SITE CHARACTERIZATION TECHNICAL MEMORANDUM

CHEMTRONICS SITE SWANNANOA, BUNCOMBE COUNTY, NORTH CAROLINA

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LIST OF ACRONYMS

1,2-DCA	1,2-Dichloroethane
BP	Bear Pit
BVL	Back Valley discharge line
BZ	3-Quinuclidinyl benzilate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPCs	Chemicals of Potential Concern
CS	ortho-Chlorobenzylidene malononitrile
CSM	Conceptual Site Model
DA	Disposal Area
DAF	Dilution-Attenuation Factor
DENR	North Carolina Department of Environment and Natural Resources
EDDs	Electronic Data Deliverables
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESVs	Ecotoxicity Screening Values
FSAP	Field Sampling and Analysis Plan
ft bgs	feet below ground surface
HGA	Hydrogeologic Areas
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQs	Hazard Quotients
IDW	Investigation-Derived Waste
µg/l	micrograms per liter
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polynuclear Aromatic Hydrocarbons
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SLERA	Screening Level Ecological Risk Assessment
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile Organic Compounds
TRA	Trajectory Area
VOCs	Volatile Organic Compounds

1.0 Introduction and Objectives

This technical memorandum summarizes field activities and preliminary data evaluation conducted as part of a Site-wide Remedial Investigation/Feasibility Study (RI/FS) at the Chemtronics Site (Site) in Swannanoa, North Carolina (Figures 1-1 and 1-2) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The RI/FS is required by an Administrative Settlement Agreement and Order on Consent which was entered into by United States Environmental Protection Agency (EPA) and Chemtronics, Inc., Northrop Grumman Systems Corporation (Northrop), and CNA Holdings, Inc. (CNA) (together, the Respondents) on October 24, 2008. The investigation and evaluation activities described in this memorandum were conducted in accordance with an RI/FS Work Plan (Work Plan) which was approved by the USEPA on November 13, 2009.

This memorandum provides a summary of the initial (Phase I) field sample collection methods, laboratory analytical methods and results, and preliminary human health and ecological risk assessments, which were conducted in support of the identification of additional data collection needs to support the RI. It also summarizes the data gaps that have been identified and presents recommendations for Phase II investigation activities to address these data gaps. A comprehensive discussion of the Site characterization will be included in an RI report, which will be prepared at the conclusion of Site characterization activities.

The objectives of this memorandum are to:

- Summarize Phase I sample collection activities by media:
  - Soil
  - Groundwater
  - Surface water
  - Sediment
- Summarize the laboratory analytical results
- Describe any deviations from the approved Work Plan
- Summarize the preliminary human health and ecological risk assessment results
- Summarize identified data gaps
- Provide an updated understanding of the Site hydrogeological characteristics
- Provide recommendations for additional (Phase II) characterization activities

This Technical Memorandum was originally provided to EPA and the North Carolina Department of Environment and Natural Resources (DENR) on August 27, 2010. EPA and DENR provided comments on the Technical Memorandum in correspondence dated September 20, 2010. The respondents provided a response to each of these comments on November 3, 2010. On November 17, 2010, the EPA provided e-mail confirmation that all comments were addressed and the responses accepted. This revised version of the Technical Memorandum incorporates the agency comments and responses where appropriate.

The Respondents and their consultants met with EPA and DENR on December 8, 2010 to review the preliminary human health and ecological risk assessment methods that were used to support evaluation of the Phase I data and scoping the Phase II work plan. EPA and DENR informed Altamont via e-mail on February 8, 2011 that the methods and assumptions used in the "mini human health risk assessment" process and in the screening level ecological risk assessment (SLERA) presented in the Technical Memorandum are acceptable.

2.0 Summary of Phase I Soil Investigation and Evaluation Activities

This section describes the soil sample collection and analyses methods, identifies any deviations from the sample collection or analyses methods in the approved RI/FS Work Plan (Work Plan), and describes the methodology and results of the preliminary human health risk assessment (HHRA), evaluation of the soil leaching potential, and the SLERA. In addition, this section identifies data gaps, and presents recommendations for Phase II soil assessment activities.

2.1 Soil Sampling Methods

Soil sampling was conducted at 45 specific areas defined in Section 4.0 and Appendix A of the Work Plan, Volume 2—Field Sampling and Analysis Plan (FSAP) as shown on Drawing 1. Soil samples were collected using the methods described in Section 4.2 of the FSAP.

Borings were drilled to first-encountered groundwater and samples were collected at select intervals as described in Section 4.1.1 of the FSAP. Occasionally it was necessary to offset a sampling location due to surface or subsurface obstructions. In these instances, a boring or surface sample was moved a distance of up to five feet horizontally from the original sampling location. For consistency, offsets were made to the west of the original location, whenever feasible. A given sampling location was offset a maximum of three times. In some instances, a sampling point was moved more than five feet from its original location to better meet the objective of the sample outlined in the FSAP. Field personnel recorded the offset locations on field sampling data sheets and in field notebooks.

Deviations from the soil sampling procedures or locations detailed in the FSAP were made under the following circumstances:

- A boring location could not be accessed by the rig and was therefore installed using a hand auger.
- A sampling location was added based on field observations.
- A sample was added due to observations while sampling (e.g., high organic vapor analyzer reading).
- An original location was moved based on observations while sampling.
- An original location was moved due to refusal.
- A separate subsurface sample was not collected from above the capillary fringe due to shallow groundwater.
- A subsurface sample was not collected from above the capillary fringe because groundwater was not encountered while installing the boring.
- A subsurface sample was not taken due to drilling refusal caused by the strength of the natural materials.
- A sample location was moved because field inspection revealed it had not been properly located in the Work Plan.

Laboratory analytical results of soil samples by area are presented in Appendix A. Figures located in Appendix B depict the area-specific soil sampling locations. In the event that a sampling location

deviated from the locations specified in the FSAP, as described above, the figure depicts both the proposed location and the actual location at which a sample was collected. A table included on the area figure provides the rationale for any deviations from the original sampling locations.

During field reconnaissance of a known on-Site debris area identified as area "DUMP" in the work plan, Altamont located a new debris area south of DA 7/8 and DA 9. This area has subsequently been relabeled as Debris Area 2. To investigate this area, three test pits were installed to a total depth of six feet using an excavator. In each test pit, samples were collected directly from the excavator bucket at depths of one foot and six feet. The collected samples were submitted to the laboratory for the analyses specified for that area in the FSAP.

Following sample collection, Altamont personnel marked all sampling locations at each area, including offsets, with steel reinforcing bar (rebar) painted with fluorescent marking paint. Exceptions were the Target Area and the trajectory areas (TRA1, TRA2, and TRA3). In these locations, wood stakes were driven at each composite aliquot location. Field maps and figures were updated to accurately depict the locations where soil samples were collected and the X and Y coordinates of each soil sampling location were derived using a GIS application.

2.2 Soil Analytical Methods

Collected samples were shipped overnight to Lancaster Laboratories Inc. (laboratory) located in Lancaster, Pennsylvania, where they were analyzed for the COPCs specified in the FSAP. The analytical methods utilized by the laboratory are identified on Table 2-1 and are consistent with the methods specified in Table A.4 of the RI/FS Work Plan (Work Plan), Volume 3—Quality Assurance Project Plan (QAPP). The specific analyses selected for each sample are indicated on the table for each area included on the figures in Appendix B.

A technical review of the analytical data was performed by the laboratory as specified in Section D2.1 of the QAPP. Upon completion of the technical review, analytical data were transmitted as electronic data deliverables (EDDs) to Conestoga-Rovers & Associates (data validator) located in Niagara Falls, NY for further validation/verification using the criteria specified in Section D2.2 of the QAPP. Tables of the analytical data for each area were prepared using the validated data and are included in Appendix A.

2.3 Quantitative Review of Soil Data

Each area was evaluated to determine whether further data collection is necessary to adequately characterize the Site conditions and support the baseline risk assessment. The evaluation consisted of both a quantitative and a qualitative data assessment. The quantitative data assessment is discussed in this section, and the qualitative data assessment is discussed in Section 2.4. The quantitative assessment included a preliminary human health risk assessment which was conducted consistent with the methodology described in Volume 1, Section 9.5.4.1 of the RI/FS Work Plan, and a screening-level ecological risk assessment (SLERA) which was conducted consistent with the methodology described in Volume 4 of the RI/FS Work Plan (i.e., the Ecological Risk Assessment [ERA] Work Plan).

The preliminary human health risk assessment for soil used the highest contaminant concentrations detected in each soil sampling area to calculate upper-bound cumulative cancer and noncancer risk estimates for the key receptors and exposure scenarios identified in the preliminary conceptual site model (CSM) for potential human exposure (Table 2 of the RI/FS Work Plan, Volume 1). The risk calculations were performed using the exposure factors in Volume 1, Appendix F of the RI/FS Work

Plan and toxicity values that were compiled in accordance with OSWER Directive 9258.7-53 (which are presented in Appendix H of this Technical Memorandum).

