and 2) are greater than the applicable risk-based concentrations (i.e., ACL or RBC). 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 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 2011, nitrobenzene (which has a GPS based on a background value equal to the QL) was initially detected in point of compliance wells 5WC22 and 5WC23 at concentrations less than the QL of 10 µg/l. As a result, sample aliquots for point of compliance wells 5WC22 and 5WC23 which had been collected during the original Second Quarter 2011 sampling event, prepared by the laboratory, and held pending the initial analytical results were analyzed by the laboratory using an alternate low-level analytical method to confirm or refute the observed initial detections. Nitrobenzene was not detected at concentrations greater than the low-level analytical method QL of 1 µg/l in the samples collected from point of compliance wells 5WC22 and 5WC23; 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 2011. 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 (current COCs) at concentrations greater than their respective GPS values were constructed (**Appendix A-4**). During Second Quarter 2011, TCE was detected in point of compliance well 5WC21 at a concentration less than the GPS of 5 µg/l and in point of compliance wells 5WC22 and 5WC23 at concentrations greater than the GPS of 5 µg/l. However, during Fourth Quarter 2010, TCE was detected in wells 5WC22 and 5WC23 at concentrations less than the GPS of 5 µg/l and in well 5WC21 at a concentration 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 2011 monitoring events. The observed concentration fluctuations of TCE in point of compliance wells 5WC21, 5WC22, and 5WC23 are consistent with typical historical concentration fluctuations of TCE in those wells. In accordance with the Permit, long-term concentration plots of the natural-log concentrations of TCE in wells 5WC21, 5WC22, and

5WC23 versus time were constructed. A linear regression line shows clearly decreasing trends in TCE concentration in wells 5WC21, 5WC22, and 5WC23 over time (**Appendix A-4**). An isoconcentration map illustrating TCE concentrations detected in groundwater during the Fourth Quarter 2011 event is included in **Appendix A-4**.

TCE was detected in monitoring well 5W5B during both 2011 monitoring events at concentrations less than the GPS of 5 µg/l. Therefore, a concentration plot was not required for TCE in that well. The TCE concentration in 5W5B continues to show a consistent decrease 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 18 monitoring events beginning with April 18, 2005 to the present (November 1, 2011).

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 (7.3 µg/l)
k_{point} = natural attenuation rate (0.0006)

$$t = -[\ln(5/7.3)]/0.0006$$
$$t = 1.73 \text{ years}$$

The calculated current MNA timeframe (date) is mid-2013.

The current MNA timeframe is less than that 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 2011, TCE was detected in point of compliance well 5WC21 at a concentration less than the GPS of 5 µg/l and in point of compliance wells 5WC22 and 5WC23 at concentrations greater than the GPS of 5 µg/l. During Fourth Quarter 2010, TCE was detected in wells 5WC22 and 5WC23 at concentrations less than the GPS of 5 µg/l and in well 5WC21 at a concentration greater 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 2011 monitoring events. The observed concentration fluctuations of TCE in point of compliance wells 5WC21, 5WC22, and 5WC23 are consistent with typical historical concentration fluctuations of TCE in those wells. TCE was not detected at concentrations greater than the GPS in any other wells comprising the CA monitoring network during the calendar year 2011 monitoring events, and no daughter products of TCE were detected in the wells comprising the CA monitoring network. In accordance with the Permit, long-term concentration plots of the natural-log concentrations of TCE in wells 5WC21, 5WC22, and 5WC23 versus time were constructed. A linear regression line shows clearly decreasing trends in TCE concentrations in wells 5WC21, 5WC22, and 5WC23 over time. Based on the data collected to date, the current calculated compliance timeframe for corrective action (monitored natural attenuation [MNA]) is mid-2013, 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.

During Second Quarter 2011, total cobalt was detected in point of compliance wells 5WC21 and 5WC22 at concentrations greater than the revised GPS of 7 µg/l. As directed by the VDEQ during a meeting with Radford AAP on May 4, 2011, total cobalt was added to the list of CA Targeted Constituents for HWMU-5. During Fourth Quarter 2011, total cobalt was detected in point of compliance well 5WC21 at a concentration greater than the GPS of 7 µg/l; 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 2011 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-7 ANNUAL GROUNDWATER MONITORING REPORT

3.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 7 (HWMU-7)
Owner/Operator: United States Army/Alliant Techsystems Inc.

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

Class: Hazardous Waste Management Unit
Type: Closed Unlined Holding and Neutralization Basin

3.2 Groundwater Monitoring Plan

Monitoring Network:

Upgradient Well:	7W12B
Point of Compliance Wells:	7WCA, 7MW6, 7W11B
Plume Monitoring Wells:	7W9C, 7W10B, 7W10C, 7W13
Observation Wells:	7MW5, 7W9B, 7W11

Monitoring Status: Compliance Monitoring Program

CY 2011 Monitoring Events:

Second Quarter 2011:	April 25-28, 2011
Fourth Quarter 2011:	October 25-26, 2011

The Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-7 were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. Therefore, the groundwater samples collected at HWMU-7 during the Fourth Quarter 2011 semiannual monitoring event were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification. Copies of the revised Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-7 as presented in the September 27, 2011 Class 3 Permit Modification are included (on CD-ROM) in **Appendix G**.

3.3 Groundwater Movement

The monitoring wells at HWMU-7 are screened entirely within alluvium, weathered carbonate bedrock residuum, or carbonate bedrock or across the interfaces between two of the listed strata. The static water level measurements gathered during the 2011 semiannual monitoring events are summarized in **Table 2**. Groundwater fluctuations ranged from 0.45 to 2.97 feet annually. As shown on the HWMU-7 Potentiometric Surface Maps (**Appendix B-1**), groundwater movement beneath the site is generally to the west towards the New River and to the northeast and southwest toward the unnamed intermittent drainages that flow into the New River north and south of the site.

Darcian flow conditions were assumed for the alluvium, residuum, and carbonate bedrock beneath HWMU-7. 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 the Fourth Quarter 2011 groundwater elevations was calculated to be 0.008 ft/ft. Historical slug test data for the site yielded an average hydraulic conductivity of 5.1×10^{-6} 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 8.81×10^{-3} ft/day or 3.2 ft/year, based on the following:

- Average hydraulic conductivity of 5.1×10^{-6} ft/second.
- Average hydraulic gradient of 0.008 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.

3.4 Groundwater Analytical Data Evaluation

The groundwater samples collected from the compliance monitoring network during the 2011 semiannual monitoring events were analyzed for the constituents listed in Appendix E to Attachment 3 of the Final Post-Closure Care Permit, plus copper (which was added to the constituent list for HWMU-7 following Third Quarter 2003) and zinc (which was added to the constituent list for HWMU-7 following Second Quarter 2004) (please note, copper and zinc were formally added to Permit Attachment 3, Appendix E in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). In addition, during Second Quarter 2011 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 2011 monitoring events are included in **Appendix B-2** (point of compliance wells) and in **Appendix B-3** (plume monitoring wells). The laboratory analytical results for the 2011 monitoring events also are included in electronic format in **Appendix E**. 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 E**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix F**.

3.4.1 Comparison to Groundwater Protection Standards

As specified in Permit Condition V.J.2.i, the 2011 groundwater analytical data for the upgradient well and the point of compliance wells were compared to the GPS for HWMU-7 listed in Appendix G of Permit Attachment 3 (please note, the GPS for HWMU-7 listed in Permit Attachment 3, Appendix G were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). 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**).

As shown in **Appendix B-2**, no constituents were detected at concentrations greater than their respective GPS in the upgradient well and in the point of compliance wells during the 2011 monitoring events.

3.4.2 Comparison to Background Concentrations

As specified in Permit Condition V.O, the 2011 groundwater analytical data for the plume monitoring wells were compared to the background concentrations for HWMU-7. The original background concentrations as presented in the Groundwater Quality Assessment Report for HWMU-7 dated August 1998 are listed in Appendix F of Permit Attachment 3. 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 B-3**).

As shown in **Appendix B-3**, total barium concentrations detected in plume monitoring wells 7W10B and 7W10C during both 2011 semiannual monitoring events were greater than the site-specific background concentration of 41 µg/l. However, the total barium concentrations detected in wells 7W10B and 7W10C were more than an order of magnitude below the USEPA MCL for barium of 2,000 µg/l. Higher total barium concentrations in downgradient plume monitoring wells relative to background at HWMU-7 may be the result of natural variations in trace element distribution in groundwater. In addition, these concentrations are consistent with previous barium concentrations detected these wells.

As shown in **Appendix B-3**, total zinc was detected in plume monitoring well 7W10B during Fourth Quarter 2011 at a concentration greater than the site-specific background concentration of 10.9 µg/l. However, the total zinc concentration detected in well 7W10B is more than an order of magnitude less than the VDEQ ACL for zinc of 4,695 µg/l. In addition, total zinc was not detected at a concentration greater than the site-specific background concentration of 10.9 µg/l in plume monitoring well 7W10C, which is located approximately 60 feet downgradient from well 7W10B.

As also shown in **Appendix B-3**, total cobalt was detected in plume monitoring well 7W13 during both 2011 monitoring events at concentrations greater than the site-specific background concentration of 5 µg/l. Additionally, the total cobalt concentration detected in plume monitoring well 7W13 during Fourth Quarter 2011 was greater than the revised GPS of 5 µg/l specified in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. However, the total cobalt concentrations detected in plume monitoring well 7W13 are consistent

with previous concentrations detected in this well. During teleconferences on November 9, 2011 and November 17, 2011, the VDEQ recommended Radford AAP submit an alternate source demonstration (ASD) for total cobalt concentrations detected in groundwater at HWMU-7. Radford AAP submitted the ASD to the VDEQ 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 VDEQ approved the ASD in correspondence dated January 5, 2012, stating that the facility is not required to remediate cobalt in groundwater at HWMU-7.

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 B-4**. The background values and associated computations are taken from the revised background values presented in the pending Closure Report for HWMU-7.

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

Upon receipt of the Second Quarter 2011 analytical data, Radford AAP notified the VDEQ of the detection of three additional Permit Attachment 1, Appendix I constituents (benzene, chloroform, and diethyl ether) that were not listed in Appendix E of Permit Attachment 3 (Unit 7 – Groundwater Compliance Monitoring (Quarterly) Constituent List). As shown on **Appendix B-2**, chloroform was detected in upgradient well 7W12B and in point of compliance wells 7WCA and 7W11B. However, Radford AAP did not verify the chloroform concentrations detected in wells 7W12B, 7WCA, and 7W11B based on the June 14, 2007 concurrence by the VDEQ with the Alternate Source Demonstration (ASD) for chloroform at HWMU-7 submitted on January 31, 2007, which identified an upgradient off-site source for chloroform in groundwater. Therefore, chloroform will not be added to the Groundwater Monitoring List for the Unit.

Benzene was initially detected in upgradient well 7W12B. Additionally, benzene was initially detected in point of compliance wells 7MW6 and 7W11B, and diethyl ether was initially detected in point of compliance well 7MW6. In accordance with the Permit, Radford AAP resampled well 7W11B for benzene and well 7MW6 for benzene and diethyl ether in order to confirm or refute the additional Permit Attachment 1, Appendix I constituent detections in the point of compliance wells. Benzene and diethyl ether were not confirmed in point of compliance wells 7MW6 and 7W11B at concentrations greater than their respective detection limits; as a result, benzene and diethyl ether will not be added to the Groundwater Monitoring List for the Unit. Furthermore, sampling of upgradient well 7W12B for Permit Attachment 1, Appendix I constituents is not required per the Post-Closure Care Permit for the Unit; therefore, benzene will not be added to the Groundwater Monitoring List for the Unit.

3.4.4 Evaluation of Total Arsenic Concentrations in Groundwater

During Fourth Quarter 2010, total arsenic was initially detected in plume monitoring well 7W13 at a concentration greater than the site-specific background concentration of 10 µg/l.

Historical data indicated that total arsenic had not been detected in well 7W13 at concentrations equal to or greater than 10 µg/l during the previous 23 monitoring events. The results of subsequent verification sampling conducted in December 2010 to confirm or refute the initial concentration were inconclusive due to laboratory inconsistencies. Radford AAP notified VDEQ regarding the inconclusive verification results in January 2011. In subsequent electronic correspondence and further clarified in a meeting between Radford AAP and VDEQ on May 4, 2011, VDEQ recommended the collection of additional independent samples from well 7W13 for analysis for total arsenic during and following the first semiannual monitoring event for calendar year 2011.

Total arsenic was not detected in well 7W13 at a concentration equal to or greater than the quantitation limit (QL) and site-specific background concentration of 10 µg/l during the Second Quarter 2011 monitoring event. Independent groundwater samples collected from well 7W13 on June 30, 2011, and on July 27, 2011, also did not exhibit total arsenic concentrations equal to or greater than 10 µg/l. Furthermore, total arsenic has not been detected historically at a concentration equal to or greater than 10 µg/l in well 7W13 prior to Fourth Quarter 2011. Therefore, Radford AAP concluded that total arsenic had not been reliably detected at a concentration greater than background in well 7W13. Radford AAP submitted these results to the VDEQ in correspondence dated August 15, 2011. In correspondence dated August 29, 2011, the VDEQ concurred with Radford AAP's conclusions and agreed that no further action with respect to total arsenic in well 7W13 is necessary at this time. Copies of the August 15, 2011 and August 29, 2011 correspondence are included in **Appendix G**.

3.5 Recommendations

Based on an evaluation of the groundwater analytical data and additional information for HWMU-7, no constituents were detected in the point of compliance wells at concentrations greater than their respective GPSs during calendar year 2011. Therefore, no further action is recommended at this time.

Initial detections of additional Permit Attachment 1, Appendix I constituents during Second Quarter 2011 were refuted by subsequent verification sampling; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit are required.

An evaluation of the plume monitoring well data indicates that the concentrations of total barium in plume monitoring wells 7W10B and 7W10C were greater than the site-specific background concentration. Additionally, the concentration of total zinc in plume monitoring well 7W10B during Fourth Quarter 2011 was greater than the site-specific background concentration. As stated previously, higher total barium and total zinc concentrations in downgradient plume monitoring wells relative to background at HWMU-7 may be the result of natural variations in trace element distribution in groundwater. In addition, these concentrations are consistent with previous barium and zinc concentrations detected these wells. Therefore, no further action regarding the total barium concentrations detected in plume monitoring wells 7W10B and 7W10C or the total zinc concentration detected in plume monitoring well 7W10B is recommended at this time.

Total cobalt was detected in plume monitoring well 7W13 during both 2011 monitoring events at concentrations greater than the site-specific background concentration of 5 µg/l. Additionally, the total cobalt concentration detected in plume monitoring well 7W13 during Fourth Quarter 2011 was greater than the revised GPS of 5 µg/l specified in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011. On December 15, 2011, Radford AAP submitted an ASD for total cobalt in groundwater at HWMU-7 as recommended by the VDEQ. 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 VDEQ approved the ASD in correspondence dated January 5, 2012, stating that the facility is not required to remediate cobalt in groundwater at HWMU-7. Therefore, no further action regarding total cobalt in plume monitoring well 7W13 is recommended at this time.

4.0 HWMU-10 ANNUAL GROUNDWATER MONITORING REPORT

4.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 10 (HWMU-10)
Owner/Operator: United States Army/Alliant Techsystems Inc.

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

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

4.2 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

CY 2011 Monitoring Events:

Second Quarter 2011:	May 2-3, 2011
Fourth Quarter 2011:	October 24, 2011

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 Fourth Quarter 2011 semiannual monitoring event were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification. Copies of the revised Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-10 as presented in the September 27, 2011 Class 3 Permit Modification are included (on CD-ROM) in **Appendix G**.

4.3 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 2011 semiannual monitoring events are summarized in **Table 3**. Groundwater fluctuations ranged from 0.56 to 2.06 feet annually. As shown on the HWMU-10 Potentiometric Surface Maps (**Appendix C-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 Fourth Quarter 2011 groundwater elevations was calculated to be 0.014 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 1.5 ft/day or 548 ft/year, based on the following:

- Average hydraulic conductivity of 4.9×10^{-4} ft/second.
- Average hydraulic gradient of 0.014 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.

4.4 Groundwater Analytical Data Evaluation

The groundwater samples collected from the compliance monitoring network during the 2011 semiannual monitoring events were analyzed for the constituents listed in Appendix E to Attachment 4 of the Final Post-Closure Care Permit, plus cobalt and vanadium (which were added to the constituent list for HWMU-10 following Second Quarter 2004) and acetone and 2-propanol (which were added to the constituent list for HMWU-10 following Second Quarter 2005) (please note, cobalt, vanadium, acetone, and 2-propanol were formally added to Permit Attachment 4, Appendix E in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). 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 2011 monitoring events are included in **Appendix C-2**. The laboratory analytical results for the 2011 monitoring events also are included in electronic format in **Appendix E**. 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 E**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix F**.

4.4.1 Comparison to Groundwater Protection Standards

As specified in Permit Condition V.J.3.i, the 2011 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 (please note, the GPS for HWMU-10 listed in Permit Attachment 4, Appendix G were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). 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**).

As shown in **Appendix C-2**, none of the constituent concentrations detected in the upgradient well and in the point of compliance wells during Second Quarter 2011 were greater than their respective GPS.

During Fourth Quarter 2011, acetone was detected in point of compliance well 10D3D at a concentration of 20,000 µg/l, which is greater than the revised GPS of 8,750.2 µg/l. Additionally, 2-propanol was detected in point of compliance well 10D3D at a concentration of 34,000 µg/l, which is greater than the revised GPS of 100 µg/l. In accordance with the Permit, Radford AAP will conduct an ASD to evaluate whether the acetone and 2-propanol concentrations detected in point of compliance well 10D3D are derived from a source other than the Unit.

4.4.2 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.

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

During Second Quarter 2011, the groundwater samples collected from the upgradient well and the point of compliance wells were analyzed for the constituents listed in Permit Attachment 1, Appendix I in accordance with Permit Condition V.J.3.e. No additional Permit Attachment 1, Appendix I, which are not listed in Appendix E of Permit Attachment 4 (Unit 10 – Groundwater Compliance Monitoring (Quarterly) Constituent List), were detected during the Second Quarter 2011 groundwater monitoring event. Therefore, no changes to the Groundwater Monitoring List for the Unit are required.

4.5 Recommendations

Based on an evaluation of the groundwater analytical data and additional information for HWMU-10, acetone and 2-propanol were detected in point of compliance well 10D3D at concentrations greater than their respective GPSs during Fourth Quarter 2011. In accordance with the Permit, Radford AAP will conduct an ASD to evaluate whether the acetone and 2-propanol concentrations detected in point of compliance well 10D3D are derived from a source other than the Unit.

No additional Permit Attachment 1, Appendix I constituents were detected during Second Quarter 2011; therefore, no changes to the Groundwater Compliance Monitoring List for the Unit are required.

5.0 HWMU-16 ANNUAL GROUNDWATER MONITORING REPORT

5.1 Waste Management Unit Information

Unit Name: Hazardous Waste Management Unit 16 (HWMU-16)
Owner/Operator: United States Army/Alliant Techsystems Inc.

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

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

5.2 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 2011 Monitoring Events:

Second Quarter 2011:	April 18-20, 2011
Fourth Quarter 2011:	October 19-20, 2011

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 Fourth Quarter 2011 semiannual monitoring event were analyzed and evaluated in accordance with the VDEQ-approved Class 3 Permit Modification. Copies of the revised Compliance Monitoring Constituent List and Groundwater Protection Standards (GPS) for HWMU-16 as presented in the September 27, 2011 Class 3 Permit Modification are included (on CD-ROM) in **Appendix G**.

5.3 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 2011 semiannual monitoring events are summarized in **Table 4**. Groundwater fluctuations ranged from 0.01 to 9.05 feet annually. As shown on the HWMU-16 Potentiometric Surface Maps (**Appendix D-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 2011 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 566 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.

5.4 Groundwater Analytical Data Evaluation

The groundwater samples collected from the compliance monitoring network during the 2010 semiannual monitoring events were analyzed for the constituents listed in Appendix E to Attachment 5 of the Final Post-Closure Care Permit, plus chloroethane, diethyl ether, dimethyl ether, and methylene chloride (which were added to the constituent list for HWMU-16 following Third Quarter 2003), and 1,1,2-trichloro-1,2,2-trifluoroethane (which was added to the constituent list for HWMU-16 following Second Quarter 2004) (please note, chloroethane, diethyl ether, dimethyl ether, methylene chloride, and 1,1,2-trichloro-1,2,2-trifluoroethane were formally added to Permit Attachment 5, Appendix E in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). 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 2011 monitoring events are included in **Appendix D-2** (point of compliance wells) and in **Appendix D-3** (plume monitoring wells). The laboratory analytical results for the 2011 monitoring events also are included in electronic format in **Appendix E**. 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 E**. Copies of field notes recorded during sample collection are included on CD-ROM in **Appendix F**.

5.4.1 Comparison to Groundwater Protection Standards

As specified in Permit Condition V.J.4.i, the 2011 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 (please note, the GPS for HWMU-16 listed in Permit Attachment 5, Appendix G were revised in the VDEQ-approved Class 3 Permit Modification dated September 27, 2011; **Appendix G**). 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 D-2**).

As shown in **Appendix D-2**, no constituents were detected at concentrations greater than their respective GPS.

5.4.2 Comparison to Background Concentrations

As specified in Permit Condition V.O, the 2011 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 D-3**).

As shown in **Appendix D-3**, total barium concentrations detected in upgradient well 16C1 and plume monitoring well 16-1 during Second Quarter 2011 and in plume monitoring wells 16-2 and 16-3 and in spring sampling location 16SPRING during both 2011 semiannual monitoring events 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 D-4**. The background values and associated computations are taken from the Groundwater Quality Assessment Report for HWMU-16 dated August 1999.

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

During Second Quarter 2011, the groundwater samples collected from the upgradient well and the point of compliance wells were analyzed for the constituents listed in Permit Attachment 1, Appendix I in accordance with Permit Condition V.J.4.e. Upon receipt of the

Second Quarter 2011 analytical data, Radford AAP notified the VDEQ of the detection of six additional Permit Attachment 1, Appendix I constituents (4,4'-DDD, benzene, 1,1-dichloroethene, aldrin, gamma-BHC, and tetrahydrofuran) that were not listed in Appendix E of Permit Attachment 5 (Unit 16 – Groundwater Compliance Monitoring (Quarterly) Constituent List). Benzene, 1,1-dichloroethene, aldrin, gamma-BHC, and tetrahydrofuran were detected in upgradient well 16C1. Additionally, benzene was initially detected in point of compliance wells 16WC1A and 16MW9, and 4,4'-DDD was initially detected in point of compliance well 16WC1B. In accordance with the Permit, Radford AAP resampled wells 16WC1A and 16MW9 for benzene and well 16WC1B for 4,4'-DDD in order to confirm or refute the additional Permit Attachment 1, Appendix I constituent detections in the point of compliance wells.

Benzene was verified at a concentration greater than the detection limit in point of compliance well 16MW9; therefore, benzene will be added to the Groundwater Compliance Monitoring List for the Unit. 4,4'-DDD was not confirmed in point of compliance well 16WC1B at a concentration greater than the detection limit; as a result, 4,4'-DDD will not be added to the Groundwater Monitoring List for the Unit. Furthermore, sampling of upgradient well 16C1 for Permit Attachment 1, Appendix I constituents is not required per the Post-Closure Care Permit for the Unit; therefore, 1,1-dichloroethene, aldrin, gamma-BHC, and tetrahydrofuran will not be added to the Groundwater Monitoring List for the Unit.

5.5 Recommendations

Based on an evaluation of the groundwater analytical data and additional information for HWMU-16, no constituents were detected at concentrations greater than their respective GPS during calendar year 2011. Therefore, no further action is recommended at this time.

The additional Permit Attachment 1, Appendix I constituent benzene was verified at a concentration greater than the detection limit in point of compliance well 16MW9; therefore, benzene will be added to the Groundwater Compliance Monitoring List for the Unit. No other additional Permit Attachment 1, Appendix I constituents were confirmed in the point of compliance wells during Second Quarter 2011.

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, 16-3, and 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 2011 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 - 2011
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	SECOND QUARTER 2011		FOURTH QUARTER 2011	
		DTW	GW ELEV	DTW	GW ELEV
5W8B	1789.58	14.41	1775.17	9.32	1780.26
5W5B	1775.13	8.76	1766.37	9.16	1765.97
5W7B	1774.78	9.05	1765.73	9.08	1765.70
5WC21	1774.43	8.56	1765.87	9.27	1765.16
5WC22	1774.45	8.45	1766.00	9.24	1765.21
5WC23	1773.84	7.80	1766.04	8.66	1765.18
5W12A	1772.46	10.42	1762.04	11.42	1761.04
S5W5	1772.31	7.96	1764.35	8.41	1763.90
S5W7	1776.08	11.37	1764.71	11.05	1765.03
5W9A	1762.20	3.65	1758.55	1.87	1760.33
5W10A	1771.40	12.24	1759.16	14.94	1756.46
5W11A	1766.20	9.08	1757.12	13.33	1752.87
5WC11	1788.92	15.92	1773.00	12.42	1776.50
5WC12	1788.96	15.61	1773.35	12.74	1776.22
5WCA	1779.05	12.24	1766.81	12.62	1766.43
S5W6	1771.43	6.50	1764.93	7.11	1764.32
S5W8	1783.68	11.75	1771.93	9.49	1774.19

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

TABLE 2
HWMU-7
GROUNDWATER ELEVATIONS - 2011
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	SECOND QUARTER 2011		FOURTH QUARTER 2011	
		DTW	GW ELEV	DTW	GW ELEV
7W12B	1717.31	23.86	1693.45	24.81	1692.50
7WCA	1715.40	24.24	1691.16	24.96	1690.44
7MW6	1715.30	24.75	1690.55	26.29	1689.01
7W11B	1715.90	24.25	1691.65	25.09	1690.81
7W9C	1704.45	12.62	1691.83	14.48	1689.97
7W10B	1706.65	14.55	1692.10	15.53	1691.12
7W10C	1709.30	17.48	1691.82	20.45	1688.85
7W13	1705.42	17.21	1688.21	19.25	1686.17
7W9B	1712.49	21.97	1690.52	22.42	1690.07
7MW5	1716.20	24.32	1691.88	24.97	1691.23
7W11	1714.82	23.08	1691.74	24.17	1690.65

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

TABLE 3
HWMU-10
GROUNDWATER ELEVATIONS - 2011
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	SECOND QUARTER 2011		FOURTH QUARTER 2011	
		DTW	GW ELEV	DTW	GW ELEV
10D4	1714.38	22.20	1692.18	22.76	1691.62
10DDH2R	1704.38	17.58	1686.80	19.64	1684.74
10D3	1702.95	16.08	1686.87	17.95	1685.00
10D3D	1702.64	16.30	1686.34	18.08	1684.56
10MW1	1703.62	15.98	1687.64	17.85	1685.77

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

TABLE 4
HWMU-16
GROUNDWATER ELEVATIONS - 2011
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

MONITORING WELL ID	ELEVATION TOP OF WELL	SECOND QUARTER 2011		FOURTH QUARTER 2011	
		DTW	GW ELEV	DTW	GW ELEV
16C1	1840.14	50.60	1789.54	49.18	1790.96
16MW8	1815.82	70.63	1745.19	77.88	1737.94
16MW9	1808.88	60.86	1748.02	66.21	1742.67
16WC1A	1812.61	64.82	1747.79	68.91	1743.70
16WC1B	1812.95	64.80	1748.15	69.20	1743.75
16-1	1815.82	51.74	1764.08	44.61	1771.21
16-2	1810.99	55.81	1755.18	55.82	1755.17
16-3	1824.77	57.40	1767.37	56.23	1768.54
16-5	1742.60	3.85	1738.75	4.41	1738.19
16WC2B	1818.71	53.77	1764.94	53.70	1765.01
16WC2A	1820.05	DRY	DRY	DRY	DRY
16C3	1822.22	59.57	1762.65	68.62	1753.60
16CDH3	1825.60	DRY	DRY	DRY	DRY
SPRING	na	na	na	na	na

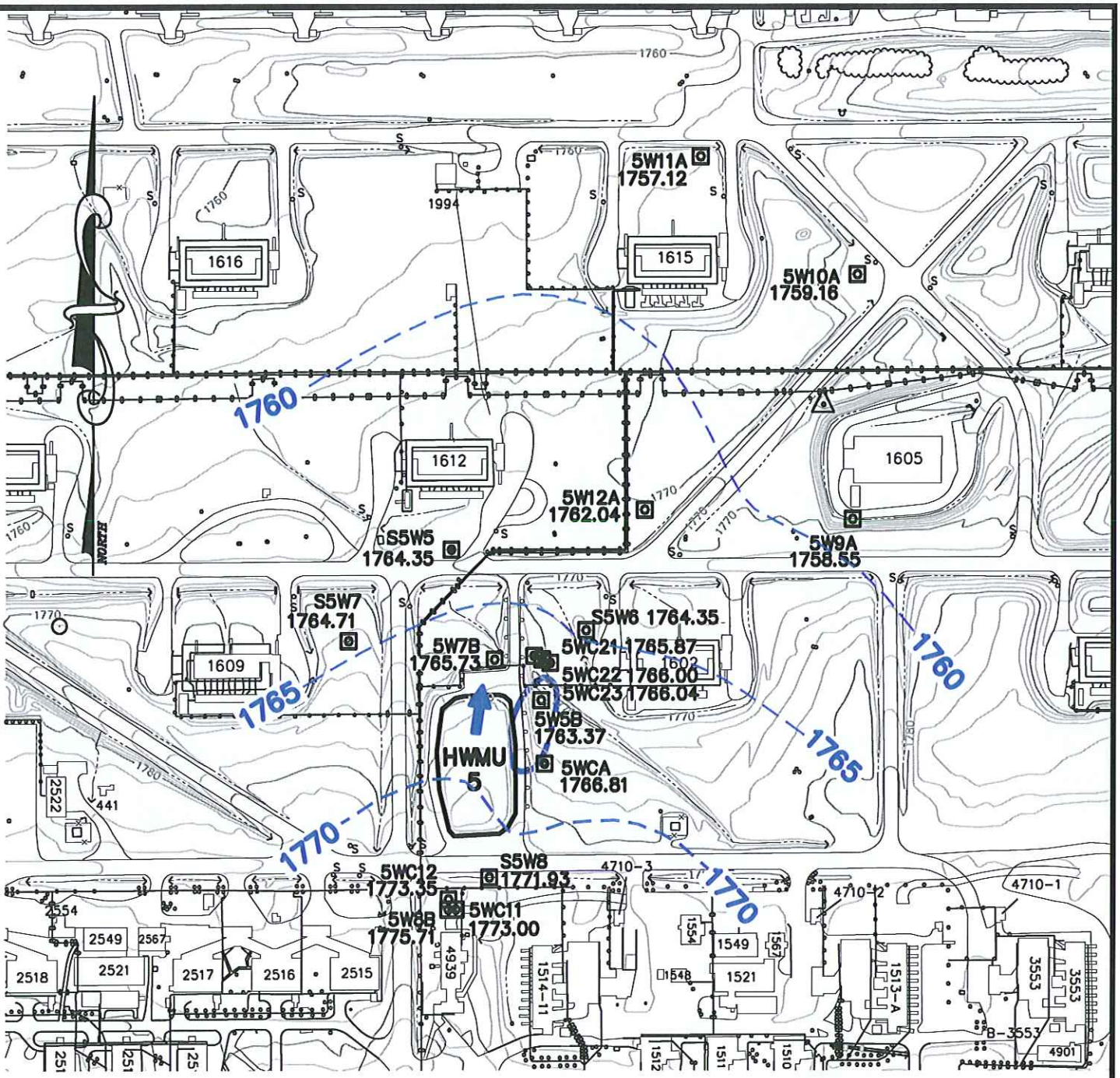
NOTES:
DTW: Depth to water from top of casing.
GW ELEV: Groundwater elevation.
All elevations in feet above mean sea level.
na: Not applicable.

