Remedial Action Plan (RAP) – Step Two

Former Copes-Vulcan Facility
601 West Summit Avenue
Charlotte, North Carolina 28203
NCDENR ID# NONCD 000 1097

Submitted to:

The North Carolina Department of Environment and Natural Resources
Division of Waste Management
Inactive Hazardous Sites Branch
Superfund Section
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Raleigh, NC 27699-1646

Submitted by:

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June 2008

REMEDIATING PARTY CERTIFICATION STATEMENT (.0306(b)(2)):

"I certify under penalty of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

JOHN A. HEER (Asst. Gen. Counsel)
(Name of Remediating Party Official)

* _____ * 6/18/08
(Signature of Remediating Party Official) Date

**** NOTE: The RSM certifies all documents LAST. Failure to do so is a violation of 15A NCAC 13C .0306(b)(2) of the REC Rules and subject to possible enforcement action against the REC and/or RSM.***

Ohio (Enter State)

Cuyahoga **COUNTY**

I, Beverly Fisher, a Notary Public of said County and State, do hereby certify that John A. Heer did personally appear and sign before me this the 18th day of June, 2008.

Beverly Fisher
Notary Public (signature)

(OFFICIAL SEAL)

My commission expires:

BEVERLY FISHER
Notary Public, State of Ohio
Recorded in Cuyahoga County
My Commission Expires 12.02.2009

REGISTERED SITE MANAGER CERTIFICATION STATEMENT (.0306(b)(1)):

"I certify under penalty of law that I am personally familiar with the information contained in this submittal, including any and all supporting documents accompanying this certification, and that the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete and complies with the Inactive Hazardous Sites Response Act G.S. 130A-310, et seq, and the voluntary remedial action program Rules 15A NCAC 13C .0300. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

Michael J. Lyden, P.E.
(Name of Registered Site Manager)

* _____ * 06/18/2008
(Signature of Registered Site Manager) Date

**** NOTE: The RSM certifies all documents LAST. Failure to do so is a violation of 15A NCAC 13C .0306(b)(2) of the REC Rules and subject to possible enforcement action against the REC and/or RSM.***

OHIO (Enter State)
Cuyahoga **COUNTY**

I, Tamika White, a Notary Public of said County and State, do hereby certify that MICHAEL J LYDEN did personally appear and sign before me this the 18 day of JUNE, 2008.

_____
Notary Public (signature) (OFFICIAL SEAL)

My commission expires: December 18-2010

NOTARIAL SEAL STATE OF OHIO

TAMIKA WHITE
Notary Public
In and for
the State of Ohio
My Commission Expires
Dec. 18, 2010

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EXECUTIVE SUMMARY

This Remedial Action Plan – Step Two (Step Two RA) has been developed for the former Copes-Vulcan facility located at 601 West Summit Avenue in Charlotte, North Carolina (the site). Electrolux Home Products, Inc. (Electrolux) is implementing a voluntary remedial action at the site under the North Carolina Department of Environment and Natural Resources (NCDENR) Registered Environmental Consultant (REC) Program, pursuant to a July 24, 2003 Administrative Agreement between Electrolux and the NCDENR. The Kelly-Buck Company is the REC assigned to implement and oversee this remedial action.

A remedial investigation (RI) was completed at the site in 2006, and identified areas of concern (AOCs) with soil and ground-water impacts. Step One of the RA, completed in 2007, addressed soil impacts in AOCs #15, #4 and #6. The Step Two RA will address soil and ground-water impacts associated with remaining AOCs. Primary objectives associated with the Step Two RA are to: (a) implement a ground-water remediation program to achieve ground-water remedial goals (RGs) for identified constituents of concern; and (b) remediate site soil to achieve health-based soil RGs for unrestricted land use, and where applicable, to achieve soil RGs designed to protect ground water. Following is a summary of work planned to achieve these objectives.

Implement Ground-Water Remediation – This RA component will include: (a) baseline ground-water, surface-water and soil vapor monitoring to establish pre-remedial conditions for tracking the progress of remediation; (b) soil removal and in situ soil treatment in AOCs #3, #13 and #21, to reduce concentrations of chlorinated volatile organic compounds (CVOCs) and hexavalent chromium (Cr(VI)), to prevent future migration to ground water, and to achieve unrestricted health-based soil RGs; (c) in situ ground-water treatment near AOCs #3, #4, #13 and #21, to reduce contaminant mass in saturated soil and bedrock intervals in, and downgradient of, these source areas; and (d) implementation of a ground-water, surface-water, soil and soil vapor monitoring program to measure the effectiveness of remediation in achieving site RGs.

Remediate Polychlorinated Biphenyls (PCBs) in Site Soil –This work will entail: (a) removal and offsite disposal of PCB-impacted soil and related media (i.e., the concrete slab associated with the former building floor) to achieve unrestricted soil RGs; and (b) confirmatory soil sampling to verify that goals have been met.

Address Other Site Soil Conditions – This task will involve soil removal and sampling to address remaining site AOCs where contaminants have been detected at levels exceeding RGs. The work will address: AOC #10 (residues in site sewers exceeding RGs); AOC #14 (elevated polynuclear aromatic hydrocarbons (PAHs) in shallow soil along the hillside in the northwest portion of the site); AOC #16 (elevated lead and mercury in soil in the south-central part of the property; and AOCs #19 (backfilled soil in former building pits in the northeast portion of the site). Remaining AOCs identified and investigated during the RI have either been: (a) determined to not exhibit soil and ground-water impacts at levels of concern (AOCs #5, #7, #8, #9, #11, #17, #18, #20); (b) were addressed during the Step One RA (AOCs #4, #6 and #15); or (c) are smaller areas contained within the overall limits of PCB-impacted soil that will be remediated during the Step Two RA (AOCs #1, #2, #12).

Remedial Action Plan (RAP) – Step Two

Former Copes-Vulcan Facility
601 West Summit Avenue
Charlotte, North Carolina 28203
NCDENR ID# NONCD 000 1097

1.0 INTRODUCTION

This Remedial Action Plan – Step Two (Step Two RAP) has been prepared for the former Copes-Vulcan site located at 601 West Summit Avenue in the City of Charlotte, Mecklenburg County, North Carolina (the site – see Figure 1). The site is undergoing a voluntary remedial action pursuant to a July 24, 2003 Administrative Agreement between Electrolux Home Products, Inc. (Electrolux) and the North Carolina Department of Environment and Natural Resources (NCDENR), in accordance with the NCDENR's Registered Environmental Consultant (REC) Program requirements – specifically, NCGS 130A-310.9(c), 15A NCAC 13C .0300, and the REC Program Implementation Guidance. The Kelly-Buck Company (Kelly-Buck, REC firm #00109) has been assigned to implement and oversee this remedial action.

Between 2004 and 2006, a remedial investigation (RI) was conducted at the site, and identified areas of concern (AOCs) where soil and other media were found to contain chemical substances above remediation goals (RGs) as defined by the REC program. Impacts to ground water and surface water were also identified and delineated. Work and results associated with the RI are detailed in the Phase I and Phase II Remedial Investigation Work Plans, and the Phase I and Phase II Remedial Investigation Reports (Kelly-Buck, 2004, 2005(a), 2005(b), 2006(a)).

A Step One Remedial Action Plan (Step One RAP) was previously prepared and implemented in association with Step One of the remedial action (Step One RA – Kelly-Buck, 2006(b)). This work was completed at the site in 2007, and involved the removal and offsite disposal of soil from AOCs #4, #6 and #15. A Construction Completion Report detailing the Step One RA was recently prepared and submitted to NCDENR (Kelly-Buck, 2008(a)).

The objective of this Step Two RA is to address site-related ground-water and surface-water impacts, as well as remaining source-area soil impacts in the identified AOCs. The following sections of this RAP provide: a summary of work and findings associated with the RI; a discussion of remedial action objectives and remedial goals; a summary of the feasibility study (FS) completed to identify and evaluate potentially viable remedial alternatives; and a description of the remedy selected for implementation at the site.

Separate from this RAP, a Pre-Remedial Characterization Work Plan is being submitted to NCDENR for implementation at the site (Kelly-Buck, 2008(b)). The pre-remedial characterization work involves data collection and other activities in order to verify remedial

design parameters, complete the final remedial design work and support implementation of the Step Two remedial action.

2.0 REMEDIAL INVESTIGATION RESULTS

2.1 RI Results - Overview

Details associated with the RI are provided in the following documents previously prepared and submitted to the NCDENR: Phase I RI Work Plan (Kelly-Buck, 2004); Phase I RI Report (Kelly-Buck, 2005(a)); Phase II RI Work Plan Addendum (Kelly-Buck, 2005(b)); Phase II RI Report (Kelly-Buck, 2006(a)).

A summary of activities and findings associated with the RI is included below.

- The RI included completion of more than 100 soil borings and 30 ground-water monitoring wells; collection and laboratory analysis of several hundred samples of soil, ground water, surface water and other environmental media; and completion of other investigative work to identify and delineate site impacts.

- Chlorinated volatile organic compounds (CVOCs), primarily tetrachloroethene (PCE), were detected in soil at several locations (primarily AOCs #4, #13 and #21). Ground-water impacts associated with these areas were found to extend vertically into unconsolidated deposits and underlying fractured bedrock, and downgradient to Irwin Creek, located approximately 500 feet (ft) west of the site.

- Polychlorinated biphenyls (PCBs) were detected in soil encompassing an area of roughly 130,000 square feet (sq ft) in the north-central portion of the site. Most areas of impact are relatively shallow, and concentrations are not significantly above site RGs; however, several areas of deeper impact and/or higher concentration have been identified. PCBs have not impacted ground water or surface water.

- Chromium compounds have impacted soil and ground water in a limited area in the north-central portion of the site (AOC #3).

- Several additional AOCs were identified, and exhibit minor quantities and/or concentrations of contaminants in soil, but do not appear to have impacted ground water nor represent a significant environmental or human health concern.

2.2 RI Results – Step Two AOCs

Sampling results specific to those areas and contaminants of concern that will be addressed during the Step Two RA are discussed below, subdivided by contaminant category. Figure 2

provides a current site survey showing soil boring and monitoring well locations; Figure 3 shows the approximate limits of those AOCs that will be addressed as part of this RAP.

CVOCs

AOCs #13 and #21 exhibit CVOCs in unsaturated soil above the ground-water table, which exceed health-based and ground water protection RGs. These elevated CVOC concentrations extend below the water table and persist in saturated soil and bedrock matrices in AOCs #13 and #21, as well as in AOC #4.

In AOC #13, the overall limits of CVOC detection measures approximately 18,000 sq ft. Within these limits, there are two sub-areas measuring approximately 3,000 and 1,500 sq ft, which exhibit primary CVOC impacts. A maximum CVOC concentration of 91 milligrams per kilogram (mg/Kg) was detected in this area.

In AOC #21, the CVOC-impacted area measures approximately 3,000 sq ft, with a maximum CVOC concentration of 2,500 mg/Kg. In both areas, CVOC concentrations in excess of 1 mg/Kg extend to depths of roughly 15 to 20 ft. In AOC #4, CVOC impacts in shallow (unsaturated) soil were previously addressed during the Step One RA; however, CVOC residues remain in deeper, saturated soil and bedrock.

These source-area conditions have the potential to continue leaching of CVOC contaminant mass to ground water. Downgradient of these source areas, dissolved CVOCs are relatively dispersed within a large volume of saturated soil, saprolite (weathered bedrock) and unweathered, fractured bedrock, extending from the western portion of the site to the vicinity of Irwin Creek, a perennial stream and ground-water discharge boundary located about 500 feet west.

Hexavalent Chromium

Elevated concentrations of hexavalent chromium (Cr(VI)) are present in AOC #3 in excess of health-based and ground-water protection RGs. Results of the RI indicate that this contaminant source area measures approximately 20 ft (north-south) by 40 ft (east-west) by 15 ft deep. Elevated chromium has been detected in ground water and surface water downgradient (to the west) of AOC #3.

PCBs

Soil in northern portions of the site exhibits PCBs above the 1 part per million (ppm) unrestricted soil RG for direct contact. Results from the RI indicate that a majority of PCB impacts are limited to surface or near-surface soil. The overall extent of this area measures approximately 850 ft (east to west) by 100 ft to 250 ft (north to south), and comprises roughly 130,000 sq ft. Within this area, most PCB detections are limited to shallow soil depths of between 1 and 3 ft; however, several detections in the western portion of the affected area extend to depths of 10 to

15 ft. The volume of soil exhibiting PCBs above the 1 ppm unrestricted RG is estimated at roughly 10,000 cubic yards.

Other Soil Impacts

Other areas of the site were identified during the RI as having constituents in soil above RGs. The magnitude and extent of impact associated with these AOCs is considered to be minor relative to the previously discussed areas. Also, in some instances these AOCs are encompassed by larger areas of concern, such as the PCB-impacted soil area. AOCs in this category include the following:

- AOC #1 (Chip Hopper): This area exhibits polynulcear aromatic hydrocarbons (PAHs), metals and PCBs in shallow soil associated with the handling of metal chips and associated waste oils, but is not considered to be a significant contaminant source area. AOC #1 is contained within the larger site area exhibiting soil PCB impacts.