The SLERA, which includes Steps 1 and 2 of USEPA's eight-step ecological risk assessment process, was conducted to determine if there is a high probability of no ecologically significant risk or if there is a need to conduct further evaluation in Step 3a. Step 1 (screening-level problem formulation) was provided in its entirety in the ERA Work Plan, and is not duplicated here. Step 2 comprises the screening-level ecological effects assessment and risk calculations. Maximum detected concentrations from each exposure area were used as the screening-level exposure estimates. These concentrations were divided by ecotoxicity screening values (ESVs) to calculate hazard quotients (HQs), as described in the ERA Work Plan. HQs less than 1 (to one significant digit) indicate that adverse impacts to wildlife are considered unlikely. Exposure units with HQs greater than 1 will be carried to Step 3a, where the assumptions responsible for these HQs will be further evaluated. Chemicals that, at this point in the process, lack a reliable and appropriate ESV and detected bioaccumulative chemicals also will be carried to Step 3a.

The results of the human health and ecological quantitative assessment for soil are discussed in the following subsections.

Similar quantitative data assessments were also conducted for groundwater, surface water, and sediment. The results of these assessments are discussed in Sections 3, 4, and 5.

2.3.1 Preliminary Human Health Risk Assessment for Soil

Table 2-2 summarizes the upper-bound cumulative cancer risk and noncancer hazard index (HI) estimates for each of the 45 areas sampled and each of the four key exposure scenarios evaluated. Cumulative cancer risk and noncancer HI estimates that exceed 10^{-4} or 1, respectively, are highlighted in bold with gray background. As shown on Table 2-2, five of the areas investigated have cumulative cancer risk and/or HI estimates that exceed the acceptable risk limits (when expressed with one significant digit in accordance with USEPA risk assessment guidance).

Table 2-3 summarizes the individual chemical concentrations at the five areas that contribute a chemical-specific cancer risk and/or noncancer hazard quotient (HQ) that is at least 10% of the acceptable limits for cumulative cancer risk and HI for at least one of the four exposure scenarios evaluated. The sample locations and sample depths at which these chemical concentrations were found are also presented on this table. Finally, the chemical-specific risk and HQ estimates that exceed 10^{-4} or 1, respectively, are highlighted in bold with gray background.

Appendix H provides information that supports Tables 2-2 and 2-3. The supporting information includes a table (Table H.6) that shows all the chemical-specific cancer risk and HQ estimates that were used in calculating the cumulative cancer and noncancer risk estimates on Tables 2-2 and 2-3. This table also includes the chemical-specific concentrations that were used in the risk calculations for each of the 45 areas, as well as the sample locations and depths of these concentrations. Appendix H also includes tables that show the toxicity values, physical-chemical parameters, and other assumptions that were used in calculating the chemical-specific cancer risk and HQ estimates on Table 2-2.

2.3.2 Screening Level Ecological Risk Assessment for Soil

The results of the Step 2 exposure assessment and risk calculations for soil are summarized on Table 2-4. A compilation of information supporting the SLERA soil risk calculations is provided in Appendix I,

which includes a detailed summary of the soil ESVs (Table I-1) calculation of maximum media-specific HQs on a location-by-location basis for each chemical of potential concern (Table I-2). Table 2-4 shows that many chemicals have HQs that exceed the USEPA threshold value of 1 at all of the investigation areas, and therefore, all of the investigation areas will be carried forward into Step 3a for one or more chemicals of potential concern. Chemicals that do not have soil ESVs are identified in Appendix I. These chemicals will also be carried forward into Step 3a of the ERA. Detected chemicals listed as bioaccumulative in Table 4-1 of the ERA Work Plan will also be carried forward into Step 3a of the ERA. Finally, as stated in the ERA Work Plan, chemicals with HQs equal to a value of 1 will also be carried forward into Step 3a (Appendix Table I-2).

The SLERA is designed to provide estimates of the potential risks that may exist for wildlife and accounts for uncertainty in a conservative (i.e., precautionary) manner. The majority of uncertainties in the SLERA lead to the overestimation of risk. The primary example of how the risk is overestimated is the use of maximum exposure assumptions and minimum ESVs. Also, the Phase I sampling design intentionally focused on locations within each area that would likely have the highest concentrations of chemicals, if present. Also, some uncertainties represent the lack of knowledge, such as the lack of ESVs for some chemicals. There are many other chemicals identified in Table 2-4 with HQs that exceed the USEPA threshold value of 1, but only very focused additional sampling is believed to be warranted to fill data gaps, as is discussed further in Section 2.6 (APDA 7-8-9 and Debris Area 1). For many chemicals with HQs greater than 1, most of these HQs are believed to reflect naturally occurring metal background concentrations based on a preliminary comparison of the soil metals data to the site-specific soil background data collected prior to the RI and mean background levels in the literature (same as those in the soil leaching to groundwater discussion in Section 2.5 for metals that lack site-specific background data). Although Step 2 of the SLERA did not account for soil background concentrations in the calculation of HQs, the Step 3a refinement of exposure assumptions will account for background concentrations for naturally occurring metals using the existing site-specific background data and additional site-specific soil background data that will be collected during the next phase of the RI (as discussed in Section 2.7). Other chemicals with elevated HQs are organics that are well delineated within the investigation areas (e.g., polynuclear aromatic hydrocarbons [PAHs] and pesticides), and all of these values reflect the worst-case ecological conditions that might be expected due to the biased sampling program implemented in Phase I. In accordance with the ERA Work Plan, Step 3a-refined exposure assumptions and potential food web evaluations are needed to identify whether potential unacceptable risks might be related to these chemicals and what data gaps (if any) may need to be filled to complete the risk assessment process.

2.4 Qualitative Review of Soils Data

In addition to the foregoing quantitative data assessment, a qualitative assessment of the soil data was performed using the criteria described in Section 9.5.4.2 of the Work Plan. The qualitative evaluation was designed to identify circumstances in which even the conservative use of the data in the quantitative preliminary HHRA or SLERA could potentially underestimate the risks to an extent that would affect the reliability of the determination regarding the need for remedial action. The results of the quantitative and qualitative assessments are summarized on Table 2-5 and areas which require further soil assessment are identified. In summary, the qualitative evaluation identified 11 areas that were considered for further assessment based on the qualitative criteria identified in Table 2-5. Five of these 11 areas also were identified by the quantitative evaluation (i.e., HHRA and/or SLERA) as warranting further assessment. Further review of the remaining six areas (i.e., those not identified by the HRRA

and SLERA as warranting further assessment) resulted in retaining one additional area (Area B109137) for Phase II soil assessment.

2.5 Evaluation of Soil-to-Groundwater Pathway

As described in Section 9.6 of the RI/FS Work Plan, the potential for surface and subsurface soil to leach unacceptable contaminant concentrations was initially assessed by comparing soil data to generic soil screening levels that were calculated using the methodology described in USEPA's Soil Screening Guidance (Equation 10). However, the current North Carolina 2L groundwater standards (including interim maximum allowable concentrations, or IMACs) were used as the acceptable groundwater concentrations. For chemicals that do not have a 2L standard, the acceptable groundwater concentration was determined from the following hierarchy, which is consistent with the Soil Screening Guidance:

- Nonzero Maximum Contaminant Level Goal (MCLG)
- Maximum Contaminant Level (MCL)
- Health-based limits (HBLs), calculated using the formulas specified under the 2L regulations at 15 NCAC 02L.0202(d)(I) and (2)

These initial soil screening levels were conservatively calculated using a dilution-attenuation factor (DAF) of 1 and the assumption of infinite contaminant mass, as specified in Section 9.6 of the RI/FS Work Plan. A comparison of the RI soil data to these screening levels identified a large number of soil concentrations that exceed these initial screening levels. These initial comparison results showed that many of the exceedances were for hydrophobic chemicals that have never been detected in groundwater (e.g., high molecular weight PAHs such as benzo(a)pyrene), or were for metal concentrations that are within typical background levels in soil (some of the initial leaching criteria are more than an order of magnitude lower than typical soil background levels). The initial exceedances were so widespread that it was difficult to discern a correlation between exceedances and potential sources of groundwater contamination.

To make the screening results usable in an efficient way, the screening evaluation was repeated with the following additional considerations, which are based on some of the considerations discussed in Section 9.6 of the RI/FS Work Plan:

- Chemicals never detected in the 2007, 2008, and 2010 groundwater monitoring data were excluded from the evaluation.
- Concentrations not in the deepest sample in a particular soil boring were excluded.
- Soil concentrations that would not fail a theoretical worst-case soil-leaching test, such as the SPLP, were excluded (i.e., if the leachate concentration would not exceed the acceptable groundwater concentration even if all soil contaminant mass is assumed to extract into the extraction fluid in the SPLP test).
- Soil metal concentrations that are within soil background levels were excluded. Site-specific soil background levels were used where available, and for metals that currently lack site-specific background data, mean values from the literature (*Elements in North American Soils*, Dragun and Chiasson, 2nd Edition, 2005) were conservatively used on an interim basis (until site-specific background data are collected in the next phase of the RI) for assessing the degree to which the metals exceedances would likely be addressed by considering background.