APPENDIX A

HWMU-5

APPENDIX A-1

HWMU-5 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2011
FOURTH QUARTER 2011



LEGEND

5W7B ◎	MONITORING WELL
1765.73	GROUNDWATER ELEVATION (feet above mean sea level)
--1770--	GROUNDWATER CONTOUR
➡	GROUNDWATER FLOW DIRECTION

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

HWMU-5 POTENTIOMETRIC SURFACE MAP (2nd QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-09

Draper Aden Associates

Engineering • Surveying • Environmental Services

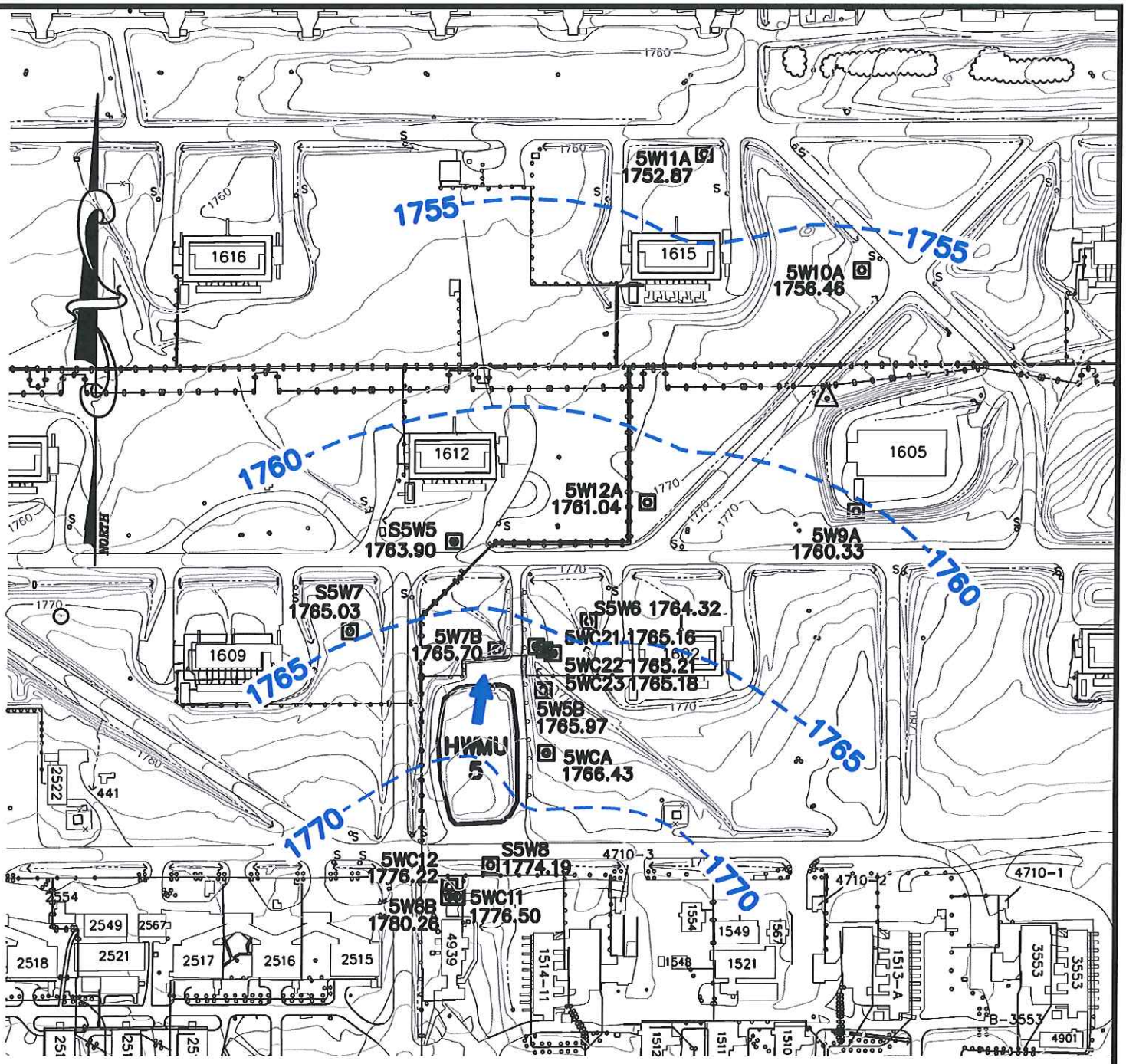
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291

Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	SN
DRAWN	JFF
CHECKED	MDL
DATE	09-27-11

FIGURE 1

P:\B03200\B03204\B03204-09\CAD\B03204-09 ENV\dwg\B03204-09_HWMU-5.dwg Sep 27, 2011 9:13am



LEGEND

5W7B ◎	MONITORING WELL
1765.70	GROUNDWATER ELEVATION (feet above mean sea level)
--1770--	GROUNDWATER CONTOUR
➡	GROUNDWATER FLOW DIRECTION

NOTE: TOPOGRAPHIC CONTOUR INTERVAL 2'

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

HWMU-5 POTENTIOMETRIC SURFACE MAP (4TH QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-09

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	02/07/12

FIGURE 1

P:\B03\200\B03204\B03204-09\CAD\B03204-09 ENV\dwg\B03204-09_HWMU-5 4TH QUARTER 2011.dwg Feb 07, 2012 4:50pm

APPENDIX A-2

HWMU-5 2011 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 2011	-	U	5.7	61.9	24.5	2.57 J	-	5	5	7	1	1	ug/l	6020A
Fourth Quarter 2011	U	U	3.68 J	55.4	4.2 J	1.77 J	U	5	5	7	1	1	UG/L	6020A
1,1-Dichloroethene						*CAS # 75-35-4*								
Second Quarter 2011	U	U	U	U	U	U	U	1	1	7	0.1	0.44	ug/l	8260B
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1	7	0.1	0.44	ug/l	8260B
cis-1,2-Dichloroethene						*CAS # 156-59-2*								
Second Quarter 2011	U	U	U	U	U	U	U	1	1	70	0.1	0.1	ug/l	8260B
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1	70	0.1	0.1	ug/l	8260B
trans-1,2-Dichloroethene						*CAS # 156-60-5*								
Second Quarter 2011	U	U	U	U	U	U	U	1	1	100	0.1	0.8	ug/l	8260B
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1	100	0.1	0.8	ug/l	8260B
Trichloroethene						*CAS # 79-01-6*								
Second Quarter 2011	U	0.9 J	U	4.9	5.2	5.3	U	1	1	5	0.1	0.177	ug/l	8260B
Fourth Quarter 2011	U	0.9 J	U	7.3	4.9	4.9	U	1	1	5	0.1	0.177	ug/l	8260B
Vinyl chloride						*CAS # 75-01-4*								
Second Quarter 2011	U	U	U	U	U	U	U	1	1	2	0.1	0.1	ug/l	8260B
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1	2	0.1	0.1	ug/l	8260B

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) 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.

See last page of this report for definitions.

APPENDIX A-3

HWMU-5 2011 LABORATORY ANALYTICAL RESULTS
GROUNDWATER CORRECTIVE ACTION ANNUAL MONITORING LIST

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 2011	-	U	U	U	U	U	2	1	6	0.4	0.4	ug/l	6020A
Arsenic						CAS # 7440-38-2							
Second Quarter 2011	-	U	U	U	U	U	10	10	10	2	2	ug/l	6020A
Barium						CAS # 7440-39-3							
Second Quarter 2011	-	30.6	41.1	14.6	40	24.7	10	10	2,000	1	1	ug/l	6020A
Beryllium						CAS # 7440-41-7							
Second Quarter 2011	-	U	0.37 J	1.35	U	U	1	1	4	0.2	0.2	ug/l	6020A
Cadmium						CAS # 7440-43-9							
Second Quarter 2011	-	U	U	0.46 J	0.27 J	0.21 J	1	1	5	0.2	0.2	ug/l	6020A
Chromium						CAS # 7440-47-3							
Second Quarter 2011	-	U	1.44 J	4.2 J	U	U	5	5	100	1	1	ug/l	6020A
Cobalt						CAS # 7440-48-4							
Second Quarter 2011	-	U	5.7	61.9	24.5	2.57 J	5	5	7	1	1	ug/l	6020A
Copper						CAS # 7440-50-8							
Second Quarter 2011	-	1.93 J	5.34	4.64 J	1.64 J	1.24 J	5	5	1,300	1	1	ug/l	6020A
Lead						CAS # 7439-92-1							
Second Quarter 2011	-	U	1.23	U	U	U	1	1	15	0.2	0.2	ug/l	6020A
Mercury						CAS # 7439-97-6							
Second Quarter 2011	-	U	U	U	U	U	2	2	2	0.2	0.2	ug/l	7471A
Nickel						CAS # 7440-02-0							
Second Quarter 2011	-	U	4.45 J	24.9	10.3	3.23 J	10	10	313	2	2	ug/l	6020A
Selenium						CAS # 7782-49-2							
Second Quarter 2011	-	5.46 J	U	U	U	U	10	10	50	3	3	ug/l	6020A
Silver						CAS # 7440-22-4							
Second Quarter 2011	-	U	U	U	U	U	2	2	78.25	0.2	0.2	ug/l	6020A
Thallium						CAS # 7440-28-0							
Second Quarter 2011	-	U	U	U	U	U	1	1	2	0.2	0.2	ug/l	6020A
Vanadium						CAS # 7440-62-2							
Second Quarter 2011	-	U	U	U	1.03 J	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 2011	-	4.5 J	28.4	32.8	4.36 J	U	10	10	4,695	3	3	ug/l	6020A
Acetone						CAS # 67-64-1							
Second Quarter 2011	-	U	U	U	U	U	10	10	8,750.2	3	3	ug/l	8260B
bis(2-Ethylhexyl)phthalate						CAS # 117-81-7							
Second Quarter 2011	-	U	U	U	U	U	6	6	10	2.7	1.5	ug/l	8270D
2-Butanone						CAS # 78-93-3							
Second Quarter 2011	-	U	U	U	U	U	10	10	2,667.6	1	1	ug/l	8260B
Chloroform						CAS # 67-66-3							
Second Quarter 2011	-	0.7 J	2.9	5.1	0.8 J	0.8 J	1	1	80	0.1	0.1	ug/l	8260B
Dichlorodifluoromethane						CAS # 75-71-8							
Second Quarter 2011	-	U	U	0.2 J	0.3 J	0.3 J	1	1	142.27	0.1	0.28	ug/l	8260B
1,2-Dichloroethane						CAS # 107-06-2							
Second Quarter 2011	-	U	U	U	U	U	1	1	5	0.1	0.147	ug/l	8260B
Diethyl ether						CAS # 60-29-7							
Second Quarter 2011	-	U	0.2 J	2.3 J	14	12	12	12	7,300	0.1	0.39	ug/l	8260B
Diethyl phthalate						CAS # 84-66-2							
Second Quarter 2011	-	U	U	U	U	U	10	10	12,520	0.62	0.5	ug/l	8270D
2,4-Dinitrotoluene						CAS # 121-14-2							
Second Quarter 2011	-	U	U	1.4 J	U	U	10	10	31.3	0.84	0.6	ug/l	8270D
2,6-Dinitrotoluene						CAS # 606-20-2							
Second Quarter 2011	-	U	U	U	U	U	10	10	15.65	0.89	0.7	ug/l	8270D
Methylene chloride						CAS # 75-09-2							
Second Quarter 2011	-	U	U	U	U	U	1	1	5	0.2	0.182	ug/l	8260B
o-Nitroaniline						CAS # 88-74-4							
Second Quarter 2011	-	U	U	U	2 J	2.4 J	10	10	110	0.99	0.7	ug/l	8270D
p-Nitroaniline						CAS # 100-01-6							
Second Quarter 2011	-	U	U	U	U	U	20	20	20	1.3	1.3	ug/l	8270D
Nitrobenzene						CAS # 98-95-3							
Second Quarter 2011	-	U	U	U	U	U	10	10	10	1.1	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 2011	-	U	U	U	U	U	1	1	1,000	0.1	0.1	ug/l	8260B
Xylenes (Total)						*CAS # 1330-20-7*							
Second Quarter 2011	-	U	U	U	U	U	3	3	10,000	0.1	0.208	ug/l	8260B

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.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Draper Aden Associates
Engineering • Surveying • Environmental Services

Facility: HWMU-5 Monitoring Event: Second Quarter 2011

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 Anallytical, Cary, NC							
Barium	5WC21	14.6		14.6		10	No action taken. Field duplicate RPD < 10.
	5WDUP	15.6		15.6		10	No action taken. Blind field duplicate for 5WC21.
Beryllium	5WC21	1.35		1.35		1	No action taken. Field duplicate RPD 12.
	5WDUP	1.52		1.52		1	No action taken. Blind field duplicate for 5WC21.
Cobalt	5WC21	61.9		61.9		5	No action taken. Field duplicate RPD < 10.
	5WDUP	65.1		65.1		5	No action taken. Blind field duplicate for 5WC21.
Nickel	5WC21	24.9		24.9		10	No action taken. Field duplicate RPD < 10.
	5WDUP	26.4		26.4		10	No action taken. Blind field duplicate for 5WC21.
Zinc	5WC21	32.8		32.8		10	No action taken. Field duplicate RPD < 10.
	5WDUP	32.2		32.2		10	No action taken. Blind field duplicate for 5WC21.
Method: 8260B							
Laboratory: Lancaster Laboratories, Lancaster, PA							
Chloroform	5WC21	5.1		5.1		1	No action taken. Field duplicate RPD < 10.
	5WDUP	5.1		5.1		1	No action taken. Blind field duplicate for 5WC21.
Trichloroethene	5WC21	4.9		4.9		1	No action taken. Field duplicate RPD < 10.
	5WDUP	4.8		4.8		1	No action taken. Blind field duplicate for 5WC21.

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.

9/15/2011

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)

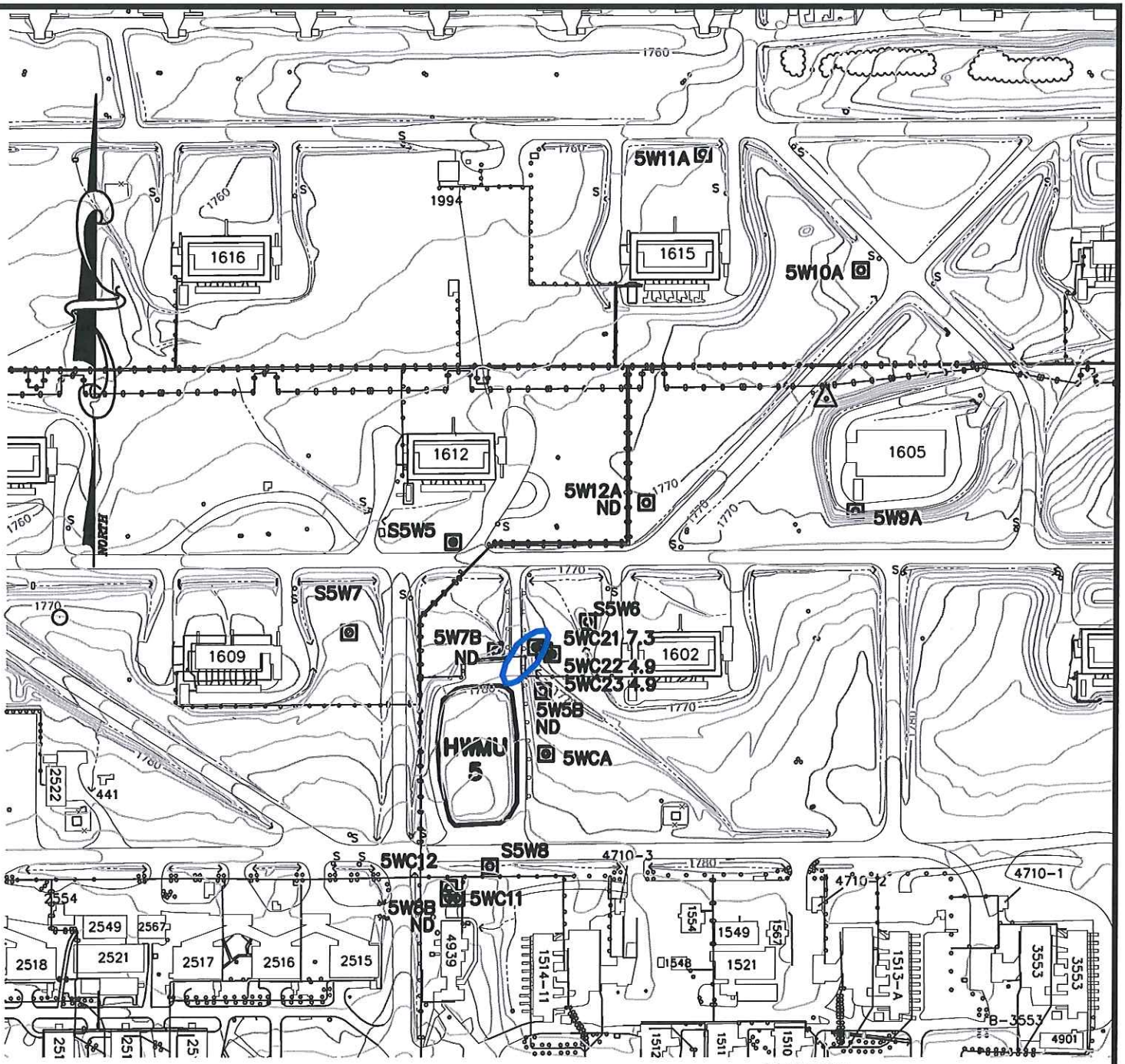
Date	5W8B	5W5B	5WC21	5WC22	5WC23	5W7B	S5WS	S5W7	5W9A	5W10A	5W11A
1st Qtr 1996	~	2.3	~	2.2	2.9	~	~	~	0.6 J	~	~
2nd Qtr 1996	~	5.7	0.4 J	3.8	4.5	~	~	~	0.7 J	~	~
3rd Qtr 1996	TC	4.3	0.4 J	5	5.8	~	~	~	0.8 J	~	~
4th Qtr 1996	~	2.4	0.9J	6.2	5.3	~	~	~	0.6 J	~	~
1st Qtr 1997	~	2.5	1.8	7.4	6.6	0.2 J	~	0.1 J	0.3 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	~					

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.



LEGEND

5W5B ◎	MONITORING WELL
7.3	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 2011)
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

SCALE: 1"=200'

PLAN NO. B03204-09

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	02/97/12

FIGURE

P:\B03\200\B03204\B03204-09\CAD\B03204-09 ENVdwg\B03204-09_4TH QUARTER 2011 FIG1.dwg Feb 07, 2012 1:59pm

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

Sample Date	TCE (ug/L)	ln TCE (ug/L)
4/18/2005	16.00	2.77
8/15/2005	10.00	2.30
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
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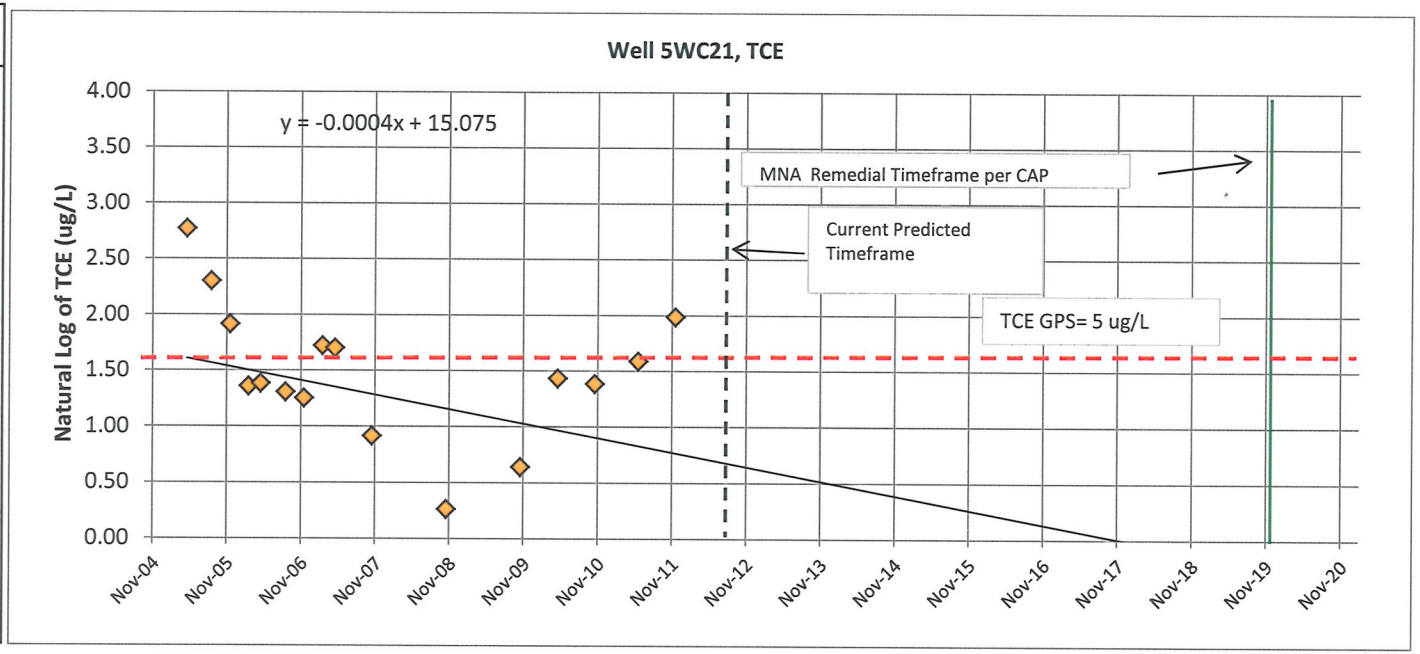
		#NUM!
		#NUM!



Last 16 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)			
4/18/2005	11/1/2011	5.000	0.0006	0.219	1.73	July-2013	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.

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

Sample Date	TCE (ug/L)	ln TCE (ug/L)
4/18/2005	5.50	1.70
8/15/2005	4.20	1.44
11/18/2005	4.40	1.48
2/14/2006	3.70	1.31
4/18/2006	4.00	1.39
8/18/2006	3.30	1.19
11/18/2006	4.70	1.55
2/14/2007	3.30	1.19
4/18/2007	3.50	1.25
10/30/2007	3.40	1.22
4/28/2008	0.50	-0.69
10/27/2008	3.00	1.10
4/20/2009	2.50	0.92
10/26/2009	3.30	1.19
4/21/2010	4.40	1.48
10/26/2010	4.00	1.39
5/4/2011	5.20	1.65
11/1/2011	4.90	1.59
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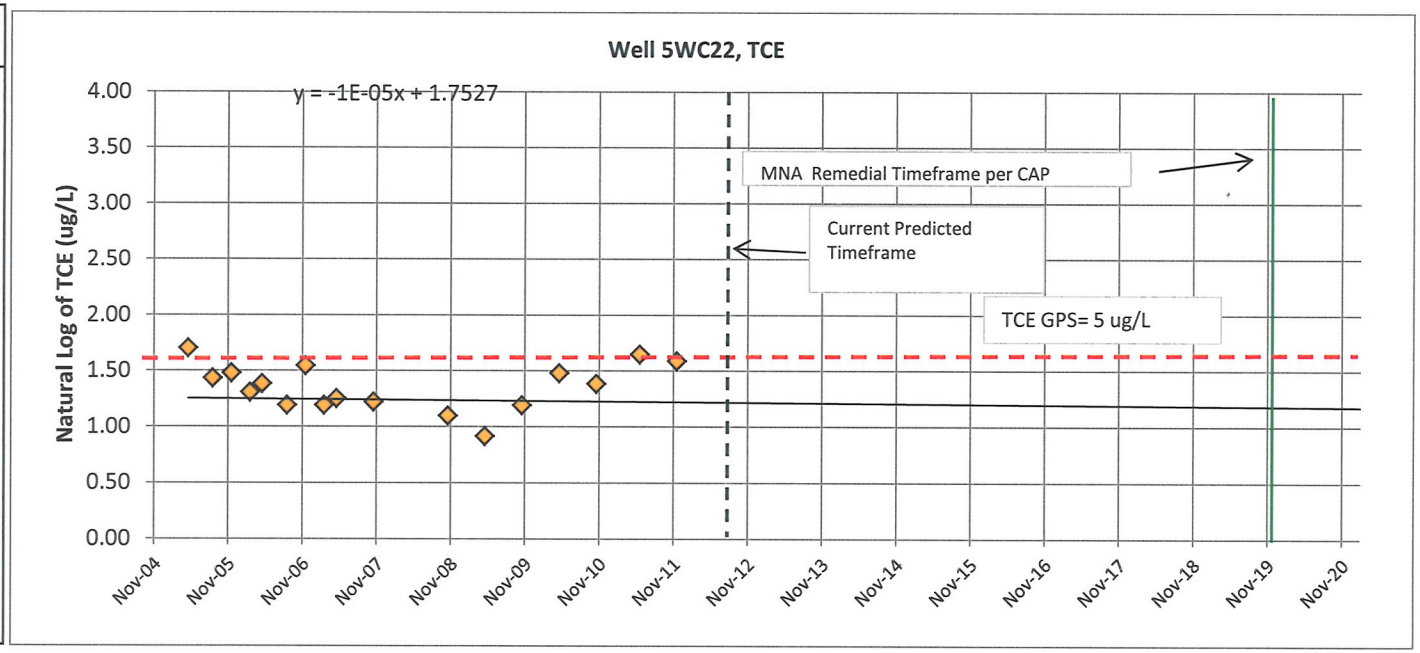
		#NUM!
		#NUM!