- AOC #2 (Northeast Dock): This area, initially identified as a separate AOC, has been determined to be part of the overall PCB-impacted area.

- AOC #10 (Site Sewers): Residues (i.e., sediment) in site sewer lines exhibit constituent concentrations (VOCs, metals, PCBs) above site RGs. Minor RG exceedances were also observed in subsurface soil adjacent to the sewer lines, and in surficial soil in the vicinity of sewer outfall locations.

- AOC #12 (Steel Wash Tank): This area was found to exhibit relatively high concentrations of PCBs in shallow soil, along with several metals above site RGs. This area is encompassed by, and classified as a part of, the PCB-impacted soil area in the north portion of the site.

- AOC #14 (Old Steel Drums, Debris and Test Pits): Soil sampling from this area indicated the presence of PCE and other constituents exceeding RGs. The north portion of this area is associated with CVOC source area AOV #21, while shallow soil in portions of this area exhibits polynuclear aromatic hydrocarbons (PAHs) above soil RGs.

- AOC #16 (Hazardous Material Storage Buildings): Concentrations of several metals were detected in soil above site RGs. The detections were sporadic, and may reflect the variable nature of fill deposits in the western portion of the site, rather than a specific release of contaminants from a source area.

- AOC #19 (Metal Prep Pit): Shallow soil in this area was found to contain semivolatile organic compounds (SVOCs) and metals above site RGs. The area measures approximately 60 ft (north-south) by 20 ft (east-west). Ground water has not been impacted.

3.0 REMEDIAL ACTION OBJECTIVES

Remedial objectives for the Step Two RA are as follows:

1. Implement a ground-water remediation and monitoring program in order to achieve ground-water remedial goals (RGs) for identified constituents of concern that have been released from the site (CVOCs and Cr(VI)).

2. Remediate site soil to achieve health-based RGs for unrestricted land use, and where applicable, ground-water protection soil RGs, for identified constituents of concern which have impacted ground water (CVOCs, Cr(VI), PCBs, PAHs and selected metals).

Remedial goals applicable to the Step Two RA have been computed pursuant to procedures defined in the REC program, and are detailed in the RI work plans and reports (Kelly-Buck, 2004, 2005(a), 2005(b), 2006(a), 2008(a)). Applicable soil and ground-water RGs for constituents targeted during the Step Two RA are presented below.

Soil and Ground-Water Remedial Goals for Step Two RA

Constituent	Health-Based Soil RG (ug/Kg)	Ground-Water Protection Soil RG (ug/Kg)	Ground-Water Protection Soil RG (ug/L via TCLP analysis)	Ground-Water RG (ug/L)
VOCs				
1,1 Dichloroethane	**102,000**	**1,400**	**70**	**70**
1,1 Dichloroethene	**24,000**	**140**	**7**	**7**
cis-1,2-Dichloroethene	**8,600**	**1,400**	**70**	**70**
trans-1,2-Dichloroethene	**13,800**	**2,000**	**100**	**100**
1,1,1,2-Tetrachloroethane	**3,200**	**8.6**	**0.43**	**0.43**
Naphthalene	**11,200**	**420**	**21**	**21**
Tetrachloroethene	**480**	**14**	**0.7**	**0.7**
Toluene	**132,000**	**20,000**	**1,000**	**1,000**
1,1,1-Trichloroethane	**400,000**	**4,000**	**200**	**200**
1,1,2-Trichloroethane	**730**	**100**	**5**	**5**
Trichloroethene	**NA**	**56**	**2.8**	**2.8**
Vinyl chloride	**79**	**0.3**	**0.015**	**0.015**
Xylenes (total)	**54,000**	**10,600**	**530**	**530**
VOCs				
Antimony	**6,200**	NA(2)	NA	NA
Arsenic	**6,000(1)**	NA	NA	NA
Barium	**1,080,000**	NA	NA	NA
Beryllium	**30,000**	NA	NA	NA
Chromium, Total	**24,000,000**	**1,000**	**50**	**50**
Chromium, Hexavalent	**44,000**	**440**	**22**	**22**

Constituent	Health-Based Soil RG (ug/Kg)	Ground-Water Protection Soil RG (ug/Kg)	Ground-Water Protection Soil RG (ug/L via TCLP analysis)	Ground-Water RG (ug/L)
Copper	**620,000**	NA	NA	NA
Cyanide	**240,000**	NA	NA	NA
Lead	**400,000**	NA	NA	NA
Manganese	**2,110,940**(1)	NA	NA	NA
Mercury	**4,600**	NA	NA	NA
Nickel	**320,000**	NA	NA	NA
Selenium	**78,000**	NA	NA	NA
Silver	**78,000**	NA	NA	NA
Thallium	**4,770**(1)	NA	NA	NA
Zinc	**4,600,000**	NA	NA	NA
PCBs				
PCBs (total)	**1.0**	NA	NA	NA
SVOCs				
Acenaphthene	**740,000**	NA	NA	NA
Acenaphthylene	**460,000**	NA	NA	NA
Anthracene	**4,400,000**	NA	NA	NA
Benzo(k)fluoranthene	**6,200**	NA	NA	NA
Benzo(b)fluoranthene	**620**	NA	NA	NA
Benzo(a)anthracene	**620**	NA	NA	NA
Benzo(g,h,i)perylene	**460,000**	NA	NA	NA
Benzo(a)pyrene	**62**	NA	NA	NA
Chrysene	**62,000**	NA	NA	NA
Dibenz[a,h]anthracene	**62**	NA	NA	NA
Dibenzofuran	**30,000**	NA	NA	NA
Fluoranthene	**460,000**	NA	NA	NA
Fluorene	**540,000**	NA	NA	NA
Indeno(1,2,3-cd)pyrene	**620**	NA	NA	NA
2-Methylnaphthalene	**11,200**	NA	NA	NA
Naphthalene	**11,200**	**420**	**21**	**21**
Phenanthrene	**460,000**	NA	NA	NA
Pyrene	**460,000**	NA	NA	NA

(1) Remedial goals based on site-specific natural background concentrations

(2) NA indicates the following: For ground-water protection soil RGs, it has been determined that all onsite disposal and releases of hazardous substances occurred over 15 years ago, and sampling demonstrates that ground-water at the source area is free of this constituent and any daughter products. For ground water RGs, the constituent has not been detected in ground-water, and is not considered to be a contaminant of concern.

4.0 FEASIBILITY STUDY

As part of the RA planning process, and in accordance with REC program requirements, a feasibility study (FS) was completed to facilitate remedy selection for the Step Two RA. The FS involved identification and evaluation of potentially viable remedial action alternatives, followed by selection of the preferred remedy, in order to achieve remedial action objectives. The FS process included: identification and screening of potentially feasible remedial technologies; detailed evaluation of viable remedial alternatives relative to criteria specified in the REC rules and implementation guidance; and remedy selection. The following sections summarize this work.

4.1 Identification and Screening of Technologies

The primary constituents of concern to be addressed during the Step Two RA are CVOCs, PCBs and Cr(VI). Remaining constituents of concern detected in several minor AOCs (i.e., PAHs and metals) are expected to require only limited soil removal and disposal. As a result, the FS focused on technologies applicable for remediation of CVOCs (primarily PCE and associated degradation products) in soil and ground water, Cr(VI) in soil and ground water, and PCBs in soil.

Technologies considered during the initial screening phase include the following main categories: in situ and ex situ biological, chemical/physical and thermal treatment methods; containment; excavation and offsite disposal; and no action. Once assembled, these technologies were screened based on the following criteria:

Effectiveness: This criterion focuses on the ability of the treatment method to remove the constituents of concern and/or reduce the toxicity, mobility, or volume of waste through treatment, immobilization or containment.

Implementability: This criterion focuses on the technical feasibility of the treatment method; that is, the relative ease with which the treatment method can be carried out.

Cost: This criterion considers the cost of construction, treatment, disposal, operation, maintenance and monitoring.

The technology screening process is summarized in Tables 1 through 3 and discussed below.

In Situ Biological Treatment

Biotreatment represents one type of in situ soil and ground water remediation, whereby soil can be treated without excavation, and ground water can be treated without extracting fluid for surface processing. In situ approaches are preferred when soil excavation is impractical - for example: when contaminants are present at a depth precluding removal; where unstable soils or

steep slopes are present; where impacted soil is beneath or adjacent to a structure; or where the magnitude of the removal volume would result in prohibitive cost. Potential disadvantages of in situ treatment include: longer time periods to achieve remedial goals; non-uniformity of treatment (e.g., more permeable zones are preferentially treated, while less permeable zones may be left untreated); and less ability to control the uniformity and rate of treatment, and to monitor results.

In situ bioremediation technologies such as bioventing and enhanced bioremediation rely on the stimulation of microorganisms to grow and utilize the contaminants as food and energy sources. Typically, bioremediation involves the addition of oxygen, nutrients or other amendments. The cost of these materials is typically low, and they often can be easily introduced into the treatment zone.

Biological methods are generally most effective for treatment of volatile organic compounds (VOCs). There has been little evidence to date indicating that biological treatment is effective for constituents such as PCBs or hexavalent chromium compounds. Within the category of VOCs, biotreatment tends to work better with lower molecular weight compounds such as petroleum-based aliphatic and aromatic hydrocarbons, relative to higher molecular weight chlorinated compounds such as PCE.

As indicated in Tables 1 through 3, screening results for in situ biological treatment methods are fairly low in comparison to many of the other potentially feasible technologies. This is due in large part to a lack of evidence that the technology would be effective for any of the contaminants of concern. As a result, in situ biological treatment was not retained for further evaluation.

In Situ Chemical/Physical Treatment

Another form of in situ remediation involves chemical and physical treatment techniques that impart physical energy or chemical reactions to transform or destroy the contaminant. Examples include chemical oxidation, chemical reduction, soil flushing and soil vapor extraction.

Chemical oxidation and reduction processes rely on the addition of an oxidant or reductant, respectively, to chemically convert the contaminant to a less toxic form. These techniques have shown promise in both the oxidation and reduction of CVOCs, and in the reduction of hexavalent chromium. Chemical oxidation/reduction techniques have generally not been effective in the destruction of PCBs.

In situ chemical oxidation is applicable to CVOCs, and typically involves the injection of a chemical oxidizer such as sodium permanganate, potassium permanganate, hydrogen peroxide, sodium persulfate or similar compounds, in order to oxidize and degrade the organic compounds. In situ chemical reduction can be applicable both to metals in a highly oxidized state, and to chlorinated compounds such as PCE. Zero valent iron (ZVI), sodium bisulfite and other chemicals are reductants that has shown favorable results in the chemical reduction of Cr(VI) to

Cr(III), and some have also shown promising results in promoting reductive dechlorination of CVOCs.

In situ oxidation/reduction technologies offer the advantage of being rapid, aggressive and less sensitive to contaminant characteristics and concentrations. In some instances, hydraulic fracturing and/or hydraulic fracturing techniques are used in combination with in situ oxidation/reduction to increase soil and bedock permeability and promote delivery of treatment chemicals. The oxidizing materials are readily available and are easily injected or infiltrated into the treatment zone. Costs associated with material purchase and technology implementation are relatively low.

As shown in Tables 1 through 3, in situ chemical/physical treatment scored relatively high for remediation of CVOCs and Cr(VI), and was retained for further evaluation with respect to these contaminants. The technology does not show sufficient promise for remediation of PCBs; and was not retained in this instance.

Ex Situ Biological Treatment

In general, ex situ treatment technologies involve excavation of soil and extraction of ground water for onsite treatment. This type of treatment often requires shorter time periods than for in situ options. There is also more control as to the uniformity and degree of treatment, due to the ability to mix and otherwise manipulate the media. However, the removal of soil and ground water results in increased remedial costs, potential for increased contaminant exposure by workers and the surrounding environment, and regulatory issues such as permitting and controls.

As is the case for in situ methods, ex situ biotreatment is only applicable to CVOCs and other volatile compounds, and offers no real promise for PCBs or Cr(VI). For ex situ biological treatment of CVOC-impacted soil, the excavated material is placed in a treatment cell and mixed with amendments such as microbes, oxygen, water and/or nutrients, in order to stimulate microbial activity and corresponding co-metabolism of the contaminants. Available technologies for soil include biopiles, composting and land farming.

For ground water, the extracted fluid may be processed in a bioreactor for addition of oxygen, nutrients and/or other chemicals, or possibly discharged to a constructed wetland for biological reduction of contaminants.

Screening results for this technology are summarized in Tables 1 through 3. For treatment of CVOCs, experience at a number of sites indicates that ex situ biological methods are relatively costly and labor intensive, relative to any increase in control or efficiency that might be gained over in situ methods. One of the more significant risks is that the excavated and treated soil will not achieve target concentrations, and subsequently require offsite disposal. Because of these considerations for CVOCs, and due to a general lack of effectiveness for PCBs or Cr(VI), this category was not retained for further evaluation.