Table H.8 in Appendix H provides the basis of the soil-to-groundwater screening criteria, including the compilation and derivation of the acceptable groundwater concentrations, and the soil background levels that were used (including the site-specific levels, the mean values from the literature for metals without site-specific background levels, and the literature source that was used).

Table H.9 presents the soil concentrations that exceed the soil-to-groundwater screening criteria after accounting for the above additional considerations. As shown on Table H.9, there are approximately 700 area/chemical pairs, at 43 of the sampled areas that exceed the soil-to-groundwater screening levels. The consideration of background levels was responsible for the largest part of the reduction in the number of exceedances. However, approximately 600 of the remaining exceedances are still for metals, and most of them are for metals that lack site-specific soil background data (potentially due to the conservative use of mean values, rather than upper percentile values, from the literature as interim background levels). These results indicate that the consideration of background levels for metals is important in the evaluation of soil leaching, and that supplemental metals background data should be collected before reaching conclusions on the need for further investigation of metals in soil as a source of groundwater contamination. It should also be noted that the existing groundwater monitoring data indicate that the metals in groundwater appear to be unrelated to the former site activities, as discussed in Section 4.2.1 and Appendix E of the RI/FS Work Plan.

Apart from the metals exceedances, Table H.9 shows 82 exceedances for non-metals which are comprised of several VOCs, SVOCs, pesticides, nitroaromatics, and perchlorate at 23 of the 45 areas sampled during the RI. The boring and sample IDs of these exceedances, which are also shown in Table H.9, were then reviewed to assess the potential for these areas to be sources of groundwater contamination. The review was conducted by evaluating groundwater, surface water, and sediment data as appropriate in the vicinity of each area. Each chemical of potential concern (COPC) identified on Table H.9 was evaluated considering the location where it was detected in soil, the depth (i.e., surface soil sample or deeper soil sample), availability and results of nearby groundwater, surface water and sediment data. Based on this review, several COPCs were not carried forward for further evaluation of the soil-to-groundwater leaching pathway, as identified below:

- *CS*: CS has been detected only once in groundwater (P7-D) in 2007, and was not detected in 2008. This well is downgradient of the Acid Pits which is one of the areas that had an exceedance of the soil-to-groundwater leaching criteria for CS. CS has not been detected in wells near other areas where soil values indicate soil-to-groundwater leaching criteria have been exceeded. Therefore, an evaluation of this pathway for CS will not be carried forward as a Phase II activity.
- *Pesticides*: Pesticide data from groundwater and surface water/sediment samples from the Site indicate that several, but varied, pesticides are present in all media. There is no apparent correlation between presence in soil and presence in groundwater, surface water, or sediment. Therefore, an evaluation of this pathway for pesticides will not be carried forward as a Phase II activity.
- *BZ*: BZ has been detected only once in groundwater (P5-D) in 2008. This well is downgradient of the Acid Pits which is not the area that had an exceedance of the soil-to-groundwater leaching criteria for BZ. Therefore, an evaluation of this pathway for BZ will not be carried forward as a Phase II activity.

- *Aniline*: Aniline has been detected only twice in groundwater (IW-2 and M85L-5) in 2007, and was not detected in 2008. These wells are located downgradient of the Acid Pits which is not the area that had an exceedance of the soil-to-groundwater leaching criteria for aniline. Therefore, an evaluation of this pathway for aniline will not be carried forward as a Phase II activity.
- *Phenol*: Phenol is found in groundwater in the Back Valley (BV) in proximity to the Acid Pits. However, with the exception of two detections in the Front Valley (FV) (MW 175-Q40F and BW-5) in 2007, neither of which was repeated in 2008, phenol is not found in groundwater in the Front Valley. Therefore, phenol is carried forward for further consideration of the soil-to-groundwater leaching pathway in the BV but further evaluation of this pathway for phenol in the FV is not recommended as a Phase II activity.
- Benzene, 1,3-dinitrobenzene, and 2,4,6-trinitrotoluene were found to be co-located with other groundwater COPCs that are already being considered in the Phase II assessment activities. Consequently no additional specific assessment activities are recommended for these COPCs.

This evaluation identified two areas (BP and Debris Area 1) that will require further soil sampling as described in Section 2.6.1 to assess the soil-to-groundwater pathway. Both exceedances in these areas were in shallow soil samples. No deeper soil samples were collected at these sample locations. Therefore, to further assess the soil to groundwater leaching potential, deeper soil samples will be collected and compared to the relevant soil leaching criteria. Three areas, B107, B119120, and B142, will require further assessment of groundwater because the exceedances were from deeper samples and there are no groundwater monitoring wells within a reasonable distance of the borings. These areas will be further assessed by installing groundwater monitoring wells downgradient of the areas identified as having soil concentrations of COPCs that may result in concentrations in underlying groundwater above the relevant criteria. As discussed in Section 9.6 of Volume 1 of the Work Plan, if groundwater samples from these wells indicate no groundwater impacts from the target COPCs, no further evaluation of this pathway will be conducted.

The remaining areas and/or COPCs identified in Table H.9 have either already been eliminated from further soil-to-groundwater pathway consideration due to adequate groundwater data or have been considered in the Phase II groundwater assessment activities discussed in Section 3.6.

2.6 Recommendations for Phase II Soil Sampling Activities

2.6.1 Area Specific Phase II Activities

The quantitative and qualitative evaluation of the data identified seven areas where further soil sampling is needed to support the baseline risk assessment and/or assist with defining a specific area of impacted soil. At three of the areas, additional soils investigation will be conducted using exploratory excavation. Since this method of investigation was not specifically addressed in the Work Plan, the proposed investigation procedures are described below:

a) Exploratory excavations will be conducted using a decontaminated wheel or track mounted back hoe.
b) During excavation, soil from the back hoe bucket will be field screened with a portable organic vapor analyzer (OVA) equipped with a photo-ionization detector (PID). The OVA will be calibrated daily in accordance with Volume 3, Section B7.1 of the Work Plan and the manufacturer's specifications.

Samples will be placed in a plastic bag, sealed and allowed to sit for a minimum of ten minutes. The probe of the OVA will be inserted into the bag to obtain a reading of the total organic vapors.

c) The excavation will continue until the tank or structure is sufficiently exposed for inspection and/or removal or the area is inspected sufficiently to meet the investigation objectives. Over-excavation is not anticipated. If unsafe conditions are encountered the excavation will be terminated.

d) To confirm the concentration of the target analytes at the limits of the excavation, soil samples will be collected from the bottom and each side wall using the procedures described in Section 7 of EPA standard operating procedure SESDPROC-300-R1. In the tank excavation, samples will be collected consistent with DENR guidance.

e) The excavated soils from each area will be stockpiled separately on plastic sheeting and each stockpile will be covered with plastic sheeting. Each stockpile will be sampled to determine the proper method for disposal. Material handling and disposal will be completed in accordance with Volume 2, Section 4.5 of the Work Plan. Sampling for disposal characterization will be completed at a frequency of one composite sample per 25 cubic yards of material, consistent with DENR guidance. Analytes will be selected based on the results of the Phase I and II soil characterization for the specific area, and the requirements of the disposal facility. In the event the excavated soil is determined to have no target constituents above the NCDENR hazardous waste section (HWS) levels for unrestricted use, found in Attachment 1, NCDENR HWS *"Contained in Policy" for Soil Contaminated with Listed Hazardous Waste*, the soil may be spread in the vicinity of the excavation. If target constituents are detected at concentrations greater than those listed in Attachment 1, the excavated materials will be disposed of at the Republic Services Inc. landfill in Union County South Carolina. This facility has been determined to be acceptable to EPA in accordance with the Off-Site Rule (40 CFR 300.440(a)(4)). If the material is determined to contain Site COPCs at concentrations which would be classified as hazardous, an appropriate disposal facility will be identified and approval from EPA will be obtained prior to shipment.

f) Each excavation will be fenced until backfilled. Backfill material will be obtained from the on-Site borrow area located north of Building 134, which is believed to not have been affected by former site activities.

g) Prior to using material from the borrow area for backfill, representative samples will be collected and analyzed to confirm that the material does not contain Site COPCs (VOCs, SVOCs, nitroaromatics and perchlorate) above the NCDENR hazardous waste section (HWS) levels for unrestricted use, found in Attachment 1, NCDENR HWS *"Contained in Policy" for Soil Contaminated with Listed Hazardous Waste.*

h) Composite sampling techniques will be utilized with the specific number of samples determined by the volume of fill material needed, but at a minimum of one per 25 cubic yards of fill material.

The sequence of activities associated with these excavations will be:

- Sampling/analysis at the borrow area to confirm backfill material is suitable for unrestricted use;
- conducting the investigatory excavation and/or tank removal;
- stockpiling the excavated soil;
- obtaining limit of excavation confirmatory samples;
- backfilling the excavation with fill from the borrow area;

- characterizing the excavated soil for disposal; and
- managing the disposal of or on-Site placement of the excavated soil.