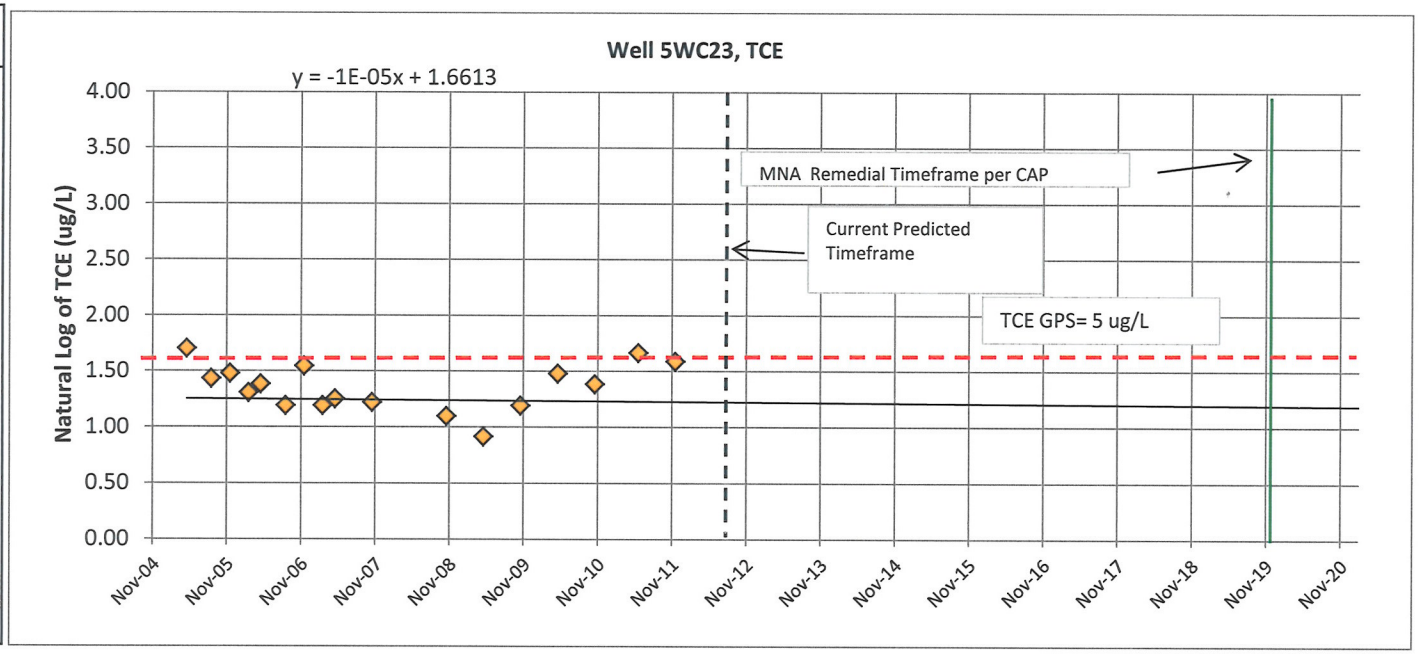


Last 16 rounds		TCE GPS	Estimated Rate and Time Required			Current MNA Timeframe Prediction	MNA Goal (per CAP)	MNA Ineffective Date (per CAP)
First Event	Last Event	ug/L	Rate (per day)	Rate (per year)	Time (years)			
4/18/2005	11/1/2011	5.000	0.0006	0.219	-0.09	September-2011	October-2019	December-2026

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.

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

Sample Date	TCE (ug/L)	ln TCE (ug/L)
4/18/2005	5.50	1.70
8/15/2005	4.20	1.44
11/18/2005	4.40	1.48
2/14/2006	3.70	1.31
4/18/2006	4.00	1.39
8/18/2006	3.30	1.19
11/18/2006	4.70	1.55
2/14/2007	3.30	1.19
4/18/2007	3.50	1.25
10/30/2007	3.40	1.22
4/28/2008	0.50	-0.69
10/27/2008	3.00	1.10
4/20/2009	2.50	0.92
10/26/2009	3.30	1.19
4/21/2010	4.40	1.48
10/26/2010	4.00	1.39
5/4/2011	5.30	1.67
11/1/2011	4.90	1.59
		#NUM!
		#NUM!
		#NUM!



Last 16 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)			
4/18/2005	11/1/2011	5.000	0.0006	0.219	-0.09	September-2011	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.

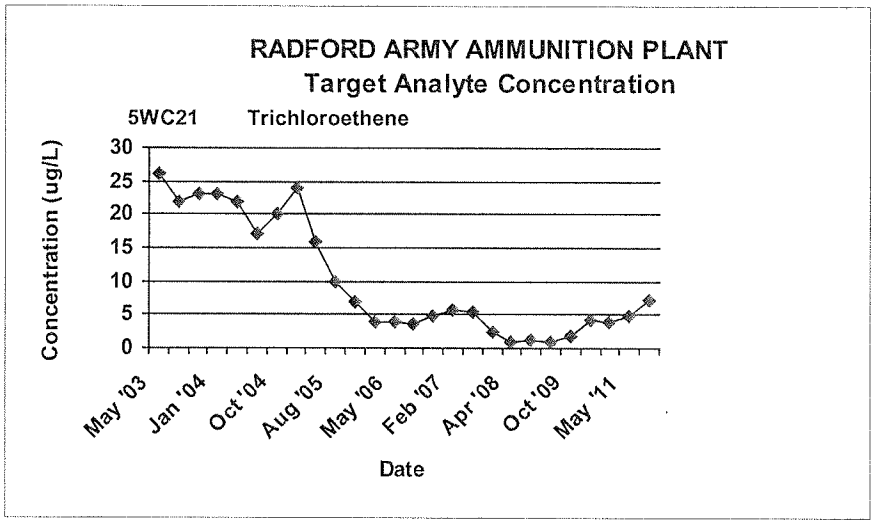
Date of Evaluation	Predicted Remedial Timeframe				
	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
Well 5W5B					
4/22/2009	October-2010	NA	NA	NA	NA
10/1/2009	NP	NA	NA	NA	NA
10/26/2010	July-2012	NA	NA	NA	NA
11/1/2011	NP	NA	NA	NA	NA
10/3/2012					
10/4/2013					
10/5/2014					
10/6/2015					
10/6/2016					
10/7/2017					
10/8/2018					
10/9/2019					
Well 5WC21					
4/22/2009	NP	NA	NA	NA	NA
10/1/2009	NP	NA	NA	NA	NA
10/2/2010	NP	NA	NA	NA	NA
11/1/2011	July-2013	NA	NA	NA	NA
10/3/2012					
10/4/2013					
10/5/2014					
10/6/2015					
10/6/2016					
10/7/2017					
10/8/2018					
10/9/2019					
Well 5WC22					
4/22/2009	NP	NA	NA	NA	NA
10/1/2009	NP	NA	NA	NA	NA
10/2/2010	NP	NA	NA	NA	NA
11/1/2011	September-2011	NA	NA	NA	NA
10/3/2012					
10/4/2013					
10/5/2014					
10/6/2015					
10/6/2016					
10/7/2017					
10/8/2018					
10/9/2019					
Well 5WC23					
4/22/2009	NP	NA	NA	NA	NA
10/1/2009	NP	NA	NA	NA	NA
10/2/2010	NP	NA	NA	NA	NA
11/1/2011	September-2011	NA	NA	NA	NA
10/3/2012					
10/4/2013					
10/5/2014					
10/6/2015					
10/6/2016					
10/7/2017					
10/8/2018					
10/9/2019					

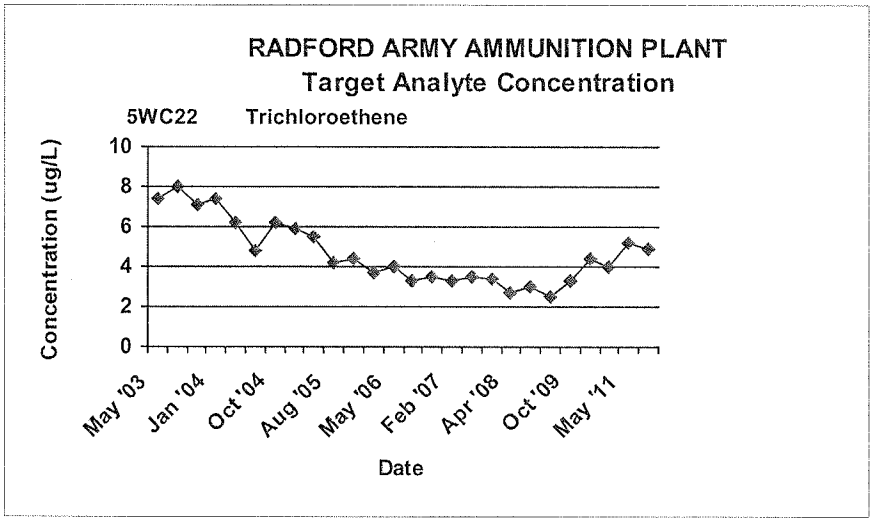
Notes:

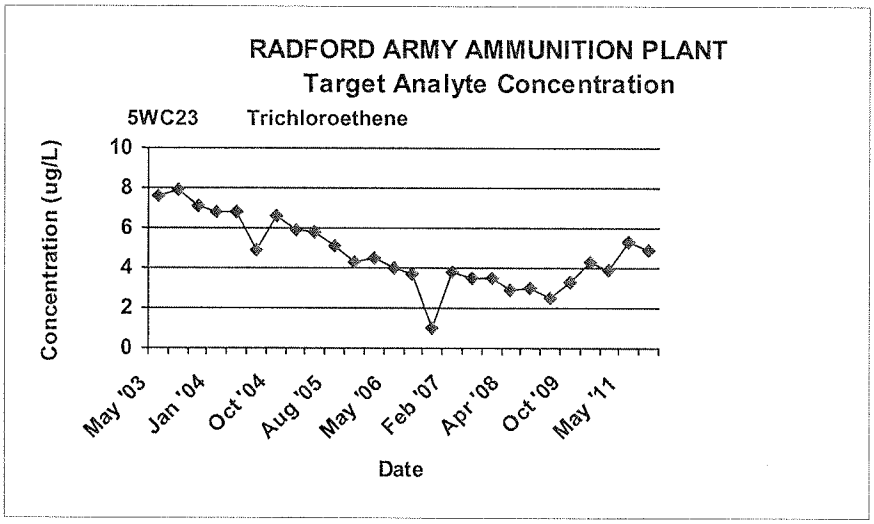
NA - Not Applicable

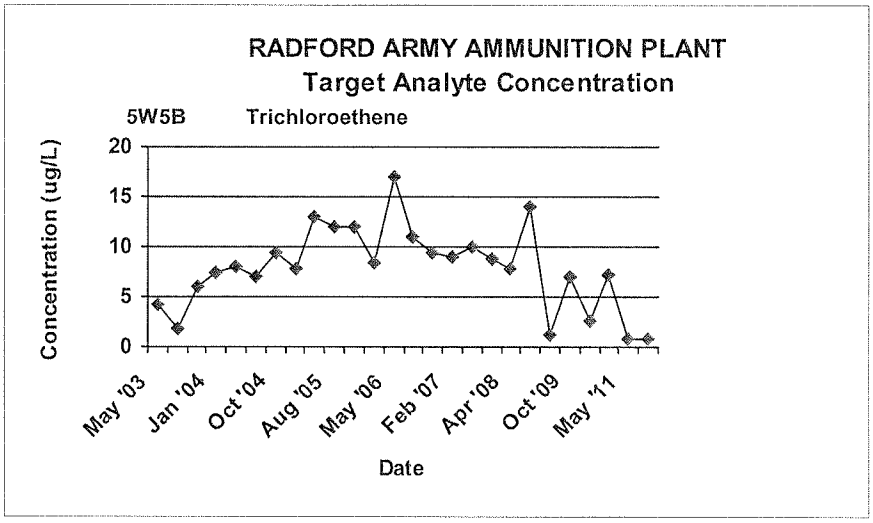
NP - Not Performed

Date of Evaluation - Refers to the date of the last monitoring event of the calendar year, the data for which was used in the evaluation.


RADFORD ARMY AMMUNITION PLANT
Target Analyte Concentration
5WC21
Trichloroethene
Concentration (ug/L)
30
25
20
15
10
5
0
May '03
Jan '04
Oct '04
Aug '05
May '06
Feb '07
Apr '08
Oct '09
May '11
Date


RADFORD ARMY AMMUNITION PLANT
Target Analyte Concentration
5WC22
Trichloroethene
Concentration (ug/L)
10
8
6
4
2
0
May '03
Jan '04
Oct '04
Aug '05
May '06
Feb '07
Apr '08
Oct '09
May '11
Date


RADFORD ARMY AMMUNITION PLANT
Target Analyte Concentration
5WC23
Trichloroethene
Concentration (ug/L)
10
8
6
4
2
0
May '03
Jan '04
Oct '04
Aug '05
May '06
Feb '07
Apr '08
Oct '09
May '11
Date

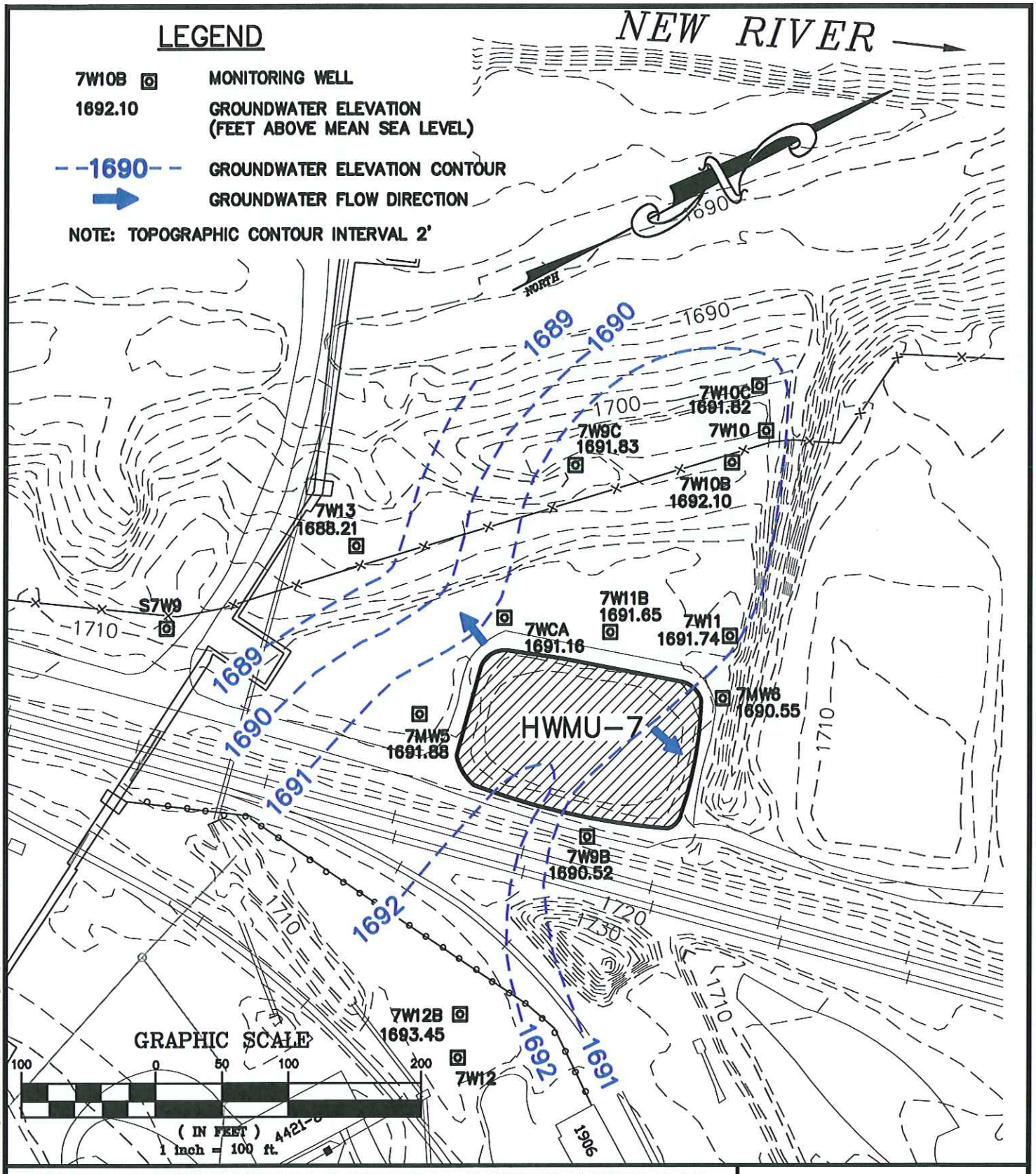

RADFORD ARMY AMMUNITION PLANT
Target Analyte Concentration
5W5B
Trichloroethene
Concentration (ug/L)
20
15
10
5
0
May '03
Jan '04
Oct '04
Aug '05
May '06
Feb '07
Apr '08
Oct '09
May '11
Date

APPENDIX B

HWMU-7

APPENDIX B-1

HWMU-7 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2011
FOURTH QUARTER 2011



HWMU-7 POTENTIOMETRIC SURFACE MAP (2ND QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-09

Draper Aden Associates

Engineering • Surveying • Environmental Services

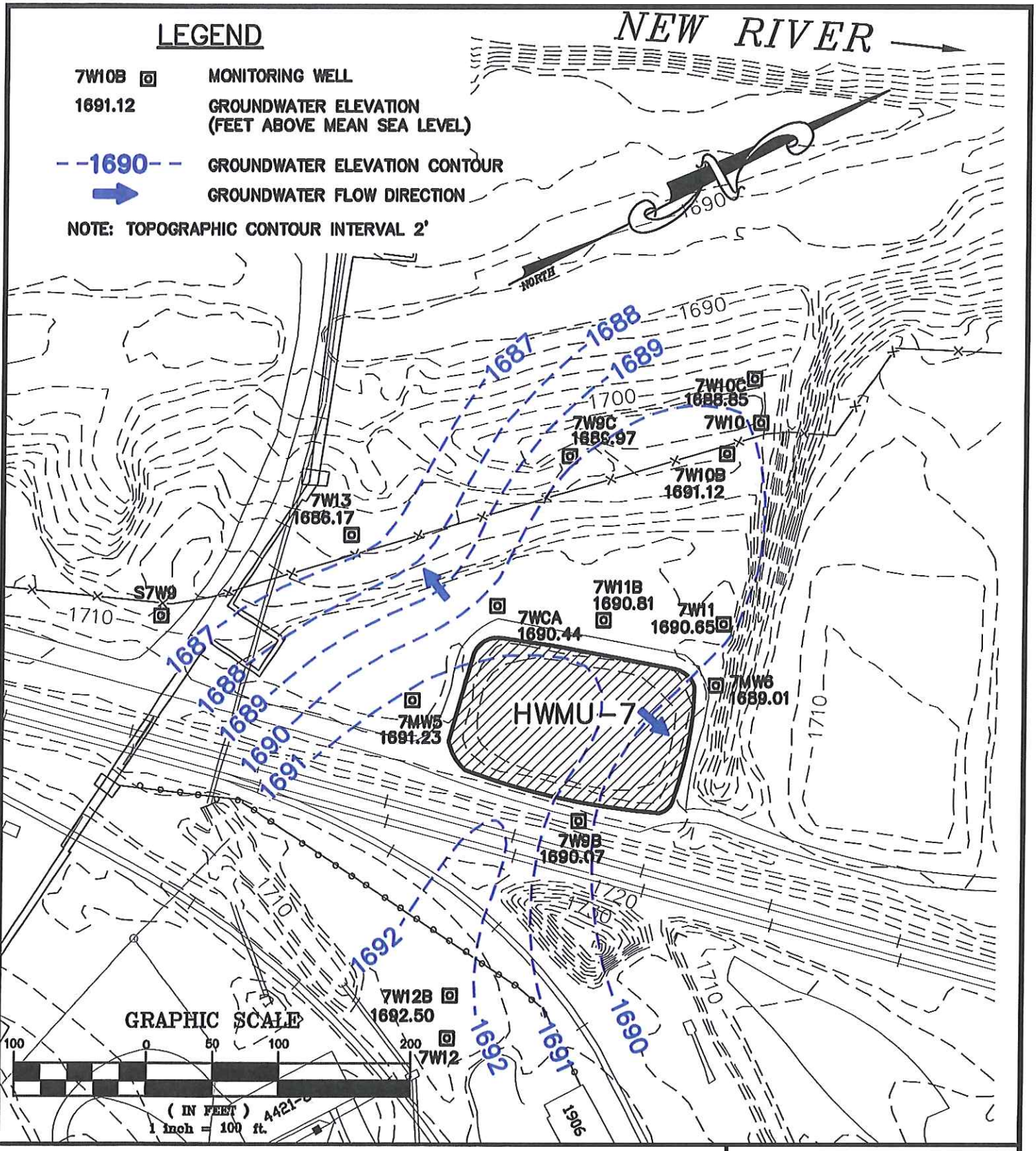
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291

Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	JFF
CHECKED	SN
DATE	09/27/11

FIGURE 2

P:\B03\200\B03204\B03204-09\CAD\B03204-09 ENV\dwg\B03204-09_HWMU-7.dwg Sep 27, 2011 10:25am



HWMU-7 POTENTIOMETRIC SURFACE MAP (4TH QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-122

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	SN
DATE	01/31/12

FIGURE 4

P:\B03200\B03204\B03204-122\CAD\B03204-122_HWMU-7 4th Quarter.dwg Jan 31, 2012 3:39pm

APPENDIX B-2

HWMU-7 2011 LABORATORY ANALYTICAL RESULTS
POINT OF COMPLIANCE WELLS

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Antimony						*CAS #*		7440-36-0
Second Quarter 2011	U	U	U	U	1	6	1	6020A
Arsenic						*CAS #*		7440-38-2
Second Quarter 2011	U	U	U	U	10	10	10	6020A
Barium						*CAS #*		7440-39-3
Second Quarter 2011	31.1	17.3	27.1	26.7	10	2000	41	6020A
Beryllium						*CAS #*		7440-41-7
Second Quarter 2011	U	U	U	U	1	-		6020A
Cadmium						*CAS #*		7440-43-9
Second Quarter 2011	U	U	U	U	1	5	1	6020A
Chromium						*CAS #*		7440-47-3
Second Quarter 2011	5.3	U	U	U	5	100	9.9	6020A
Cobalt						*CAS #*		7440-48-4
Second Quarter 2011	U	U	3.73 J	1.49 J	5	156.65	5	6020A
Copper						*CAS #*		7440-50-8
Second Quarter 2011	3.15J	3.46 J	1.9 J	U	5	1300	5	6020A
Lead						*CAS #*		7439-92-1
Second Quarter 2011	U	U	U	U	1	15	1	6020A
Mercury						*CAS #*		7439-97-6
Second Quarter 2011	U	U	U	U	2	2	2	7470A
Nickel						*CAS #*		7440-02-0
Second Quarter 2011	U	2.05 J	10.7	U	10	313	10	6020A
Selenium						*CAS #*		7782-49-2
Second Quarter 2011	U	U	U	U	10	50	10	6020A
Silver						*CAS #*		7440-22-4
Second Quarter 2011	U	U	U	U	2	78.25	2	6020A
Thallium						*CAS #*		7440-28-0
Second Quarter 2011	U	U	U	U	1	2	1	6020A
Tin						*CAS #*		7440-31-5
Second Quarter 2011	U N	U N	U N	U	20	-		6010C
Vanadium						*CAS #*		7440-62-2
Second Quarter 2011	U	U	U	U	10	-		6020A
Zinc						*CAS #*		7440-66-6
Second Quarter 2011	7.78J	6.7 J	6.07 J	3.3 J	10	4695	10.9	6020A
Cyanide						*CAS #*		57-12-5
Second Quarter 2011	U	U	U	U	20	200	20	9012A
Sulfide						*CAS #*		Q1314
Second Quarter 2011	U J	U J	U J	U J	3000	-		9034
Total Recoverable Phenolics						*CAS #*		C-020
Second Quarter 2011	U	U N	U	U N	50	-		9066
Acenaphthene						*CAS #*		83-32-9
Second Quarter 2011	U	U	U	U	5	-		8270D
Acenaphthylene						*CAS #*		208-96-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Acetone						*CAS #*		67-64-1
Second Quarter 2011	U	U	U	U	10	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Acetonitrile							*CAS #*	75-05-8
Second Quarter 2011	U	U	U	U	100	-		8260B
Acetophenone							*CAS #*	98-86-2
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Acetylaminofluorene							*CAS #*	53-96-3
Second Quarter 2011	U	U	U	U	5	-		8270D
Acrolein							*CAS #*	107-02-8
Second Quarter 2011	U J	U J	U J	U J	25	-		8260B
Acrylonitrile							*CAS #*	107-13-1
Second Quarter 2011	U	U	U	U	10	-		8260B
Aldrin							*CAS #*	309-00-2
Second Quarter 2011	U	U	U	U	0.025	-		8081B
Allyl chloride							*CAS #*	107-05-1
Second Quarter 2011	U	U	U	U	10	-		8260B
4-Aminobiphenyl							*CAS #*	92-67-1
Second Quarter 2011	U	U	U	U	5	-		8270D
Aniline							*CAS #*	62-53-3
Second Quarter 2011	U	U	U	U	5	-		8270D
Anthracene							*CAS #*	120-12-7
Second Quarter 2011	U	U	U	U	5	-		8270D
Aramite							*CAS #*	140-57-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Benzene							*CAS #*	71-43-2
Second Quarter 2011	0.1 J	U	U	U	1	-		8260B
Benzo[a]anthracene							*CAS #*	56-55-3
Second Quarter 2011	U	U	U	U	5	-		8270D
Benzo[b]fluoranthene							*CAS #*	205-99-2
Second Quarter 2011	U	U	U	U	5	-		8270D
Benzo[k]fluoranthene							*CAS #*	207-08-9
Second Quarter 2011	U	U	U	U	5	-		8270D
Benzo[ghi]perylene							*CAS #*	191-24-2
Second Quarter 2011	U	U	U	U	5	-		8270D
Benzo(a)pyrene							*CAS #*	50-32-8
Second Quarter 2011	U	U	U	U	5	-		8270D
1,4-Benzenediamine							*CAS #*	106-50-3
Second Quarter 2011	U J	U J	U J	U J	7.5	-		8270D
Benzyl alcohol							*CAS #*	100-51-6
Second Quarter 2011	U	U	U	U	5	-		8270D
alpha-BHC							*CAS #*	319-84-6
Second Quarter 2011	U	U	U	U	0.025	-		8081B
beta-BHC							*CAS #*	319-85-7
Second Quarter 2011	U	U	U	U	0.025	-		8081B
delta-BHC							*CAS #*	319-86-8
Second Quarter 2011	U	U	U	U	0.025	-		8081B
gamma-BHC							*CAS #*	58-89-9
Second Quarter 2011	U	U	U	U	0.025	-		8081B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
bis(2-Chloroethoxy)methane							*CAS #*	111-91-1
Second Quarter 2011	U	U	U	U	5	-		8270D
bis(2-Chloroethyl)ether							*CAS #*	111-44-4
Second Quarter 2011	U	U	U	U	5	-		8270D
bis(2-Chloro-1-methylethyl)ether							*CAS #*	108-60-1
Second Quarter 2011	U	U	U	U	5	-		8270D
bis(2-Ethylhexyl)phthalate							*CAS #*	117-81-7
Second Quarter 2011	U	U	U	U	5	6	6	8270D
Bromobenzene							*CAS #*	108-86-1
Second Quarter 2011	U	U	U	U	1	-		8260B
Bromochloromethane							*CAS #*	74-97-5
Second Quarter 2011	U	U	U	U	1	-		8260B
Bromodichloromethane							*CAS #*	75-27-4
Second Quarter 2011	U	U	U	U	1	-		8260B
Bromoform							*CAS #*	75-25-2
Second Quarter 2011	U	U	U	U	1	-		8260B
4-Bromophenyl phenyl ether							*CAS #*	101-55-3
Second Quarter 2011	U	U	U	U	5	-		8270D
n-Butyl alcohol							*CAS #*	71-36-3
Second Quarter 2011	U	U	U	U	50	-		8260B
tert-Butyl alcohol							*CAS #*	75-65-0
Second Quarter 2011	U	U	U	U	200	-		8260B
n-Butylbenzene							*CAS #*	104-51-8
Second Quarter 2011	U	U	U	U	1	-		8260B
sec-Butylbenzene							*CAS #*	135-98-8
Second Quarter 2011	U	U	U	U	1	-		8260B
tert-Butylbenzene							*CAS #*	98-06-6
Second Quarter 2011	U	U	U	U	1	-		8260B
Butyl benzyl phthalate							*CAS #*	85-68-7
Second Quarter 2011	U	U	U	U	10	3130	10	8270D
Carbon disulfide							*CAS #*	75-15-0
Second Quarter 2011	U	U	U	U	10	-		8260B
Carbon tetrachloride							*CAS #*	56-23-5
Second Quarter 2011	U	U	U	U	1	-		8260B
Chlordane							*CAS #*	57-74-9
Second Quarter 2011	U	U	U	U	0.8	-		8081B
p-Chloroaniline							*CAS #*	106-47-8
Second Quarter 2011	U	U	U	U	10	-		8270D
Chlorobenzene							*CAS #*	108-90-7
Second Quarter 2011	U	U	U	U	1	-		8260B
Chlorobenzilate							*CAS #*	510-15-6
Second Quarter 2011	U	U	U	U	5	-		8270D
p-Chloro-m-cresol							*CAS #*	59-50-7
Second Quarter 2011	U	U	U	U	10	-		8270D
Chloroethane							*CAS #*	75-00-3
Second Quarter 2011	U	U	U	U	1	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B

All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Chloroform							*CAS #*	67-66-3
Second Quarter 2011	3	U	0.8 J	0.6 J	1	-		8260B
2-Chloroethyl vinyl ether							*CAS #*	110-75-8
Second Quarter 2011	U J	U J	U J	U J	20	-		8260B
2-Chloronaphthalene							*CAS #*	91-58-7
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Chlorophenol							*CAS #*	95-57-8
Second Quarter 2011	U	U	U	U	10	-		8270D
4-Chlorophenyl phenyl ether							*CAS #*	7005-72-3
Second Quarter 2011	U	U	U	U	5	-		8270D
Chloroprene							*CAS #*	126-99-8
Second Quarter 2011	U	U	U	U	10	-		8260B
2-Chlorotoluene							*CAS #*	95-49-8
Second Quarter 2011	U	U	U	U	1	-		8260B
4-Chlorotoluene							*CAS #*	106-43-4
Second Quarter 2011	U	U	U	U	1	-		8260B
Chrysene							*CAS #*	218-01-9
Second Quarter 2011	U	U	U	U	5	-		8270D
Cyclohexane							*CAS #*	110-82-7
Second Quarter 2011	U	U	U	U	1	-		8260B
2,4-Dichlorophenoxyacetic acid							*CAS #*	94-75-7
Second Quarter 2011	U	U	U	U	5	-		8151A
4,4'-DDD							*CAS #*	72-54-8
Second Quarter 2011	U	U	U	U	0.05	-		8081B
4,4'-DDE							*CAS #*	72-55-9
Second Quarter 2011	U	U	U	U	0.05	-		8081B
4,4'-DDT							*CAS #*	50-29-3
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Diallate							*CAS #*	2303-16-4
Second Quarter 2011	U	U	U	U	10	-		8270D
Dibenz(a,h)anthracene							*CAS #*	53-70-3
Second Quarter 2011	U	U	U	U	5	-		8270D
Dibenzofuran							*CAS #*	132-64-9
Second Quarter 2011	U	U	U	U	5	-		8270D
Dibromochloromethane							*CAS #*	124-48-1
Second Quarter 2011	U	U	U	U	1	-		8260B
1,2-Dibromo-3-chloropropane							*CAS #*	96-12-8
Second Quarter 2011	U	U	U	U	1	-		8260B
1,2-Dibromoethane							*CAS #*	106-93-4
Second Quarter 2011	U	U	U	U	1	-		8260B
Di-n-butyl phthalate							*CAS #*	84-74-2
Second Quarter 2011	U	U	U	U	5	-		8270D
1,2-Dichlorobenzene							*CAS #*	95-50-1
Second Quarter 2011	U	U	U	U	1	-		8260B
1,3-Dichlorobenzene							*CAS #*	541-73-1
Second Quarter 2011	U	U	U	U	1	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B

All Results in ug/L.