Ex Situ Chemical/Physical Treatment

Ex situ chemical/physical treatment methods are similar to those discussed previously for in situ chemical/physical treatment approaches, with the added step of first excavating the soil or extracting the ground water. In the case of CVOC-impacted soil, the material would typically be placed in a treatment cell or pile and be mixed with chemical oxidants, or undergo physical treatment such as vapor extraction with a blower and vent pipe system. For soil with hexavalent chromium, the method would most often involve mixing with a reductant such as sodium bisulfite. Once again, there is little or no experience in successfully treating PCB-impacted soil by physical and chemical methods.

Tables 1 through 3 summarize screening results for ex situ chemical/physical treatment. As indicated, this approach shows only moderate potential effectiveness for CVOCs, and little or no effectiveness for PCBs or Cr(VI). In addition, the technology is difficult to implement, and shows low cost-effectiveness. Therefore, this category was not retained for further evaluation.

In Situ Thermal Treatment

In situ thermal treatment can involve the use of electrical current, hot air or steam to heat the soil and/or ground water in order to enhance volatilization of contaminants and facilitate extraction. In situ thermal treatment can offer rapid reduction in the concentration of many volatile compounds; however, the method is very costly. In addition, performance can vary, and can be inadequate when the necessary temperature is not achieved, or if soil characteristics such as moisture content and permeability are unfavorable. The capture and treatment of volatilized contaminants in the air stream must also be a consideration. Available technologies such as steam injection, electromagnetic heating, and hot air injection have shown promising treatment for CVOCs, but not for metals or PCBs.

Screening results for in situ thermal treatment are listed in Tables 1 through 3. While effective for CVOCs, the method is cost-intensive for all contaminants, and is ineffective for PCBs or Cr(VI). As a result, this treatment alternative was not retained for further evaluation.

Ex Situ Thermal Treatment

As is the case with in situ thermal treatment technologies, ex situ methods employ treatment at elevated temperatures to desorb or destroy contaminants. In this context, ex situ thermal treatment options would involve portable onsite systems, as opposed to fixed-base (offsite) waste treatment facilities. Also, the technology is not applicable to onsite treatment of contaminated ground water.

Onsite thermal treatment is sometimes applied to sites with VOCs and certain other organic contaminants. However, for PCBs, only very high temperature incinerators can be employed, and they are suitable only for high-volume, high-concentration sites. In all cases, thermal treatment units are costly and labor-intensive to set up and operate, may require capture and

treatment of air emissions, and have perceived exposure issues that result in a lack of community acceptance. Thermal systems are not designed for treatment of soil containing metals such as hexavalent chromium.

As shown in Tables 1 through 3, this option scores low for all screening criteria, and was not retained for further evaluation.

Containment

Containment applies to impacted soil in contaminant source areas, and involves an approach where some or all of the contaminated soil is left in place, in conjunction with controls such as an engineered cap or other cover, and land-use restrictions. It is a widely implemented technology, especially in the case of soil impacted with PCBs or other relatively non-volatile, immobile contaminants. Containment methods are best suited for sites where removal for onsite treatment or offsite disposal is technically impractical and/or cost prohibitive, and the potential for contaminant exposure and/or migration to ground water is minimal.

Capping and other forms of containment are not considered to be a preferred remedy, because waste is left in place at a site and the solution is not permanent. However, in instances where other alternatives cannot be supported as feasible, the containment option may be the most viable one. As such, this option was retained for further evaluation (see Tables 1 through 3).

Other Treatment (Excavation & Offsite Disposal)

This remedial alternative typically involves the excavation, offsite transportation and treatment/disposal of contaminated soil in a permitted facility. Ground-water remediation is not directly relevant here; however, permanent removal from the relatively uncontrolled situation is a significant option for purposes of addressing source-area residues that may otherwise continue to leach to ground water.

For a given volume of soil, costs for this approach vary primarily as a function of classification for disposal purposes. Costs for pretreatment and disposal of soil in a licensed RCRA (hazardous waste) or TSCA (PCB waste) facility exceed those for solid waste landfill disposal by a factor of approximately five to ten, depending on the specific waste classifications. Other factors to consider include the generation of fugitive emissions during soil removal and transport, the distance that the media must be transported to a permitted facility, and the potential migration of contaminants during transfer.

Due to the relative permanence of this alternative, particularly in removing a source of future exposure and/or ground water impact from the site, combined with generally good ease of implementation and cost-effectiveness, this alternative was retained for further evaluation (Tables 1 through 3).

No Action

The no action alternative is considered as the base option, from which all other alternatives can be compared. Under a no action scenario, contaminated soil and ground water would be left in place without treatment or containment. This option may also include continued monitoring of the site for chemicals of concern, but does not include a formal program of monitored natural attenuation.

The no action alternative represents the lowest cost, most implementable option. However, it is ineffective, as it fails to achieve the remedial objectives of implementing ground water and soil remediation in order to achieve remedial goals. Nevertheless, the alternative was retained to serve as a baseline for evaluation of other options.

4.2 Detailed Evaluation of Remedial Alternatives

Based on the above screening of potentially applicable technologies for the treatment of CVOCs in ground water and soil, Cr(VI) in ground water and soil, and PCBs in soil, selected remedial alternatives for each contaminant category were retained for further development and evaluation. Each alternative was evaluated based on the following eight criteria specified by NCDENR under the REC Program Rules (15A NCAC 13C .0306(l)(3)):

- Protection of human health and the environment, including attainment of cleanup levels;
- Compliance with applicable federal, state and local regulations;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility and volume;
- Short-term effectiveness (i.e., effectiveness at minimizing the impact of the site remedial action on the environment and the local community);
- Implementability (technical and logistical feasibility, including an estimate of time required for completion);
- Cost; and
- Community acceptance.

Results of this evaluation are summarized in Tables 4 through 6, and are discussed below according to contaminant category. The alternatives are listed in order of preference.

CVOCs in Soil and Ground Water

In order to evaluate the selected alternatives for CVOC remediation, the following source area dimensions and characteristics are used:

Approximate Characteristics of CVOC Source Areas

AOC#	Approximate Dimensions (ft)	Area (sq ft)	Maximum Detected CVOC soil concentration (ppm)	Approximate Depth of Elevated (Source Area) CVOC Concentrations (ft)	Volume of Source Area Soil (cu yd)
4	40 x 55	2,200	7	5 – 15	800
13*	30 x 100; 30 x 50; 30 x 30	5,400	135	0 – 15	3,000
21	50 x 60	3,000	2,500	0 – 20	2,200
Total:		**10,600**			**6,000**

* The overall limits of CVOC detection in AOC #13 measure roughly 75 ft by 250 ft. Within those limits, there are two sub-areas measuring approximately 30 x 100 ft and 30 x 50 ft which exhibit maximum detected concentrations. For sporadic detections requiring treatment/removal, an additional area totaling 30 x 30 ft is estimated, resulting in a total area of 5,400 sq ft.

Remedial Alternative #1: In Situ Chemical/Physical Treatment (Chemical Oxidation)

CVOC Remedial Alternative #1 involves in situ chemical oxidation (ISCO) – specifically, the introduction of a chemical oxidant into source area soil and bedrock intervals that exhibit elevated CVOC concentrations. The oxidant reacts with and degrades (mineralizes) the volatile compounds. In this case, the chemical oxidant solution would most likely involve potassium permanganate, sodium permanganate, hydrogen peroxide or sodium persulfate.

CVOC Remedial Alternative #1 would be implemented as follows: Shallow soil would be excavated to a depth of approximately 3 ft within the limits of impacted soil areas in AOCs #13 and #21, and transported offsite for treatment/disposal. Infiltration galleries would then be constructed in the excavated areas for in situ treatment of deeper unsaturated soil intervals in AOCs #13 and #21. Injection well points would be installed in the deeper (saturated) soil intervals, extending to upper bedrock, in AOCs #13, #21 and #4. Where appropriate, hydraulic fracturing and injection of oxidant, possibly in slurry or solid form, would be included to optimize oxidant delivery and provide residual oxidant for ongoing treatment. A minimum of two applications of oxidant solution would be performed over a period of weeks or months, spaced to allow infiltration and dispersion of each dose without inducing oxidant overloading, chemical precipitation or other undesirable effects.

Construction of infiltration galleries would generate approximately 1,000 cu yd of soil requiring characterization and disposal.

Pre-remedial characterization sampling and laboratory testing would be conducted to assess soil oxidant demand (SOD) for confirmation of oxidant type and dose, and to collect additional design parameters as necessary. Because the ISCO technique has proven effective at a variety of sites with CVOCs, detailed treatability studies are not likely to be needed. However, full-scale implementation would most likely be phased, starting with one source area and proceeding to the others, in order to verify adequate performance and optimize treatment parameters. Soil

sampling and ground-water monitoring would be performed prior to, during and following the treatment period, in order to track progress toward completion.

Assuming that the volume of soil and bedrock targeted for ISCO treatment totals approximately 6,000 cubic yards (cu yds), as discussed above, and assuming a unit rate of approximately $80 per cu yd for treatment, the cost for ISCO treatment would be approximately $480,000. This amount would include preliminary preparation and construction work, application of chemical oxidation treatments and monitoring. Added to this would be the cost for disposal of soil associated with infiltration gallery construction, estimated at $175,000 (1,000 cu yd at an average cost of $175 per cu yd for disposal; i.e., 75% non-hazardous and 25% hazardous disposal). Therefore, the total cost for this alternative is on the order of $655,000.

In situ chemical oxidation is a viable remedial technology for both mass reduction in source areas as well as ground water plume treatment downgradient of the source areas. The alternative is favored as an in situ treatment technique since, if the oxidant is properly delivered to volatile contaminant mass, the destruction is rapid and complete, without formation of toxic transformation byproducts. This treatment method is relatively easy to implement with readily available equipment, is cost-effective relative to alternatives such as full excavation or construction and operation of highly mechanized treatment units. Community acceptance for this alternative is favorable. Potential limitations and considerations include the need for proper handling of oxidizing chemicals; limited effectiveness in some instances due to excessive oxidant demand of the soil/bedrock matrix, and reduction of soil/bedrock permeability (e.g., precipitation of oxidant solids, formation of excessive carbon dioxide levels). The treatment may require multiple applications in order to effectively degrade the contaminants.

<u>Remedial Alternative #2: Other Treatment (Excavation & Offsite Disposal)</u>

Alternative #2 would involve the removal and offsite disposal of source area soil that exhibits CVOC contaminant levels in excess of site RGs. This alternative is not applicable as a direct means of treating CVOC-impacted ground water; however, by removing source area soil with elevated CVOC concentrations, future leaching to ground water would be addressed, and natural attenuation processes may then be sufficient to degrade residual concentrations in the aquifer.

CVOC alternative #2 would involve excavation of approximately 6,000 cu yd of soil from AOCs #13 and #21 for offsite transportation and disposal. No soil excavation would be conducted in AOC #4, as shallow soil in this area was previously remediated during the Step One RA.

Portions of the soil have the potential to exhibit a toxicity characteristic for PCE and/or other volatile compounds under the Resource Conservation and Recovery Act (RCRA). Therefore, pre-removal waste characterization, would be necessary to determine disposal methods.

A complicating factor associated with this alternative involves the proximity of AOC #21 to a steep slope. Deep excavation in this area would result in unstable soil conditions, thus requiring sheeting or other stabilization methods.

The cost to implement this alternative, assuming 6,000 cu yds at an average cost of $175 per cu yd for disposal, plus detailed pre-characterization ($90,000) and slope stabilization in AOC #21 ($40,000) is estimated at $1,180,000.

Removal of contamination from the site, and offsite disposal in a secure facility, provides a rapid and full degree of remediation for source area soil, and complies with applicable regulations. This treatment method is relatively easy to implement with readily available equipment, and offers a high degree of predictability that it will be effective at reducing contaminant concentrations and corresponding site exposure risks. Community acceptance is relatively good, provided that intrusive activities and associated disturbances (airborne dust emissions, truck traffic) are well controlled. The main disadvantages to this option are cost; the lack of a direct ground water treatment component that options such as in situ chemical oxidation provide; and the fact that the contaminants do not undergo permanent destruction, but rather, are transferred to a more secure disposal facility.

Remedial Alternative #3: Containment

This alternative would involve the construction of an engineered cap to cover areas of CVOC soil impacts, minimizing the vertical infiltration of water and reducing the potential for direct exposure. This alternative would not directly address CVOC ground water impacts at the site, but would indirectly assist by significantly reducing future contribution of contaminant mass to the aquifer.

Land use restrictions would need to be implemented for the affected areas, along with a plan for long-term inspection and maintenance of cap integrity. Proper design and installation of an engineered cap is critical to ensure adequate barrier and drainage layer properties. Final design is site-specific and would most likely include the use of low permeability materials such as a compacted clay and/or synthetic membrane to divert water and prevent passage to the impacted soil.

The assumed area requiring capping is approximately 23,950 sq ft, as the entire limits of AOC #13 would need to be included. Costs for this alternative would be on the order of $479,000, assuming a $20 per sq ft unit cost for a design involving a compacted clay and synthetic liner composite, geotextile drainage layer and vegetated soil cover.