The specific Phase II RI activities proposed for these seven areas are described below:

B109-137

Although no sample from this area exceeded HHRA criteria, a subsurface structure which may be a fuel oil tank was identified in the vicinity of boring B4. The recommended Phase II activity associated with this area is to inspect the subsurface structure, including opening any fill caps or vents and measuring the dimensions of the structure and assessing its contents. If it is determined that the structure is some type of storage vessel or tank, a sample will be collected of any contents and inspected. A sample of the tank contents may also be submitted for laboratory analysis if warranted. In the event a subsurface tank or storage vessel is identified, the vessel will be cleaned and removed in accordance with NCDENR guidance found in *Guidelines for Site Checks, Tank Closure and Initial Response and Abatement for UST Releases.* If a vessel is removed, the subsequent steps will include excavation of any identifiably contaminated soil. During excavation, the soils will be screened using a portable organic vapor analyzer. The lateral and vertical extent of the excavation will be determined by the conditions encountered. Soil samples will be collected from the boundaries of the excavation in accordance with the referenced guidelines. Excavated soil will be staged on plastic sheeting (minimum 6 mil thickness), sampled and analyzed in preparation for disposal, covered, and managed as investigation derived waste (IDW) in accordance with the procedures in Section 4.5 of Volume 2 of the Work Plan. Samples will be analyzed for VOCs and SVOCs using the approved laboratory methods. Other analyses, if indicated by the tank contents evaluation, will be selected using the NCDENR guidance and consultation with EPA. The location of boring B4 and the approximate area of potential excavation is shown on Figure 2-1.

B116-128

This area had one sample from boring B2 at a depth of seven to eight feet bgs with a concentration of several VOCs that exceeded the HHRA criteria for one or more of the receptors evaluated (Table 2-2). This sample was collected from an interval where metal shards are noted in the boring and some type of subsurface structure is suspected. The recommended Phase II evaluation is to excavate the area around boring B2 to determine the presence and character of the suspected subsurface structure. The location of boring B2 and the approximate area of excavation is shown on Figure 2-2. During excavation, the soils will be screened using a portable organic vapor analyzer. The lateral and vertical extent of the excavation will be determined by the conditions encountered. Soil samples will be collected from the excavated material and the boundaries of the excavation. Samples will be analyzed for VOCs using the approved laboratory method. Additionally, due to the presence of two nitroaromatic compounds at concentrations that are within one order of magnitude below the relevant HHRA criteria (Table 2-3) nitroaromatics will also be analyzed in these samples. Excavated soil will be staged on plastic sheeting (minimum 6 mil thickness), sampled for disposal, covered, and managed as investigation derived waste (IDW) in accordance with the procedures in Section 4.5 of Volume 2 of the Work Plan.

B122

This area had one sample from boring B4 at a depth of seven to eight feet bgs with concentrations of two VOCs, benzyl chloride, and 1,3,5-trimethylbenzene, which exceeded the HHRA vapor pathway criteria for industrial workers. Field observations (i.e., organic vapor analyzer readings and/or visual and olfactory evidence) indicate that contamination begins at a depth of approximately seven feet and may extend several feet deeper than the deepest soil sample at boring B4. The recommended Phase II evaluation will consist of an exploratory excavation in the vicinity of boring B4 to define the areal and vertical extent of impacted soil. The location of boring B4 and the approximate area of excavation is shown on Figure 2-3. In order to characterize the extent of the impacted soil identified in boring B4, the depth of the excavation will extend to a depth at which field evidence of contamination is no longer evident. During excavation, the soils will be screened using a portable organic vapor analyzer. The lateral and vertical extent of the excavation will be determined by the conditions encountered. Soil samples will be collected from the excavated material and the boundaries of the excavation. Samples will be analyzed for VOCs including the target compounds, 1,3,5-trimethylbenzene and benzyl chloride, using the approved laboratory method. Excavated soil will be staged on plastic sheeting (minimum 6 mil thickness), sampled for disposal, covered, and managed as investigation derived waste (IDW) in accordance with the procedures in Section 4.5 of Volume 2 of the Work Plan.

AP-DA7-8-9

This area had one sample from boring B2 at a depth of seven feet bgs with a concentration of one VOC, cyclohexane that exceeded the HHRA vapor pathway criteria for industrial workers. The recommended Phase II evaluation will consist of drilling three additional soil borings in the vicinity of B2. The location of these borings is shown on Figure 2-4. The objective of these borings is to define the lateral and vertical extent of cyclohexane in soil above the HHRA criteria. Borings will be advanced to the capillary zone (approximately eight feet to ten feet bgs). During drilling, field screening of sample intervals using an organic vapor analyzer will be conducted. Samples will be collected for laboratory analyses from the two-foot to three-foot, six-foot to seven-foot, and above the capillary zone intervals in each boring. Additional samples may be selected for laboratory analyses based on the field screening results or other field observations. In the event that field evidence indicates additional borings may be necessary to define the extent of impacted soil, additional borings may be field-selected. Each sample selected will be submitted for analysis for VOCs including the target compound cyclohexane. Additional surface soil delineation for aldrin in the vicinity of B2 is needed to address potential ecological risks because this single, relatively high detection of aldrin is unbounded on the southeast. Two additional surface soil samples are proposed, one between B2 and B3 and another approximately 50 feet south of B2 (Figure 2-4).

Bear Pit

Soil concentrations of phenol, 2,4,6- trinitrotoluene, CS, and RDX were identified in two sample locations (S1 and S2) that could result in exceedances of relevant criteria in the underlying groundwater. In order to further evaluate this potential pathway, a soil boring will be drilled at each of these locations (Figure 2-5) and soil samples will be collected at depths of 3 feet and 5 feet bgs and just above the capillary fringe (estimated at 10 feet bgs). Each sample will be submitted for analysis of phenol, 2,4,6-trinitrotoluene and RDX. In the event that the sample analytical results indicate the potential for soil

leaching to groundwater, a single monitoring well will be installed immediately downgradient of the affected sample location(s). A groundwater sample will be collected from the monitoring well and submitted to the laboratory for analysis of the chemical(s) resulting in the potential for a soil-leaching-to-groundwater pathway.

DA23

The sample collected from boring B3 at a depth of three feet bgs had a concentration of one VOC, 1,2-dichloroethane, that exceeded the HHRA vapor pathway criteria for industrial workers. The recommended Phase II evaluation will consist of drilling two additional soil borings in the vicinity of B3. The location of these borings is shown on Figure 2-6. The objective of these borings is to define the lateral and vertical extent of 1,2-dichloroethane in soil above the HHRA criteria. Borings will be advanced to the capillary zone (approximately four feet to six feet bgs). During drilling, field screening of sample intervals using an organic vapor analyzer will be conducted. Samples for laboratory analyses will be collected from the zero-foot to one-foot, two-foot to three-foot, and above the capillary zone intervals in each boring. Additional samples may be selected for laboratory analyses based on the field screening results or other field observations. In the event that field evidence indicates additional borings may be necessary to define the extent of impacted soil, additional borings may be field-selected. Each sample will be submitted for analyses for VOCs including the target compound, 1,2-dichloroethane.

Debris Area 1

The surface sample located at S3 contained a nitroaromatic compound (RDX) at a concentration above the HHRA criteria for exposure by industrial workers or recreators/trespassers. The RDX concentration was also elevated in comparison to ecological soil screening values. This sample was collected in an area where, due to the presence of debris such as drums and rocket parts, the presence of explosives manufacturing and testing debris is suspected. In addition, the sample contained concentrations of HMX and RDX that could result in concentrations in underlying groundwater above the relevant criteria. The recommended Phase II evaluation is to conduct an additional soil sampling event to define the areal extent of the explosives residue. Surface and near-surface (two to three feet bgs) samples will be collected on a 50-foot grid laid out to cover the area where debris is present on the surface. The approximate area included for sampling is shown on Figure 2-7. Each sample will be submitted for analysis of HMX and RDX. In the event that the subsurface sample analytical results indicate the potential for soil leaching to groundwater, a single monitoring well will be installed immediately downgradient of the affected sample location(s). A groundwater sample will be collected from the monitoring well and submitted to the laboratory for analysis of the chemical(s) resulting in the potential for a soil-leaching-to-groundwater pathway.

2.7 Background Soil Metals Evaluation

Some metals have been identified in soil throughout the Site at concentrations that could potentially contribute to ecological risk. In order to adequately characterize the Site risks, the naturally occurring regional background concentration of these metals needs to be established.

In order to determine the range of naturally occurring concentrations for metals to be used as a background population, samples need to be collected from areas that represent the range of soil and underlying rock types present at the Site. Samples will be collected in on-Site areas that have not been

impacted by Site activities or other identified anthropogenic sources of metals. The locations of the background soil samples are shown on Figure 2-8. The criteria used to select each sample location are given on Table 2-6. At each of the locations, four discrete samples will be obtained from the 0-12 inch interval at locations selected within ten feet of the identified location. These four samples will then be composited into one sample for analyses. Samples will be collected using the procedures described in Section 4.2 of the FSAP and will be analyzed for the metals identified in Section 4.3 of the FSAP.