Analtye/Quarter	7W12B Q	7MW6 Q	7WCA Q	7W11B Q	QL	GPS	Background	Method
1,4-Dichlorobenzene							CAS #	106-46-7
Second Quarter 2011	U	U	U	U	1	-		8260B
3,3'-Dichlorobenzidine							CAS #	91-94-1
Second Quarter 2011	U	U	U	U	5	-		8270D
trans-1,4-Dichloro-2-butene							CAS #	110-57-6
Second Quarter 2011	U J	U J	U J	U J	10	-		8260B
Dichlorodifluoromethane							CAS #	75-71-8
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1-Dichloroethane							CAS #	75-34-3
Second Quarter 2011	U	U	U	U	1	-		8260B
1,2-Dichloroethane							CAS #	107-06-2
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1-Dichloroethene							CAS #	75-35-4
Second Quarter 2011	U	U	U	U	1	-		8260B
trans-1,2-Dichloroethene							CAS #	156-60-5
Second Quarter 2011	U	U	U	U	1	-		8260B
2,4-Dichlorophenol							CAS #	120-83-2
Second Quarter 2011	U	U	U	U	10	-		8270D
2,6-Dichlorophenol							CAS #	87-65-0
Second Quarter 2011	U	U	U	U	10	-		8270D
1,2-Dichloropropane							CAS #	78-87-5
Second Quarter 2011	U	U	U	U	1	-		8260B
1,3-Dichloropropane							CAS #	142-28-9
Second Quarter 2011	U	U	U	U	1	-		8260B
2,2-Dichloropropane							CAS #	594-20-7
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1-Dichloropropene							CAS #	563-58-6
Second Quarter 2011	U	U	U	U	1	-		8260B
cis-1,3-Dichloropropene							CAS #	10061-01-5
Second Quarter 2011	U	U	U	U	1	-		8260B
trans-1,3-Dichloropropene							CAS #	10061-02-6
Second Quarter 2011	U	U	U	U	1	-		8260B
Dieldrin							CAS #	60-57-1
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Diethyl ether							CAS #	60-29-7
Second Quarter 2011	U	U	U	U	12.5	-		8260B
Diethyl phthalate							CAS #	84-66-2
Second Quarter 2011	U	U	U	U	5	-		8270D
O,O-Diethyl O-2-pyrazinyl							CAS #	297-97-2
Second Quarter 2011	U	U	U	U	5	-		8270D
Dimethoate							CAS #	60-51-5
Second Quarter 2011	U	U	U	U	5	-		8270D
Dimethyl ether							CAS #	115-10-6
Second Quarter 2011	U	U	U	U	12.5	-		8260B
p-(Dimethylamino)azobenzene							CAS #	60-11-7
Second Quarter 2011	U	U	U	U	5	-		8270D

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
7,12-Dimethylbenz[a]anthracene						*CAS #*		57-97-6
Second Quarter 2011	U	U	U	U	5	-		8270D
3,3'-Dimethylbenzidine						*CAS #*		119-93-7
Second Quarter 2011	U	U	U	U	5	-		8270D
a,a-Dimethylphenethylamine						*CAS #*		122-09-8
Second Quarter 2011	U J	U J	U J	U J	15	-		8270D
2,4-Dimethylphenol						*CAS #*		105-67-9
Second Quarter 2011	U	U	U	U	10	-		8270D
Dimethyl phthalate						*CAS #*		131-11-3
Second Quarter 2011	U	U	U	U	5	-		8270D
m-Dinitrobenzene						*CAS #*		99-65-0
Second Quarter 2011	U	U	U	U	5	-		8270D
4,6-Dinitro-o-cresol						*CAS #*		534-52-1
Second Quarter 2011	U	U	U	U	10	-		8270D
2,4-Dinitrophenol						*CAS #*		51-28-5
Second Quarter 2011	U J	U J	U J	U J	10	31.3	10	8270D
2,4-Dinitrotoluene						*CAS #*		121-14-2
Second Quarter 2011	U	U	0.974 J	U	10	31.3	10	8270D
2,6-Dinitrotoluene						*CAS #*		606-20-2
Second Quarter 2011	U	U	U	U	10	15.65	10	8270D
Dinoseb						*CAS #*		88-85-7
Second Quarter 2011	U	U	U	U	2.5	-		8151A
Di-n-octyl phthalate						*CAS #*		117-84-0
Second Quarter 2011	U	U	U	U	5	-		8270D
1,4-Dioxane						*CAS #*		123-91-1
Second Quarter 2011	U	U	U	U	200	-		8260B
Diphenylamine						*CAS #*		86-30-6
Second Quarter 2011	U	U	U	U	5	-		8270D
Disulfoton						*CAS #*		298-04-4
Second Quarter 2011	U	U	U	U	5	-		8270D
Endosulfan I						*CAS #*		959-98-8
Second Quarter 2011	U	U	U	U	0.025	-		8081B
Endosulfan II						*CAS #*		33213-65-9
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Endosulfan sulfate						*CAS #*		1031-07-8
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Endrin						*CAS #*		72-20-8
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Ethyl acetate						*CAS #*		141-78-6
Second Quarter 2011	U	U	U	U	10	-		8260B
Endrin aldehyde						*CAS #*		7421-93-4
Second Quarter 2011	U	U	U	U	0.05	-		8081B
Ethanol						*CAS #*		64-17-5
Second Quarter 2011	U	U	U	U	250	-		8260B
Ethylbenzene						*CAS #*		100-41-4
Second Quarter 2011	U	U	U	U	1	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B

All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Ethyl methacrylate							*CAS #*	97-63-2
Second Quarter 2011	U	U	U	U	10	-		8260B
Ethyl methanesulfonate							*CAS #*	62-50-0
Second Quarter 2011	U	U	U	U	5	-		8270D
Ethylene oxide							*CAS #*	75-21-8
Second Quarter 2011	U J	U J	U J	U J	100	-		8260B
Famphur							*CAS #*	52-85-7
Second Quarter 2011	U	U	U	U	5	-		8270D
Fluoranthene							*CAS #*	206-44-0
Second Quarter 2011	U	U	U	U	5	-		8270D
Fluorene							*CAS #*	86-73-7
Second Quarter 2011	U	U	U	U	5	-		8270D
Heptachlor							*CAS #*	76-44-8
Second Quarter 2011	U	U	U	U	0.025	-		8081B
Heptachlor epoxide							*CAS #*	1024-57-3
Second Quarter 2011	U	U	U	U	0.025	-		8081B
Hexachlorobenzene							*CAS #*	118-74-1
Second Quarter 2011	U	U	U	U	5	-		8270D
Hexachlorobutadiene							*CAS #*	87-68-3
Second Quarter 2011	U	U	U	U	1	-		8260B
Hexachlorocyclopentadiene							*CAS #*	77-47-4
Second Quarter 2011	U	U	U	U	5	-		8270D
Hexachloroethane							*CAS #*	67-72-1
Second Quarter 2011	U	U	U	U	10	-		8260B
Hexachlorophene							*CAS #*	70-30-4
Second Quarter 2011	U	U	U	U	40	-		8270D
Hexachloropropene							*CAS #*	1888-71-7
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Hexanone							*CAS #*	591-78-6
Second Quarter 2011	U	U	U	U	10	-		8260B
Indeno[1,2,3-cd]pyrene							*CAS #*	193-39-5
Second Quarter 2011	U	U	U	U	5	-		8270D
Isobutyl alcohol							*CAS #*	78-83-1
Second Quarter 2011	U	U	U	U	200	-		8260B
Isodrin							*CAS #*	465-73-6
Second Quarter 2011	U	U	U	U	5	-		8270D
Isophorone							*CAS #*	78-59-1
Second Quarter 2011	U	U	U	U	5	-		8270D
Isopropylbenzene							*CAS #*	98-82-8
Second Quarter 2011	U	U	U	U	1	-		8260B
Isopropylether							*CAS #*	108-20-3
Second Quarter 2011	U	U	U	U	10	-		8260B
4-Isopropyltoluene							*CAS #*	99-87-6
Second Quarter 2011	U	U	U	U	1	-		8260B
Isosafrole							*CAS #*	120-58-1
Second Quarter 2011	U J	U J	U J	U J	5	-		8270D

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Kepone							*CAS #*	143-50-0
Second Quarter 2011	U	U	U	U	5	-		8270D
Methacrylonitrile							*CAS #*	126-98-7
Second Quarter 2011	U	U	U	U	100	-		8260B
Methapyrilene							*CAS #*	91-80-5
Second Quarter 2011	U	U	U	U	5	-		8270D
Methoxychlor							*CAS #*	72-43-5
Second Quarter 2011	U	U	U	U	0.25	-		8081B
Bromomethane							*CAS #*	74-83-9
Second Quarter 2011	U	U	U	U	1	-		8260B
Chloromethane							*CAS #*	74-87-3
Second Quarter 2011	U	U	U	U	1	-		8260B
3-Methylcholanthrene							*CAS #*	56-49-5
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Butanone							*CAS #*	78-93-3
Second Quarter 2011	U	U	U	U	10	-		8260B
Iodomethane							*CAS #*	74-88-4
Second Quarter 2011	U	U	U	U	10	-		8260B
Methyl methacrylate							*CAS #*	80-62-6
Second Quarter 2011	U	U	U	U	10	-		8260B
Methyl methane sulfonate							*CAS #*	66-27-3
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Methylnaphthalene							*CAS #*	91-57-6
Second Quarter 2011	U	U	U	U	5	-		8270D
Methyl parathion							*CAS #*	298-00-0
Second Quarter 2011	U	U	U	U	5	-		8270D
4-Methyl-2-pentanone							*CAS #*	108-10-1
Second Quarter 2011	U	U	U	U	10	-		8260B
2-Methylphenol							*CAS #*	95-48-7
Second Quarter 2011	U	U	U	U	10	-		8270D
3 & 4-Methylphenol							*CAS #*	106-44-5
Second Quarter 2011	U	U	U	U	10	-		8270D
Methyl tert-butyl ether							*CAS #*	1634-04-4
Second Quarter 2011	U	U	U	U	10	-		8260B
Dibromomethane							*CAS #*	74-95-3
Second Quarter 2011	U	U	U	U	1	-		8260B
Methylene chloride							*CAS #*	75-09-2
Second Quarter 2011	U	U	U	U	1	-		8260B
Naphthalene							*CAS #*	91-20-3
Second Quarter 2011	U	U	U	U	1	-		8260B
1,4-Naphthoquinone							*CAS #*	130-15-4
Second Quarter 2011	U J	U J	U J	U J	5	-		8270D
1-Naphthylamine							*CAS #*	134-32-7
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Naphthylamine							*CAS #*	91-59-8
Second Quarter 2011	U	U	U	U	5	-		8270D

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
o-Nitroaniline							*CAS #*	88-74-4
Second Quarter 2011	U	U	U	U	10	-		8270D
m-Nitroaniline							*CAS #*	99-09-2
Second Quarter 2011	U	U	U	U	10	-		8270D
p-Nitroaniline							*CAS #*	100-01-6
Second Quarter 2011	U	U	U	U	10	-		8270D
Nitrobenzene							*CAS #*	98-95-3
Second Quarter 2011	U	U	U	U	5	-		8270D
o-Nitrophenol							*CAS #*	88-75-5
Second Quarter 2011	U	U	U	U	10	-		8270D
p-Nitrophenol							*CAS #*	100-02-7
Second Quarter 2011	U	U	U	U	10	50	20	8270D
4-Nitroquinoline-1-oxide							*CAS #*	56-57-5
Second Quarter 2011	U J	U J	U J	U J	5	-		8270D
N-Nitrosodi-n-butylamine							*CAS #*	924-16-3
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosodiethylamine							*CAS #*	55-18-5
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosodimethylamine							*CAS #*	62-75-9
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosodiphenylamine							*CAS #*	86-30-6
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosodipropylamine							*CAS #*	621-64-7
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosomethylethylamine							*CAS #*	10595-95-6
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosomorpholine							*CAS #*	59-89-2
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosopiperidine							*CAS #*	100-75-4
Second Quarter 2011	U	U	U	U	5	-		8270D
N-Nitrosopyrrolidine							*CAS #*	930-55-2
Second Quarter 2011	U	U	U	U	5	-		8270D
5-Nitroso-o-toluidine							*CAS #*	99-55-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Parathion							*CAS #*	56-38-2
Second Quarter 2011	U	U	U	U	5	-		8270D
Pentachlorobenzene							*CAS #*	608-93-5
Second Quarter 2011	U	U	U	U	5	-		8270D
Pentachloroethane							*CAS #*	76-01-7
Second Quarter 2011	U	U	U	U	10	-		8260B
Pentachloronitrobenzene							*CAS #*	82-68-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Pentachlorophenol							*CAS #*	87-86-5
Second Quarter 2011	U	U	U	U	10	-		8270D
Phenacetin							*CAS #*	62-44-2
Second Quarter 2011	U	U	U	U	5	-		8270D

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analyte/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Phenanthrene							*CAS #*	85-01-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Phenol							*CAS #*	108-95-2
Second Quarter 2011	U	U	U	U	10	-		8270D
Phorate							*CAS #*	298-02-2
Second Quarter 2011	U	U	U	U	5	-		8270D
2-Picoline							*CAS #*	109-06-8
Second Quarter 2011	U	U	U	U	5	-		8270D
Pronamide							*CAS #*	23950-58-5
Second Quarter 2011	U	U	U	U	5	-		8270D
1-Propanol							*CAS #*	71-23-8
Second Quarter 2011	U J	U J	U J	U J	100	-		8260B
2-Propanol							*CAS #*	67-63-0
Second Quarter 2011	U	U	U	U	100	-		8260B
Propionitrile							*CAS #*	107-12-0
Second Quarter 2011	U	U	U	U	100	-		8260B
n-Propylbenzene							*CAS #*	103-65-1
Second Quarter 2011	U	U	U	U	1	-		8260B
Pyrene							*CAS #*	129-00-0
Second Quarter 2011	U	U	U	U	5	-		8270D
Pyridine							*CAS #*	110-86-1
Second Quarter 2011	U	U	U	U	5	-		8270D
Safrole							*CAS #*	94-59-7
Second Quarter 2011	U	U	U	U	5	-		8270D
Silvex							*CAS #*	93-72-1
Second Quarter 2011	U	U	U	U	2.5	-		8151A
Styrene							*CAS #*	100-42-5
Second Quarter 2011	U	U	U	U	1	-		8260B
Sulfotep							*CAS #*	3689-24-5
Second Quarter 2011	U	U	U	U	5	-		8270D
2,4,5-Trichlorophenoxyacetic acid							*CAS #*	93-76-5
Second Quarter 2011	U	U	U	U	2.5	-		8151A
1,2,4,5-Tetrachlorobenzene							*CAS #*	95-94-3
Second Quarter 2011	U	U	U	U	5	-		8270D
1,1,1,2-Tetrachloroethane							*CAS #*	630-20-6
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1,2,2-Tetrachloroethane							*CAS #*	79-34-5
Second Quarter 2011	U	U	U	U	1	-		8260B
Tetrachloroethene							*CAS #*	127-18-4
Second Quarter 2011	U	U	U	U	1	-		8260B
Tetrahydrofuran							*CAS #*	109-99-9
Second Quarter 2011	U	U	U	U	25	-		8260B
2,3,4,6-Tetrachlorophenol							*CAS #*	58-90-2
Second Quarter 2011	U	U	U	U	10	-		8270D
Toluene							*CAS #*	108-88-3
Second Quarter 2011	U	U	U	U	1	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
o-Toluidine							*CAS #*	95-53-4
Second Quarter 2011	U	U	U	U	5	-		8270D
Toxaphene							*CAS #*	8001-35-2
Second Quarter 2011	U	U	U	U	2.5	-		8081B
1,2,3-Trichlorobenzene							*CAS #*	87-61-6
Second Quarter 2011	U	U	U	U	1	-		8260B
1,2,4-Trichlorobenzene							*CAS #*	120-82-1
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1,1-Trichloroethane							*CAS #*	71-55-6
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1,2-Trichloroethane							*CAS #*	79-00-5
Second Quarter 2011	U	U	U	U	1	-		8260B
Trichloroethene							*CAS #*	79-01-6
Second Quarter 2011	U	U	U	U	1	-		8260B
Trichlorofluoromethane							*CAS #*	75-69-4
Second Quarter 2011	U	U	U	U	1	-		8260B
2,4,5-Trichlorophenol							*CAS #*	95-95-4
Second Quarter 2011	U	U	U	U	10	-		8270D
2,4,6-Trichlorophenol							*CAS #*	88-06-2
Second Quarter 2011	U	U	U	U	10	-		8270D
1,2,3-Trichloropropane							*CAS #*	96-18-4
Second Quarter 2011	U	U	U	U	1	-		8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane							*CAS #*	76-13-1
Second Quarter 2011	U	U	U	U	1	-		8260B
O,O,O-Triethyl phosphorothioate							*CAS #*	126-68-1
Second Quarter 2011	U	U	U	U	5	-		8270D
1,2,4-Trimethylbenzene							*CAS #*	95-63-6
Second Quarter 2011	U	U	U	U	1	-		8260B
1,3,5-Trimethylbenzene							*CAS #*	108-67-8
Second Quarter 2011	U	U	U	U	1	-		8260B
sym-Trinitrobenzene							*CAS #*	99-35-4
Second Quarter 2011	U	U	U	U	5	-		8270D
Vinyl acetate							*CAS #*	108-05-4
Second Quarter 2011	U	U	U	U	10	-		8260B
Vinyl chloride							*CAS #*	75-01-4
Second Quarter 2011	U	U	U	U	1	-		8260B
Xylenes (Total)							*CAS #*	1330-20-7
Second Quarter 2011	U	U	U	U	3	-		8260B

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*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.

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.
Background Denotes background concentrations listed in the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes groundwater protection standard.

The following definitions apply to results reported for non-Appendix IX monitoring events.
All non-Appendix IX monitoring results for compliance wells are reported to 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 the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes groundwater protection standard.

Notes:

-Appendix IX Groundwater Monitoring Events:

Third Quarter 2003, Second Quarter 2004, Second Quarter 2005, Third Quarter 2006, Second Quarter 2007, Second Quarter 2008, Second Quarter 2009, Second Quarter 2010, Second Quarter 2011

All Appendix IX results evaluated and reported to detection limit.
-9/29/2003: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA (copper and zinc).
Verification results reported in this table for copper and zinc.
-6/21-22/2004: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA.
Verification results reported in this table for chloroform (7W12B).
-3/23/2005: Verification sampling event for 7MW6. Verification results reported in this table for bis(2-ethylhexyl)phthalate).
-7/26/2005: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA (ethyl acetate), 7W11B (beta-BHC), and 7MW6 (alpha-BHC). All Verification results reported as not detected. Verification results reported.
-Sept 2006: Verification sampling event for 7W12B and 7W11B 3Q2006 for chloroform. Initial results reported in this table for chloroform (7W11B,
-July 17, 2008: Verification sampling event for 7W13 arsenic and cobalt. 7W9C cobalt
-June 11, 2009, Verification sampling event for 7MW6 Diethyl ether. Analyte not detected. Verification results reported.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-7 Monitoring Event: Second Quarter 2011

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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	7WCA	27.1		27.1		10	No action taken. Field duplicate result was 26.0 ug/l. RPD <10.
	7WDUP	26		26		10	No action taken. Field duplicate of 7WCA. RPD <10.
Nickel	7WCA	10.7		10.7		10	No action taken. Field duplicate result was 10.0 ug/l. RPD <10.
	7WDUP	10		10		10	No action taken. Field duplicate of 7WCA. RPD <10.

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

JLF 9/16/2011

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 6010C		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Tin	20	2.87
Method: 6020A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Antimony	1	0.4
Arsenic	10	2
Barium	10	1
Beryllium	1	0.2
Cadmium	1	0.2
Chromium	5	1
Cobalt	5	1
Copper	5	1
Lead	1	0.2
Nickel	10	2
Selenium	10	3
Silver	2	0.2
Thallium	1	0.2
Vanadium	10	1
Zinc	10	3
Method: 7470A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Mercury	2	0.2
Method: 8081B		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Aldrin	0.025	0.0027
alpha-BHC	0.025	0.0019
beta-BHC	0.025	0.0095
delta-BHC	0.025	0.0032
gamma-BHC	0.025	0.0019
Chlordane	0.8	0.24
4,4'-DDD	0.05	0.0055
4,4'-DDE	0.05	0.0039
4,4'-DDT	0.05	0.0051
Dieldrin	0.05	0.0051
Endosulfan I	0.025	0.0043
Endosulfan II	0.05	0.0055
Endosulfan sulfate	0.05	0.0068
Endrin	0.05	0.0069
Endrin aldehyde	0.05	0.012
Heptachlor	0.025	0.0024
Heptachlor epoxide	0.025	0.0028
Methoxychlor	0.25	0.015
Toxaphene	2.5	0.48
Method: 8151A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
2,4-Dichlorophenoxyacetic acid	5	3.4
Dinoseb	2.5	0.93
Silvex	2.5	0.59
2,4,5-Trichlorophenoxyacetic acid	2.5	0.74

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Acetone	10	3
Acetonitrile	100	32
Acrolein	25	5
Acrylonitrile	10	1
Allyl chloride	10	0.8
Benzene	1	0.1
Bromobenzene	1	0.1
Bromochloromethane	1	0.2
Bromodichloromethane	1	0.1
Bromoform	1	0.1
n-Butyl alcohol	50	20
tert-Butyl alcohol	200	50
n-Butylbenzene	1	0.1
sec-Butylbenzene	1	0.1
tert-Butylbenzene	1	0.1
Carbon disulfide	10	0.4
Carbon tetrachloride	1	0.2
Chlorobenzene	1	0.1
Chloroethane	1	0.1
Chloroform	1	0.1
2-Chloroethyl vinyl ether	20	0.5
Chloroprene	10	0.5
2-Chlorotoluene	1	0.1
4-Chlorotoluene	1	0.1
Cyclohexane	1	0.2
Dibromochloromethane	1	0.1
1,2-Dibromo-3-chloropropane	1	0.2
1,2-Dibromoethane	1	0.1
1,2-Dichlorobenzene	1	0.1
1,3-Dichlorobenzene	1	0.1
1,4-Dichlorobenzene	1	0.1
trans-1,4-Dichloro-2-butene	10	1
Dichlorodifluoromethane	1	0.1
1,1-Dichloroethane	1	0.1
1,2-Dichloroethane	1	0.1
1,1-Dichloroethene	1	0.2
trans-1,2-Dichloroethene	1	0.2
1,2-Dichloropropane	1	0.1
1,3-Dichloropropane	1	0.1
2,2-Dichloropropane	1	0.3
1,1-Dichloropropene	1	0.1
cis-1,3-Dichloropropene	1	0.1
trans-1,3-Dichloropropene	1	0.1
Diethyl ether	12.5	1.1
Dimethyl ether	12.5	0.1
1,4-Dioxane	200	45
Ethyl acetate	10	1
Ethanol	250	52
Ethylbenzene	1	0.1
Ethyl methacrylate	10	0.8
Ethylene oxide	100	20
Hexachlorobutadiene	1	0.1

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Hexachloroethane	10	0.1
2-Hexanone	10	1
Isobutyl alcohol	200	10
Isopropylbenzene	1	0.1
Isopropylether	10	0.6
4-Isopropyltoluene	1	0.1
Methacrylonitrile	100	9.8
Bromomethane	1	0.5
Chloromethane	1	0.2
2-Butanone	10	1
Iodomethane	10	0.6
Methyl methacrylate	10	3.6
4-Methyl-2-pentanone	10	1
Methyl tert-butyl ether	10	0.4
Dibromomethane	1	0.1
Methylene chloride	1	0.2
Naphthalene	1	0.1
Pentachloroethane	10	0.8
1-Propanol	100	20
2-Propanol	100	50
Propionitrile	100	10
n-Propylbenzene	1	0.1
Styrene	1	0.1
1,1,1,2-Tetrachloroethane	1	0.1
1,1,2,2-Tetrachloroethane	1	0.2
Tetrachloroethene	1	0.1
Tetrahydrofuran	25	2
Toluene	1	0.1
1,2,3-Trichlorobenzene	1	0.1
1,2,4-Trichlorobenzene	1	0.1
1,1,1-Trichloroethane	1	0.1
1,1,2-Trichloroethane	1	0.1
Trichloroethene	1	0.2
Trichlorofluoromethane	1	0.2
1,2,3-Trichloropropane	1	0.3
1,1,2-Trichloro-1,2,2-Trifluoroethane	1	0.2
1,2,4-Trimethylbenzene	1	0.2
1,3,5-Trimethylbenzene	1	0.2
Vinyl acetate	10	3.3
Vinyl chloride	1	0.2
Xylenes (Total)	3	0.2

Summary of Quantitation Limits and Detection Limits
Appendix IX Monitoring Event
Monitoring Event: Second Quarter 2011

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Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Acenaphthene	5	1.1
Acenaphthylene	5	0.95
Acetophenone	5	0.99
2-Acetylaminofluorene	5	1.7
4-Aminobiphenyl	5	0.57
Aniline	5	0.93
Anthracene	5	0.69
Aramite	5	0.79
Benzo[a]anthracene	5	1.5
Benzo[b]fluoranthene	5	0.55
Benzo[k]fluoranthene	5	1.9
Benzo[ghi]perylene	5	1.7
Benzo(a)pyrene	5	0.56
1,4-Benzenediamine	7.5	7.5
Benzyl alcohol	5	0.99
bis(2-Chloroethoxy)methane	5	0.9
bis(2-Chloroethyl)ether	5	0.97
bis(2-Chloro-1-methylethyl)ether	5	0.99
bis(2-Ethylhexyl)phthalate	5	2.7
4-Bromophenyl phenyl ether	5	0.74
Butyl benzyl phthalate	5	1.6
p-Chloroaniline	10	1
Chlorobenzilate	5	1.5
p-Chloro-m-cresol	10	0.86
2-Chloronaphthalene	5	1.2
2-Chlorophenol	10	0.94
4-Chlorophenyl phenyl ether	5	1
Chrysene	5	1.5
Diallate	10	0.8
Dibenz(a,h)anthracene	5	1.7
Dibenzofuran	5	1.1
Di-n-butyl phthalate	5	1.5
3,3'-Dichlorobenzidine	5	0.52
2,4-Dichlorophenol	10	0.87
2,6-Dichlorophenol	10	0.89
Diethyl phthalate	5	0.62
O,O-Diethyl O-2-pyrazinyl	5	0.53
Dimethoate	5	3.9
p-(Dimethylamino)azobenzene	5	0.51
7,12-Dimethylbenz[a]anthracene	5	1.5
3,3'-Dimethylbenzidine	5	1.4
a,a-Dimethylphenethylamine	15	15
2,4-Dimethylphenol	10	0.98
Dimethyl phthalate	5	0.76
m-Dinitrobenzene	5	0.96
4,6-Dinitro-o-cresol	10	1.4
2,4-Dinitrophenol	10	5.1
2,4-Dinitrotoluene	5	0.84
2,6-Dinitrotoluene	5	0.89
Di-n-octyl phthalate	5	1.6
Diphenylamine	5	0.73
Disulfoton	5	0.54

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Ethyl methanesulfonate	5	0.9
Famphur	5	5
Fluoranthene	5	0.61
Fluorene	5	1
Hexachlorobenzene	5	0.77
Hexachlorocyclopentadiene	5	0.76
Hexachlorophene	40	8
Hexachloropropene	5	0.95
Indeno[1,2,3-cd]pyrene	5	1.3
Isodrin	5	0.65
Isophorone	5	0.95
Isosafrole	5	1
Kepone	5	5
Methapyrilene	5	5
3-Methylcholanthrene	5	1.4
Methyl methane sulfonate	5	0.87
2-Methylnaphthalene	5	1.1
Methyl parathion	5	2.7
2-Methylphenol	10	0.74
3 & 4-Methylphenol	10	0.83
1,4-Naphthoquinone	5	0.64
1-Naphthylamine	5	0.78
2-Naphthylamine	5	1.3
o-Nitroaniline	10	0.99
m-Nitroaniline	10	0.84
p-Nitroaniline	10	0.57
Nitrobenzene	5	1.1
o-Nitrophenol	10	0.57
p-Nitrophenol	10	10
4-Nitroquinoline-1-oxide	5	1.2
N-Nitrosodi-n-butylamine	5	0.96
N-Nitrosodiethylamine	5	0.98
N-Nitrosodimethylamine	5	0.55
N-Nitrosodiphenylamine	5	0.73
N-Nitrosodipropylamine	5	1.1
N-Nitrosomethylethylamine	5	0.84
N-Nitrosomorpholine	5	1.1
N-Nitrosopiperidine	5	1
N-Nitrosopyrrolidine	5	2.2
5-Nitroso-o-toluidine	5	0.71
Parathion	5	0.59
Pentachlorobenzene	5	1.1
Pentachloronitrobenzene	5	0.69
Pentachlorophenol	10	0.62
Phenacetin	5	0.67
Phenanthrene	5	0.82
Phenol	10	0.46
Phorate	5	0.57
2-Picoline	5	0.59
Pronamide	5	0.55
Pyrene	5	1.6
Pyridine	5	0.71

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Safrole	5	1
Sulfotep	5	1.1
1,2,4,5-Tetrachlorobenzene	5	0.99
2,3,4,6-Tetrachlorophenol	10	0.61
o-Toluidine	5	1
2,4,5-Trichlorophenol	10	1.1
2,4,6-Trichlorophenol	10	0.74
O,O,O-Triethyl phosphorothioate	5	0.8
sym-Trinitrobenzene	5	0.65
Method: 9012A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Cyanide	20	3.5
Method: 9034		
Laboratory: TestAmerica, North Canton, OH		
Sulfide	3000	2000
Method: 9066		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Total Recoverable Phenolics	50	2.9

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*Method*
Arsenic						*CAS #*		7440-38-2
Fourth Quarter 2011	U	U	U	U	10	10	10	6020A
Barium						*CAS #*		7440-39-3
Fourth Quarter 2011	32.2	14.8	24.6	52.8	10	2000	41	6020A
Cadmium						*CAS #*		7440-43-9
Fourth Quarter 2011	U	U	U	U	1	5	1	6020A
Chromium						*CAS #*		7440-47-3
Fourth Quarter 2011	5.62	U	U	U	5	100	9.9	6020A
Cobalt						*CAS #*		7440-48-4
Fourth Quarter 2011	U	U	U	U	5	5	5	6020A
Copper						*CAS #*		7440-50-8
Fourth Quarter 2011	U	U	U	U	5	1300	5	6020A
Lead						*CAS #*		7439-92-1
Fourth Quarter 2011	U	U	U	U	1	15	1	6020A
Nickel						*CAS #*		7440-02-0
Fourth Quarter 2011	U	U	10.3	U	10	313	10	6020A
Selenium						*CAS #*		7782-49-2
Fourth Quarter 2011	U	U	U	U	10	50	10	6020A
Silver						*CAS #*		7440-22-4
Fourth Quarter 2011	U	U	U	U	2	78.25	2	6020A
Thallium						*CAS #*		7440-28-0
Fourth Quarter 2011	U	U	U	U	1	2	1	6020A
Zinc						*CAS #*		7440-66-6
Fourth Quarter 2011	12.1J	13.3 J	72.3 J	22.3 J	10	4695	10.9	6020A
Cyanide						*CAS #*		57-12-5
Fourth Quarter 2011	U	U	U	U	20	200	20	9012A
bis(2-Ethylhexyl)phthalate						*CAS #*		117-81-7
Fourth Quarter 2011	U	U	U	U	6	6	6	8270D
2,4-Dinitrotoluene						*CAS #*		121-14-2
Fourth Quarter 2011	U	U	U	U	10	31.3	10	8270D
2,6-Dinitrotoluene						*CAS #*		606-20-2
Fourth Quarter 2011	U	U	U	U	10	15.65	10	8270D

Target Analyte Monitoring Results - HWMU-7 Point of Compliance Wells
Radford Army Ammunition Plant, Radford, Virginia
Upgradient well = 7W12B
All Results in ug/L.