While engineered caps are typically the least expensive alternative, in this case, costs are comparable to Alternative #1, primarily because a larger area of AOC #13 would need to be capped if sporadic CVOC detections were not otherwise addressed. Alternative #3 does not lessen the toxicity, mobility, or volume of impacted soil at the site, and future land use would need to be restricted. Also, some amount of residual CVOC contamination present in shallow soil would continue to leach to ground water, even if a cap were installed to limit future infiltration of precipitation. Therefore, this option would not fully reduce the potential for continued migration of contaminants of concern, nor does it provide any measure of direct

treatment for impacted ground water. The level of community acceptance is greater than for the no action alternative, but less preferred than a remedy such as treatment or removal which provides a full and permanent solution.

Remedial Alternative #4: No Action

As previously discussed, the no action alternative is carried through the feasibility study process for comparison with other alternatives. No action is considered in some situations where contaminant concentrations are already sufficiently low, such that the cost of other alternatives cannot be justified relative to the incremental degree of risk reduction. However, in the case of CVOC contamination in soil and ground water at this site, there is the possibility of environmental exposure and continued ground water impacts under a no action scenario. As a result, the no action alternative is inappropriate for dealing with site CVOC impacts.

Cr(VI) in Soil and Ground Water

Shallow soil in AOC #3 exhibits elevated chromium concentrations, primarily Cr(VI) with some elevated total Cr, above health-based and ground-water protection RGs. RI data indicate that the extent of this source area is limited, involving an area of roughly 20 ft by 40 ft, with highest Cr(VI) concentrations in the upper several feet of the subsurface, and lower Cr(VI) levels extending into deeper unsaturated and saturated intervals. Ground water downgradient of AOC #3 is also affected. The preferred remedial alternatives are discussed below.

Remedial Alternative #1: In Situ Chemical/Physical Treatment (Chemical Reduction)

Cr(VI) Remedial Alternative #1 would involve shallow soil removal and in situ chemical reduction using zero valent iron (ZVI), sodium bisulfite or a similar reductant chemical, in order to promote the transformation of chromium from a highly oxidized and soluble Cr(VI) valence state, to a less soluble, less mobile and less toxic form. The reductant would be introduced in solid, slurry or semi-dissolved form to soil and upper bedrock in the source area, via the use of an infiltration gallery and injection well points. If necessary, hydraulic fracturing of upper bedrock would be included to optimize delivery of the reductant chemical. Some degree of treatability studies and/or field-scale pilot testing may be necessary to optimize the treatment system design; however, the technique has been used at a number of sites and is readily implementable. Pre-construction characterization sampling, combined with ground-water and soil monitoring during and following the treatment cycles, would be performed.

The estimated cost for this alternative is approximately $97,500. This amount is based on a total volume of 1,000 cu yds for source area soil and underlying soil/bedrock targeted for treatment, at a unit cost of $80 per cu yd, combined with offsite disposal of approximately 100 cu yds of shallow soil at $175 per cu yd.

In situ chemical reduction is a viable remedial technology for both mass reduction in the source area, as well as for ground water treatment downgradient of the source. The potential benefits

include the rapid reaction of the reductant with Cr(VI). This treatment method can be easily implemented with readily available equipment. It is likely that multiple injections of the chemical reductant would be required in order to effectively degrade the contaminants. Some amount of treatability and/or pilot testing may be helpful in order to optimize the effectiveness of the remedial design.

Remedial Alternative #2: Other Treatment (Excavation & Offsite Disposal)

This alternative would involve the removal and offsite disposal of all source area soil that exhibits Cr(VI) levels in excess of site RGs. For Cr(VI)-impacted soil in AOC #3, the soil removal volume is estimated to be approximately 450 cu yd (i.e., 20 ft x 40 ft x 15 ft deep). Because portions of the soil, if excavated, have the potential to exhibit a toxicity characteristic for one or more compounds under RCRA, detailed pre-remedial grid soil sampling or other characterization methods would be necessary to pre-determine disposal methods (hazardous or non-hazardous).

The costs for this alternative is estimated at $95,000. This amount assumes that a volume of 450 cu yd of soil would be removed, representing source area soil to a depth of approximately 15 ft, but not underlying residues that have migrated to ground water. The estimate also assumes that approximately 75% of the excavated soil would be disposed of as a non-hazardous waste, while approximately 25% would require treatment/disposal as a hazardous waste (average cost of $175 per cu yd). An additional cost of approximately $15,000 is included for pre-disposal characterization.

Excavation and offsite disposal is a well proven and readily implementable technology. Removal of contamination from the site and offsite disposal in a secure facility provides the greatest degree of protection to human health and environment, and complies with applicable regulations. Remedial Alternative #2 offers a high degree of predictability that it will be effective at reducing contaminant concentration and corresponding site exposure risks. The main disadvantages to this option are cost, absence of a direct ground water treatment component, and the fact that the contaminants do not undergo permanent destruction or transformation.

Remedial Alternative #3: Containment

This alternative would involve the construction of an engineered cap over the area of Cr(VI) soil impacts, to minimize direct contact and vertical infiltration of water that would continue to leach contaminants to ground water. Land use restrictions would need to be implemented for the affected area, along with a plan for long-term inspection and maintenance of the cap.

Proper design and installation of an engineered cap is critical to ensure adequate barrier and drainage layer properties. As with the containment option for CVOC impacted source areas, here, the cap would most likely involve a compacted clay and synthetic membrane, with a geotextile drainage layer and vegetated soil cover.

The assumed area requiring capping is approximately 800 sq ft. Costs for construction of a cap would be on the order of $32,000, assuming a $40 per sq ft unit cost (double that for the CVOC areas, due to the very small area involved). Costs associated with long-term inspection and maintenance of the cap are not included.

This alternative reduces the potential for direct contact with contaminated media, and lessens (but does not completely eliminate) further contaminant migration to ground water. The containment option does not lessen the toxicity, mobility, or volume of impacted soil, and provides no component for direct ground water treatment.

Remedial Alternative #4: No Action

The no action alternative is carried through for comparison, and is considered in situations where contaminant concentrations are already relatively low. In the case of Cr(VI) impacts in soil in AOC #3, there is the possibility of environmental exposure and continued contaminant migration to ground water. Therefore, the no action alternative is considered inappropriate for addressing potential exposure risks.

PCBs in Soil

The overall limits of area delineated during the RI as having PCBs in soil above the 1 ppm RG represents approximately 130,000 sq ft. Most impacts appear to be shallow, and are believed to have been caused by surface spillage or application for dust/vegetation control. Several apparently isolated detections of PCBs at depth were observed in the west portion of the impacted area. The volume of impacted soil is estimated at 10,000 CY, with 90 percent assumed to have PCB concentrations greater than 1 ppm but less than 50 ppm, and 10 percent having PCB concentrations above 50 ppm).

Remedial Alternative #1: Other Treatment (Excavation & Offsite Disposal)

Under Remedial Alternative #1 for PCBs, all impacted soil at the site which exceeds the unrestricted RG of 1 ppm would be excavated and disposed of offsite. Pre-remedial characterization sampling would be completed to confirm in detail the horizontal and vertical limits of removal areas, and to sub-divide soil on an “as-found” basis for management and disposal at a municipal solid waste landfill (PCB concentration below 50 ppm), or at a disposal facility for wastes regulated under the Toxic Substances Control Act (TSCA - PCB concentration 50 ppm or above).

Using the above assumptions, combined with unit costs of $75 per cu yd for non-TSCA disposal and $475 per cu yd for TSCA disposal, and allowing up to $140,000 for pre-construction characterization, the cost associated with this alternative is approximately $1,290,000.

Removal of PCB-impacted soil from the site, and offsite disposal in a secure facility, provides a high degree of protection to human health and environment, and complies with applicable

regulations. Remedial Alternative #1 also offers a high degree of predictability that it will be effective at reducing contaminant concentrations and corresponding site exposure risks. The main disadvantages to this option are cost, along with the fact that the contaminants do not undergo permanent destruction.

Remedial Alternative #2: Containment

Remedial Alternative #2 for PCBs would involve leaving PCB-impacted soil in place, and constructing an engineered containment system over the impacted area. In addition, land-use restrictions would be implemented for the affected areas, along with a long term plan for maintaining the structural integrity of the cover.

As with Alternative #1, pre-construction characterization sampling would be needed to verify the limits for final cover design and placement; however, the extent of sampling (in the interior portions of the area) would be much less. Sampling would also need to be completed to confirm that PCBs are not leachable to ground water at concentrations of concern, although TCLP testing results to date have shown that the PCBs are immobile.

For PCBs, the containment system design would be closer to a soil or concrete cover designed to prevent direct exposure and airborne dispersion of dust, rather than a very low permeability barrier for preventing or limiting water movement. As such, an approximate unit cost for construction would be between $5 and $10 per sq ft for clay/soil or concrete, respectively. Assuming the least cost option (clay/soil), and allowing approximately $75,000 for pre-construction characterization, the cost for Alternative #2 is estimated at $725,000 to install an engineered cap over 130,000 sq ft of PCB-impacted soil.

This remedial alternative, involving an engineered soil cover and land-use restrictions, offers a relatively rapid and moderate cost solution for minimizing direct exposure to PCB-impacted soil. However, the alternative does not lessen the toxicity or volume of impacted soil at the site, and does not have good community acceptance.

Remedial Alternative #3: No Action

The no action alternative is considered in some situations, typically where contaminant concentrations are already sufficiently low so that the cost associated with additional action cannot be justified relative to the incremental degree of risk reduction. In the case of PCB-impacted areas at the site, there is the possibility of future exposure under a no action scenario. Therefore, the no action alternative is not appropriate to address potential exposure risks and satisfy remedial goals.

5.0 SELECTION AND DESCRIPTION OF PROPOSED REMEDY

Tables 4 through 6 summarize the previously described analysis and comparison of potentially viable options for remediation of soil and ground water in the primary areas of concern. Based on this evaluation, the following measures have been selected, and form the remedy proposed for implementation during the Step Two RA:

CVOC Impacts - Partial Removal Combined with In Situ Treatment & Monitoring

- Pre-remedial characterization in CVOC source areas AOC #13 and #21, to confirm removal and treatment limits, provide pre-removal waste characterization, and obtain other parameters for final design and construction. This work will be completed separately from this RAP, as part of the Pre-Remedial Characterization Work Plan).
- Baseline ground water, surface water and soil vapor monitoring to establish pre-remedial conditions for tracking the progress of remediation.
- Removal and offsite disposal of shallow soil from CVOC source areas AOC #13 and #21.
- Installation of infiltration galleries, and implementation of an in situ treatment program for chemical oxidation of CVOCs in deeper unsaturated zone soil in AOC #13 and #21.
- Installation of infiltration/injection wells, and in situ chemical oxidation of CVOCs in saturated ground water intervals in the vicinity of CVOC source areas AOCs #4, #13 and #21.
- Confirmatory soil sampling to verify progress toward attainment of soil RGs for CVOCs.
- Ground water, surface water and soil vapor monitoring to track and verify progress of remediation, including reduction of CVOC concentrations in ground water and surface water to RGs.

Cr(VI) Impacts - Partial Removal Combined with In Situ Treatment & Monitoring

- Pre-remedial characterization in Cr(VI) source area AOC #3, to confirm removal and treatment limits, provide pre-removal waste characterization, and obtain other parameters for final design and construction. This work will be completed separately from this RAP, as part of the Pre-Remedial Characterization Work Plan.
- Baseline ground-water and surface water monitoring to establish pre-remedial conditions for tracking the progress of remediation.
- Removal and offsite disposal of shallow soil in Cr(VI) source area AOC #3.
- Installation of an infiltration gallery, and implementation of an in situ treatment program for chemical reduction of Cr(VI) in deeper unsaturated zone soil in AOC #3.
- Installation of infiltration/injection wells, and in situ chemical reduction of Cr(VI) in saturated ground water intervals beneath AOC #3.
- Confirmatory soil sampling to verify progress toward attainment of soil RGs for Cr(VI).
- Ground water and surface water monitoring to track and verify progress toward reduction of Cr(VI) concentrations to RGs.

PCB Impacts - Removal to RGs (Subject to Pre-Remedial Characterization to Confirm Feasibility of Full Removal)

- Pre-remedial characterization to confirm that PCB soil impacts are predominantly shallow and can be feasibly addressed by soil removal. The characterization will also serve to verify in detail the horizontal and vertical limits of soil removal, and provide as-found waste characterization for planning TSCA/non-TSCA waste management. This work will be completed separate from the RAP, as part of the Pre-Remedial Characterization Work Plan.
- Removal and offsite disposal of shallow soil exhibiting PCBs above the 1 ppm RG.
- Confirmatory soil sampling to verify that the soil RG for PCBs has been met.

Other Site Impacts in Minor AOCs - Removal to RGs (Subject to Pre-Remedial Characterization to Confirm Feasibility of Full Removal)

- Pre-remedial characterization sampling, where needed (i.e., in AOC #14 and #16), to confirm limits of removal and characterize soil for waste disposal purposes (completed separately from this RAP, as part of the Pre-Remedial Characterization Work Plan).
- Removal and offsite disposal of soil and other affected media (i.e., residues in site sewers, concrete flooring) exhibiting contaminant concentrations above soil RGs.
- Confirmatory soil sampling to verify that the soil RGs have been met.

The following sections provide a description and conceptual design for the selected remedy. Figure 4 shows the approximate locations of remedial system components.