2.8 Additional Soil pH Sampling

One soil sample per area was analyzed for pH during Phase I sampling. These soil pH data were used in conjunction with the soil aluminum data to interpret HQs calculated in the SLERA. According to USEPA (Ecological Soil Screening Levels for Aluminum, OSWER Directive 9285.7-60, November, 2003), aluminum in soil is not bioavailable at pH levels greater than 5.5. Although pH levels less than 5.5 alone do not indicate a risk associated with aluminum, these lower measures warrant further evaluation to determine if conditions may indicate aluminum bioavailability. Specifically, as pH decreases, aluminum can become more toxic to plants. However, a broad range of plants can inhabit soils at pH levels less than 5.5, so consideration of the site-specific vegetative condition is appropriate to understand actual toxicity and risk at a particular area of the Site. The following areas have a soil pH measurement that is lower than 5.5 and HQs greater than 1 for aluminum: Building 116/128, Building 117, Building 155, Debris Area 1, Process Sewer Overflow, Target Area, and Trajectory Paths 1 through 3. Additional soil pH data will be collected in each of these areas to supplement the existing soil pH measurement and provide additional bases for interpreting the HQs for aluminum.

Approximately four to eight surface soil samples will be collected from each of the areas identified above and sent to the laboratory for pH analysis using the method specified in the Phase I Work Plan. Three samples will be randomly collected from vegetated portions of each investigation area. Up to four additional samples will be collected from portions of each area that show stressed or no vegetation, if present. Stressed vegetation will be characterized as having discolored, stunted, or visually unusual conditions. Areas with no vegetation will only be considered relevant if the reasons for the bare soil are not explained by human use of the area and conditions of the area are such that vegetation would be expected. For example, a previously paved area will not be included, but a bare patch of soil in the midst of other vegetation will be considered. Locations of stressed or no vegetation, if any, will be photo-documented for consideration along with the pH data. In additional, one soil pH sample will be collected near (within approximately 25 feet) the sample location where the maximum aluminum concentration was found for the investigation area during the initial phase of RI soil sampling. This soil pH sample could be targeted at an area of stressed vegetation or absence of vegetation, if any. The sample locations with the maximum aluminum concentrations are identified as follows:

- B116128B4S1
- B117S4S1
- B155S1S1
- DebrisArea1S2S1
- PSOB1S1
- TAS8S1
- TRA1S2S1
- TRA2S1S1
- TRA3S6S1

3.0 Summary of Phase I Groundwater Investigation and Evaluation Activities

This section describes the monitoring well drilling and installation techniques, groundwater sample collection and analyses methods, and identifies any deviations from the sample collection or analyses methods in the approved RI/FS Work Plan (Work Plan). The section also describes the methodology and results of the preliminary human health risk assessment (HHRA). Data gaps are identified and recommendations for Phase II RI activities presented.

3.1 Monitoring Well Installation

Twenty-nine monitoring wells were installed at the Site during the Phase I RI activities in general accordance with the Work Plan. Specifically, sixteen (16) Zone A/B wells, twelve (12) Zone C/D wells, and two (2) Zone E/F wells were installed (see Table 3-1, Figures 3-1 through 3-3, and Appendix C for well construction details and locations).

Deviations from Section 7.2 of the Work Plan are as follows:

- One Zone A/B monitoring well proposed in HGA 2 (MW189-N27A/B) was not installed because the depth to competent bedrock encountered in the adjacent monitoring well (MW196-N27CD) was very shallow; only about 10 feet of saturated saprolite was encountered during the drilling of the Zone C/D monitoring well.
- One Zone A/B well proposed in HGA1 (MW178-H38AB) was not installed because of the presence of an adequate existing Zone A/B monitoring well (MW-147-1), which is located approximately 60 feet away from the proposed location. Information obtained during Phase I activities supported the location of MW-147-1 in meeting the objective(s) of the proposed MW178-H38AB. Therefore, MW178-H38AB was considered redundant and was not installed.
- Section 7.2.2 of the Work Plan noted that three HGA3 monitoring wells (MW194-Q38AB, MW193-Q40AB, and MW194-P41AB) were to be installed approximately five feet into rock. Because of this construction, these three monitoring wells are considered Zone C/D monitoring wells instead of Zone A/B wells and their nomenclature has been adjusted accordingly.
- One monitoring well, MW183-O39CD, was installed in Zone C/D rather than Zone A/B, as noted in Section 7.2.1, because of the presence of a nearby Zone A/B monitoring well (MW-149-1) located less than 50 feet away and the relatively shallow depth of bedrock.

All twenty-nine new monitoring wells were surveyed by North Carolina licensed surveyor, Western North Carolina (WNC) Professional Engineers and Surveyors, Inc. The surveyed well locations are shown on Figures 3-1 through 3-3.

AE Drilling Services LLC of Greenville, South Carolina (North Carolina license numbers 2277 and 3671) was the well-drilling contractor who installed and developed the twenty-nine new monitoring wells. The monitoring wells were constructed to meet the requirements of North Carolina Administrative Code Title 15A subchapter 2C, Well Construction Standards.

Drilling was performed in accordance with the methods described in Section 7.3 of the FSAP. No deviations from the FSAP occurred during the drilling and installation of the Phase I RI monitoring

wells. Similarly, no deviations from Section 7.4 of the FSAP occurred during the development of the Phase I RI monitoring wells.

3.2 Groundwater Sampling

Each of the newly installed monitoring wells was sampled once during the period from February 26, 2010 through March 11, 2010 in accordance with the methodology defined in Section 7.5 of the FSAP. Monitoring well MW208-L26AB, the monitoring well intended to replace the recently abandoned CERCLA monitoring well (SW-8), will not be sampled until the annual CERCLA compliance sampling event in October, 2010. One monitoring well (MW156-P44A) was sampled using a bailer because of a slow recharge rate. This well was purged dry and sampled after a sufficient quantity of water had recharged. Two bedrock wells (MW175-Q40F and MW177-M44F) were sampled using a Grundfos pump because of the depths of the wells (251 ft bgs and 290 ft bgs, respectively). Three volumes of water were purged from these monitoring wells prior to collecting samples.

In addition, nineteen existing monitoring wells near the Site boundary (i.e., “perimeter” wells) were sampled once during the period from February 22, 2010 through March 10, 2010 in accordance with Sections 3.2 and 7.5 of the FSAP. These monitoring wells were sampled to further evaluate groundwater quality at the property boundary.

3.3 Analytical Methods

The twenty-eight new wells, and the nineteen existing perimeter wells, were sampled and analyzed for the laboratory analyses and methods summarized in Table 2-1.

3.4 Groundwater Results

Tables D1 and D2 in Appendix D summarize the analytical data from the newly installed monitoring wells and the perimeter monitoring wells. The groundwater data were evaluated to identify any data gaps with regard to remedial action objectives (RAOs; as described in Section 6.0 of the Work Plan Vol. 1). These data gaps are used in this document to recommend additional monitoring wells for the Phase II RI. The following narrative summarizes the results that provide a basis for the recommended Phase II activities. A more complete discussion of the groundwater analytical results will be provided in the RI Report.

To evaluate the results of the Phase I RI groundwater sampling, the following elements of the data were considered:

- Concentrations of constituents
- Frequency of detections of constituents
- Frequency of exceedances of applicable groundwater quality standards (for example, 2L Standards)

To evaluate plume geometries, the lateral extent of key constituents were mapped on a zone-specific basis (Appendix E) and the hydrogeologic conceptual site model was updated (Appendix F). The constituents were chosen based on two criteria including the constituents that showed the highest concentrations and the most frequently detected constituents. On this basis, the lateral extent with regard to groundwater standards were mapped by zone for four VOCs (1,2-dichloroethane (1,2-DCA),

trichloroethene (TCE), tetrachloroethene (PCE), and chloroform; Figures E1 and E2) and three nitroaromatics (HMX, perchlorate, and RDX; Figures E4 and E5). The criteria used to define the lateral extent for VOCs in Zones A/B and C/D were the applicable North Carolina 2L Standards and the criteria used for the nitroaromatics were those developed as described in Section 9.5.2 and Appendix F of the Work Plan Volume 1. The referenced plume maps include posted data for all monitoring wells for which groundwater data were available since 2007. Where multiple data sets were available, the most recent results were posted. Plume maps for Zones E/F were not prepared because these wells are constructed in fractured bedrock and a plume map may not accurately depict the plume boundaries. For Zones E/F, data are posted for the selected VOCs on Figure E3 and for nitroaromatics on Figure E6.