Analtye/Quarter	*7W12B Q*	*7MW6 Q*	*7WCA Q*	*7W11B Q*	*QL*	*GPS*	*Background*	*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.

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.
Background Denotes background concentrations listed in the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes groundwater protection standard.

The following definitions apply to results reported for non-Appendix IX monitoring events.
All non-Appendix IX monitoring results for compliance wells are reported to 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 the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number.
GPS Denotes groundwater protection standard.

Notes:
-**Appendix IX Groundwater Monitoring Events**:
Third Quarter 2003, Second Quarter 2004, Second Quarter 2005, Third Quarter 2006, Second Quarter 2007, Second Quarter 2008, Second Quarter 2009, Second Quarter 2010, Second Quarter 2011
All Appendix IX results evaluated and reported to detection limit.
-9/29/2003: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA (copper and zinc). Verification results reported in this table for copper and zinc.
-6/21-22/2004: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA. Verification results reported in this table for chloroform (7W12B).
-3/23/2005: Verification sampling event for 7MW6. Verification results reported in this table for bis(2-ethylhexyl)phthalate).
-7/26/2005: Verification sampling event for 7MW6, 7W11B, 7W12B, 7WCA (ethyl acetate), 7W11B (beta-BHC), and 7MW6 (alpha-BHC). All Verification results reported as not detected. Verification results reported.
-Sept 2006: Verification sampling event for 7W12B and 7W11B 3Q2006 for chloroform. Initial results reported in this table for chloroform (7W11B,
-July 17, 2008: Verification sampling event for 7W13 arsenic and cobalt. 7W9C cobalt
-June 11, 2009, Verification sampling event for 7MW6 Diethyl ether. Analyte not detected. Verification results reported.

APPENDIX B-3

HWMU-7 2011 LABORATORY ANALYTICAL RESULTS
PLUME MONITORING WELLS

Target Analyte Monitoring Results At or Above Permit Quantitation Limit
HWMU 7 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L. *Upgradient well = 7W12B*

Analyte/Quarter	*7W12B Q*	*7W9C Q*	*7W10B Q*	*7W10C Q*	*7W13 Q*	*QL*	*Background*	*GPS*	*Method*	*CAS #*
Antimony										
Second Quarter 2011	U	U	U	U	U	1	1	6	6020A	7440-36-0
Arsenic										
Second Quarter 2011	U	U	U	U	U	10	10	10	6020A	7440-38-2
Barium										
Second Quarter 2011	31.1	21.2	57.5	42.7	14.5	10	41	2000	6020A	7440-39-3
Cadmium										
Second Quarter 2011	U	U	U	U	U	1	1	5	6020A	7440-43-9
Chromium										
Second Quarter 2011	5.3	U	U	U	U	5	9.9	100	6020A	7440-47-3
Cobalt										
Second Quarter 2011	U	U	U	U	9.41	5	5	156.65	6020A	7440-48-4
Copper										
Second Quarter 2011	3.15 J	U	U	U	U	5	5	1300	6020A	7440-50-8
Lead										
Second Quarter 2011	U	U	U	U	U	1	1	15	6020A	7439-92-1
Mercury										
Second Quarter 2011	U	U	U	U	U	2	2	2	7470A	7439-97-6
Nickel										
Second Quarter 2011	U	U	U	U	U	10	10	313	6020A	7440-02-0
Selenium										
Second Quarter 2011	U	U	U	U	U	10	10	50	6020A	7782-49-2
Silver										
Second Quarter 2011	U	U	U	U	U	2	2	78.25	6020A	7440-22-4
Thallium										
Second Quarter 2011	U	U	U	U	U	1	1	2	6020A	7440-28-0
Zinc										
Second Quarter 2011	7.78 J	U	U	U	U	10	10.9	4695	6020A	7440-66-6
Cyanide										
Second Quarter 2011	U	U	U	U	U	20	20	200	9012A	57-12-5
bis(2-Ethylhexyl)phthalate										
Second Quarter 2011	U	U	U	U	U	5	6	6	8270D	117-81-7
Butyl benzyl phthalate										
Second Quarter 2011	U	U	U	U	U	10	10	3130	8270D	85-68-7
2,4-Dinitrophenol										
Second Quarter 2011	U J	U	U	U	U	10	10	31.3	8270D	51-28-5
2,4-Dinitrotoluene										
Second Quarter 2011	U	U	U	U	U	10	10	31.3	8270D	121-14-2
2,6-Dinitrotoluene										
Second Quarter 2011	U	U	U	U	U	10	10	15.65	8270D	606-20-2
p-Nitrophenol										
Second Quarter 2011	U	U	U	U	U	10	20	50	8270D	100-02-7

See last page of this report for definitions.

Target Analyte Monitoring Results At or Above Permit Quantitation Limit
HWMU 7 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L. *Upgradient well = 7W12B*

Analyte/Quarter	*7W12B Q*	*7W9C Q*	*7W10B Q*	*7W10C Q*	*7W13 Q*	*QL*	*Background*	*GPS*	*Method*	*CAS #*

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 the Appendix IX monitoring 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 the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number. **GPS** Denotes groundwater protection standard.

Notes:
-January 2005: Verification sampling event for 7MW13 4Q2004 arsenic. Verification results reported in this table for arsenic (7W13).
-March 2006: Verification sampling event for 7MW13 1Q2006 arsenic. Verification results reported in this table for arsenic (7W13).
-July 2006: Verification sampling event for 7MW13 2Q2006 arsenic. Verification results reported in this table for arsenic (7W13).
-Sept 2006: Verification sampling event for 7W12B 3Q2006 chloroform. Initial results reported in this table for chloroform (7W12B).
-July 17, 2007: Verification sampling event for 7W13 arsenic-verification event result reported, highest of four quadruplicate results, 7W13 cobalt-original result reported.. 7W9C cobalt- Verification result reported.

-Dec 17, 2008: Verification sampling event for 7W13 . cobalt- Original result reported.
-June 28, 2010 - Verification sampling event for 7W13 . cobalt- Original result reported.
Also, verification sampling event for 7W13 . cobalt- verification result reported.
-Dec 16, 2010 - Verification sampling event for 7W13 . arsenic- Verification result reported.
- June 27, 2011 - Verification sampling event for 7MW6 benzene and diethyl ether and 7W11B - Benzene - Verification result reported.

See last page of this report for definitions.

Target Analyte Monitoring Results At or Above Permit Quantitation Limit
HWMU 7 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L. *Upgradient well = 7W12B*

Analyte/Quarter	*7W12B Q*	*7W9C Q*	*7W10B Q*	*7W10C Q*	*7W13 Q*	*QL*	*Background*	*GPS*	*Method*	*CAS #*
Arsenic										
Fourth Quarter 2011	U	U	U	U	U	10	10	10	6020A	7440-38-2
Barium										
Fourth Quarter 2011	32.2	18.3	59.7	45	14.7	10	41	2000	6020A	7440-39-3
Cadmium										
Fourth Quarter 2011	U	U	U	U	U	1	1	5	6020A	7440-43-9
Chromium										
Fourth Quarter 2011	5.62	U	U	U	U	5	9.9	100	6020A	7440-47-3
Cobalt										
Fourth Quarter 2011	U	U	U	U	11.7	5	5	5	6020A	7440-48-4
Copper										
Fourth Quarter 2011	U	U	U	U	U	5	5	1300	6020A	7440-50-8
Lead										
Fourth Quarter 2011	U	U	U	U	U	1	1	15	6020A	7439-92-1
Nickel										
Fourth Quarter 2011	U	U	U	U	U	10	10	313	6020A	7440-02-0
Selenium										
Fourth Quarter 2011	U	U	U	U	U	10	10	50	6020A	7782-49-2
Silver										
Fourth Quarter 2011	U	U	U	U	U	2	2	78.25	6020A	7440-22-4
Thallium										
Fourth Quarter 2011	U	U	U	U	U	1	1	2	6020A	7440-28-0
Zinc										
Fourth Quarter 2011	12.1 J	U J	17.4 J	10.2 J	10.6 J	10	10.9	4695	6020A	7440-66-6
Cyanide										
Fourth Quarter 2011	U	U	U	U	U	20	20	200	9012A	57-12-5
bis(2-Ethylhexyl)phthalate										
Fourth Quarter 2011	U	U	U	U	U	6	6	6	8270D	117-81-7
2,4-Dinitrotoluene										
Fourth Quarter 2011	U	U	U	U	U	10	10	31.3	8270D	121-14-2
2,6-Dinitrotoluene										
Fourth Quarter 2011	U	U	U	U	U	10	10	15.65	8270D	606-20-2

See last page of this report for definitions.

Target Analyte Monitoring Results At or Above Permit Quantitation Limit
HWMU 7 Plume Monitoring Wells
Radford Army Ammunition Plant, Radford, Virginia

All Results in ug/L. ***Upgradient well = 7W12B***

Analyte/Quarter	*7W12B Q*	*7W9C Q*	*7W10B Q*	*7W10C Q*	*7W13 Q*	*QL*	*Background*	*GPS*	*Method*	*CAS #*

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 the Appendix IX monitoring 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 the pending Class 3 Permit Modification for the Post-Closure Care Permit for HWMUs 5, 7, 10 and 16.
CAS# Denotes Chemical Abstract Services registration number. **GPS** Denotes groundwater protection standard.

Notes:
-January 2005: Verification sampling event for 7MW13 4Q2004 arsenic. Verification results reported in this table for arsenic (7W13).
-March 2006: Verification sampling event for 7MW13 1Q2006 arsenic. Verification results reported in this table for arsenic (7W13).
-July 2006: Verification sampling event for 7MW13 2Q2006 arsenic. Verification results reported in this table for arsenic (7W13).
-Sept 2006: Verification sampling event for 7W12B 3Q2006 chloroform. Initial results reported in this table for chloroform (7W12B).
-July 17, 2007: Verification sampling event for 7W13 arsenic-verification event result reported, highest of four quadruplicate results, 7W13 cobalt-original result reported.. 7W9C cobalt- Verification result reported.

-Dec 17, 2008: Verification sampling event for 7W13 . cobalt- Original result reported.
-June 28, 2010 - Verification sampling event for 7W13 . cobalt- Original result reported.
Also, verification sampling event for 7W13 . cobalt- verification result reported.
-Dec 16, 2010 - Verification sampling event for 7W13 . arsenic- Verification result reported.
- June 27, 2011 - Verification sampling event for 7MW6 benzene and diethyl ether and 7W11B - Benzene - Verification result reported.

See last page of this report for definitions.

APPENDIX B-4

ESTABLISHED BACKGROUND VALUES AND COMPUTATIONS FOR HWMU-7

CONSTITUENT BACKGROUND VALUES
FOR THE
COMPLIANCE GROUNDWATER MONITORING PROGRAM

HWMU-7
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Prepared for:

Alliant Techsystems Inc.
Radford Army Ammunition Plant
Route 114
Radford, Virginia 24141-0100

Prepared by:

Draper Aden Associates
2206 South Main Street
Blacksburg, Virginia 24060
(540) 552-0444

February 2008
DAA Job No. B03204-122

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RADFORD ARMY AMMUNITION PLANT – HWMU-7
CALCULATION OF CONSTITUENT BACKGROUND VALUES

Draper Aden Associates recalculated background values for the plume monitoring well constituents of the groundwater monitoring program for Hazardous Waste Management Unit No. 7 (HWMU-7) located at the Radford Army Ammunition Plant (Radford AAP) in Radford, Virginia. Background values were calculated for all plume monitoring well constituents.

The background values for HWMU-7 plume monitoring well constituents were calculated using the analytical data for upgradient well 7W12B using data from Second Quarter 2003 through Second Quarter 2007 (available most recent data with one exception-cyanide includes 4th Quarter 2007 data). 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)). Where applicable, the background value calculations were based on site-wide 95% confidence, 95% coverage upper prediction intervals. The calculated background values for all target constituents are listed on **Table 1**.

Background Data and Background Value Calculations

The constituents listed below were 100% non-detected (<LOQ) in the background well. The background values for these constituents were established as equal to their quantitation limits (QL).

Background Value = Quantitation Limit (QL)				
Constituent	**Sample Size**	**% Non-Detects**	**QL (µg/l)**	**Background Value (µg/l)**
Antimony	17	100	1	1
Arsenic	17	100	10	10
Cadmium	17	100	1	1
Cobalt	17	100	5	5
Copper	16	100	5	5
Lead	17	100	1	1
Mercury	17	100	2	2
Nickel	17	100	10	10
Selenium	17	100	10	10
Silver	17	100	2	2
Thallium	17	100	1	1
Cyanide	18	100	20	20
Bis(2-ethylhexyl)phthalate	17	100	6	6
Butyl benzyl phthalate	17	100	10	10
2,4-Dinitrophenol	17	100	10	10
2,4-Dinitrotoluene	17	100	10	10
2,6-Dinitrotoluene	17	100	10	10
p-Nitrophenol	17	100	10	10

Non-parametric prediction intervals were computed for the constituents for which the data from upgradient well 7W-12B 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.

Only one result for zinc was reported above its LOQ. The reported result (10.9 µg/l) is the NUPL for zinc. The non-parametric prediction limit computation for chromium is presented in **Appendix A**.

Background Value = UPL of Non-parametric Prediction Interval (NUPL)					
Parameter	**Sample Size**	**% Non-Detects**	**QL (µg/l)**	**NUPL (µg/l)**	**Background Value (µg/l)**
Chromium	17	12	5	9.9	9.9
Zinc	14	93	10	10.9	10.9

The following constituent (barium) exhibited normally distributed background data with less than 0% non-detects. One sided parametric prediction interval was computed on the background data for barium. The background value for barium was set as equal to its UPL. The background concentration calculations were based on a site wide 95% confidence, 95% coverage upper prediction intervals. The background and relevant statistical data for barium is summarized below. The prediction interval computation is presented in **Appendix A**.

Background Value = UPL of one-sided Prediction Interval					
Parameter	**Sample Size**	**% Non-Detects**	**QL (µg/l)**	**UPL (µg/l)**	**Background Value (µg/l)**
Barium	17	0	10	41.0	41.0

TABLE 1

HWMU-7
CALCULATED BACKGROUND VALUES

Constituent	Background Value (µg/l unless otherwise noted)
Antimony	1
Arsenic	10
Barium	41.0
Cadmium	1
Chromium	9.9
Cobalt	5
Copper	5
Lead	1
Mercury	2
Nickel	10
Selenium	10
Silver	2
Thallium	1
Zinc	10.9
Cyanide	20
Bis(2-ethylhexyl)phthalate	6
Butyl benzyl phthalate	10
2,4-Dinitrophenol	10
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
p-Nitrophenol	10

APPENDIX A

HWMU-7
BACKGROUND VALUE CALCULATIONS
STATISTICAL COMPUTATIONS FOR BARIUM AND CHROMIUM

RAAP-HWMU-7 - Background Calculation - December 2007

17-Dec-07

Y2K Correction dates are as shown in table below.

Actual Event			Date Used in Stat Software
2003-Qtr2			8/1/1999
2003-Qtr3			8/2/1999
2003-Qtr4			8/3/1999
2004-Qtr1			8/4/1999
2004-Qtr2			8/5/1999
2004-Qtr3			8/6/1999
2004-Qtr4			8/7/1999
2005-Qtr1			8/8/1999
2005-Qtr2			8/9/1999
2005-Qtr3			8/10/1999
2005-Qtr4			8/11/1999
2006-Qtr1			8/12/1999
2006-Qtr2			8/13/1999
2006-Qtr3			8/14/1999
2006-Qtr4			8/15/1999
2007-Qtr1			8/16/1999
2007-Qtr2			8/17/1999

Notes:

1) Background data was computed for all target constituents using the 2Q 2003 - 2Q 2007 data for background well 7W12B. Background data was 100% <LOQ for all target parameters except barium, chromium and zinc. Zinc had only one reported result > LOQ.

Statistical computations using GRITS/STAT V5.0 performed only for barium and chromium, as applicable.

Normality Tests

Report Printed: 12-17-2007 16:02

Facility:RAAPHWMU7 Haz. Waste Unit 7 - RAAP

Address:

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

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:Ba Barium, total

CAS Number: 7440-39-3
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 2.000 ppb

Start Date:Aug 01 1999
End Date:Aug 17 1999

Normality Test on Observations for wells listed below:

Well:7W12B Position:Upgradient Observations:17

Scale	Minimum	Maximum	Mean	Std Dev
Original:	32.800	39.800	36.253	1.875
Log:	3.490	3.684	3.589	0.052

Pooled Statistics
Observations: 17

Statistic	Original Scale	Log Scale
Mean:	36.253	3.589
Std Dev:	1.875	0.052
Skewness:	-0.019	-0.150
Kurtosis:	-0.236	-0.251
Minimum:	32.800	3.490
Maximum:	39.800	3.684
CV:	0.052	0.014

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.9602	0.8920	0.8510

Log:	0.9592	0.8920	0.8510

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

Parametric Prediction Interval
Report Printed December 17,2007

Facility:Haz. Waste Unit 7 - RAAP
Parameter:Barium, total(CAS Number:7440-39-3)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n):	17
Shapiro-Wilk (W):	0.9602
Critical W,α=0.01:	0.8510
Mean:	36.253 ppb
Std Dev:	1.875 ppb
DF:	16
Conf. Level (1-α):	0.9500
Future Samples (k):	4
$t_{\left[1-\frac{\alpha}{k}\right]}$:	2.4729
Kappa:	2.5446
UL:	41.024 ppb
LL:	-∞

Report Produced by GRITS/STAT 5.01

Normality Tests

Report Printed: 12-17-2007 16:05

Facility:RAAPHWMU7 Haz. Waste Unit 7 - RAAP

Address:

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

Contact:
Phone:( ) -

Permit Type:Detection

Constituent:Cr Chromium, total

CAS Number: 7440-47-3
MCL: 0.000 ppb
ACL: 0.000 ppb
Detect Limit: 1.000 ppb

Start Date:Aug 01 1999
End Date:Aug 17 1999

Normality Test on Observations for wells listed below:

Well:7W12B Position:Upgradient Observations:17

Scale	Minimum	Maximum	Mean	Std Dev
Original:	0.500	9.900	6.612	2.648
Log:	-0.693	2.293	1.672	0.909

Pooled Statistics
Observations: 17

Statistic	Original Scale	Log Scale
Mean:	6.612	1.672
Std Dev:	2.648	0.909
Skewness:	-1.317*	-2.191*
Kurtosis:	1.110	3.139
Minimum:	0.500	-0.693
Maximum:	9.900	2.293
CV:	0.401	0.543

Shapiro-Wilk Statistics

Scale	Test Statistic	5% Critical Value	1% Critical Value
Original:	0.8293*	0.8920	0.8510

Log:	0.5707*	0.8920	0.8510

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

Nonparametric Prediction Interval
Report Printed December 17,2007

Facility:Haz. Waste Unit 7 - RAAP
Parameter:Chromium, total(CAS Number:7440-47-3)

ONE-TAILED UPPER PARAMETRIC PREDICTION INTERVAL

Observations (n): 17
Conf. Level (1-α): ~~94.440%~~ N/A

UL: 9.900 ppb
LL: 0.000

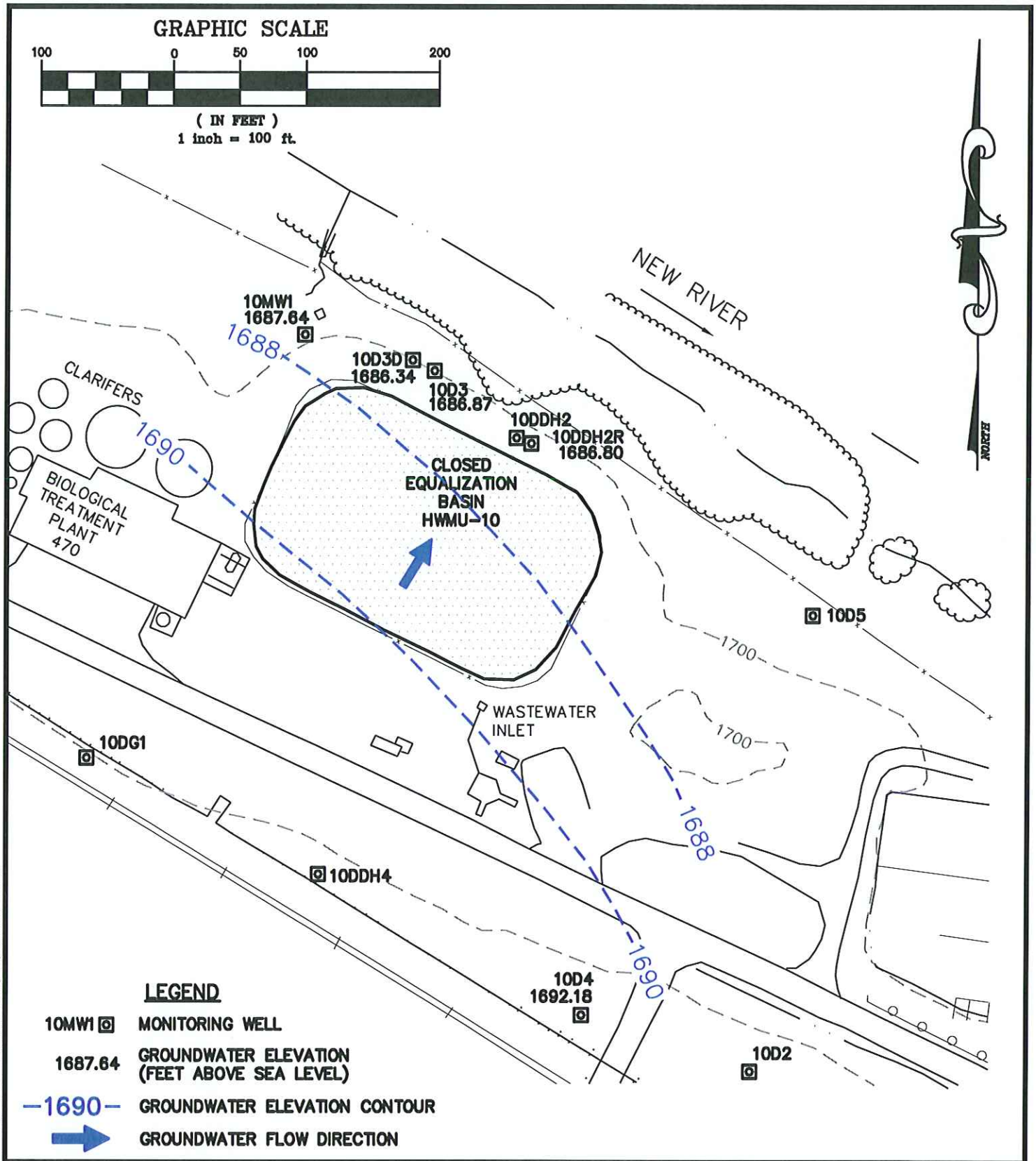
Report Produced by GRITS/STAT 5.01

APPENDIX C

HWMU-10

APPENDIX C-1

HWMU-10 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2011
FOURTH QUARTER 2011



HWMU-10 POTENTIOMETRIC SURFACE MAP (2ND QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-09

Draper Aden Associates

Engineering • Surveying • Environmental Services

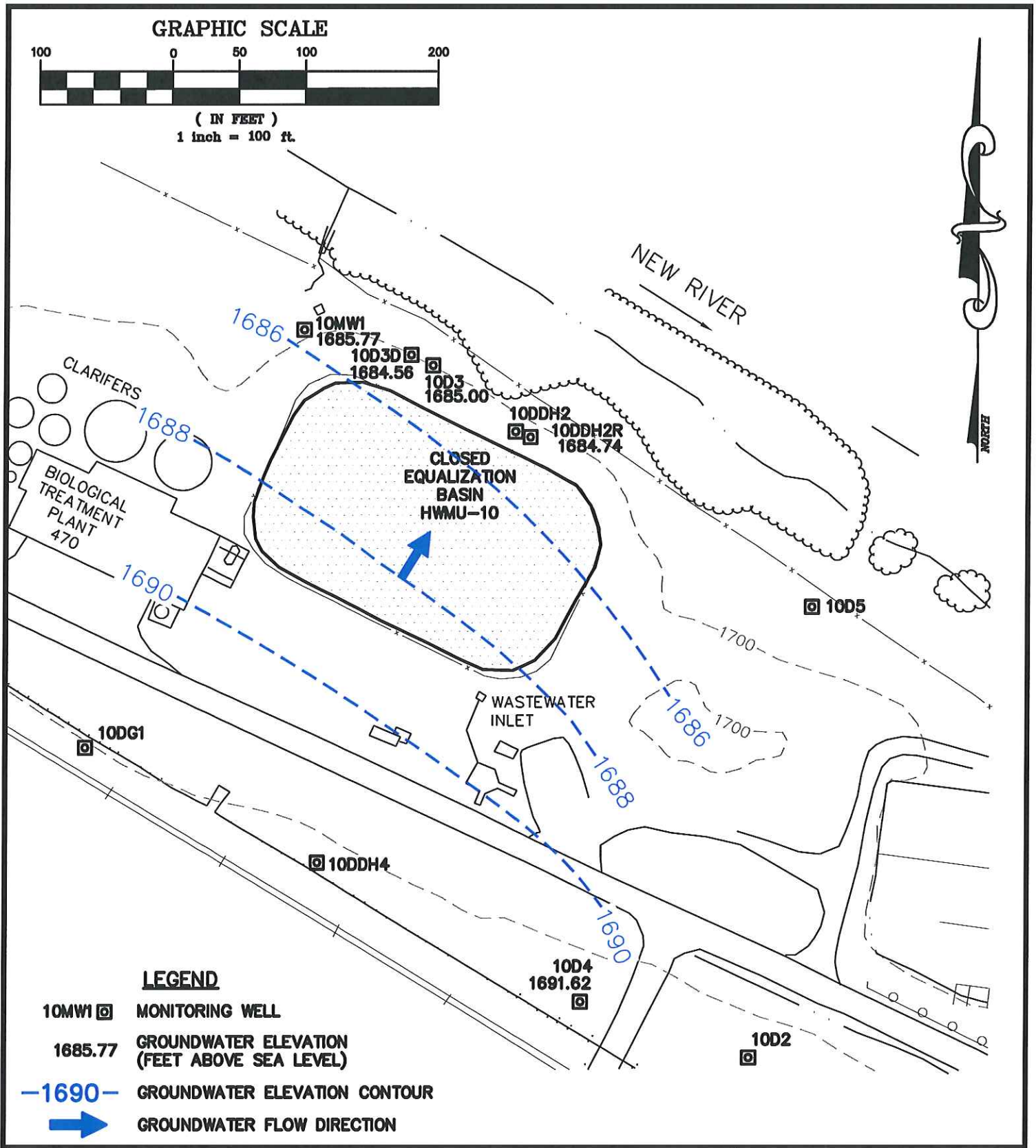
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291

Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	RGM
DRAWN	JFF
CHECKED	SN
DATE	09-27-11

FIGURE 3

P:\B03\200\B03204\B03204-09\CAD\B03204-09 ENV\dwg\B03204-09_HWMU-10.dwg Sep 27, 2011 9:38am



HWMU-10 POTENTIOMETRIC SURFACE MAP (4TH QUARTER 2011)

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-09

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	SN
DATE	02/07/12

FIGURE 3

P:\B03200\B03204\B03204-09\CAD\B03204-09 ENV\dwg\B03204-09_HWMU-10 4TH QUARTER 2011.dwg Feb 07, 2012 3:02pm

APPENDIX C-2

HWMU-10 2011 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 2011	U	U	U	U	U	1	-	6020A
Arsenic				*CAS # 7440-38-2*				
Second Quarter 2011	U	U	U	U	U	10	50	6020A
Barium				*CAS # 7440-39-3*				
Second Quarter 2011	120	85	50.1	46.1	72.6	10	2000	6020A
Beryllium				*CAS # 7440-41-7*				
Second Quarter 2011	U	U	U	U	U	1	-	6020A
Cadmium				*CAS # 7440-43-9*				
Second Quarter 2011	U	U	U	U	U	1	-	6020A
Chromium				*CAS # 7440-47-3*				
Second Quarter 2011	4.93 J	1.65 J	U	U	2.39 J	5	100	6020A
Cobalt				*CAS # 7440-48-4*				
Second Quarter 2011	U	U	U	U	U	5	-	6020A
Copper				*CAS # 7440-50-8*				
Second Quarter 2011	3.61 J	1.02 J	2.35 J	1.52 J	1.03 J	5	1300	6020A
Lead				*CAS # 7439-92-1*				
Second Quarter 2011	1.79	U	U	U	U	1	15	6020A
Mercury				*CAS # 7439-97-6*				
Second Quarter 2011	U	U	U	U	U	2	2	7470A
Nickel				*CAS # 7440-02-0*				
Second Quarter 2011	U	U	U	U	U	10	313	6020A
Selenium				*CAS # 7782-49-2*				
Second Quarter 2011	U	U	U	U	U	10	50	6020A
Silver				*CAS # 7440-22-4*				
Second Quarter 2011	U	U	U	U	U	2	78.25	6020A
Thallium				*CAS # 7440-28-0*				
Second Quarter 2011	U	U	U	U	U	1	-	6020A
Tin				*CAS # 7440-31-5*				
Second Quarter 2011	U N	U	U	U N	U N	20	-	6010C
Vanadium				*CAS # 7440-62-2*				
Second Quarter 2011	3.18 J	U	U	U	U	10	-	6020A
Zinc				*CAS # 7440-66-6*				
Second Quarter 2011	12.3	10.4	12.6	7.25 J	U	10	4695	6020A
Sulfide				*CAS # 18496-25-8*				
Second Quarter 2011	U J	U J	U J	U J	U J	3000	-	9034
Cyanide				*CAS # 57-12-5*				
Second Quarter 2011	U	U	U	U	U	20	200	9012A
Total Recoverable Phenolics				*CAS # C-020*				
Second Quarter 2011	U	U	U	U	U	50	-	9066
Acenaphthene				*CAS # 83-32-9*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acenaphthylene				*CAS # 208-96-8*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acetone				*CAS # 67-64-1*				
Second Quarter 2011	U	U	840	U	U	10	-	8260B
Acetonitrile				*CAS # 75-05-8*				
Second Quarter 2011	U	U	U	U	U	100	-	8260B

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 2011	U	U	U	U	U	5	-	8270D
2-Acetylaminofluorene				*CAS # 53-96-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acrolein				*CAS # 107-02-8*				
Second Quarter 2011	U J	U J	U J	U J	U J	25	-	8260B
Acrylonitrile				*CAS # 107-13-1*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Aldrin				*CAS # 309-00-2*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Allyl chloride				*CAS # 107-05-1*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
4-Aminobiphenyl				*CAS # 92-67-1*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Aniline				*CAS # 62-53-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Anthracene				*CAS # 120-12-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Aramite				*CAS # 140-57-8*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzene				*CAS # 71-43-2*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Benzo[a]anthracene				*CAS # 56-55-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[b]fluoranthene				*CAS # 205-99-2*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[k]fluoranthene				*CAS # 207-08-9*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[ghi]perylene				*CAS # 191-24-2*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo(a)pyrene				*CAS # 50-32-8*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,4-Benzenediamine				*CAS # 106-50-3*				
Second Quarter 2011	U J	U J	U J	U J	U J	7.5	-	8270D
Benzyl alcohol				*CAS # 100-51-6*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
alpha-BHC				*CAS # 319-84-6*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
beta-BHC				*CAS # 319-85-7*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
delta-BHC				*CAS # 319-86-8*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
gamma-BHC				*CAS # 58-89-9*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
bis(2-Chloroethoxy)methane				*CAS # 111-91-1*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
bis(2-Chloroethyl)ether				*CAS # 111-44-4*				
Second Quarter 2011	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 2011	U	U	U	U	U	5	-	8270D
bis(2-Ethylhexyl)phthalate				*CAS # 117-81-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Bromobenzene				*CAS # 108-86-1*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Bromochloromethane				*CAS # 74-97-5*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Bromodichloromethane				*CAS # 75-27-4*				
Second Quarter 2011	U	U	U	U	U	1	80	8260B
Bromoform				*CAS # 75-25-2*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
4-Bromophenyl phenyl ether				*CAS # 101-55-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Butanone				*CAS # 78-93-3*				
Second Quarter 2011	U	U	U	U	U	10	691.08	8260B
n-Butyl alcohol				*CAS # 71-36-3*				
Second Quarter 2011	U	U	U	U	U	50	-	8260B
tert-Butyl alcohol				*CAS # 75-65-0*				
Second Quarter 2011	U	U	U	U	U	200	-	8260B
n-Butylbenzene				*CAS # 104-51-8*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
sec-Butylbenzene				*CAS # 135-98-8*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
tert-Butylbenzene				*CAS # 98-06-6*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Butyl benzyl phthalate				*CAS # 85-68-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Carbon disulfide				*CAS # 75-15-0*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Carbon tetrachloride				*CAS # 56-23-5*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chlordane				*CAS # 57-74-9*				
Second Quarter 2011	U	U	U	U	U	0.8	-	8081B
p-Chloroaniline				*CAS # 106-47-8*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Chlorobenzene				*CAS # 108-90-7*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chlorobenzilate				*CAS # 510-15-6*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
p-Chloro-m-cresol				*CAS # 59-50-7*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Chloroethane				*CAS # 75-00-3*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chloroform				*CAS # 67-66-3*				
Second Quarter 2011	5	4.2	4.2	0.1 J	5.5	1	80	8260B
2-Chloroethyl vinyl ether				*CAS # 110-75-8*				
Second Quarter 2011	U J	U J	U J	U J	U J	20	-	8260B

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 2011	U	U	U	U	U	5	-	8270D
2-Chlorophenol				CAS # 95-57-8				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
4-Chlorophenyl phenyl ether				CAS # 7005-72-3				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Chloroprene				CAS # 126-99-8				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
2-Chlorotoluene				CAS # 95-49-8				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
4-Chlorotoluene				CAS # 106-43-4				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chrysene				CAS # 218-01-9				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Cyclohexane				CAS # 110-82-7				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,4-Dichlorophenoxyacetic acid				CAS # 94-75-7				
Second Quarter 2011	U	U	U	U	U	5	-	8151A
4,4'-DDD				CAS # 72-54-8				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
4,4'-DDE				CAS # 72-55-9				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
4,4'-DDT				CAS # 50-29-3				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Diallate				CAS # 2303-16-4				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Dibenz(a,h)anthracene				CAS # 53-70-3				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dibenzofuran				CAS # 132-64-9				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dibromochloromethane				CAS # 124-48-1				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2-Dibromo-3-chloropropane				CAS # 96-12-8				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2-Dibromoethane				CAS # 106-93-4				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Di-n-butyl phthalate				CAS # 84-74-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,2-Dichlorobenzene				CAS # 95-50-1				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3-Dichlorobenzene				CAS # 541-73-1				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,4-Dichlorobenzene				CAS # 106-46-7				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
3,3'-Dichlorobenzidine				CAS # 91-94-1				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
trans-1,4-Dichloro-2-butene				CAS # 110-57-6				
Second Quarter 2011	U J	U J	U J	U J	U J	10	-	8260B

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 2011	U	U	U	U	U	1	-	8260B
1,1-Dichloroethane				*CAS # 75-34-3*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2-Dichloroethane				*CAS # 107-06-2*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1-Dichloroethene				*CAS # 75-35-4*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
trans-1,2-Dichloroethene				*CAS # 156-60-5*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,4-Dichlorophenol				*CAS # 120-83-2*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,6-Dichlorophenol				*CAS # 87-65-0*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
1,2-Dichloropropane				*CAS # 78-87-5*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3-Dichloropropane				*CAS # 142-28-9*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,2-Dichloropropane				*CAS # 594-20-7*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1-Dichloropropene				*CAS # 563-58-6*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
cis-1,3-Dichloropropene				*CAS # 10061-01-5*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
trans-1,3-Dichloropropene				*CAS # 10061-02-6*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Dieldrin				*CAS # 60-57-1*				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Diethyl ether				*CAS # 60-29-7*				
Second Quarter 2011	U	U	U	U	U	12.5	-	8260B
Diethyl phthalate				*CAS # 84-66-2*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
O,O-Diethyl O-2-pyrazinyl				*CAS # 297-97-2*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dimethoate				*CAS # 60-51-5*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dimethyl ether				*CAS # 115-10-6*				
Second Quarter 2011	U	U	U	U	U	12.5	-	8260B
p-(Dimethylamino)azobenzene				*CAS # 60-11-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
7,12-Dimethylbenz[a]anthracene				*CAS # 57-97-6*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
3,3'-Dimethylbenzidine				*CAS # 119-93-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
a,a-Dimethylphenethylamine				*CAS # 122-09-8*				
Second Quarter 2011	U J	U J	U J	U J	U J	15	-	8270D
2,4-Dimethylphenol				*CAS # 105-67-9*				
Second Quarter 2011	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*
Dimethyl phthalate				*CAS # 131-11-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
m-Dinitrobenzene				*CAS # 99-65-0*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
4,6-Dinitro-o-cresol				*CAS # 534-52-1*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,4-Dinitrophenol				*CAS # 51-28-5*				
Second Quarter 2011	U J	U J	U J	U J	U J	10	-	8270D
2,4-Dinitrotoluene				*CAS # 121-14-2*				
Second Quarter 2011	U	U	U	U	U	5	31.3	8270D
2,6-Dinitrotoluene				*CAS # 606-20-2*				
Second Quarter 2011	U	U	U	U	U	5	15.65	8270D
Dinoseb				*CAS # 88-85-7*				
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
Di-n-octyl phthalate				*CAS # 117-84-0*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,4-Dioxane				*CAS # 123-91-1*				
Second Quarter 2011	U	U	U	U	U	200	-	8260B
Diphenylamine				*CAS # 86-30-6*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Disulfoton				*CAS # 298-04-4*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Endosulfan I				*CAS # 959-98-8*				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Endosulfan II				*CAS # 33213-65-9*				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Endosulfan sulfate				*CAS # 1031-07-8*				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Endrin				*CAS # 72-20-8*				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Ethyl acetate				*CAS # 141-78-6*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Endrin aldehyde				*CAS # 7421-93-4*				
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Ethanol				*CAS # 64-17-5*				
Second Quarter 2011	U	U	U	U	U	250	-	8260B
Ethylbenzene				*CAS # 100-41-4*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Ethyl methacrylate				*CAS # 97-63-2*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Ethyl methanesulfonate				*CAS # 62-50-0*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Ethylene oxide				*CAS # 75-21-8*				
Second Quarter 2011	U J	U J	U J	U J	U J	100	-	8260B
Famphur				*CAS # 52-85-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Fluoranthene				*CAS # 206-44-0*				
Second Quarter 2011	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 2011	U	U	U	U	U	5	-	8270D
Heptachlor				CAS # 76-44-8				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Heptachlor epoxide				CAS # 1024-57-3				
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Hexachlorobenzene				CAS # 118-74-1				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Hexachlorobutadiene				CAS # 87-68-3				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Hexachlorocyclopentadiene				CAS # 77-47-4				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Hexachloroethane				CAS # 67-72-1				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Hexachlorophene				CAS # 70-30-4				
Second Quarter 2011	U	U	U	U	U	40	-	8270D
Hexachloropropene				CAS # 1888-71-7				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Hexanone				CAS # 591-78-6				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Indeno[1,2,3-cd]pyrene				CAS # 193-39-5				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isobutyl alcohol				CAS # 78-83-1				
Second Quarter 2011	U	U	U	U	U	200	-	8260B
Isodrin				CAS # 465-73-6				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isophorone				CAS # 78-59-1				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isopropylbenzene				CAS # 98-82-8				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Isopropylether				CAS # 108-20-3				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
4-Isopropyltoluene				CAS # 99-87-6				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Isosafrole				CAS # 120-58-1				
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
Kepone				CAS # 143-50-0				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methacrylonitrile				CAS # 126-98-7				
Second Quarter 2011	U	U	U	U	U	100	-	8260B
Methapyrilene				CAS # 91-80-5				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methoxychlor				CAS # 72-43-5				
Second Quarter 2011	U	U	U	U	U	0.25	-	8081B
Bromomethane				CAS # 74-83-9				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chloromethane				CAS # 74-87-3				
Second Quarter 2011	U	U	U	U	U	1	-	8260B

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 2011	U	U	U	U	U	5	-	8270D
Iodomethane				*CAS # 74-88-4*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Methyl methacrylate				*CAS # 80-62-6*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Methyl methane sulfonate				*CAS # 66-27-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Methylnaphthalene				*CAS # 91-57-6*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methyl parathion				*CAS # 298-00-0*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
4-Methyl-2-pentanone				*CAS # 108-10-1*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
2-Methylphenol				*CAS # 95-48-7*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
3 & 4-Methylphenol				*CAS # 106-44-5*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Methyl tert-butyl ether				*CAS # 1634-04-4*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Dibromomethane				*CAS # 74-95-3*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Methylene chloride				*CAS # 75-09-2*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Naphthalene				*CAS # 91-20-3*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,4-Naphthoquinone				*CAS # 130-15-4*				
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
1-Naphthylamine				*CAS # 134-32-7*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Naphthylamine				*CAS # 91-59-8*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
o-Nitroaniline				*CAS # 88-74-4*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
m-Nitroaniline				*CAS # 99-09-2*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
p-Nitroaniline				*CAS # 100-01-6*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Nitrobenzene				*CAS # 98-95-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
o-Nitrophenol				*CAS # 88-75-5*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
p-Nitrophenol				*CAS # 100-02-7*				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
4-Nitroquinoline-1-oxide				*CAS # 56-57-5*				
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
N-Nitrosodi-n-butylamine				*CAS # 924-16-3*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D

See last page of this report for definitions.

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 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodimethylamine				CAS # 62-75-9				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodiphenylamine				CAS # 86-30-6				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodipropylamine				CAS # 621-64-7				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosomethylethylamine				CAS # 10595-95-6				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosomorpholine				CAS # 59-89-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosopiperidine				CAS # 100-75-4				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosopyrrolidine				CAS # 930-55-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
5-Nitroso-o-toluidine				CAS # 99-55-8				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Parathion				CAS # 56-38-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachlorobenzene				CAS # 608-93-5				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachloroethane				CAS # 76-01-7				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Pentachloronitrobenzene				CAS # 82-68-8				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachlorophenol				CAS # 87-86-5				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Phenacetin				CAS # 62-44-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Phenanthrene				CAS # 85-01-8				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Phenol				CAS # 108-95-2				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Phorate				CAS # 298-02-2				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Picoline				CAS # 109-06-8				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pronamide				CAS # 23950-58-5				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1-Propanol				CAS # 71-23-8				
Second Quarter 2011	U J	U J	U J	U J	U J	100	-	8260B
2-Propanol				CAS # 67-63-0				
Second Quarter 2011	U	U	1500	U	U	100	-	8260B
Propionitrile				CAS # 107-12-0				
Second Quarter 2011	U	U	U	U	U	100	-	8260B
n-Propylbenzene				CAS # 103-65-1				
Second Quarter 2011	U	U	U	U	U	1	-	8260B

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 2011	U	U	U	U	U	5	-	8270D
Pyridine				CAS # 110-86-1				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Safrole				CAS # 94-59-7				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Silvex				CAS # 93-72-1				
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
Styrene				CAS # 100-42-5				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Sulfotep				CAS # 3689-24-5				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2,4,5-Trichlorophenoxyacetic acid				CAS # 93-76-5				
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
1,2,4,5-Tetrachlorobenzene				CAS # 95-94-3				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,1,1,2-Tetrachloroethane				CAS # 630-20-6				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,2,2-Tetrachloroethane				CAS # 79-34-5				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Tetrachloroethene				CAS # 127-18-4				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Tetrahydrofuran				CAS # 109-99-9				
Second Quarter 2011	U	U	U	U	U	25	-	8260B
2,3,4,6-Tetrachlorophenol				CAS # 58-90-2				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Toluene				CAS # 108-88-3				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
o-Toluidine				CAS # 95-53-4				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Toxaphene				CAS # 8001-35-2				
Second Quarter 2011	U	U	U	U	U	2.5	-	8081B
1,2,3-Trichlorobenzene				CAS # 87-61-6				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2,4-Trichlorobenzene				CAS # 120-82-1				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,1-Trichloroethane				CAS # 71-55-6				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,2-Trichloroethane				CAS # 79-00-5				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Trichloroethene				CAS # 79-01-6				
Second Quarter 2011	U	U	U	U	U	1	5	8260B
Trichlorofluoromethane				CAS # 75-69-4				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,4,5-Trichlorophenol				CAS # 95-95-4				
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,4,6-Trichlorophenol				CAS # 88-06-2				
Second Quarter 2011	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 2011	U	U	U	U	U	1	-	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane				*CAS # 76-13-1*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
O,O,O-Triethyl phosphorothioate				*CAS # 126-68-1*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,2,4-Trimethylbenzene				*CAS # 95-63-6*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3,5-Trimethylbenzene				*CAS # 108-67-8*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
sym-Trinitrobenzene				*CAS # 99-35-4*				
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Vinyl acetate				*CAS # 108-05-4*				
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Vinyl chloride				*CAS # 75-01-4*				
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Xylenes (Total)				*CAS # 1330-20-7*				
Second Quarter 2011	U	U	U	U	U	3	10000	8260B

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). For cobalt, vanadium, acetone and 2-propanol, these analytes are not listed in Appendix VIII to 40 CFR Part 261; therefore, GPSs will not be established for these constituents.
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
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.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-10 Monitoring Event: Second Quarter 2011

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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	85		85		10	No action taken. Field duplicate result was 84.9 ug/l. RPD <10.
	10DUP	84.9		84.9		10	No action taken. Field duplicate of 10D3. RPD <10.
Zinc	10D3	10.4		10.4		10	No action taken. Field duplicate result was 11.8 ug/l. 13 RPD.
	10DUP	11.8		11.8		10	No action taken. Field duplicate of 10D3. 13 RPD.
Method: 8260B							
Laboratory: Lancaster Laboratories, Lancaster, PA							
Chloroform	10D3	4.2		4.2		1	No action taken. Field duplicate result was 4.2 ug/l. RPD <10.
	10DUP	4.2		4.2		1	No action taken. Field duplicate of 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.

JLF 9/23/2011

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 6010C		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Tin	20	2.87
Method: 6020A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Antimony	1	0.4
Arsenic	10	2
Barium	10	1
Beryllium	1	0.2
Cadmium	1	0.2
Chromium	5	1
Cobalt	5	1
Copper	5	1
Lead	1	0.2
Nickel	10	2
Selenium	10	3
Silver	2	0.2
Thallium	1	0.2
Vanadium	10	1
Zinc	10	3
Method: 7470A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Mercury	2	0.2
Method: 8081B		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Aldrin	0.025	0.0027
alpha-BHC	0.025	0.0019
beta-BHC	0.025	0.0095
delta-BHC	0.025	0.0032
gamma-BHC	0.025	0.0019
Chlordane	0.8	0.24
4,4'-DDD	0.05	0.0055
4,4'-DDE	0.05	0.0039
4,4'-DDT	0.05	0.0051
Dieldrin	0.05	0.0051
Endosulfan I	0.025	0.0043
Endosulfan II	0.05	0.0055
Endosulfan sulfate	0.05	0.0068
Endrin	0.05	0.0069
Endrin aldehyde	0.05	0.012
Heptachlor	0.025	0.0024
Heptachlor epoxide	0.025	0.0028
Methoxychlor	0.25	0.015
Toxaphene	2.5	0.48
Method: 8151A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
2,4-Dichlorophenoxyacetic acid	5	3.4
Dinoseb	2.5	0.93
Silvex	2.5	0.59
2,4,5-Trichlorophenoxyacetic acid	2.5	0.74

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Acetone	10	3
Acetonitrile	100	32
Acrolein	25	5
Acrylonitrile	10	1
Allyl chloride	10	0.8
Benzene	1	0.1
Bromobenzene	1	0.1
Bromochloromethane	1	0.2
Bromodichloromethane	1	0.1
Bromoform	1	0.1
n-Butyl alcohol	50	20
tert-Butyl alcohol	200	50
n-Butylbenzene	1	0.1
sec-Butylbenzene	1	0.1
tert-Butylbenzene	1	0.1
Carbon disulfide	10	0.4
Carbon tetrachloride	1	0.2
Chlorobenzene	1	0.1
Chloroethane	1	0.1
Chloroform	1	0.1
2-Chloroethyl vinyl ether	20	0.5
Chloroprene	10	0.5
2-Chlorotoluene	1	0.1
4-Chlorotoluene	1	0.1
Cyclohexane	1	0.2
Dibromochloromethane	1	0.1
1,2-Dibromo-3-chloropropane	1	0.2
1,2-Dibromoethane	1	0.1
1,2-Dichlorobenzene	1	0.1
1,3-Dichlorobenzene	1	0.1
1,4-Dichlorobenzene	1	0.1
trans-1,4-Dichloro-2-butene	10	1
Dichlorodifluoromethane	1	0.1
1,1-Dichloroethane	1	0.1
1,2-Dichloroethane	1	0.1
1,1-Dichloroethene	1	0.2
trans-1,2-Dichloroethene	1	0.2
1,2-Dichloropropane	1	0.1
1,3-Dichloropropane	1	0.1
2,2-Dichloropropane	1	0.3
1,1-Dichloropropene	1	0.1
cis-1,3-Dichloropropene	1	0.1
trans-1,3-Dichloropropene	1	0.1
Diethyl ether	12.5	1.1
Dimethyl ether	12.5	0.1
1,4-Dioxane	200	45
Ethyl acetate	10	1
Ethanol	250	52
Ethylbenzene	1	0.1
Ethyl methacrylate	10	0.8
Ethylene oxide	100	20
Hexachlorobutadiene	1	0.1

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Hexachloroethane	10	0.1
2-Hexanone	10	1
Isobutyl alcohol	200	10
Isopropylbenzene	1	0.1
Isopropylether	10	0.6
4-Isopropyltoluene	1	0.1
Methacrylonitrile	100	9.8
Bromomethane	1	0.5
Chloromethane	1	0.2
2-Butanone	10	1
Iodomethane	10	0.6
Methyl methacrylate	10	3.6
4-Methyl-2-pentanone	10	1
Methyl tert-butyl ether	10	0.4
Dibromomethane	1	0.1
Methylene chloride	1	0.2
Naphthalene	1	0.1
Pentachloroethane	10	0.8
1-Propanol	100	20
2-Propanol	100	50
Propionitrile	100	10
n-Propylbenzene	1	0.1
Styrene	1	0.1
1,1,1,2-Tetrachloroethane	1	0.1
1,1,2,2-Tetrachloroethane	1	0.2
Tetrachloroethene	1	0.1
Tetrahydrofuran	25	2
Toluene	1	0.1
1,2,3-Trichlorobenzene	1	0.1
1,2,4-Trichlorobenzene	1	0.1
1,1,1-Trichloroethane	1	0.1
1,1,2-Trichloroethane	1	0.1
Trichloroethene	1	0.2
Trichlorofluoromethane	1	0.2
1,2,3-Trichloropropane	1	0.3
1,1,2-Trichloro-1,2,2-Trifluoroethane	1	0.2
1,2,4-Trimethylbenzene	1	0.2
1,3,5-Trimethylbenzene	1	0.2
Vinyl acetate	10	3.3
Vinyl chloride	1	0.2
Xylenes (Total)	3	0.2

Summary of Quantitation Limits and Detection Limits
Appendix IX Monitoring Event
Monitoring Event: Second Quarter 2011

Draper Aden Associates
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Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Acenaphthene	5	1.1
Acenaphthylene	5	0.95
Acetophenone	5	0.99
2-Acetylaminofluorene	5	1.7
4-Aminobiphenyl	5	0.57
Aniline	5	0.93
Anthracene	5	0.69
Aramite	5	0.79
Benzo[a]anthracene	5	1.5
Benzo[b]fluoranthene	5	0.55
Benzo[k]fluoranthene	5	1.9
Benzo[ghi]perylene	5	1.7
Benzo(a)pyrene	5	0.56
1,4-Benzenediamine	7.5	7.5
Benzyl alcohol	5	0.99
bis(2-Chloroethoxy)methane	5	0.9
bis(2-Chloroethyl)ether	5	0.97
bis(2-Chloro-1-methylethyl)ether	5	0.99
bis(2-Ethylhexyl)phthalate	5	2.7
4-Bromophenyl phenyl ether	5	0.74
Butyl benzyl phthalate	5	1.6
p-Chloroaniline	10	1
Chlorobenzilate	5	1.5
p-Chloro-m-cresol	10	0.86
2-Chloronaphthalene	5	1.2
2-Chlorophenol	10	0.94
4-Chlorophenyl phenyl ether	5	1
Chrysene	5	1.5
Diallate	10	0.8
Dibenz(a,h)anthracene	5	1.7
Dibenzofuran	5	1.1
Di-n-butyl phthalate	5	1.5
3,3'-Dichlorobenzidine	5	0.52
2,4-Dichlorophenol	10	0.87
2,6-Dichlorophenol	10	0.89
Diethyl phthalate	5	0.62
O,O-Diethyl O-2-pyrazinyl	5	0.53
Dimethoate	5	3.9
p-(Dimethylamino)azobenzene	5	0.51
7,12-Dimethylbenz[a]anthracene	5	1.5
3,3'-Dimethylbenzidine	5	1.4
a,a-Dimethylphenethylamine	15	15
2,4-Dimethylphenol	10	0.98
Dimethyl phthalate	5	0.76
m-Dinitrobenzene	5	0.96
4,6-Dinitro-o-cresol	10	1.4
2,4-Dinitrophenol	10	5.1
2,4-Dinitrotoluene	5	0.84
2,6-Dinitrotoluene	5	0.89
Di-n-octyl phthalate	5	1.6
Diphenylamine	5	0.73
Disulfoton	5	0.54

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
Engineering ♦ Surveying ♦ Environmental Services

Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Ethyl methanesulfonate	5	0.9
Famphur	5	5
Fluoranthene	5	0.61
Fluorene	5	1
Hexachlorobenzene	5	0.77
Hexachlorocyclopentadiene	5	0.76
Hexachlorophene	40	8
Hexachloropropene	5	0.95
Indeno[1,2,3-cd]pyrene	5	1.3
Isodrin	5	0.65
Isophorone	5	0.95
Isosafrole	5	1
Kepone	5	5
Methapyrilene	5	5
3-Methylcholanthrene	5	1.4
Methyl methane sulfonate	5	0.87
2-Methylnaphthalene	5	1.1
Methyl parathion	5	2.7
2-Methylphenol	10	0.74
3 & 4-Methylphenol	10	0.83
1,4-Naphthoquinone	5	0.64
1-Naphthylamine	5	0.78
2-Naphthylamine	5	1.3
o-Nitroaniline	10	0.99
m-Nitroaniline	10	0.84
p-Nitroaniline	10	0.57
Nitrobenzene	5	1.1
o-Nitrophenol	10	0.57
p-Nitrophenol	10	10
4-Nitroquinoline-1-oxide	5	1.2
N-Nitrosodi-n-butylamine	5	0.96
N-Nitrosodiethylamine	5	0.98
N-Nitrosodimethylamine	5	0.55
N-Nitrosodiphenylamine	5	0.73
N-Nitrosodipropylamine	5	1.1
N-Nitrosomethylethylamine	5	0.84
N-Nitrosomorpholine	5	1.1
N-Nitrosopiperidine	5	1
N-Nitrosopyrrolidine	5	2.2
5-Nitroso-o-toluidine	5	0.71
Parathion	5	0.59
Pentachlorobenzene	5	1.1
Pentachloronitrobenzene	5	0.69
Pentachlorophenol	10	0.62
Phenacetin	5	0.67
Phenanthrene	5	0.82
Phenol	10	0.46
Phorate	5	0.57
2-Picoline	5	0.59
Pronamide	5	0.55
Pyrene	5	1.6
Pyridine	5	0.71

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
Engineering ♦ Surveying ♦ Environmental Services

Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Safrole	5	1
Sulfotep	5	1.1
1,2,4,5-Tetrachlorobenzene	5	0.99
2,3,4,6-Tetrachlorophenol	10	0.61
o-Toluidine	5	1
2,4,5-Trichlorophenol	10	1.1
2,4,6-Trichlorophenol	10	0.74
O,O,O-Triethyl phosphorothioate	5	0.8
sym-Trinitrobenzene	5	0.65
Method: 9012A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Cyanide	20	3.5
Method: 9034		
Laboratory: TestAmerica, North Canton, OH		
Sulfide	3000	2000
Method: 9066		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Total Recoverable Phenolics	50	2.9

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*
Arsenic				*CAS # 7440-38-2*				
Fourth Quarter 2011	U	U	U	U	U	10	10	6020A
Barium				*CAS # 7440-39-3*				
Fourth Quarter 2011	83.6	79	43.6	42.5	65.4	10	2000	6020A
Chromium				*CAS # 7440-47-3*				
Fourth Quarter 2011	U	U	U	U	U	5	100	6020A
Cobalt				*CAS # 7440-48-4*				
Fourth Quarter 2011	U	U	U	U	U	5	5	6020A
Copper				*CAS # 7440-50-8*				
Fourth Quarter 2011	U	U	U	U	U	5	1300	6020A
Lead				*CAS # 7439-92-1*				
Fourth Quarter 2011	U	U	U	U	U	1	15	6020A
Mercury				*CAS # 7439-97-6*				
Fourth Quarter 2011	U	U	U	U	U	2	2	7470A
Nickel				*CAS # 7440-02-0*				
Fourth Quarter 2011	U	U	U	U	U	10	313	6020A
Selenium				*CAS # 7782-49-2*				
Fourth Quarter 2011	U	U	U	U	U	10	50	6020A
Vanadium				*CAS # 7440-62-2*				
Fourth Quarter 2011	U	U	U	U	U	10	109.55	6020A
Zinc				*CAS # 7440-66-6*				
Fourth Quarter 2011	18.2	U	32.1	26.8	U	10	4695	6020A
Acetone				*CAS # 67-64-1*				
Fourth Quarter 2011	U	U	20000	U	U	10	8750.2	8260B
Bromodichloromethane				*CAS # 75-27-4*				
Fourth Quarter 2011	U	U	U	U	U	1	80	8260B
2-Butanone				*CAS # 78-93-3*				
Fourth Quarter 2011	U	U	U	U	U	10	2667.6	8260B
Chloroform				*CAS # 67-66-3*				
Fourth Quarter 2011	22	6.9	3.8 J	U	3.9	1	80	8260B
2,4-Dinitrotoluene				*CAS # 121-14-2*				
Fourth Quarter 2011	U	U	U	U	U	10	31.3	8270D
2,6-Dinitrotoluene				*CAS # 606-20-2*				
Fourth Quarter 2011	U	U	U	U	U	10	15.65	8270D
2-Propanol				*CAS # 67-63-0*				
Fourth Quarter 2011	U	U	34000	U	U	100	100	8260B

See last page of this report for definitions.