5.1 CVOC Remediation

Removal of CVOC-Impacted Soil (AOC #13 and #21)

In AOCs #13 and #21, grid soil sampling will be completed separate from this RAP, as part of the Pre-Remedial Characterization Work Plan, to confirm removal limits and pre-characterize soil for waste disposal. Remedial work will then start with the removal of shallow soil overlying areas with CVOC-impacted soil, involving excavation to a depth of approximately 3 ft. Based on the results of pre-remedial characterization sampling and analysis, the excavated soil will be managed either as a non-hazardous solid waste or a RCRA hazardous waste, and transported to the appropriate facility for treatment and disposal. The excavated areas will then be prepared for construction of infiltration galleries in order to implement in situ chemical oxidation, as discussed below.

In Situ Chemical Oxidation of CVOC-Impacted Unsaturated Zone Soil (AOC #13 and #21)

In those portions of AOC #13 and #21 where shallow soil has been excavated for offsite disposal, infiltration galleries will be constructed in order to prepare for the treatment of unsaturated zone soil using in situ chemical oxidation. This will involve multiple applications of chemical oxidant solution, involving potassium permanganate or a similar oxidant (subject to

pre-remedial soil oxidant demand (SOD) analysis and other characterization work). Construction of the infiltration galleries will include vertical drains extending below the bottom elevation of the excavation. The vertical drains will help to facilitate distribution of the oxidant solution to deeper soil intervals. Some or all of the vertical drains may involve soil sampling boreholes completed under the Pre-Remedial Characterization work, which will be backfilled with perforated piping and/or sand.

Above the vertical drains, perforated distribution piping will be laid horizontally along the base of the excavation, between layers of granular material, to allow for the delivery and dispersion of the oxidant solution in the infiltration galleries. Solid piping will extend to a central sump and fill pipe to allow for delivery of the oxidant solution. Vertical riser pipes will also extend to surface for venting, and the areas will be backfilled to surface. See Figure 5 for an illustration of infiltration gallery construction.

Using the sump and distribution piping as the method of oxidant delivery, the oxidant solution will be applied and allowed to permeate via gravity into the unsaturated zone, providing uniform dispersion in a wetting front throughout the contaminated soil column.

Multiple applications of oxidant solution will be conducted at each infiltration gallery, as needed for treatment. The total volume to be applied during each episode will depend on the final infiltration gallery dimensions, on pre-characterization results for parameters such as soil oxidant demand (SOD), and on the estimated volume needed to adequately fill void space in the soil column to be treated. Final design parameters will take into account contaminant and site characteristics, in addition to experience at other sites.

Following one or more episodes of oxidation treatment, soil sampling will be conducted in the treatment areas to help gauge the effectiveness of CVOC reduction. Based on these results, and on results from the ground water and surface water monitoring program, additional episodes of oxidant application may be conducted as necessary in order to achieve further contaminant reduction and attainment of site RGs.

In Situ Chemical Oxidation of CVOC-Impacted Saturated Zone Soil and Ground Water (AOC #13, #21 and #4)

In AOCs #4, #13 and #21, in situ chemical oxidation will also be conducted in the deeper, ground water saturated soil and upper bedrock intervals to help reduce CVOC concentrations in source area ground water. This will involve the construction of well points to allow oxidant delivery.

Hydraulic fracturing may also be utilized as needed, to help provide for efficient oxidant delivery to deeper intervals and less permeable treatment zones. Hydraulic fracturing involves application of water under pressure to form or enlarge voids and increase the effective hydraulic conductivity in the vicinity of the borehole. The process is repeated at various depths within the

injection wells, and may involve placement of granular material to hold voids open, or treatment chemicals in solid form for long-term, slow release treatment.

Once the well points have been installed, injection of the oxidant solution will proceed, with the existing soil pores and bedrock fractures (or enhanced voids, where hydraulic fracturing is performed) providing pathways for distribution of the chemical oxidant. It is anticipated that a minimum of two applications of treatment solution will be conducted at each injection well point for oxidative treatment. Final determination of the make-up and concentration of oxidant solution, and on the rate of application, will be determined following pre-construction characterization. Currently, it is anticipated that the oxidant will be $KMnO_4$ at a 3 to 4 percent solution (by weight), and that at least two applications will be performed over an interval of several weeks to several months.

Ground Water, Surface Water & Soil Vapor Monitoring

A monitoring program will be initiated to gauge the effectiveness of the ISCO treatment in reducing CVOC concentrations in source area soil and bedrock, and in attenuating dissolved CVOC residues in downgradient ground water, surface water and soil vapor. Existing and newly constructed monitoring wells, along with surface water and soil vapor monitoring points installed and sampled during the RI, will be utilized for this program. Based on these results, additional episodes of oxidant injection may be conducted in order to achieve contaminant reduction to levels below site RGs.

5.2 Cr(VI) Remediation

Removal of Cr(VI)-Impacted Soil (AOC #3)

In AOC #3, grid soil sampling will be completed separate from this RAP, as part of the Pre-Remedial Characterization Work Plan, to confirm removal limits and pre-characterize soil for waste disposal. Following this, upper portions of Cr(VI)-impacted soil will be removed. Current estimates are to remove soil from an area measuring approximately 20 ft by 40 ft, to a depth of 3 to 5 ft.

Based on the results of the pre-characterization sampling and analysis, the excavated soil will be managed either as a non-hazardous solid waste or a RCRA hazardous waste, and transported to the appropriate facility for treatment and disposal. The excavated area will then be prepared for implementation of in situ chemical reduction, as discussed below.

In Situ Chemical Reduction of Cr(VI)-Impacted Soil (AOC #3)

Within AOC #3, in situ chemical reduction will be conducted to remediate Cr(VI)-impacted saturated zone soil and ground water. This measure will involve construction of an infiltration gallery, combined with vertical sand drains and injection well points, to allow introduction of the chemical reductant solution into the deeper unsaturated and saturated soil and bedrock zones. As

with the ISCO treatment for deeper CVOC impacts, hydraulic fracturing may be applied where hydraulic conductivity of the formation is deemed insufficient to accept the reductant treatment solution, or where a reductant in slurry or solid form is to be introduced for long-term residual treatment.

The ground water and surface water monitoring program previously discussed for CVOC remediation will similarly be used to gauge the effectiveness of the ZVI treatments in reducing Cr(VI) to site RGs. Existing and newly constructed monitoring wells, along with surface water monitoring points sampled during the RI, will be utilized to assess treatment progress and results. Based on these results, additional episodes of in situ chemical reduction may be conducted in order to achieve site RGs.

5.3 PCB Remediation

Removal of PCB-Impacted Soil

Grid soil sampling will be completed in the PCB-impacted soil areas, separate from this RAP, as part of the Pre-Remedial Characterization Work Plan. Results of this work will help to accurately define the horizontal and vertical limits of removal for PCB-impacted soil exceeding the 1 ppm goal. The sampling will also confirm the locations and limits of any sub-areas having as-found PCB concentrations above the 50 ppm limit, for segregation and management as a TSCA waste. Finally, the pre-remedial characterization will serve to confirm the continued viability of full removal of all PCB-impacted soil to RGs, based on prior estimates of depth, areal extent and quantity requiring management as a TSCA waste.

Following pre-construction sampling and analysis, soil removal activities will proceed. Currently, it is anticipated that soil removal in most areas will be limited to depths of approximately 1 to 2 ft, with limited areas requiring some amount of deeper soil removal. Also, while current estimates assume removal of a fairly large volume of soil (approximately 10,000 cu yd), it is assumed that only about 10% of that total (i.e., 1,000 cu yd or less) will be subject to management as a TSCA waste.

After excavation, confirmatory soil sampling and laboratory analysis will be conducted to verify adequate soil removal (i.e., PCB concentrations below the 1 ppm site RG). Based on the results of these analyses, additional soil removal may be conducted, as required. Soil exceeding as-found PCB concentrations of 1 ppm, but less than 50 ppm, will be transported to a Subtitle D solid waste facility for disposal. Soil exceeding as-found PCB concentrations of 50 ppm will be transported to a TSCA-approved facility for disposal.

5.4 Remediation of Other Soil Impacts

As previously identified during the RI, additional areas exhibiting minor soil impacts have been identified at the site. These impacts are considered to be minimal in terms of the magnitude and extent of contamination. Table 7 summarizes all AOCs identified during the RI, including:

contaminants of concern; media type impacted; estimated horizontal and vertical extent of contamination; and a synopsis of the proposed remedial method. Those areas where additional soil removal and sampling work is planned include AOCs #10 (including residues contained in onsite sewer lines, and impacted soil in identified locations adjacent to the sewers), #14, #16, #19 and the concrete floor slab associated with the former building (which contains PCB residues above the 1 ppm site RG).

For these AOCs, impacted soil and media will be remediated by removal and offsite disposal at a permitted facility. In several areas, pre-remedial characterization sampling will be conducted in order to verify impacts and determine removal limits, followed by excavation and offsite disposal of soil and other residues (i.e., AOC #14 and #16). Following excavation, confirmatory soil sampling and laboratory analysis will be conducted to verify that constituent concentrations are below applicable site RGs.

6.0 JUSTIFICATION FOR SELECTION OF PROPOSED REMEDY

The proposed remedy is supported by the feasibility study, including results of comparison to the eight criteria specified in the REC rules and guidelines. The following discussion provides details in support of this remedy, which focuses on in situ chemical oxidation and in situ chemical reduction technologies, combined with excavation and offsite disposal.

Protection of Human Health and the Environment

Excavation, removal and offsite disposal of impacted shallow soil provides for the protection of human health and the environment by effectively removing the contaminant sources from the site; thereby achieving site RGs for soil, eliminating the potential for human health risks associated with direct contact or other exposure to these chemicals, and preventing release and migration of contaminants into the environment.

Chemical oxidation and reduction technologies, implemented in deeper unsaturated and saturated soil and bedrock intervals, provide for the protection of human health and the environment through rapid and complete chemical destruction of the contaminants of concern in the source area; thereby minimizing further release and migration of contaminants from the source areas to ground water, surface water and other media, and make it possible for remaining, lower concentrations of contaminants downgradient from the source areas to reduce and attenuate.

Compliance with Applicable Federal, State and Local Regulations

The U.S. EPA and NCDENR both recognize excavation and offsite disposal as a viable means to remediate contaminated soil. Removal and disposal in the appropriate licensed, secure facilities provides for compliance with applicable federal, state and local regulations. Soil and other media slated for removal have been, or will be, properly characterized per North Carolina and U.S. EPA regulations and guidelines prior to offsite transportation and disposal. No additional

permit requirements or waivers are currently required for the planned excavation and offsite disposal.

Chemical oxidation and chemical reduction are accepted by U.S. EPA and NCDENR as means for treating contaminants in both soil and ground water. In addition, risk assessments have been completed by NCDENR for injection of a variety of oxidants and reductants as in situ treatment chemicals, and these chemicals have been approved for use. An Application for Permit to Construct and/or Use a Well for Injection (NCDENR Form #UIC-5I/5T) will be submitted to NCDENR for approval prior to implementation of this alternative. Due to the potential hazards associated with the handling of these chemicals, work will be conducted in accordance with OSHA guidelines and supplier recommendations.

Long-Term Effectiveness and Permanence

Excavation and offsite disposal meets the goal of eliminating risk associated with potential exposures to the chemicals of concern, and in reducing or eliminating future releases from affected source areas. This method is an effective, permanent solution for removal of impacted materials from the site.

Chemical oxidation and reduction will effectively and permanently treat the contaminants of concern in both soil and ground water, thereby eliminating long-term risk. In general, these methods are capable of achieving high treatment efficiencies, with relatively rapid reaction times. With adequate dosage and application, source area contaminants should be effectively reduced and downgradient residuals attenuated under this alternative.

Reduction of Toxicity, Mobility and Volume

Excavation and removal provides the most readily implementable and cost-effective means of reducing exposure and migration of contaminants in shallow soil, as well as reducing the volume of impacted materials remaining on the site. Due to the persistent nature of the contaminants (i.e., chlorinated volatile organic compounds, PCBs), excavation and removal to a permitted offsite disposal facility eliminates the potential for future exposure to these compounds.

Chemical oxidation and chemical reduction provide for rapid and effective means of reducing the toxicity, mobility and volume of contaminants of concern in both soil and ground water. These are viable treatment methods for mass reduction in source areas as well as for plume treatment. For this site, where source areas currently have the potential to leach additional contaminants to ground water, chemical oxidation and chemical reduction will target these source areas to significantly reduce the concentration of contaminants available for migration.

Short-Term Effectiveness

Excavation and offsite disposal provides a highly effective means for protection of human health and the environment. During the implementation of this remedy, the greatest potential risk posed

would be the release of contaminated dust or surface runoff during excavation and handling of media. Therefore, engineering controls will be implemented to minimize such releases, and work zone and site perimeter air monitoring will be conducted to ensure that exposure of the local community does not occur.

Chemical oxidation and chemical reduction provide for the rapid and effective reduction of contaminants in both soil and ground water. By delivering the oxidant/reductant in situ, potential exposure is typically limited to onsite personnel. Adequate safety measures will be employed to prevent worker exposure to the oxidants and reductants. In addition, proper storage methods and personnel/perimeter air monitoring will be utilized to prevent potential exposure of the chemicals to workers and the surrounding community.