3.5 Preliminary Human Health Risk Assessment for Groundwater

The preliminary human health risk assessment for groundwater was conducted using the highest contaminant concentrations detected in each monitoring well, during the 2007 and 2008 Site-wide sampling events and the 2010 Phase I RI groundwater sampling event. Table 3-2 summarizes the upper-bound cumulative cancer risk and noncancer HI estimates for each of the 147 monitoring wells. Risk estimates were calculated for industrial worker vapor intrusion, industrial worker drinking water, maintenance worker contact, and construction worker contact. These estimates were calculated for all scenarios and for all monitoring wells even though the vapor intrusion and excavation scenarios are relevant to only shallow groundwater. This was done in order to have all of the risk estimates for each well available in case of any uncertainty about whether a particular well monitors shallow groundwater. Cumulative cancer risk and noncancer HI estimates that exceed 10^{-4} or 1, respectively, are highlighted in bold with gray background. As shown on Table 3-2, no monitoring wells have cumulative cancer risk and/or HI estimates for vapor intrusion that exceed the acceptable risk limits (when expressed with one significant digit in accordance with USEPA risk assessment guidance) and only a few of the 147 wells (near the Acid Pits and DA23) have cumulative cancer risk and/or HI estimates for maintenance and/or construction worker contact that exceed the acceptable risk limits. For industrial worker drinking water, 39 wells have concentrations that would result in unacceptable risks.

Table 3-3 summarizes the individual groundwater chemical concentrations that contributed a chemical-specific cancer risk and/or noncancer HQ that is at least 10% of the acceptable limits for cumulative cancer risk and noncancer HI for maintenance and construction workers' exposure. The sample locations and sample dates at which these chemical concentrations were found are also presented on this table. Finally, the chemical-specific risk and HQ estimates that exceed 10^{-4} or 1, respectively, are highlighted in bold with gray background.

Appendix H provides information that support Tables 3-2 and 3-3. The supporting information includes a table (Table H.7) that shows all the chemical-specific cancer risk and HQ estimates that were used in calculating the cumulative cancer risk and noncancer HI estimates on Tables 3-2 and 3-3. This table also includes the chemical-specific concentrations that were used in the risk calculations for each of the wells, as well as the sample locations and dates of these concentrations. Appendix H also includes tables that show the toxicity values, physical-chemical parameters, and other assumptions that were used in calculating the chemical-specific cancer risk and HQ estimates on Table H.

3.6 Data Gaps and Recommended Phase II Activities

On the basis of the evaluation above, the following paragraphs describe the recommended Phase II groundwater activities (Table 3-4; Figures 3-4 through 3-6r).

B107

Soil concentrations of ethyl benzene, styrene, TCE, phenol, and beta-BHC were identified in one or more soil sample locations at concentrations that could result in concentrations in underlying groundwater above the relevant criteria. In order to evaluate the soil-to-groundwater leaching pathway for VOCs (see Section 2.5 for COPC selection criteria), one monitoring well (MW216-G37AB) will be installed in Zone A/B downgradient of Building 107. Additionally, during drilling of the proposed AB well, the total thickness of overburden will be established. In the event of a significant transition zone i.e. greater than 10 feet below the bottom depth of proposed zone AB well MW216-G37AB, installation of a paired AB and CD well set will be conducted.

Areas B110-111-112 and B113

Groundwater data indicates an apparent source for groundwater contamination of VOCs and nitroaromatics in this area. These areas have also been identified as having concentrations of COPCs in soil that could result in concentrations in underlying groundwater above the relevant criteria (see Section 2.5).

Phase II assessment activities will include the installation of one Zone A/B monitoring well MW213-J33AB) to confirm the upgradient extent of COPCs (VOCs, nitroaromatics, perchlorate) in these areas. Additionally, during drilling of the proposed AB well, the total thickness of overburden will be established. In the event of a significant transition zone i.e. greater than 10 feet below the bottom depth of proposed zone AB well MW213-J33AB, installation of a paired AB and CD well set will be conducted.

B114

Phenol and perchlorate were identified at one soil sample location (B2) at concentrations that could result in concentrations in underlying groundwater above the relevant criteria. In order to evaluate the soil-to-groundwater leaching pathway, one monitoring well (MW214-I35AB) will be installed in Zone A/B downgradient of sample location B2.

B119-120

In order to evaluate the northern extent of COPCs detected in the Front Valley, two monitoring wells (MW211-L37AB and MW220-L37CD) will be installed downgradient of B119120. In addition, these wells will evaluate the RDX contamination identified at two soil sample locations (B2 and B3) at concentrations that could result in concentrations in underlying groundwater above the relevant criteria.

B142

Gamma-BHC and RDX were identified in soil samples (B2 and B3, respectively) at concentrations that could result in concentrations in underlying groundwater above the relevant criteria. In order to evaluate the soil-to-groundwater leaching pathway, one monitoring well (MW215-G36AB) will be installed in Zone A/B downgradient of B142.

B146

VOCs were detected in the Zone A/B monitoring well (MW191-K40AB) located at Area B146. Soil borings were located to assess the contributions from previously identified potential sources of contamination, including a sump at the boring B2 location. However, soil data collected in Area B146 did not identify a source of the VOC contamination found in groundwater in this area. Only one soil sample in Area B146 contained VOCs and this was the deep soil sample in boring B1. This sample, which contained TCE, was collected near the water table, suggesting that the elevated TCE detected in the soil sample may be associated with the groundwater smear zone.

As part of the Phase II assessment activities, one Zone C/D monitoring well (MW217-J40CD) will be installed to evaluate whether the VOCs detected in Area B146 are in Zone C/D and also to evaluate the southwestward lateral extent of perchlorate and RDX in Zone C/D.

B147

Area B147 has been identified as a potential source of VOCs, nitroaromatics, and perchlorate in groundwater in the Front Valley. In addition, TCE, phenol, perchlorate, and gamma-BHC were identified at soil sample locations (B2 and B11) at concentrations that could result in concentrations in underlying groundwater above the relevant criteria. In order to evaluate the contributions to the Front Valley groundwater plumes from Area B147, one Zone A/B monitoring well (MW210-J38AB), and one Zone C/D monitoring well (MW218-J38CD) will be installed downgradient of the area. Additionally, in order to evaluate the lateral extent of the Front Valley groundwater plumes (especially considering a source at Area B147) a Zone A/B monitoring well (MW209-I39AB) will be installed at the location shown on Figure 3-4.

Area B149

The extent of the groundwater impacts in Area B149 and their relationship to either upgradient sources or connectivity with the primary Front Valley plume has not been determined (see Figure 3-5). In order to address these issues, two Zone C/D monitoring wells (MW219-O39CD and MW221-O40CD) will be installed at the locations shown on Figure 3-5.

Front Valley Primary Plume

A data gap exists between Zone C/D wells DW-152-2 and MW147-N42C. In order to further define the leading edge of the Front Valley primary plume, a Zone C/D monitoring well (MW224-N42CD) will be installed at the location shown on Figure 3-5.

VOCs and RDX, believed to be emanating from DA23, have been detected northeast of the Unnamed Branch in grid L41, but there are no monitoring wells on the northeast side of the Unnamed Branch north of this grid. MW-1S, which is located south of DA23, encountered very shallow bedrock. It is possible that there is a contaminant plume from the east side of DA23 that is not being monitored. There are no groundwater data to confirm or refute a groundwater plume migrating southeastward along the northern side of Unnamed Branch. In order to evaluate the potential component of flow to the east from DA23 a Zone A/B monitoring well (MW212-K36AB) will be installed at the location shown on Figure 3-4.

Additionally, in order to evaluate the extent of COPCs in the bedrock groundwater system in the lower Front Valley, a bedrock (Zone E/F) monitoring well (MW222-K46EF) will be installed on the southern property boundary at the location shown on Figure 3-6r. Consistent with Phase I bedrock well installation, the proposed new bedrock well will have packer testing and geophysical logging conducted prior to well construction and this data will be used to select a final screened interval for the well.

DA 9

In order to determine if the TCE detected in the P-7 set of monitoring wells is emanating from DA9, a Zone A/B monitoring well (MW223-L26AB) will be installed downgradient of the southwest corner of DA9, as shown in Figure 3-4.

Back Valley Primary Plume

In order to evaluate the presence or extent of COPCs in the bedrock groundwater system in the southeast portion of the Back Valley, a bedrock (Zone E/F) monitoring well (MW225-T32EF) will be installed on the eastern property boundary at the location shown on Figure 3-6r. The location of the bedrock monitoring well was targeted based on prior bedrock evaluations (fracture trace analysis, outcrop mapping, review of regional geologic information, etc.). Consistent with Phase I bedrock well installation, the proposed new bedrock well will have packer testing and geophysical logging conducted prior to well construction and this data will be used to select a final screened interval for the well.

Hydrologic Characterization of the Bedrock System

In order to further characterize the bedrock groundwater flow system and evaluate the inter-connectivness of the bedrock and non-bedrock hydraulic systems, transducers and data loggers will be installed to collect water level data from select on-Site bedrock and non-bedrock wells and from Bee Tree Creek. The transducers will be used to record water level changes for a period of approximately 30 days. The data obtained will be used to evaluate inter-connectiveness of the aquifer units in which the various wells are completed and the relationships between the bedrock system and the overlying aquifer units. Additionally, water levels from two locations in Bee Tree Creek will be obtained concurrently. Data developed during this hydraulic monitoring, combined with the sample results, will be used to evaluate the need for additional hydraulic characterization during the Feasibility Study (FS).

In order to take advantage of the induced hydraulic stresses which will occur during drilling and packer testing of the Phase II bedrock wells, the proposed 30 day time frame will bracket the planned bedrock well installation. Baseline water level data will be collected before well drilling activities commence and data will be collected during and after well installation.