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). For cobalt, vanadium, acetone and 2-propanol, these analytes are not listed in Appendix VIII to 40 CFR Part 261; therefore, GPSs will not be established for these constituents.
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
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.

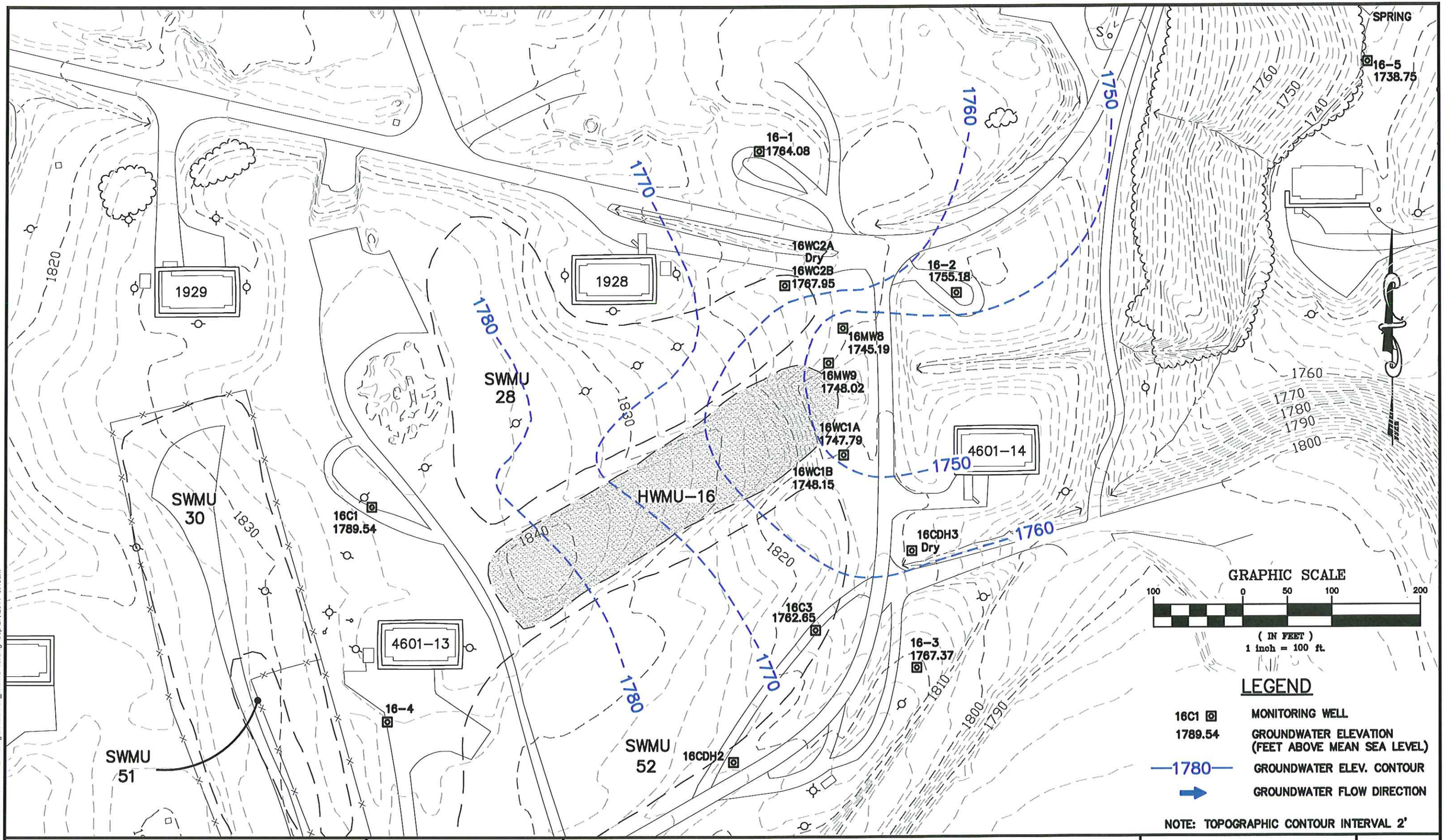
QL Denotes permit required quantitation limit.
U denotes not detected at or above the detection limit or QL.
UA denotes not detected at or above the adjusted detection limit or adjusted QL.
J Denotes result is estimated. When used with "U" (i.e., "UJ"), denotes analyte not detected at or above the detection 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.

APPENDIX D

HWMU-16

APPENDIX D-1

HWMU-16 POTENTIOMETRIC SURFACE MAPS
SECOND QUARTER 2011
FOURTH QUARTER 2011



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Hampton Roads, VA

DESIGNED	RGM
DRAWN	JFF
CHECKED	SN
DATE	09/27/11

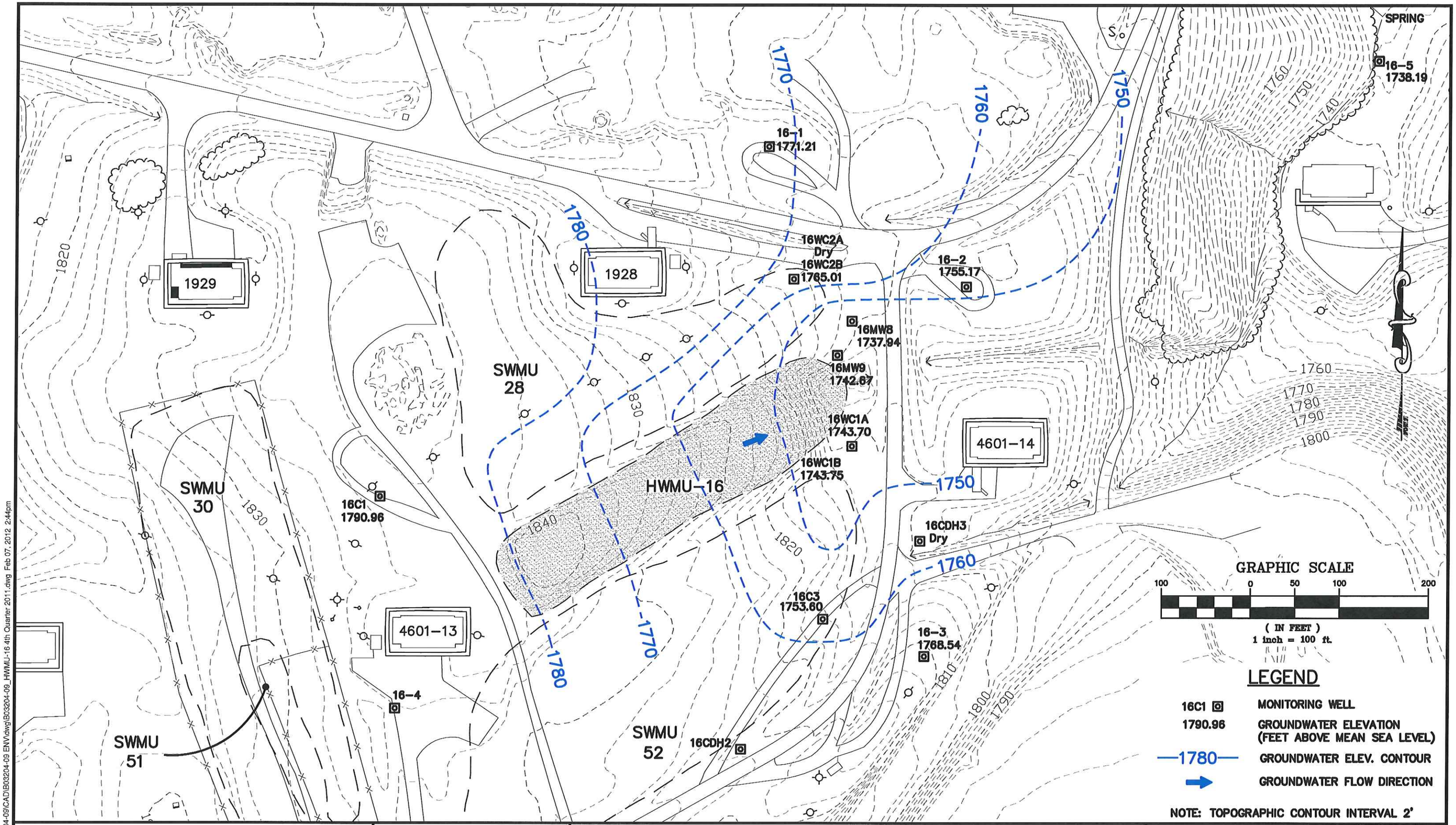
HWMU-16 POTENTIOMETRIC SURFACE MAP (2ND QUARTER 2011)
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-09

FIGURE 4

P:\B03\200\B03204\B03204-09\CAD\B03204-09 ENV.dwg\B03204-09_HWMU-16.dwg Sep 27, 2011 8:43am



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Hampton Roads, VA

DESIGNED	RGM
DRAWN	DLD
CHECKED	SN
DATE	02/07/12

HWMU-16 POTENTIOMETRIC SURFACE MAP (4TH QUARTER 2011)
RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B03204-09

FIGURE 4

APPENDIX D-2

HWMU-16 2011 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.

Analyte/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*OL*	*GPS*	*Method*
Antimony					*CAS #*	*7440-36-0*		
Second Quarter 2011	U	U	U	U	U	1	6	6020A
Arsenic					*CAS #*	*7440-38-2*		
Second Quarter 2011	U	U	U	U	U	10	50	6020A
Barium					*CAS #*	*7440-39-3*		
Second Quarter 2011	205	123	493	308	163	10	2000	6020A
Beryllium					*CAS #*	*7440-41-7*		
Second Quarter 2011	U	0.338 J	U	U	U	1	4	6020A
Cadmium					*CAS #*	*7440-43-9*		
Second Quarter 2011	U	0.273 J	U	U	U	1	5	6020A
Chromium					*CAS #*	*7440-47-3*		
Second Quarter 2011	U	U	U	U	1.11 J	5	100	6020A
Cobalt					*CAS #*	*7440-48-4*		
Second Quarter 2011	U	U	2.77 J	9.24	U	5	313	6020A
Copper					*CAS #*	*7440-50-8*		
Second Quarter 2011	1.02 J	10.1	U	1.03 J	2.35 J	5	1300	6020A
Lead					*CAS #*	*7439-92-1*		
Second Quarter 2011	U	0.75 J	U	U	U	1	15	6020A
Mercury					*CAS #*	*7439-97-6*		
Second Quarter 2011	U	U	U	U	0.799 J	2	2	7470A
Nickel					*CAS #*	*7440-02-0*		
Second Quarter 2011	U	3.34 J	9.88 J	9.3 J	3.07 J	10	313	6020A
Selenium					*CAS #*	*7782-49-2*		
Second Quarter 2011	U	U	U	U	U	10	50	6020A
Silver					*CAS #*	*7440-22-4*		
Second Quarter 2011	U	2.08	U	U	U	2	78.25	6020A
Thallium					*CAS #*	*7440-28-0*		
Second Quarter 2011	U	U	U	U	U	1	-	6020A
Tin					*CAS #*	*7440-31-5*		
Second Quarter 2011	U	U N	U	U N	U N	20	-	6010C
Vanadium					*CAS #*	*7440-62-2*		
Second Quarter 2011	U	U	U	U	U	10	109.55	6020A
Zinc					*CAS #*	*7440-66-6*		
Second Quarter 2011	U	49	U	11.2	7.52 J	10	4695	6020A
Sulfide					*CAS #*	*18496-25-8*		
Second Quarter 2011	U	U	U	U	U	3000	-	9034
Cyanide					*CAS #*	*57-12-5*		
Second Quarter 2011	U	U	U	U	U	20	-	9012A
Acenaphthene					*CAS #*	*83-32-9*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acenaphthylene					*CAS #*	*208-96-8*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acetone					*CAS #*	*67-64-1*		
Second Quarter 2011	U	U	U	U	U	10	223.57	8260B
Acetonitrile					*CAS #*	*75-05-8*		
Second Quarter 2011	U	U	U	U	U	100	-	8260B
Acetophenone					*CAS #*	*98-86-2*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Acetylaminofluorene					*CAS #*	*53-96-3*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Acrolein					*CAS #*	*107-02-8*		
Second Quarter 2011	U J	U J	U J	U J	U J	25	-	8260B
Acrylonitrile					*CAS #*	*107-13-1*		
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Aldrin					*CAS #*	*309-00-2*		
Second Quarter 2011	0.0036J	U	U	U	U	0.025	-	8081B
Allyl chloride					*CAS #*	*107-05-1*		
Second Quarter 2011	U J	U J	U J	U J	U J	10	-	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.

Analyte/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*QL*	*GPS*	*Method*
4-Aminobiphenyl					*CAS #* 92-67-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Aniline					*CAS #* 62-53-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Anthracene					*CAS #* 120-12-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Aramite					*CAS #* 140-57-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzene					*CAS #* 71-43-2			
Second Quarter 2011	0.3 J	U	0.2 J	U	U	1	5	8260B
Benzo[a]anthracene					*CAS #* 56-55-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[b]fluoranthene					*CAS #* 205-99-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[k]fluoranthene					*CAS #* 207-08-9			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo[ghi]perylene					*CAS #* 191-24-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Benzo(a)pyrene					*CAS #* 50-32-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,4-Benzenediamine					*CAS #* 106-50-3			
Second Quarter 2011	U J	U J	U J	U J	U J	7.5	-	8270D
Benzyl alcohol					*CAS #* 100-51-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
alpha-BHC					*CAS #* 319-84-6			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
beta-BHC					*CAS #* 319-85-7			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
delta-BHC					*CAS #* 319-86-8			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
gamma-BHC					*CAS #* 58-89-9			
Second Quarter 2011	0.0031J	U	U	U	U	0.025	-	8081B
bis(2-Chloroethoxy)methane					*CAS #* 111-91-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
bis(2-Chloroethyl)ether					*CAS #* 111-44-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
bis(2-Chloro-1-methylethyl)ether					*CAS #* 108-60-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
bis(2-Ethylhexyl)phthalate					*CAS #* 117-81-7			
Second Quarter 2011	U	U	U	U	U	5	10	8270D
Bromobenzene					*CAS #* 108-86-1			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Bromochloromethane					*CAS #* 74-97-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Bromodichloromethane					*CAS #* 75-27-4			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Bromoform					*CAS #* 75-25-2			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
4-Bromophenyl phenyl ether					*CAS #* 101-55-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Butanone					*CAS #* 78-93-3			
Second Quarter 2011	U	U	U	U	U	10	691.08	8260B
n-Butyl alcohol					*CAS #* 71-36-3			
Second Quarter 2011	U	U	U	U	U	50	-	8260B
tert-Butyl alcohol					*CAS #* 75-65-0			
Second Quarter 2011	U J	U J	U J	U J	U J	200	-	8260B
n-Butylbenzene					*CAS #* 104-51-8			
Second Quarter 2011	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.*

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
sec-Butylbenzene					CAS # 135-98-8			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
tert-Butylbenzene					CAS # 98-06-6			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Butyl benzyl phthalate					CAS # 85-68-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Carbon disulfide					CAS # 75-15-0			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Carbon tetrachloride					CAS # 56-23-5			
Second Quarter 2011	U	U	U	U	U	1	5	8260B
Chlordane					CAS # 57-74-9			
Second Quarter 2011	U	U	U	U	U	0.8	-	8081B
p-Chloroaniline					CAS # 106-47-8			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Chlorobenzene					CAS # 108-90-7			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chlorobenzilate					CAS # 510-15-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
p-Chloro-m-cresol					CAS # 59-50-7			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Chloroethane					CAS # 75-00-3			
Second Quarter 2011	4.2	U	1.7	0.7 J	U	1	-	8260B
Chloroform					CAS # 67-66-3			
Second Quarter 2011	U	U	U	U	U	1	80	8260B
2-Chloroethyl vinyl ether					CAS # 110-75-8			
Second Quarter 2011	U J	U J	U J	U J	U J	20	-	8260B
2-Chloronaphthalene					CAS # 91-58-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Chlorophenol					CAS # 95-57-8			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
4-Chlorophenyl phenyl ether					CAS # 7005-72-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Chloroprene					CAS # 126-99-8			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
2-Chlorotoluene					CAS # 95-49-8			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
4-Chlorotoluene					CAS # 106-43-4			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chrysene					CAS # 218-01-9			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Cyclohexane					CAS #			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,4-Dichlorophenoxyacetic acid					CAS # 94-75-7			
Second Quarter 2011	U	U	U	U	U	5	-	8151A
4,4'-DDD					CAS # 72-54-8			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
4,4'-DDE					CAS # 72-55-9			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
4,4'-DDT					CAS # 50-29-3			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Diallate					CAS # 2303-16-4			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Dibenz(a,h)anthracene					CAS # 53-70-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dibenzofuran					CAS # 132-64-9			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dibromochloromethane					CAS # 124-48-1			
Second Quarter 2011	U	U	U	U	U	1	-	8260B

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

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	OL	GPS	Method
1,2-Dibromo-3-chloropropane					CAS # 96-12-8			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2-Dibromoethane					CAS # 106-93-4			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Di-n-butyl phthalate					CAS # 84-74-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,2-Dichlorobenzene					CAS # 95-50-1			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3-Dichlorobenzene					CAS # 541-73-1			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,4-Dichlorobenzene					CAS # 106-46-7			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
3,3'-Dichlorobenzidine					CAS # 91-94-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
trans-1,4-Dichloro-2-butene					CAS # 110-57-6			
Second Quarter 2011	U J	U J	U J	U J	U J	10	-	8260B
Dichlorodifluoromethane					CAS # 75-71-8			
Second Quarter 2011	0.4 J	U	U	U	U	1	46.5	8260B
1,1-Dichloroethane					CAS # 75-34-3			
Second Quarter 2011	7.4	0.3 J	5.7	2.3	0.1 J	1	296.08	8260B
1,2-Dichloroethane					CAS # 107-06-2			
Second Quarter 2011	U	U	U	U	U	1	5	8260B
1,1-Dichloroethene					CAS # 75-35-4			
Second Quarter 2011	0.3 J	U	U	U	U	1	-	8260B
trans-1,2-Dichloroethene					CAS # 156-60-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,4-Dichlorophenol					CAS # 120-83-2			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,6-Dichlorophenol					CAS # 87-65-0			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
1,2-Dichloropropane					CAS # 78-87-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3-Dichloropropane					CAS # 142-28-9			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
2,2-Dichloropropane					CAS # 594-20-7			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1-Dichloropropene					CAS # 563-58-6			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
cis-1,3-Dichloropropene					CAS # 10061-01-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
trans-1,3-Dichloropropene					CAS # 10061-02-6			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Dieldrin					CAS # 60-57-1			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Diethyl ether					CAS # 60-29-7			
Second Quarter 2011	30	4.1 J	15	5.8 J	U	12.5	-	8260B
Diethyl phthalate					CAS # 84-66-2			
Second Quarter 2011	U	U	U	U	U	5	12,520	8270D
O,O-Diethyl O-2-pyrazinyl					CAS # 297-97-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dimethoate					CAS # 60-51-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Dimethyl ether					CAS # 115-10-6			
Second Quarter 2011	11 J	U J	8.3 J	3.7 J	U J	12.5	-	8260B
p-(Dimethylamino)azobenzene					CAS # 60-11-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
7,12-Dimethylbenz[a]anthracene					CAS # 57-97-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D

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

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
3,3'-Dimethylbenzidine					CAS # 119-93-7			
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
a,a-Dimethylphenethylamine					CAS # 122-09-8			
Second Quarter 2011	U J	U J	U J	U J	U J	15	-	8270D
2,4-Dimethylphenol					CAS # 105-67-9			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Dimethyl phthalate					CAS # 131-11-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
m-Dinitrobenzene					CAS # 99-65-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
4,6-Dinitro-o-cresol					CAS # 534-52-1			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,4-Dinitrophenol					CAS # 51-28-5			
Second Quarter 2011	U J	U J	U J	U J	U J	10	-	8270D
2,4-Dinitrotoluene					CAS # 121-14-2			
Second Quarter 2011	U	U	U	U	U	10	31.3	8270D
2,6-Dinitrotoluene					CAS # 606-20-2			
Second Quarter 2011	U	U	U	U	U	10	15.65	8270D
Dinoseb					CAS # 88-85-7			
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
Di-n-octyl phthalate					CAS # 117-84-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,4-Dioxane					CAS # 123-91-1			
Second Quarter 2011	U	U	U	U	U	200	-	8260B
Diphenylamine					CAS # 122-39-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Disulfoton					CAS # 298-04-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Endosulfan I					CAS # 959-98-8			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Endosulfan II					CAS # 33213-65-9			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Endosulfan sulfate					CAS # 1031-07-8			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Endrin					CAS # 72-20-8			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Ethyl acetate					CAS # 141-78-6			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Endrin aldehyde					CAS # 7421-93-4			
Second Quarter 2011	U	U	U	U	U	0.05	-	8081B
Ethanol					CAS # 64-17-5			
Second Quarter 2011	U J	U J	U J	U J	U J	250	-	8260B
Ethylbenzene					CAS # 100-41-4			
Second Quarter 2011	U	U	U	U	U	1	70	8260B
Ethyl methacrylate					CAS # 97-63-2			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Ethyl methanesulfonate					CAS # 62-50-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Ethylene oxide					CAS # 75-21-8			
Second Quarter 2011	U J	U J	U J	U J	U J	100	-	8260B
Famphur					CAS # 52-85-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Fluoranthene					CAS # 206-44-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Fluorene					CAS # 86-73-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Heptachlor					CAS # 76-44-8			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B

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

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
Heptachlor epoxide					CAS # 1024-57-3			
Second Quarter 2011	U	U	U	U	U	0.025	-	8081B
Hexachlorobenzene					CAS # 118-74-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Hexachlorobutadiene					CAS # 87-68-3			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Hexachlorocyclopentadiene					CAS # 77-47-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Hexachloroethane					CAS # 67-72-1			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Hexachlorophene					CAS # 70-30-4			
Second Quarter 2011	U	U	U	U	U	40	-	8270D
Hexachloropropene					CAS # 1888-71-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Hexanone					CAS # 591-78-6			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Indeno[1,2,3-cd]pyrene					CAS # 193-39-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isobutyl alcohol					CAS # 78-83-1			
Second Quarter 2011	U	U	U	U	U	200	-	8260B
Isodrin					CAS # 465-73-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isophorone					CAS # 78-59-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Isopropylbenzene					CAS # 98-82-8			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Isopropylether					CAS # 108-20-3			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
4-Isopropyltoluene					CAS # 99-87-6			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Isosafrole					CAS # 120-58-1			
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
Kepone					CAS # 143-50-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methacrylonitrile					CAS # 126-98-7			
Second Quarter 2011	U	U	U	U	U	100	-	8260B
Methapyrilene					CAS # 91-80-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methoxychlor					CAS # 72-43-5			
Second Quarter 2011	U	U	U	U	U	0.25	-	8081B
Bromomethane					CAS # 74-83-9			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Chloromethane					CAS # 74-87-3			
Second Quarter 2011	U	U	U	U	U	1	2.11	8260B
3-Methylcholanthrene					CAS # 56-49-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Iodomethane					CAS # 74-88-4			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Methyl methacrylate					CAS # 80-62-6			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Methyl methane sulfonate					CAS # 66-27-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Methylnaphthalene					CAS # 91-57-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Methyl parathion					CAS # 298-00-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
4-Methyl-2-pentanone					CAS # 108-10-1			
Second Quarter 2011	U	U	U	U	U	10	-	8260B

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

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	OL	GPS	Method
2-Methylphenol					CAS # 95-48-7			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
3 & 4-Methylphenol					CAS # m 108-39-4 p 106-44-5			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Methyl tert-butyl ether					CAS # 1634-04-4			
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Dibromomethane					CAS # 74-95-3			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Methylene chloride					CAS # 75-09-2			
Second Quarter 2011	5.1	U	U	U	U	1	-	8260B
Naphthalene					CAS # 91-20-3			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,4-Naphthoquinone					CAS # 130-15-4			
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
1-Naphthylamine					CAS # 134-32-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Naphthylamine					CAS # 91-59-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
o-Nitroaniline					CAS # 88-74-4			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
m-Nitroaniline					CAS # 99-09-2			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
p-Nitroaniline					CAS # 100-01-6			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Nitrobenzene					CAS # 98-95-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
o-Nitrophenol					CAS # 88-75-5			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
p-Nitrophenol					CAS # 100-02-7			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
4-Nitroquinoline-1-oxide					CAS # 56-57-5			
Second Quarter 2011	U J	U J	U J	U J	U J	5	-	8270D
N-Nitrosodi-n-butylamine					CAS # 924-16-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodiethylamine					CAS # 55-18-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodimethylamine					CAS # 62-75-9			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodiphenylamine					CAS # 86-30-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosodipropylamine					CAS # 621-64-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosomethylethylamine					CAS # 10595-95-6			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosomorpholine					CAS # 59-89-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosopiperidine					CAS # 100-75-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
N-Nitrosopyrrolidine					CAS # 930-55-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
5-Nitroso-o-toluidine					CAS # 99-55-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Parathion					CAS # 56-38-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachlorobenzene					CAS # 608-93-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachloroethane					CAS # 76-01-7			
Second Quarter 2011	U	U	U	U	U	10	-	8260B

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

Analyte/Quarter	16C1	16MW8	16MW9	16WC1A	16WC1B	QL	GPS	Method
Pentachloronitrobenzene					CAS # 82-68-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pentachlorophenol					CAS # 87-86-5			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Phenacetin					CAS # 62-44-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Phenanthrene					CAS # 85-01-8			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Phenol					CAS # 108-95-2			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Total Recoverable Phenolics					CAS # C-020			
Second Quarter 2011	U	U	U	U	U	50	-	9066
Phorate					CAS # 298-02-2			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2-Picoline					CAS # 931-19-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pronamide					CAS # 23950-58-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1-Propanol					CAS # 71-23-8			
Second Quarter 2011	U J	U J	U J	U J	U J	100	-	8260B
2-Propanol					CAS # 67-63-0			
Second Quarter 2011	U	U	U	U	U	100	-	8260B
Propionitrile					CAS # 107-12-0			
Second Quarter 2011	U	U	U	U	U	100	-	8260B
n-Propylbenzene					CAS # 103-65-1			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Pyrene					CAS # 129-00-0			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Pyridine					CAS # 110-86-1			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Safrole					CAS # 94-59-7			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Silvex					CAS # 93-72-1			
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
Styrene					CAS # 100-42-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Sulfotep					CAS # 3689-24-5			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
2,4,5-Trichlorophenoxyacetic acid					CAS # 93-76-5			
Second Quarter 2011	U	U	U	U	U	2.5	-	8151A
1,2,4,5-Tetrachlorobenzene					CAS # 95-94-3			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,1,1,2-Tetrachloroethane					CAS # 630-20-6			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,2,2-Tetrachloroethane					CAS # 79-34-5			
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Tetrachloroethene					CAS # 127-18-4			
Second Quarter 2011	0.4 J	U	U	U	U	1	5	8260B
Tetrahydrofuran					CAS # 109-99-9			
Second Quarter 2011	24 J	U	U	U	U	25	-	8260B
2,3,4,6-Tetrachlorophenol					CAS # 58-90-2			
Second Quarter 2011	U	U	U	U	U	10	-	8270D
Toluene					CAS # 108-88-3			
Second Quarter 2011	U	U	U	U	U	1	1000	8260B
o-Toluidine					CAS # 95-53-4			
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Toxaphene					CAS # 8001-35-2			
Second Quarter 2011	U	U	U	U	U	2.5	-	8081B

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

All Results in ug/L.