Implementability

Excavation and offsite disposal is a proven and readily implementable technology for the management of contaminated soil and materials. With properly trained personnel and careful planning and execution, this remedial alternative is expected to be carried out over a relatively brief period. No special equipment beyond typical excavation and material handling equipment will be necessary. Locating and securing approval for disposal of non-hazardous and hazardous soil will be required, but is not expected to pose difficulties for implementation.

Successful implementation of in situ chemical oxidation and reduction rely on proper characterization and screening of site conditions (e.g., soil oxidant demand, contaminant levels). Proper design and construction of the delivery systems (i.e., infiltration gallery, injection wells) will ensure adequate contact of the oxidant and reductant with contaminants in soil and ground water. These systems can be constructed with readily available equipment. Hydraulic fracturing equipment, if needed, is readily available and commonly used for remediation and other subsurface applications. Coordinating this work with contractors who have experience with in situ treatment methods such as chemical oxidation, chemical reduction and hydraulic fracturing will be important to the successful implementation of this alternative. If properly tailored to the site, this technology can be implemented with readily available equipment.

Cost

A preliminary estimate of costs for implementation of this remedy is summarized below.

RA Component	Description	Estimated Cost ($)
CVOCs	Implementation of in situ chemical oxidation, including pre-construction characterization, treatment system construction, application of treatment chemicals and monitoring – 6,000 cu yds @ $80/cu yd	$480,000
	Soil disposal associated with shallow removal & infiltration gallery construction – 1,000 cu yds @ $175/cu yd	$175,000
	Subtotal:	**$655,000**
Cr(VI)	Implementation of in situ chemical reduction, including pre-construction characterization, treatment system construction, application of treatment chemicals and monitoring – 1,000 cu yds @ $80/cu yd	$80,000
	Soil disposal associated with shallow removal & infiltration gallery construction – 100 cu yds @ $175/cu yd	$17,500
	Subtotal:	**$97,500**
PCBs	Pre-construction characterization	$140,000
	Removal & disposal of non-TSCA soil – 9,000 cu yds @ $75/cu yd	$675,000
	Removal & disposal of TSCA soil – 1,000 cu yds @ $475/cu yd	$475,000
	Subtotal:	**$1,290,000**
Other impacts	Pre-construction characterization	$20,000
	Removal & disposal of non-RCRA soil – 2,000 cu yds @ $75/cu yd	$150,000
	Subtotal:	**$170,000**
Other activities	Installation of additional ground-water monitoring wells	$75,000
	Site engineering	$175,000
	Subtotal:	**$250,000**
	Total Estimated Cost:	**$2,462,500**

This cost estimate for implementation of the Step Two RA, combined with costs incurred for the Step One RA (approximately $720,000), result in a total estimated cost for remedial action at the site of $3,182,500. Based on requirements under the REC program, approval from the NCDENR will be required for implementation of the remedy, as total costs are expected to exceed $3 million.

Community Acceptance

During the excavation and offsite disposal activities, engineering controls and monitoring of remedial work will be conducted to ensure that exposure of the surrounding community and onsite workers to contaminants is minimized. Site work will only be conducted during hours permissible by local ordinances, and vehicles entering and leaving the site will be required to comply with all applicable traffic rules and regulations. The remedy is viewed as providing for

community acceptance, in that it removes contaminants from the area, thereby minimizing concerns associated with future exposure.

During implementation of in situ chemical treatment program, appropriate procedures will be in place for storage and handling of the treatment chemicals, in order to minimize potential exposure to site workers and the surrounding community.

7.0 ACTIVITES NECESSARY FOR IMPLEMENTATION

Activities deemed necessary to implement Step Two of the RA are summarized below.

Area Preparation

- Based on results from the pre-remedial characterization, areas targeted for soil removal will be identified and marked. This will include: (a) areas where CVOC and Cr(VI) impacts have been confirmed, and infiltration galleries are planned; (b) areas where PCB concentrations are above the 1 ppm unrestricted use RG, but below 50 ppm; (c) sub-areas where PCB concentrations are greater than 50 ppm; (d) minor AOC areas slated for soil removal.
- All existing monitoring wells within these areas of concern will be marked and secured prior to soil excavation activities.
- Decontamination areas for equipment and personnel will be constructed.

Soil Excavation and Removal Activities

- During soil excavation activities (i.e., loading and unloading), measures will be taken to minimize the generation of dust which may become airborne. Suppression methods include tarps, covers and/or water mist as deemed necessary.
- Upon soil removal, the limits and elevations of the excavated areas will be surveyed, as necessary.

Chemical Oxidation/Reduction Implementation

- Following removal of shallow soil in the CVOC and Cr(VI) impacted AOCs, the excavated areas will be prepared by removing loose debris to provide a level surface, and infiltration galleries will be constructed. Well points for injection and infiltration of in situ treatment chemicals to deeper intervals will also be installed.
- Holding tanks and secondary containment will be provided, as required, to store the chemical oxidants and chemical reductants used for in situ treatment.
- A series of in situ chemical treatments will be then completed in AOCs #3, #4, #13 and #21.

Well Installation/Abandonment and Preparation

- Additional ground-water monitoring wells will be constructed downgradient of CVOC and Cr(VI) source areas for inclusion in the post-remediation monitoring program (work to be completed as part of the Pre-Remedial Characterization Work Plan).
- Monitoring wells considered no longer necessary for future monitoring will be properly abandoned in accordance with NCDENR guidelines.
- Dedicated sampling systems will be installed in monitoring wells included in the long-term ground water monitoring program. See Figure 6 for a site plan of the well network.

Pre-Remediation Ground-Water Sampling

- An initial (baseline) round of ground water and surface water sampling and analysis will be completed. Samples will be analyzed for VOCs and Cr(VI), along with indicator parameters at selected wells to help track the progress of in situ chemical oxidation and reduction (e.g., oxidation reduction potential (ORP), dissolved gases).

Confirmation Sampling and Analysis

Post In Situ Remediation Sampling

- Following application of in situ chemical treatments, confirmation soil sampling will be conducted to assess the progress of contaminant reduction and attenuation in the source areas. Methods will follow the project Sampling & Analysis Plan, the project Quality Assurance Project Plan and REC guidelines. Based on the results of this sampling, additional treatment applications may be conducted, or adjustments made to the treatment approach as deemed necessary.
- A post-remediation ground water, surface water and soil vapor monitoring program will be implemented to track and confirm that constituent concentrations are being reduced, and progress toward site RGs is occurring. Sampling will be conducted on a quarterly basis for the first year, and semi-annually thereafter, until RGs are achieved. Monitoring procedures will be consistent with the project Sampling & Analysis Plan, the project Quality Assurance Project Plan and REC guidelines.

Post Excavation Sampling

- Following excavation of shallow soil, confirmatory soil sampling will be conducted to verify that soil meets applicable site RGs for contaminants of concern. Sampling location, type (i.e., grab, composite), method, and required analysis will be consistent with the project Sampling & Analysis Plan, the project Quality Assurance Project Plan and REC guidelines. Based on these results, additional soil excavation and confirmatory sampling may be conducted, as deemed necessary.

Permits and Other Authorizations

- An Application for Permit to Construct and/or Use a Well(s) for Injection (Form #UIC-5I/5T) will be submitted to the NCDENR Division of Water Quality for infiltration and injection of chemical oxidants and reductants during in situ treatment.
- An access agreement will be developed with Norfolk-Southern Railroad for work planned on facility property, but falling within the railroad right-of-way (primarily soil removal associated with PCB impacts).
- An EPA Notification of Hazardous Waste Activity will be prepare and submitted to reflect anticipated hazardous waste activity during Step Two of the RA.
- A National Pollutant Discharge Elimination System (NPDES) General Permit for storm water discharges associated with construction activities will be obtained for this remedial work, and the required Erosion and Sedimentation Control Plan (ESCP) will be prepared and implemented.

Waste Analysis and Characterization

- Prior to offsite transport and disposal of excavated soil and debris, any materials not already fully pre-characterized will be sampled for purposes of waste characterization, in accordance with NCDENR and RCRA guidelines. Based on these results, excavated material will be categorized as hazardous or non-hazardous for purposes of disposal.

Offsite Transportation and Disposal

- Based on the final waste characterization results, pre-authorizations and approvals will be obtained for transportation and disposal of soil and debris as non-hazardous, hazardous or TSCA wastes.

Site Restoration and Security

- Following soil removal and other remedial activities, excavated areas will be backfilled with clean soil, graded to prevent ponding of water, and re-vegetated. The site will remain fenced and locked during RA activities to prevent unauthorized access.

8.0 TREATABILITY STUDIES AND ADDITIONAL SITE CHARACTERIZATION

Pre-Remedial Characterization

A Pre-Remedial Characterization Work Plan is being submitted to NCDENR separate from this RAP. The Work Plan describes work that will be conducted to help collect additional site data for purposes of final design and implementation of the remedial action (Kelly-Buck, 2008 (b)).

9.0 PROCEDURES AND SCHEDULE FOR REMEDIAL ACTION

A preliminary schedule outlining the Step Two remedial work is provided in Table 8. This schedule is approximate, and will be revised and updated as necessary.

10.0 PROPOSED CRITERIA FOR REMEDIAL ACTION COMPLETION

10.1 Soil Sampling

Following soil excavation and in situ chemical treatment in the remediation areas, sampling will take place to confirm that soil and ground water meet applicable RGs for the chemicals of concern. Sampling protocols will be conducted in accordance with the project Sampling and Analysis Plan (Appendix A) and current REC Program Guidelines. Sampling details are discussed below.

Confirmatory Sampling of In Situ Remediation Areas

Following implementation of in situ chemical treatment, confirmation sampling will be conducted to assess progress toward site RGs. A three-dimensional sampling grid will be developed over the treatment areas, with grid spacing consistent with that shown on Figure 8. At each grid node, candidate sampling locations will be collected at 0 to 6 inches below the base elevation of the infiltration area, and at vertical intervals to the limit of contamination, or to the ground water table. At each node, two samples will be selected for further screening and analysis, using biased and random sample selection.

Same-depth samples at adjacent grid nodes may be composited. For samples submitted for VOC analysis, at least five samples, or a minimum of 25 percent of the node samples, whichever is greater, will be unmixed grab samples. These unmixed grab samples will be evaluated using field methods (i.e., screened with a photoionization detector (PID); evaluated for visible signs of contamination), and selected samples will be submitted for laboratory analysis.

Confirmatory Sampling of Excavated Soil Areas

For soil removal areas, a sampling grid will be established over the base and sidewalls of the excavated area. Grid spacing will typically be 50 ft or less. At each grid node, an individual soil sample will be collected from 0-3 inches into the base or sidewall of the excavation, as applicable. Additional biased samples may also be collected from other areas exhibiting signs of possible residual contamination, and/or from areas where previous RI sampling has indicated contaminants to be above site RGs.

For excavations measuring less than 62,500 sq ft, samples from adjacent grid nodes may be composited. Samples from different sidewalls will not be composited. For samples submitted for VOCs, at least five samples, or 25 percent of the node samples, which ever is greater, will be

unmixed grab samples. For each area, the unmixed grab samples collected from each base and sidewall node will be evaluated using field methods (i.e., screened with a PID; evaluated for visible signs of contamination), and selected samples analyzed individually or as composites, as appropriate.

Confirmatory Sampling Results and Interpretation

Based on the confirmatory sampling results, additional episodes of in situ chemical treatment and additional soil excavation may be necessary where contaminants of concern remain in soil above site RGs.

10.2 Groundwater Sampling

Two types of ground-water monitoring will be conducted in order to assess the effectiveness of the remedial action program. Process and performance monitoring will be completed during the active phase of in situ chemical oxidation and chemical reduction, in order to ensure adequate distribution of treatment chemicals, and to monitor the reduction of contaminants of concern. Post-treatment monitoring will be conducted primarily to verify that residual contaminant concentrations continue to decrease at rates leading toward eventual attainment of RGs. This monitoring program will be conducted at ground water locations identified as part of the post-remediation monitoring network. Also included in this network are the previously identified surface water sampling and soil vapor monitoring points utilized during the RI. Approximate locations of monitoring points are shown on Figure 6.

Process and Performance Monitoring

For areas undergoing in situ chemical treatment for the remediation of ground water (i.e., AOC #3, #4, #13 and #21), a process and performance monitoring program will be implemented to demonstrate and track the attenuation of chemicals of concern in ground water. Information obtained during this assessment will be compared to short-term treatment goals based on the site RGs. Table 9 includes a preliminary timeframe for this monitoring program, along with short-term, interim remedial goals. Highlights of this program are as follows:

- For approximately 12 months following implementation of in situ chemical oxidation/reduction treatments, quarterly ground water, surface water and soil vapor monitoring will be conducted at all points within the network. Samples will be analyzed for VOCs and Cr(VI). Additional in situ treatment indicator parameters, such as oxidation reduction potential, pH, and residual concentrations of the oxidants and reductants, may also be included in the monitoring program as appropriate.

- Following the initial 12 months, monitoring will continue on a semi-annual basis.