The locations of the Phase II bedrock wells and monitoring wells and surface water monitoring stations proposed for water level measurement are shown on Figure 3-7. Table 3-5 provides well details and transducer parameters.

4.0 Summary of Phase I Surface Water Investigation and Evaluation Activities

This section describes the surface water sample collection and analyses methods, identifies any deviations from the sample collection or analyses methods in the approved Work Plan, and describes the results of the HHRA and SLERA. Based on a review of the data collected during the Phase I activities and previously collected data (2007-2009), surface water is adequately characterized to support the objectives of the RI. No Phase II activities for surface water are recommended.

4.1 Surface Water Sampling Methods

Surface water samples were collected in conjunction with sediment samples during low-stream-flow conditions from the on-Site streams and ponds as described in Section 5.2 of the FSAP. Surface water samples were also collected from the streams during a high-stream-flow event on May 7, 2009 (FSAP, Section 5.2). Samples collected during both events were submitted to the laboratory for analysis of the COPC suite detailed in Section 5.3 of Volume 2.

Surface water samples were collected from a total of fifty-three locations in streams and ponds located throughout the Site, including fifty-two of the fifty-four locations identified in Section 5.1 and Figure 7 of the FSAP. Specifically:

- One surface water sample was collected from each of the three on-Site ponds.
- Surface water samples were collected from forty-nine of the fifty-one planned surface water sampling locations in the on-Site streams.

Deviations from the surface water sampling procedures detailed in the Section 5.1 of the FSAP include the following:

- Altamont was unable to collect surface water samples at two locations along an upper tributary of Gregg Branch, GBW 5-O22 and GBW 6-O21, due to inadequate stream flow at these locations.
- Altamont collected one additional surface water sample from an upper tributary of Gregg Branch, GBW3-L27, downstream from a new debris area (Debris Area 2) that was identified and investigated during the Phase I RI/FS soil sampling event. See Drawing 1 for the location of Debris Area 2.

Figure 4-1 identifies the surface water and sediment sampling locations for the Phase I sampling activities.

4.2 Surface Water Analytical Methods

All samples were shipped overnight to the laboratory where they were analyzed for the COPCs specified in the FSAP. The analytical methods utilized by the laboratory are identified on Table 2-1 and are consistent with the methods specified in Table A.3 of the QAPP.

A technical review of the analytical data was performed by the laboratory as specified in Section D2.1 of the QAPP. Upon completion of the technical review, analytical data were transmitted as electronic data deliverables (EDDs) to the data validator for further validation/verification using the criteria specified in

Section D2.2 of the QAPP. Tables of the analytical data were prepared using the validated data and are included in Appendix G.

4.3 Surface Water Results

The base flow surface water data collected in 2010 during the Phase I RI/FS generally confirm the surface water data collected during the low-flow sampling events conducted in 2007 and 2008, and the high-flow sampling event in 2009. Table G-1 (located in Appendix G) presents the analytical data from the Phase I surface water sampling. Metals, nitroaromatics, perchlorate and VOCs were detected in one or more of the surface water samples collected.

The COPC list of metals for the 2010 surface water sampling event was limited to aluminum, iron, mercury, and titanium. Based on a review of historical analytical surface water data, all other metals were eliminated as surface water COPCs. Mercury was not detected in any of the samples collected from the Site-wide surface water bodies.

Based on a review of the 2007, 2008, 2009, and 2010 surface water analytical results, the following general conclusions can be made:

- COPCs are not migrating from the Site via surface water at concentrations exceeding the North Carolina 2B standards.
- Low levels of VOCs and perchlorate were detected near the southern property boundary, but were not detected in the off-Site sample collected from Bee Tree Creek.
- VOC concentrations appear to decrease in the downstream direction in the Unnamed Branch and Gregg Branch.
- Various pesticides are detected in both on-Site surface water bodies and the upgradient sampling location (representing off-Site and upstream conditions).
- The analytical results of the high-stream-flow sampling event are generally consistent with the base flow sampling and will be discussed in the RI Report.

4.4 Preliminary Human Health Risk Assessment for Surface Water

The preliminary human health risk assessment was conducted using the highest contaminant concentrations detected in surface water during the 2007, 2008, and 2009 sampling events and the Phase I RI sampling event. Table 4-1 summarizes the upper-bound cumulative cancer risk and noncancer HI estimates for each of the surface water bodies sampled and for each of key exposure scenarios evaluated. Cumulative cancer risk and noncancer HI estimates that exceed 10^{-4} and 1, respectively, are highlighted in bold with gray background. As shown on Table 4-1, only one of the six surface water bodies investigated (i.e., Bee Tree Creek) has a cumulative cancer risk and/or noncancer HI estimate that exceeds the acceptable risk limits (when expressed with one significant digit in accordance with USEPA risk assessment guidance). Bee Tree Creek had a noncancer HI of 2 for the fish ingestion exposure scenario. This HI is almost entirely due to a chlordane concentration of 0.015 micrograms per liter (µg/L) from the upstream location BTW3-U30 in 2007 (where chlordane has not been detected subsequently). Excluding this chlordane concentration from the data set, since it is not related to the Site, results in a noncancer HI for Bee Tree Creek that is only $4x10^{-6}$ which is below the acceptable noncancer HI limit of 1.

Appendix H provides information that supports Table 4-1. The supporting information includes a table (Table H.10) that shows all the chemical-specific cancer risk and HQ estimates that were used in calculating the cumulative cancer risk and noncancer HI estimates on Table 4-1. This table also includes the chemical-specific concentrations that were used in the risk calculations for each of the surface water bodies, as well as the sample locations and dates of these concentrations. Appendix H also includes tables that show the toxicity values, physical-chemical parameters, and other assumptions that were used in calculating the chemical-specific cancer risk and HQ estimates on Table H.10.

4.5 Screening-Level Ecological Risk Assessment for Surface Water

The results of the Step 2 exposure assessment and risk calculations for surface water are summarized on Table 4-2. A compilation of information supporting the SLERA surface water risk calculations is provided in Appendix I, with detailed summary of the surface water ESVs (Table I-3) calculation of maximum media-specific HQs on a location-by-location basis for each chemical of potential concern (Table I-4A). Table 4-2 shows that seven chemicals have HQs that exceed the USEPA threshold value of 1 in one or more of the aquatic exposure units (Gregg Branch, Bee Tree Creek, Unnamed Branch, and Pond 3). Therefore, these exposure units will be carried forward into Step 3a for one or more chemicals of potential concern. Chemicals that do not have surface water ESVs are identified in Appendix I (Table I-3). These chemicals will also be carried forward into Step 3a of the ERA where detected. Finally, as stated in the ERA Work Plan, chemicals with HQs equal to a value of 1 will also be carried forward into Step 3a (Appendix Table I-4A).

As part of the overall consideration of surface water in the groundwater/surface water transition zone, the groundwater for monitoring wells within reasonable proximity (e.g., within 100 feet) to a surface water body and having a reasonable potential to discharge into the surface water body were compared to the surface water ESVs. This groundwater evaluation is summarized in Table 4-3 and the full evaluation is presented in Table I-4B. The list of monitoring wells included in this evaluation is provided in Table 4-3. The results show some chemicals were detected in groundwater at concentrations that would yield HQs that exceed the threshold value of 1, if these concentrations were to be found in surface water. However, adequate surface water data have been collected in close proximity to and downstream of these groundwater monitoring wells.

The uncertainties associated with this Step 2 analysis are similar to those described in Section 2.5. As stated for the soil SLERA, exceedance of the HQ threshold value alone does not necessarily indicate the need for additional sampling, particularly when areas and chemicals are well characterized. The SMPD based on the SLERA HQs presented in Table 4-2 and Appendix I indicate that the available information is not adequate to make a decision, and the ERA process should continue. Therefore, four of the six aquatic exposure units will be carried forward into Step 3a of the ERA for chemicals with surface water HQs that exceed the value of 1. In addition, according to the Work Plan, chemicals lacking ESVs and with HQs equal to 1 will also be carried forward into Step 3a. HQs greater than a value of 1 for groundwater will also be carried forward for further qualitative and quantitative evaluation in Step 3a. Step 3a refined exposure assumptions and potential food web evaluations are needed to identify whether potential unacceptable risks might be related to these chemicals and what data gaps (if any) may be needed to make management decisions.

4.6 Data Gaps and Recommended Phase II Activities

Surface water, both on-Site and in Bee Tree Creek, are adequately characterized for remedial option evaluation. Consequently, no on-Site Phase II sampling activities are recommended.

5.0 Summary of Phase I Sediment Investigation and Evaluation Activities

This section describes the sediment sample collection and analyses methods, identifies any deviations from the sample collection or analyses methods in the approved RI/FS Work Plan (Work Plan), and describes the results of the screening-level ecological risk assessment. Based on a review of the data collected during the Phase I activities, sediment is adequately characterized to support the objectives of the RI. No Phase II activities for sediment are recommended.