Analyte/Quarter	*16C1*	*16MW8*	*16MW9*	*16WC1A*	*16WC1B*	*OL*	*GPS*	*Method*
1,2,3-Trichlorobenzene					*CAS #*	*87-61-6*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,2,4-Trichlorobenzene					*CAS #*	*120-82-1*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,1-Trichloroethane					*CAS #*	*71-55-6*		
Second Quarter 2011	0.9 J	U	U	U	U	1	200	8260B
1,1,2-Trichloroethane					*CAS #*	*79-00-5*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Trichloroethene					*CAS #*	*79-01-6*		
Second Quarter 2011	0.2 J	U	U	U	U	1	5	8260B
Trichlorofluoromethane					*CAS #*	*75-69-4*		
Second Quarter 2011	0.3 J	U	U	U	U	1	469.5	8260B
2,4,5-Trichlorophenol					*CAS #*	*95-95-4*		
Second Quarter 2011	U	U	U	U	U	10	-	8270D
2,4,6-Trichlorophenol					*CAS #*	*88-06-2*		
Second Quarter 2011	U	U	U	U	U	10	-	8270D
1,2,3-Trichloropropane					*CAS #*	*96-18-4*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane					*CAS #*	*76-13-1*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
O,O,O-Triethyl phosphorothioate					*CAS #*	*126-68-1*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
1,2,4-Trimethylbenzene					*CAS #*	*95-63-6*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
1,3,5-Trimethylbenzene					*CAS #*	*108-67-8*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
sym-Trinitrobenzene					*CAS #*	*99-35-4*		
Second Quarter 2011	U	U	U	U	U	5	-	8270D
Vinyl acetate					*CAS #*	*108-05-4*		
Second Quarter 2011	U	U	U	U	U	10	-	8260B
Vinyl chloride					*CAS #*	*75-01-4*		
Second Quarter 2011	U	U	U	U	U	1	-	8260B
Xylenes (Total)					*CAS #*	*1330-20-7*		
Second Quarter 2011	U	U	U	U	U	3	10000	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:

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

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).
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), 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).

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.

Comprehensive Data Validation Report

Sample/Blind Field Duplicate Results Greater Than the Quantitation Limit

Facility: HWMU-16 Monitoring Event: Second Quarter 2011

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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	308		308		10	No action taken. Field duplicate result was 305 ug/l. RPD <10.
	16WDUP	305		305		10	No action taken. Field duplicate of 16WC1A. RPD <10.
Cobalt	16WC1A	9.24		9.24		5	No action taken. Field duplicate result was 8.02 ug/l. 14 RPD.
	16WDUP	8.02		8.02		5	No action taken. Field duplicate of 16WC1A. 14 RPD.
Zinc	16WC1A	11.2		11.2		10	No action taken. Field duplicate result was < QL. RPD is not calculable.
Method: 8260B							
Laboratory: Lancaster Laboratories, Lancaster, PA							
1,1-Dichloroethane	16WC1A	2.3		2.3		1	No action taken. Field duplicate result 2.3 ug/l. RPD <10.
	16WDUP	2.3		2.3		1	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.

Summary of Quantitation Limits and Detection Limits

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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 6010C		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Tin	20	2.87
Method: 6020A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Antimony	1	0.4
Arsenic	10	2
Barium	10	1
Beryllium	1	0.2
Cadmium	1	0.2
Chromium	5	1
Cobalt	5	1
Copper	5	1
Lead	1	0.2
Nickel	10	2
Selenium	10	3
Silver	2	0.2
Thallium	1	0.2
Vanadium	10	1
Zinc	10	3
Method: 7470A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Mercury	2	0.2
Method: 8081B		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Aldrin	0.025	0.0027
alpha-BHC	0.025	0.0019
beta-BHC	0.025	0.0095
delta-BHC	0.025	0.0032
gamma-BHC	0.025	0.0019
Chlordane	0.8	0.24
4,4'-DDD	0.05	0.0055
4,4'-DDE	0.05	0.0039
4,4'-DDT	0.05	0.0051
Dieldrin	0.05	0.0051
Endosulfan I	0.025	0.0043
Endosulfan II	0.05	0.0055
Endosulfan sulfate	0.05	0.0068
Endrin	0.05	0.0069
Endrin aldehyde	0.05	0.012
Heptachlor	0.025	0.0024
Heptachlor epoxide	0.025	0.0028
Methoxychlor	0.25	0.015
Toxaphene	2.5	0.48
Method: 8151A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
2,4-Dichlorophenoxyacetic acid	5	3.4
Dinoseb	2.5	0.93
Silvex	2.5	0.59
2,4,5-Trichlorophenoxyacetic acid	2.5	0.74

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Acetone	10	3
Acetonitrile	100	32
Acrolein	25	5
Acrylonitrile	10	1
Allyl chloride	10	0.8
Benzene	1	0.1
Bromobenzene	1	0.1
Bromochloromethane	1	0.2
Bromodichloromethane	1	0.1
Bromoform	1	0.1
n-Butyl alcohol	50	20
tert-Butyl alcohol	200	50
n-Butylbenzene	1	0.1
sec-Butylbenzene	1	0.1
tert-Butylbenzene	1	0.1
Carbon disulfide	10	0.4
Carbon tetrachloride	1	0.2
Chlorobenzene	1	0.1
Chloroethane	1	0.1
Chloroform	1	0.1
2-Chloroethyl vinyl ether	20	0.5
Chloroprene	10	0.5
2-Chlorotoluene	1	0.1
4-Chlorotoluene	1	0.1
Cyclohexane	1	0.2
Dibromochloromethane	1	0.1
1,2-Dibromo-3-chloropropane	1	0.2
1,2-Dibromoethane	1	0.1
1,2-Dichlorobenzene	1	0.1
1,3-Dichlorobenzene	1	0.1
1,4-Dichlorobenzene	1	0.1
trans-1,4-Dichloro-2-butene	10	1
Dichlorodifluoromethane	1	0.1
1,1-Dichloroethane	1	0.1
1,2-Dichloroethane	1	0.1
1,1-Dichloroethene	1	0.2
trans-1,2-Dichloroethene	1	0.2
1,2-Dichloropropane	1	0.1
1,3-Dichloropropane	1	0.1
2,2-Dichloropropane	1	0.3
1,1-Dichloropropene	1	0.1
cis-1,3-Dichloropropene	1	0.1
trans-1,3-Dichloropropene	1	0.1
Diethyl ether	12.5	1.1
Dimethyl ether	12.5	0.1
1,4-Dioxane	200	45
Ethyl acetate	10	1
Ethanol	250	52
Ethylbenzene	1	0.1
Ethyl methacrylate	10	0.8
Ethylene oxide	100	20
Hexachlorobutadiene	1	0.1

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
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Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8260B		
Laboratory: Lancaster Laboratories, Lancaster, PA		
Hexachloroethane	10	0.1
2-Hexanone	10	1
Isobutyl alcohol	200	10
Isopropylbenzene	1	0.1
Isopropylether	10	0.6
4-Isopropyltoluene	1	0.1
Methacrylonitrile	100	9.8
Bromomethane	1	0.5
Chloromethane	1	0.2
2-Butanone	10	1
Iodomethane	10	0.6
Methyl methacrylate	10	3.6
4-Methyl-2-pentanone	10	1
Methyl tert-butyl ether	10	0.4
Dibromomethane	1	0.1
Methylene chloride	1	0.2
Naphthalene	1	0.1
Pentachloroethane	10	0.8
1-Propanol	100	20
2-Propanol	100	50
Propionitrile	100	10
n-Propylbenzene	1	0.1
Styrene	1	0.1
1,1,1,2-Tetrachloroethane	1	0.1
1,1,2,2-Tetrachloroethane	1	0.2
Tetrachloroethene	1	0.1
Tetrahydrofuran	25	2
Toluene	1	0.1
1,2,3-Trichlorobenzene	1	0.1
1,2,4-Trichlorobenzene	1	0.1
1,1,1-Trichloroethane	1	0.1
1,1,2-Trichloroethane	1	0.1
Trichloroethene	1	0.2
Trichlorofluoromethane	1	0.2
1,2,3-Trichloropropane	1	0.3
1,1,2-Trichloro-1,2,2-Trifluoroethane	1	0.2
1,2,4-Trimethylbenzene	1	0.2
1,3,5-Trimethylbenzene	1	0.2
Vinyl acetate	10	3.3
Vinyl chloride	1	0.2
Xylenes (Total)	3	0.2

Summary of Quantitation Limits and Detection Limits
Appendix IX Monitoring Event
Monitoring Event: Second Quarter 2011

Draper Aden Associates
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Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Acenaphthene	5	1.1
Acenaphthylene	5	0.95
Acetophenone	5	0.99
2-Acetylaminofluorene	5	1.7
4-Aminobiphenyl	5	0.57
Aniline	5	0.93
Anthracene	5	0.69
Aramite	5	0.79
Benzo[a]anthracene	5	1.5
Benzo[b]fluoranthene	5	0.55
Benzo[k]fluoranthene	5	1.9
Benzo[ghi]perylene	5	1.7
Benzo(a)pyrene	5	0.56
1,4-Benzenediamine	7.5	7.5
Benzyl alcohol	5	0.99
bis(2-Chloroethoxy)methane	5	0.9
bis(2-Chloroethyl)ether	5	0.97
bis(2-Chloro-1-methylethyl)ether	5	0.99
bis(2-Ethylhexyl)phthalate	5	2.7
4-Bromophenyl phenyl ether	5	0.74
Butyl benzyl phthalate	5	1.6
p-Chloroaniline	10	1
Chlorobenzilate	5	1.5
p-Chloro-m-cresol	10	0.86
2-Chloronaphthalene	5	1.2
2-Chlorophenol	10	0.94
4-Chlorophenyl phenyl ether	5	1
Chrysene	5	1.5
Diallate	10	0.8
Dibenz(a,h)anthracene	5	1.7
Dibenzofuran	5	1.1
Di-n-butyl phthalate	5	1.5
3,3'-Dichlorobenzidine	5	0.52
2,4-Dichlorophenol	10	0.87
2,6-Dichlorophenol	10	0.89
Diethyl phthalate	5	0.62
O,O-Diethyl O-2-pyrazinyl	5	0.53
Dimethoate	5	3.9
p-(Dimethylamino)azobenzene	5	0.51
7,12-Dimethylbenz[a]anthracene	5	1.5
3,3'-Dimethylbenzidine	5	1.4
a,a-Dimethylphenethylamine	15	15
2,4-Dimethylphenol	10	0.98
Dimethyl phthalate	5	0.76
m-Dinitrobenzene	5	0.96
4,6-Dinitro-o-cresol	10	1.4
2,4-Dinitrophenol	10	5.1
2,4-Dinitrotoluene	5	0.84
2,6-Dinitrotoluene	5	0.89
Di-n-octyl phthalate	5	1.6
Diphenylamine	5	0.73
Disulfoton	5	0.54

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
Engineering ♦ Surveying ♦ Environmental Services

Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Ethyl methanesulfonate	5	0.9
Famphur	5	5
Fluoranthene	5	0.61
Fluorene	5	1
Hexachlorobenzene	5	0.77
Hexachlorocyclopentadiene	5	0.76
Hexachlorophene	40	8
Hexachloropropene	5	0.95
Indeno[1,2,3-cd]pyrene	5	1.3
Isodrin	5	0.65
Isophorone	5	0.95
Isosafrole	5	1
Kepone	5	5
Methapyrilene	5	5
3-Methylcholanthrene	5	1.4
Methyl methane sulfonate	5	0.87
2-Methylnaphthalene	5	1.1
Methyl parathion	5	2.7
2-Methylphenol	10	0.74
3 & 4-Methylphenol	10	0.83
1,4-Naphthoquinone	5	0.64
1-Naphthylamine	5	0.78
2-Naphthylamine	5	1.3
o-Nitroaniline	10	0.99
m-Nitroaniline	10	0.84
p-Nitroaniline	10	0.57
Nitrobenzene	5	1.1
o-Nitrophenol	10	0.57
p-Nitrophenol	10	10
4-Nitroquinoline-1-oxide	5	1.2
N-Nitrosodi-n-butylamine	5	0.96
N-Nitrosodiethylamine	5	0.98
N-Nitrosodimethylamine	5	0.55
N-Nitrosodiphenylamine	5	0.73
N-Nitrosodipropylamine	5	1.1
N-Nitrosomethylethylamine	5	0.84
N-Nitrosomorpholine	5	1.1
N-Nitrosopiperidine	5	1
N-Nitrosopyrrolidine	5	2.2
5-Nitroso-o-toluidine	5	0.71
Parathion	5	0.59
Pentachlorobenzene	5	1.1
Pentachloronitrobenzene	5	0.69
Pentachlorophenol	10	0.62
Phenacetin	5	0.67
Phenanthrene	5	0.82
Phenol	10	0.46
Phorate	5	0.57
2-Picoline	5	0.59
Pronamide	5	0.55
Pyrene	5	1.6
Pyridine	5	0.71

Summary of Quantitation Limits and Detection Limits

Draper Aden Associates
Engineering ♦ Surveying ♦ Environmental Services

Appendix IX Monitoring Event

Monitoring Event: Second Quarter 2011

Analyte	Quantitation Limit/QL (ug/L)	Detection Limit/DL (ug/L)
Method: 8270D		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Safrole	5	1
Sulfotep	5	1.1
1,2,4,5-Tetrachlorobenzene	5	0.99
2,3,4,6-Tetrachlorophenol	10	0.61
o-Toluidine	5	1
2,4,5-Trichlorophenol	10	1.1
2,4,6-Trichlorophenol	10	0.74
O,O,O-Triethyl phosphorothioate	5	0.8
sym-Trinitrobenzene	5	0.65
Method: 9012A		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Cyanide	20	3.5
Method: 9034		
Laboratory: TestAmerica, North Canton, OH		
Sulfide	3000	2000
Method: 9066		
Laboratory: CompuChem, a Division of Liberty Analytical, Cary, NC		
Total Recoverable Phenolics	50	2.9

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*
Arsenic					*CAS #*	*7440-38-2*		
Fourth Quarter 2011	U	U	U	U	U	10	10	6020A
Barium					*CAS #*	*7440-39-3*		
Fourth Quarter 2011	173	90.1	466	212	123	10	2000	6020A
Beryllium					*CAS #*	*7440-41-7*		
Fourth Quarter 2011	U	U	U	U	U	1	4	6020A
Cadmium					*CAS #*	*7440-43-9*		
Fourth Quarter 2011	U	U	U	U	U	1	5	6020A
Chromium					*CAS #*	*7440-47-3*		
Fourth Quarter 2011	U	U	U	U	U	5	100	6020A
Cobalt					*CAS #*	*7440-48-4*		
Fourth Quarter 2011	U	U	U	U	U	5	5	6020A
Copper					*CAS #*	*7440-50-8*		
Fourth Quarter 2011	U	17.7	U	U	U	5	1300	6020A
Lead					*CAS #*	*7439-92-1*		
Fourth Quarter 2011	U	1.02	U	U	U	1	15	6020A
Mercury					*CAS #*	*7439-97-6*		
Fourth Quarter 2011	U	U	U	U	U	2	2	7470A
Nickel					*CAS #*	*7440-02-0*		
Fourth Quarter 2011	U	U	U	U	U	10	313	6020A
Vanadium					*CAS #*	*7440-62-2*		
Fourth Quarter 2011	U	U	U	U	U	10	151	6020A
Zinc					*CAS #*	*7440-66-6*		
Fourth Quarter 2011	U	49.1	24.1	U	14	10	4695	6020A
Benzene					*CAS #*	*71-43-2*		
Fourth Quarter 2011	U	U	U	U	U	1	5	8260B
2-Butanone					*CAS #*	*78-93-3*		
Fourth Quarter 2011	U	U	U	U	U	10	2667.6	8260B
Carbon tetrachloride					*CAS #*	*56-23-5*		
Fourth Quarter 2011	U	U	U	U	U	1	5	8260B
Chloroethane					*CAS #*	*75-00-3*		
Fourth Quarter 2011	7.3	U	3.3	U	U	1	1293.39	8260B
Dichlorodifluoromethane					*CAS #*	*75-71-8*		
Fourth Quarter 2011	U	U	U	U	U	1	142.3	8260B
1,1-Dichloroethane					*CAS #*	*75-34-3*		
Fourth Quarter 2011	11	U	8.6	2.3	U	1	9.5	8260B
Diethyl ether					*CAS #*	*60-29-7*		
Fourth Quarter 2011	37	U	30	U	U	12.5	7300	8260B
Dimethyl ether					*CAS #*	*115-10-6*		
Fourth Quarter 2011	U J	U	U J	U J	U J	12.5	17	8260B
2,4-Dinitrotoluene					*CAS #*	*121-14-2*		
Fourth Quarter 2011	U	U	U	U	U	10	31.3	8270D
2,6-Dinitrotoluene					*CAS #*	*606-20-2*		
Fourth Quarter 2011	U	U	U	U	U	10	15.65	8270D
Ethylbenzene					*CAS #*	*100-41-4*		
Fourth Quarter 2011	U	U	U	U	U	1	700	8260B
Chloromethane					*CAS #*	*74-87-3*		
Fourth Quarter 2011	U	U	U	U	U	1	1.4	8260B
Methylene chloride					*CAS #*	*75-09-2*		
Fourth Quarter 2011	6.3	U	U	U	U	1	13.95	8260B
Tetrachloroethene					*CAS #*	*127-18-4*		
Fourth Quarter 2011	U	U	U	U	U	1	5	8260B
Toluene					*CAS #*	*108-88-3*		
Fourth Quarter 2011	U	U	U	U	U	1	1000	8260B
1,1,1-Trichloroethane					*CAS #*	*71-55-6*		
Fourth Quarter 2011	1.1	U	U	U	U	1	200	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*
Trichloroethene					*CAS #*	*79-01-6*		
Fourth Quarter 2011	U	U	U	U	U	1	5	8260B
Trichlorofluoromethane					*CAS #*	*75-69-4*		
Fourth Quarter 2011	U	U	U	U	U	1	469.5	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane					*CAS #*	*76-13-1*		
Fourth Quarter 2011	U	U	U	U	U	1	59000	8260B
Xylenes (Total)					*CAS #*	*1330-20-7*		
Fourth Quarter 2011	U	U	U	U	U	3	10000	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:

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

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).
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), 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).

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.

See last page of this report for definitions.

APPENDIX D-3

HWMU-16 2011 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

Analyte/Quarter	*16C1 Q*	*16-1 Q*	*16-2 Q*	*16-3 Q*	*16-5 Q*	*16WC2B Q*	*16SPRING Q*	*QL*	*Background*	*Method*
Antimony						*CAS # 7440-36-0*				
Second Quarter 2011	U	U	U	U	U	U	U	1	3	6020A
Arsenic						*CAS # 7440-38-2*				
Second Quarter 2011	U	U	U	U	U	U	U	10	1	6020A
Barium						*CAS # 7440-39-3*				
Second Quarter 2011	205	208	235	701	163	111	213	10	175.4	6020A
Beryllium						*CAS # 7440-41-7*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.7	6020A
Cadmium						*CAS # 7440-43-9*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.2	6020A
Chromium						*CAS # 7440-47-3*				
Second Quarter 2011	U	U	U	U	U	U	U	5	6.2	6020A
Cobalt						*CAS # 7440-48-4*				
Second Quarter 2011	U	U	U	U	U	U	U	5	5	6020A
Copper						*CAS # 7440-50-8*				
Second Quarter 2011	1.02 J	U	U	U	U	U	U	5	13	6020A
Lead						*CAS # 7439-92-1*				
Second Quarter 2011	U	U	U	U	U	U	U	1	10	6020A
Mercury						*CAS # 7439-97-6*				
Second Quarter 2011	U	U	U	U	U	U	U	2	0.2	7470A
Nickel						*CAS # 7440-02-0*				
Second Quarter 2011	U	U	U	U	U	U	U	10	16	6020A
Selenium						*CAS # 7782-49-2*				
Second Quarter 2011	U	U	U	U	U	U	U	10	1	6020A
Silver						*CAS # 7440-22-4*				
Second Quarter 2011	U	U	U	U	U	U	U	2	0.5	6020A
Vanadium						*CAS # 7440-62-2*				
Second Quarter 2011	U	U	U	U	U	U	U	10	151	6020A
Zinc						*CAS # 7440-66-6*				
Second Quarter 2011	U	11.7	U	U	13.9	U	U	10	51	6020A
Benzene						*CAS # 71-43-2*				
Second Quarter 2011	0.3 J	-	-	-	-	-	-	1	1	8260B
2-Butanone						*CAS # 78-93-3*				
Second Quarter 2011	U	U	U	U	U	U	U	10	1.1	8260B
Carbon tetrachloride						*CAS # 56-23-5*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.2	8260B
Chloroethane						*CAS # 75-00-3*				
Second Quarter 2011	4.2	U	U	U	U	U	U	1	20.7	8260B
Dichlorodifluoromethane						*CAS # 75-71-8*				
Second Quarter 2011	0.4 J	U	U	U	U	U	U	1	46.5	8260B
1,1-Dichloroethane						*CAS # 75-34-3*				
Second Quarter 2011	7.4	U	U	U	U	U	U	1	9.5	8260B
Diethyl ether						*CAS # 60-29-7*				
Second Quarter 2011	30	U	U	U	U	U	U	12.5	75.5	8260B
Dimethyl ether						*CAS # 115-10-6*				
Second Quarter 2011	11 J	U J	U J	U J	U J	U J	U J	12.5	17.0	8260B

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*

Analyte/Quarter	*16C1 Q*	*16-1 Q*	*16-2 Q*	*16-3 Q*	*16-5 Q*	*16WC2B Q*	*16SPRING Q*	*QL*	*Background*	*Method*
2,4-Dinitrotoluene						*CAS # 121-14-2*				
Second Quarter 2011	U	U	-	U J	U	U	U	10	0.1	8270D
2,6-Dinitrotoluene						*CAS # 606-20-2*				
Second Quarter 2011	U	U	U	U J	U	U	U	10	0.11	8270D
Ethylbenzene						*CAS # 100-41-4*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.1	8260B
Chloromethane						*CAS # 74-87-3*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.3	8260B
Methylene chloride						*CAS # 75-09-2*				
Second Quarter 2011	5.1	U	U	U	U	U	U	1	13.95	8260B
Tetrachloroethene						*CAS # 127-18-4*				
Second Quarter 2011	0.4 J	U	U	U	U	U	U	1	0.7	8260B
Toluene						*CAS # 108-88-3*				
Second Quarter 2011	U	U	U	U	U	U	U	1	0.1	8260B
1,1,1-Trichloroethane						*CAS # 71-55-6*				
Second Quarter 2011	0.9 J	U	U	U	U	U	U	1	9.2	8260B
Trichloroethene						*CAS # 79-01-6*				
Second Quarter 2011	0.2 J	U	U	U	U	U	U	1	0.1	8260B
Trichlorofluoromethane						*CAS # 75-69-4*				
Second Quarter 2011	0.3 J	U	U	U	U	U	U	1	11.3	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane						*CAS # 76-13-1*				
Second Quarter 2011	U	U	U	U	U	U	U	1	1.2	8260B
Xylenes (Total)						*CAS # 1330-20-7*				
Second Quarter 2011	U	U	U	U	U	U	U	3	0.2	8260B

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*

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).
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.

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*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	1	6020A
Barium						*CAS # 7440-39-3*				
Fourth Quarter 2011	173	156	222	711	161	103	193	10	175.4	6020A
Beryllium						*CAS # 7440-41-7*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.7	6020A
Cadmium						*CAS # 7440-43-9*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.2	6020A
Chromium						*CAS # 7440-47-3*				
Fourth Quarter 2011	U	U	U	U	U	U	U	5	6.2	6020A
Cobalt						*CAS # 7440-48-4*				
Fourth Quarter 2011	U	U	U	U	U	U	U	5	5	6020A
Copper						*CAS # 7440-50-8*				
Fourth Quarter 2011	U	U	U	U	U	U	U	5	13	6020A
Lead						*CAS # 7439-92-1*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	10	6020A
Mercury						*CAS # 7439-97-6*				
Fourth Quarter 2011	U	U	U	U	U	U	U	2	0.2	7470A
Nickel						*CAS # 7440-02-0*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	16	6020A
Vanadium						*CAS # 7440-62-2*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	151	6020A
Zinc						*CAS # 7440-66-6*				
Fourth Quarter 2011	U	U	17.8	U	U	U	U	10	51	6020A
Benzene						*CAS # 71-43-2*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1	8260B
2-Butanone						*CAS # 78-93-3*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	1.1	8260B
Carbon tetrachloride						*CAS # 56-23-5*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.2	8260B
Chloroethane						*CAS # 75-00-3*				
Fourth Quarter 2011	7.3	U	U	U	U	U	U	1	20.7	8260B
Dichlorodifluoromethane						*CAS # 75-71-8*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	46.5	8260B
1,1-Dichloroethane						*CAS # 75-34-3*				
Fourth Quarter 2011	11	U	U	U	U	U	U	1	9.5	8260B
Diethyl ether						*CAS # 60-29-7*				
Fourth Quarter 2011	37	U	U	U	U	U	U	12.5	75.5	8260B
Dimethyl ether						*CAS # 115-10-6*				
Fourth Quarter 2011	U J	U J	U J	U J	U J	U J	U J	12.5	17.0	8260B
2,4-Dinitrotoluene						*CAS # 121-14-2*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	10	8270D
2,6-Dinitrotoluene						*CAS # 606-20-2*				
Fourth Quarter 2011	U	U	U	U	U	U	U	10	10	8270D
Ethylbenzene						*CAS # 100-41-4*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.1	8260B

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*
Chloromethane						*CAS # 74-87-3*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.3	8260B
Methylene chloride						*CAS # 75-09-2*				
Fourth Quarter 2011	6.3	U	U	U	U	U	U	1	13.95	8260B
Tetrachloroethene						*CAS # 127-18-4*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.7	8260B
Toluene						*CAS # 108-88-3*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.1	8260B
1,1,1-Trichloroethane						*CAS # 71-55-6*				
Fourth Quarter 2011	1.1	U	U	U	U	U	U	1	9.2	8260B
Trichloroethene						*CAS # 79-01-6*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	0.1	8260B
Trichlorofluoromethane						*CAS # 75-69-4*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	11.3	8260B
1,1,2-Trichloro-1,2,2-Trifluoroethane						*CAS # 76-13-1*				
Fourth Quarter 2011	U	U	U	U	U	U	U	1	1.2	8260B
Xylenes (Total)						*CAS # 1330-20-7*				
Fourth Quarter 2011	U	U	U	U	U	U	U	3	0.2	8260B

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).
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 D-4

ESTABLISHED BACKGROUND VALUES AND COMPUTATIONS FOR HWMU-16

APPENDIX D-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:	$-\infty$

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

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.

See last page of this report for definitions.

APPENDIX E

LABORATORY ANALYTICAL RESULTS – YEAR 2011
(CD-ROM)

APPENDIX F

FIELD NOTES
(CD-ROM)

APPENDIX G

CORRESPONDENCE
(CD-ROM)