- A report will be prepared after each monitoring event, and analytical results compared to the interim goals and final site RGs.

Based on the results of these monitoring events, additional applications of in situ treatment chemicals, and or other remedial measures, may be implemented as deemed necessary. Expansion or other modification of the treatment program will be considered if interim results are not adequate for attainment of final RGs.

Post-Treatment and Closure Monitoring

Confirmation sampling will be completed to demonstrate that site ground water has been remediated to levels below site RGs. This will be demonstrated using the following procedures, in accordance with REC guidelines:

- Ground-water remediation systems may be shut down when two consecutive semiannual sampling events demonstrate that onsite and offsite monitoring wells and other sampling points are free of contamination above site RGs. To account for the effects of seasonal fluctuations in the water table, semiannual sampling events should be conducted in both the winter and summer months.

- Following shut down of the remediation system, data from at least four consecutive quarterly sampling events must demonstrate that monitoring wells and other sampling points within the network are free of contamination above site RGs, and contaminant concentrations are not increasing.

11.0 COMMUNITY HEALTH AND SAFETY PLAN

Adequate measures to protect site personnel and the surrounding community will be implemented, and modified as necessary during site remedial activities. The following discussion is a summary of the requirements found in Appendix B (Project Health and Safety Plan).

- Only authorized personnel will be permitted onsite, and the site will be locked and secured when no activities are occurring.
- Designated work zones (Exclusion Zone, Contaminant-Reduction Zone and Support Zone) will be established, and decontamination procedures will be implemented to prevent contaminant dispersion and offsite migration.
- Suppression measures and other engineering controls (e.g., water misting) will be implemented to minimize dispersion of contaminants.
- Air monitoring will be conducted to verify the effectiveness of engineering controls.
- Controls will be employed to minimize disturbances such as noise and vibration.
- Excavations will be secured with barriers, fencing, covers or other measures, if unable to be backfilled the same day as opened.

12.0 DECONTAMINATION PROCEDURES

Decontamination of personnel and equipment will be conducted to minimize worker exposure to contaminants, prevent the migration of contaminants offsite and to other portions of the site, and to protect the health and safety of the surrounding community. Following is a summary of decontamination requirements (see Appendix B, Health and Safety Plan).

- Separate facilities will be established for equipment leaving the site and for personnel, tools and equipment which are to remain onsite (i.e., leaving the Exclusion Zone).
- Pressure-washers, scrub brush with non-phosphate soap with water rinse and/or other devices will be used as needed for equipment decontamination.
- Facilities used to contain and collect decontamination residues will be constructed of impervious materials and be of sufficient size and shape to contain water and residues.
- All water and residues will be properly managed and characterized prior to offsite transportation and disposal.

13.0 REFERENCES

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TABLES

FIGURES

APPENDIX A

APPENDIX B

TABLES

Table 1. Treatment Technology Screening – *CVOCs in Soil and Ground Water*

Scoring System: Good – 1 point Better – 2 points Best – 3 points		Effectiveness	Implementability	Cost	Total Score	Screening Status
Technology	***Description***					
a. In Situ Biological Treatment	Includes technologies such as bioventing and enhanced bioremediation, and phytoremediation.	2	1	2	5	Not Retained
b. In Situ Chemical/Physical Treatment	Includes technologies such as chemical oxidation/reduction, soil flushing and soil vapor extraction.	3	2	2	*7*	**Retained**
c. Ex Situ Biological Treatment	Includes technologies such as biopiles, composting, constructed wetlands, and landfarming.	2	1	1	4	Not Retained
d. Ex Situ Chemical/Physical Treatment	Includes technologies such as chemical extraction, chemical reduction/oxidation and soil washing.	2	1	1	4	Not Retained
e. In Situ Thermal Treatment	Includes thermal treatment technologies such as steam injection, electrical resistance heating, electromagnetic heating and hot air injection.	3	1	1	5	Not Retained
f. Ex Situ Thermal Treatment	Includes technologies such as incineration, open burning and thermal desorption.	2	1	1	4	Not Retained
g. Containment	Includes engineering controls (i.e., concrete cap, vegetative cover) and land use restrictions.	1	3	3	*7*	**Retained**
h. Other Treatment	Includes excavation, removal and off-site disposal.	3	2	2	*7*	**Retained**
i. No Action	Base option for which all other technologies can be compared to.	1	3	3	*7*	**Retained**

Table 2. Treatment Technology Screening – *Hexavalent Chromium in Soil and Ground Water*

Scoring System: Good – 1 point Better – 2 points Best – 3 points		Effectiveness	Implementability	Cost	Total Score	Screening Status
Technology	***Description***					
a. In Situ Biological Treatment	Includes technologies such as bioventing, enhanced bioremediation, and phytoremediation.	1	1	2	4	Not Retained
b. In Situ Chemical/Physical Treatment	Includes technologies such as chemical oxidation/reduction, soil flushing and soil vapor extraction.	2	2	2	*6*	**Retained**
c. Ex Situ Biological Treatment	Includes technologies such as biopiles, composting, constructed wetlands, and landfarming.	1	1	1	3	Not Retained
d. Ex Situ Chemical/Physical Treatment	Includes technologies such as chemical extraction, chemical reduction/oxidation and soil washing.	1	1	1	3	Not Retained
e. In Situ Thermal Treatment	Includes thermal treatment technologies such as steam injection, electrical resistance heating, electromagnetic heating and hot air injection.	1	1	1	3	Not Retained
f. Ex Situ Thermal Treatment	Includes technologies such as incineration, open burning and thermal desorption.	1	1	1	3	Not Retained
g. Containment	Includes engineering controls (i.e., concrete cap, vegetative cover) and land use restrictions.	1	3	3	*7*	**Retained**
h. Other Treatment	Includes excavation, removal and off-site disposal.	3	2	2	*7*	**Retained**
i. No Action	Base option for which all other technologies can be compared to.	1	3	3	*7*	**Retained**

Table 3. Treatment Technology Screening – *PCBs in Soil*

Scoring System: Good – 1 point Better – 2 points Best – 3 points		Effectiveness	Implementability	Cost	Total Score	Screening Status
Technology	***Description***					
a. In Situ Biological Treatment	Includes technologies such as bioventing, enhanced bioremediation, and phytoremediation.	1	1	2	4	Not Retained
b. In Situ Chemical/Physical Treatment	Includes technologies such as chemical oxidation/reduction, soil flushing and soil vapor extraction.	1	2	2	5	Not Retained
c. Ex Situ Biological Treatment	Includes technologies such as biopiles, composting, constructed wetlands, and landfarming.	1	1	1	3	Not Retained
d. Ex Situ Chemical/Physical Treatment	Includes technologies such as chemical extraction, chemical reduction/oxidation and soil washing.	1	1	1	3	Not Retained
e. In Situ Thermal Treatment	Includes thermal treatment technologies such as steam injection, electrical resistance heating, electromagnetic heating and hot air injection.	1	1	1	3	Not Retained
f. Ex Situ Thermal Treatment	Includes technologies such as incineration, open burning and thermal desorption.	1	1	1	3	Not Retained
g. Containment	Includes engineering controls (i.e., concrete cap, vegetative cover) and land use restrictions.	2	3	2	*7*	**Retained**
h. Other Treatment	Includes excavation, removal and off-site disposal.	3	2	2	*7*	**Retained**
i. No Action	Base option for which all other technologies can be compared to.	1	3	3	*7*	**Retained**

Table 4. Evaluation of Available Remedial Alternatives – *CVOCs*

Good ■ Better ▲ Best ● **Technology** (Ranked in Order of Preference)	**Protection of Human Health and the Environment**	**Compliance with Applicable Federal, State and Local Regulations**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility and Volume**	**Short Term Effectiveness**	**Implementability**	**Cost**	**Community Acceptance**	**Status**
1. In Situ Chemical/Physical Treatment (Chemical Oxidation)	●	●	●	●	●	■	■	▲	**Selected**
2. Other Treatment (Removal and Off-Site Disposal)	▲	▲	▲	▲	▲	●	■	▲	**Selected**
3. Containment	●	▲	■	■	▲	■	●	▲	Not Selected
4. No Action	■	■	■	■	■	●	●	■	Not Selected

Table 5. Evaluation of Available Remedial Alternatives – *Cr(VI)*

Good ■ Better ▲ Best ● **Technology** (Ranked in Order of Preference)	**Protection of Human Health and the Environment**	**Compliance with Applicable Federal, State and Local Regulations**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility and Volume**	**Short Term Effectiveness**	**Implementability**	**Cost**	**Community Acceptance**	**Status**
1. In Situ Chemical/Physical Treatment (Chemical Oxidation)	●	●	●	●	●	■	■	▲	**Selected**
2. Other Treatment (Removal and Off-Site Disposal)	▲	▲	▲	▲	▲	●	■	▲	**Selected**
3. Containment	●	▲	▲	■	▲	■	●	▲	Not Selected
4. No Action	■	■	■	■	■	●	●	■	Not Selected

Table 6. Evaluation of Available Remedial Alternatives - *PCBs*

Good ■ Better ▲ Best ● **Technology** (Ranked in Order of Preference)	**Protection of Human Health and the Environment**	**Compliance with Applicable Federal, State and Local Regulations**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility and Volume**	**Short Term Effectiveness**	**Implementability**	**Cost**	**Community Acceptance**	**Status**
1. Other Treatment (Removal and Off-Site Disposal)	●	▲	●	●	▲	■	■	▲	**Selected**
2. Containment	▲	▲	▲	■	▲	■	●	▲	Not Selected
3. No Action	■	■	■	■	■	●	●	■	Not Selected

Table 7.
Summary of RI Results

Area Of Concern (AOC #)	Description (Location)	Contaminants of Concern (COCs) [i.e., VOCs, SVOCs, Metals, PCBs]	Media Contaminated (Soil = S, Ground Water = GW, Surface Water = SW)	Horizontal Extent of Contamination	Vertical Extent of Contamination	Planned Remedial Method	Anticipated Date of Implementation	Anticipated Date of Completion
1	Chip Hopper	VOCs, Metals, PCBs	S	Approximately 100 ft (E-W) x 50 ft (N-S)	Approximately 4 ft	Remediate in conjunction with planned methods for PCB Impacts	Spring 2008	Fall 2008
2	Northeast Dock	PCBs	S	Approximately 100 ft (E-W) x 50 ft (N-S)	Approximately 4 ft	Remediate in conjunction with planned methods for PCB Impacts	Spring 2008	Fall 2008
3	Former Chrome Plating Area	Metals (CR(VI))	S, GW	Approximately 40 ft (E-W) x 55 ft (N-S)	Approximately 15 ft	1. Excavation & off-site disposal of shallow soil 2. In Situ Chemical Reduction of soil and ground water	Spring 2008	Fall 2008
4	Former Solvent Degreaser Area	VOCs	S, GW	Approximately 40 ft (E-W) x 55 ft (N-S)	Approximately 15 ft	1. Excavation & off-site disposal of shallow soil (completed during Step One RA) 2. In Situ Chemical Oxidation (ISCO) of soil and ground water	Spring 2008	Fall 2008
5	Former Solvent Degreaser Area	NA	-	-	-	-	-	-
6	Former Solvent Degreaser Area	VOCs, Metals, PCBs	S, GW	Each Pit Approximately 8 ft (E-W) x 30 ft (N-S)	Approximately 6 ft	1. Excavation and off-site disposal of soil and pit debris	Completed under RAP Step One	Completed under RAP Step One
7	Former Solvent Degreaser Area	NA	-	-	-	-	-	-
8	Former Solvent Degreaser Area	NA	-	-	-	-	-	-
9	Former Solvent Degreaser Area	NA	-	-	-	-	-	-
10	Storm Sewers	VOCs, Metals, PCBs	S	Approximately 400 ft (E-W) North Storm 200 ft (E-W) South Storm	Approximately 4 ft	1. Excavation and off-site disposal of storm sewers, sediment and surrounding soil, as necessary	Summer 2008	Fall 2008
11	Furnace Pit	VOCs	-	-	-	-	-	-
12	Steel Wash Tank (North-Central Portion of Former Building)	VOCs, PCBs, Metals	S	Approximately 35 ft (E-W) x 30 ft (N-S)	Approximately 10 ft	1. Excavation and off-site disposal of soil	Spring 2008	Fall 2008
13	Oil Storage Hut (Northwest portion of former building)	VOCs, PCBs	S, GW	Approximately 300 ft (E-W) x 60 ft (N-S)	Approximately 15 to 25 ft	1. Excavation & off-site disposal of shallow soil 2. In Situ Chemical Oxidation (ISCO) of soil and ground water	Spring 2008	Fall 2008
14	Old Steel Drums and Debris; Test Pits	VOCs, SVOCs, PCBs	S	Approximately 100 ft (E-W) x 100 ft (N-S); Other minor areas	Assumed to be < 5 ft	1. Excavation & off-site disposal of shallow soil and debris	Summer 2008	Fall 2008