5.1 Sediment Sampling

Sediment samples were collected in conjunction with surface water samples during low-stream-flow conditions from the on-Site streams and ponds as described in Section 6.2 of the FSAP. Sediment samples were collected from a depth of zero to one foot. Depth of water at the sediment sampling locations ranged from 0.5 to 5 feet. Collected samples were submitted to the laboratory for analysis of the COPC suite detailed in Section 6.3 of the FSAP.

Sediment samples were collected from a total of fifty-four locations in streams and ponds located throughout the Site, including fifty-three of the fifty-four locations identified in Section 5.2 and Figure 7 of the Work Plan (Volume 2). Specifically:

- One sediment sample was collected from each of the three on-Site ponds.
- Sediment samples were collected from 50 of the 51 sampling locations in the on-Site streams.

Deviations from the sediment sampling procedures detailed in Section 6.2 of the FSAP include the following:

- Altamont did not collect a sediment sample at GBW 6-O21 (Figure 4-1, grid O-21) located at the headwaters of one of the northernmost tributaries of Gregg Branch. The sampling point is no longer located in a stream channel or seep, and has historically been dry.
- Altamont collected one additional sediment sample from an upper tributary of Gregg Branch, GBW3-L27, downstream from a new debris area (Debris Area 2) that was identified and investigated during the Phase I RI/FS soil sampling event.
- In place of the Ponar-style sampling device stated in the Work Plan, Altamont used a hand auger fitted with a clay bucket to collect sediment samples from the three ponds.

Figure 4-1 identifies the surface water and sediment sampling locations for the Phase I sampling activities.

5.2 Sediment Analytical Methods

Collected samples were shipped overnight to the laboratory where they were analyzed for the COPCs specified in the FSAP. The analytical methods utilized by the laboratory are identified on Table 2-1 and are consistent with the methods specified in Table A.4 of the QAPP.

A technical review of the analytical data was performed by the laboratory as specified in Section D2.1 of the QAPP. Upon completion of the technical review, analytical data were transmitted as electronic data

deliverables (EDDs) to the data validator for further validation/verification using the criteria specified in Section D2.2 of the QAPP. Tables of the analytical data for each area were prepared using the validated data and are included in Appendix G.

5.3 Sediment Results

Table G-2 (located in Appendix G) presents the analytical data from the Phase I sediment sampling. Metals, nitroaromatics, perchlorate, pesticides, SVOCs, and VOCs were detected in one or more of the sediment samples collected.

5.4 Preliminary Human Health Risk Assessment for Sediment

Table 5-1 summarizes the upper-bound cumulative cancer risk and noncancer HI estimates for sediment from each of the surface water bodies sampled and for each of key exposure scenarios evaluated. As shown on Table 5-1, none of the surface water bodies has a cumulative cancer risk and/or noncancer HI estimate that exceeds the acceptable risk limits (when expressed with one significant digit in accordance with USEPA risk assessment guidance).

Appendix H provides information that supports Table 5-1. The supporting information includes a table (Table H.11) that shows all the chemical-specific cancer risk and HQ estimates that were used in calculating the cumulative cancer risk and noncancer HI estimates on Tables 5-1. This table also includes the chemical-specific concentrations that were used in the risk calculations for each of the surface water bodies, as well as the sample locations of these concentrations. Appendix H also includes tables that show the toxicity values, physical-chemical parameters, and other assumptions that were used in calculating the chemical-specific cancer risk and HQ estimates on Table H.11.

5.5 Screening Level Ecological Risk Assessment for Sediment

The results of the Step 2 exposure assessment and risk calculations for sediment are summarized on Table 5-2. A compilation of information supporting the SLERA sediment risk calculations is provided in Appendix I, with detailed summary of the sediment ESVs (Table I-5) calculation of maximum media-specific HQs on a location-by-location basis for each chemical of potential concern (Table I-6). Table 5-2 shows that a variety of chemicals have HQs that exceed the USEPA threshold value of 1 in one or more of the aquatic exposure units. Therefore, these exposure units (Gregg Branch, Bee Tree Creek, Unnamed Branch, and Pond 2) will be carried forward into Step 3a for one or more chemicals of potential concern. Chemicals that do not have sediment ESVs are identified in Appendix I (Table I-5). These chemicals will also be carried forward into Step 3a of the ERA. Finally, as stated in the ERA Work Plan, chemicals with HQs equal to a value of 1 will also be carried forward into Step 3a (Appendix Table I-6).

The uncertainties associated with this Step 2 analysis are similar to those described in Section 2.5. There are chemicals identified in Table 5-2 with HQs that exceed the USEPA threshold value of 1 but no additional sediment sampling is warranted because the aquatic exposure units have been well characterized. The SMPD based on the SLERA HQs presented in Table 5-2 and Appendix I indicate that the available information is not adequate to make a decision, and the ERA process should continue. Therefore, aquatic exposure units will be carried forward into Step 3a of the ERA for chemicals with HQs that exceed the value of 1 and chemicals lacking ESVs. In addition, according to the Work Plan, chemicals with HQs equal to 1 will also be carried forward into Step 3a. In accordance with the ERA

Work Plan, Step 3a refined exposure assumptions and potential food web evaluations are needed to identify whether potential unacceptable risks might be related to these chemicals and what data gaps (if any) may need to be filled to make management decisions.

5.6 Data Gaps and Recommended Phase II Activities

Sediment, both on-Site and in Bee Tree Creek, is adequately characterized for evaluation of remedial options. Consequently, no on-Site Phase II sampling activities are recommended.

6.0 Well Receptor Survey

This section provides results of a groundwater well receptor survey conducted between March and July, 2010. This well receptor survey was conducted as discussed in Sections 2.1.1 and 3.2 of the FSAP. This survey was performed to supplement the information collected during a prior 2003 off-Site well receptor survey and to address elements of the North Carolina 2L groundwater protection program.

6.1 Survey Methods

During the Phase I RI, the 2003 well receptor survey was updated in accordance with Section 2.1.1 of the Work Plan. The well receptor survey included the following activities:

- Visiting DENR Asheville Regional office and reviewing well records available from 2003 through March 2010
- Conducting a windshield survey to document all observed wells that had been installed since the 2003 survey and changes in land use (for example, unimproved to residential dwelling) since 2003
- Contacting residences via letters to request additional information pertaining to their water supply wells, including permission to sample if they used water from their well for potable purposes
- Collecting groundwater samples from wells whose owners granted permission

6.2 Survey Results

The survey confirmed four properties that contained residential water supply wells installed since the 2003 survey (Figure 6-1). These new wells were identified at the following addresses:

- 33 Hunter Kilby Road (two wells; Map ID No. 186D)
- 11 Hunter Kilby Road (Map ID No. 186B)
- 849 Bee Tree Road (Map ID No. 84A)
- 847 Bee Tree Road (Map ID No. 84B)

6.3 Well Sampling and Analytical Methods

The wells at the first four properties listed above were sampled. In addition, two existing residential water wells (at 17 Lauren Ridge Way and 80 McKinney Road; Map ID Nos. 199 and 31 on Figure 6-1) were also sampled, based on the residents' request. All samples were collected from a spigot at the wellhead after purging the well for at least 10 minutes. Purge flow rates were commonly about 10 gallons per minute. Field indicator parameters were collected at the completion of the well purge.

All samples were analyzed for VOCs, nitroaromatics, and perchlorate. A technical review of the analytical data was performed by the laboratory as specified in Section D2.1 of the QAPP. Upon completion of the technical review, analytical data were transmitted as electronic data deliverables (EDDs) to the data validator for further validation/verification using the criteria specified in Section D2.2 of the QAPP.

6.4 Analytical Results

Samples collected from one of the wells at 33 Hunter Kilby Road (Map ID No. 186D), and the wells at 849 Bee Tree Road (Map ID No. 84A), and 80 McKinney Road (Map ID No. 31) showed no detections of constituents. Samples from the remaining three wells showed the following detections and J values:

- The remaining well at 33 Hunter Kilby Road (Map ID No. 186D), chloroform at 0.4 J µg/L (re-sampling event showed chloroform 0.8 µg/L)
- 17 Lauren Ridge Road (Map ID No. 199), chloroform at 0.2 J µg/L (re-sampling event showed the same J value result of chloroform at 0.2 J µg/L)
- 11 Hunter Kilby Road (Map ID No. 186), chloroform at 1.9 µg/L and tert-butyl alcohol (TBA) at 4.9 J µg/L (re-sampling event showed chloroform at 0.2J µg/L, TBA was not detected).

Chloroform is commonly formed during water treatment as a degradation product of chlorine. In addition, the concentrations of the chloroform detections are well below the 2L Standard of 70 µg/L.

6.5 Recommendations

The Companies do not anticipate additional sampling at this time with regard to the detections of chloroform in the samples described above.

7.0 Well Abandonment Methods

During the Phase I of the RI/FS, twenty-nine wells were abandoned in accordance with the work plan and procedures defined in the North Carolina Administrative Code Title 15A, Subchapter 2C .0113. The wells were abandoned by AE Drilling, a North Carolina licensed drilling contractor. Field notes and documentation will be provided in the Phase I Report. No further work is required.