Table 7.
Summary of RI Results

Area Of Concern (AOC #)	Description (Location)	Contaminants of Concern (COCs) [i.e., VOCs, SVOCs, Metals, PCBs]	Media Contaminated (Soil = S, Ground Water = GW, Surface Water = SW)	Horizontal Extent of Contamination	Vertical Extent of Contamination	Planned Remedial Method	Anticipated Date of Implementation	Anticipated Date of Completion
15	Creosote-Treated Flooring System	SVOCs	Wood flooring, subbase, S	40,000 sq ft	1.5 ft (flooring system) 1.0 ft (soil)	1. Excavation and off-site disposal of flooring system and soil	Completed under RAP Step One	Completed under RAP Step One
16	Hazardous Material Storage Buildings (South Central Property)	VOCs, Metals (vinyl chloride in GW only)	S, GW	Approximately 80 ft (E-W) x 60 ft (N-S)	Approximately 16 ft	1. Excavation & off-site disposal of shallow soil 2. Ground water to be addressed in conjunction with other planned CVOC treatment (i.e., ISCO)	Spring 2008	Fall 2008
17	Air Compressor Room	NA	-	-	-	-	-	-
18	Old Heat Treat Pit (Southeast Portion of Former Building)	SVOCs, PCBs, Metals	-	-	-	-	-	-
19	Metal Prep Pit (Central Portion of Former Building)	VOCs, SVOCs, PCBs, Metals	S, Pit Residues	Approximately 20 ft (E-W) x 60 ft (N-S)	< 5 ft	1. Excavation & off-site disposal of shallow soil	Spring 2008	Fall 2008
20	CNC Pit (Southwest Corner of Former Building)	NA	-	-	-	-	-	-
21	West Debris Field (West of Former Building, Outside Fence)	VOCs, SVOCs, PCBs	S, GW	Approximately 80 ft x 80 ft	Approximately 25 ft	1. Excavation & off-site disposal of shallow soil 2. In Situ Chemical Oxidation (ISCO) of soil and ground water	Spring 2008	Fall 2008
PCB Impacts	Site-Wide PCB Impacts	PCBs	S	Approximately 800 ft (E-W) x 200 ft (N-S)	Typically < 5 ft; Isolated Areas between 5 ft and 25 ft	1. Excavation & off-site disposal of shallow soil and debris 2. Industrial/Commercial RGs with LURs	Spring 2008	Fall 2008

NA - Determined not to be a source of contamination based on results of the previous Remedial Investigation (RI).

Table 8. Preliminary Project Schedule - Step Two Remedial Action

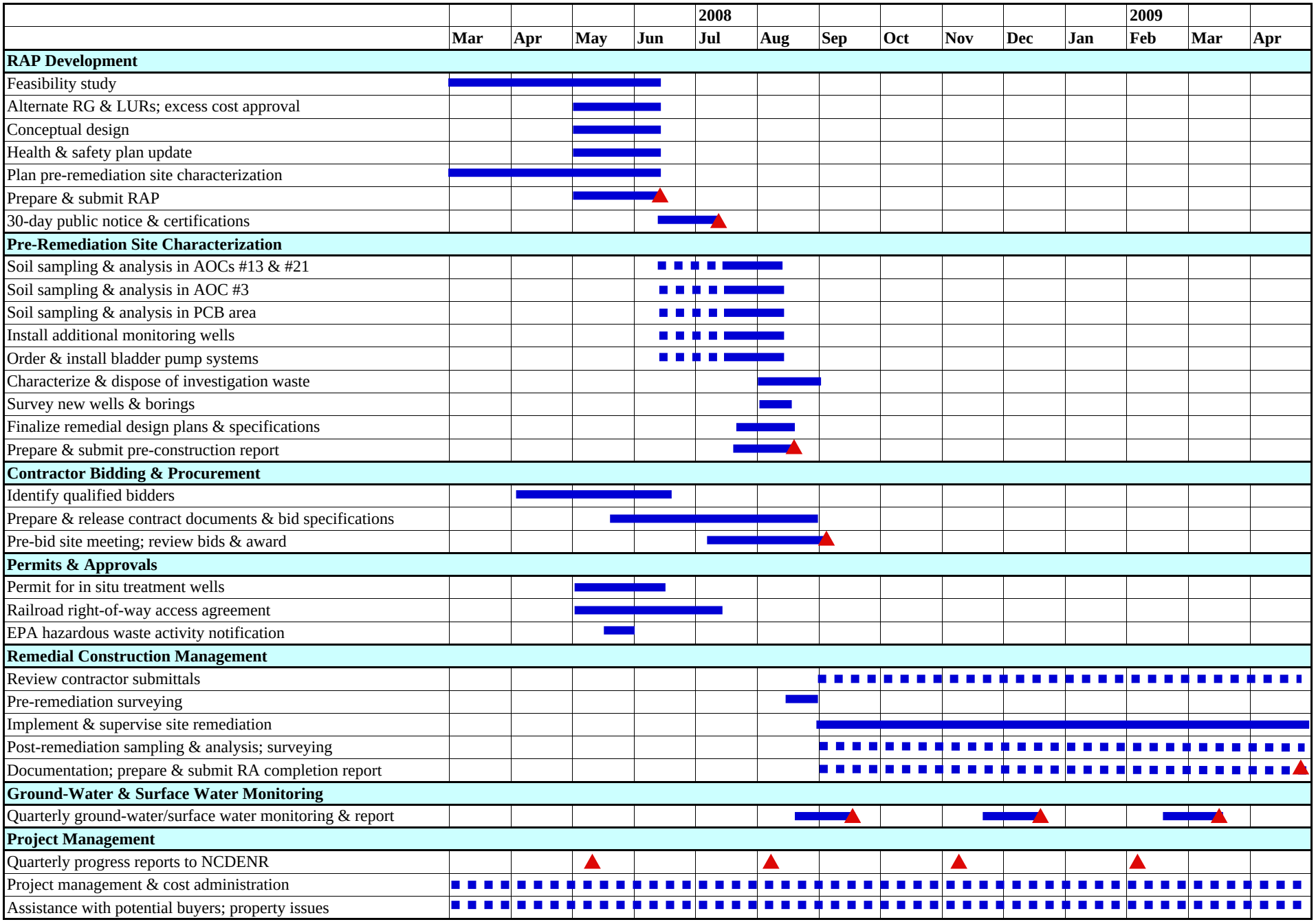


Table 9. Interim Remediation Goals for Ground Water and Soil
(for initial application in or near source areas)

Interim 1st Quarter Remediation Goals for Soil & Ground Water – CVOCs

Constituent	Remediation Goal for Soil – *Health-Based* (ug/Kg – total analysis)	Remediation Goal for Soil – *Protection of Ground Water* (ug/Kg – total analysis)	Remediation Goal for Ground Water (ug/L) & Soil – *Protection of Ground Water* (ug/L – TCLP analysis)
VOCs			
1,1 Dichloroethene	NA	NA	**28**
cis-1,2-Dichloroethene	**34,400**	**5,600**	**NA**
Methylene Chloride	**36,400**	**NA**	**NA**
Naphthalene	**44,800**	**1,680**	**84**
Tetrachloroethene	**1,920**	**56**	**2.8**
Trichloroethene	**NA**	**224**	**11.2**
Vinyl chloride	**316**	**1**	**0.06**
Xylenes (total)	**216,000**	**NA**	**NA**

Interim 4th Quarter Remediation Goals for Soil & Ground Water – CVOCs

Constituent	Remediation Goal for Soil – *Health-Based* (ug/Kg – total analysis)	Remediation Goal for Soil – *Protection of Ground Water* (ug/Kg – total analysis)	Remediation Goal for Ground Water (ug/L) & Soil – *Protection of Ground Water* (ug/L – TCLP analysis)
VOCs			
1,1 Dichloroethene	NA	NA	**14**
cis-1,2-Dichloroethene	**17,200**	**2,800**	**NA**
Methylene Chloride	**18,200**	**NA**	**NA**
Naphthalene	**22,400**	**840**	**42**
Tetrachloroethene	**960**	**28**	**1.4**
Trichloroethene	**NA**	**112**	**5.6**
Vinyl chloride	**158**	**1**	**0.03**
Xylenes (total)	**108,000**	**NA**	**NA**

Table 9. Interim Remediation Goals for Ground Water and Soil (for initial application in or near source areas) (cont.)

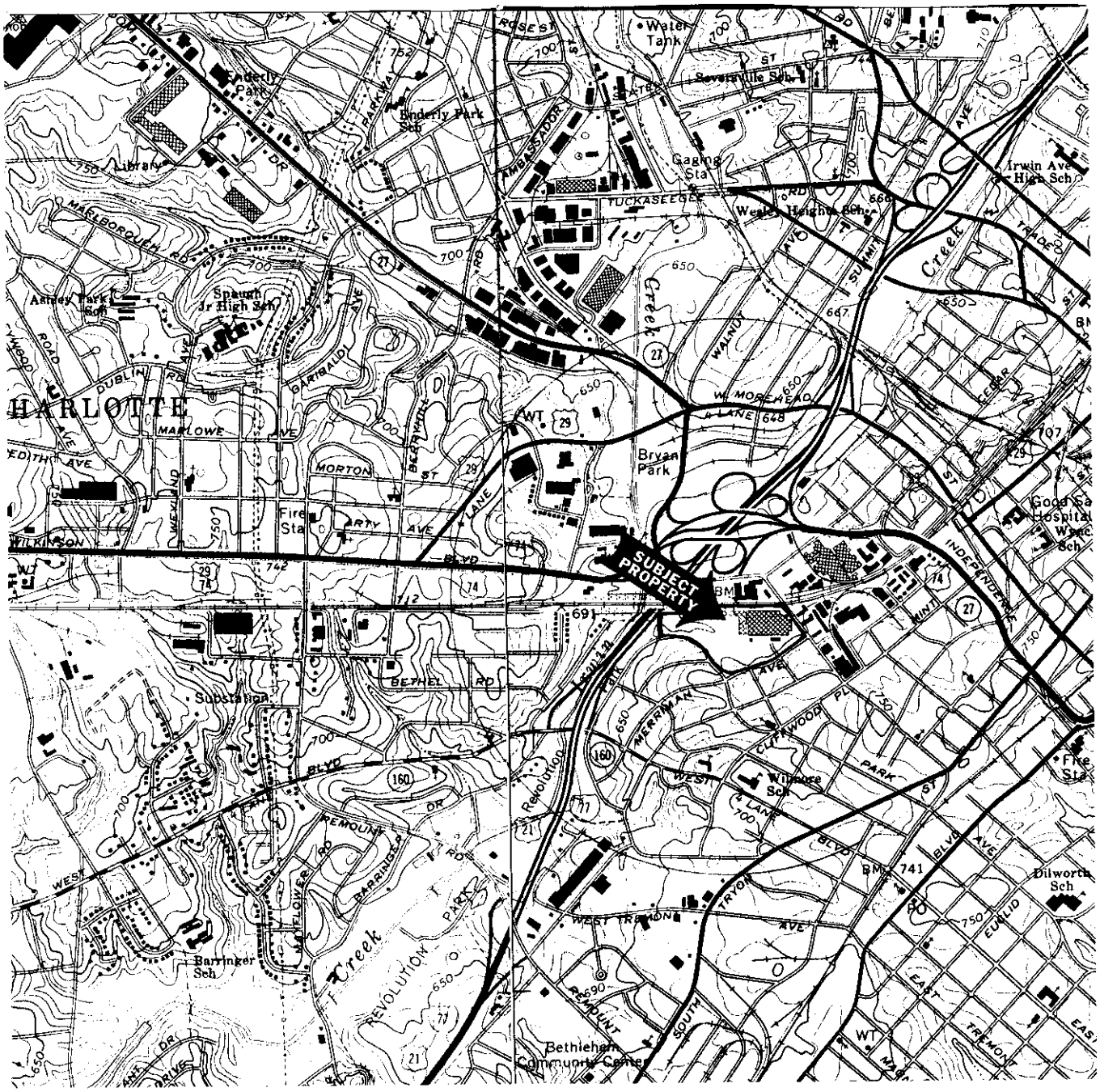
Interim 1st Quarter Remediation Goals for Soil & Ground Water – Cr

Constituent	Remediation Goal for Soil – *Health-Based* (ug/Kg – total analysis)	Remediation Goal for Soil – *Protection of Ground Water* (ug/Kg – total analysis)	Remediation Goal for Ground Water (ug/L) & Soil – *Protection of Ground Water* (ug/L – TCLP analysis)
Chromium, Total	**96,000,000**	NA	**200**
Chromium, Hexavalent	**176,000**	**NA**	**88**

Interim 4th Quarter Remediation Goals for Soil & Ground Water – Cr

Constituent	Remediation Goal for Soil – *Health-Based* (ug/Kg – total analysis)	Remediation Goal for Soil – *Protection of Ground Water* (ug/Kg – total analysis)	Remediation Goal for Ground Water (ug/L) & Soil – *Protection of Ground Water* (ug/L – TCLP analysis)
Chromium, Total	**48,000,000**	NA	**100**
Chromium, Hexavalent	**88,000**	**NA**	**44**

FIGURES



APPROXIMATE SCALE 1 INCH = 2,000 FEET

Map Source: U.S. GEOLOGICAL SURVEY

APPROXIMATE NORTH

FIGURE 1. SITE LOCATION MAP

SUBJECT PROPERTY
CHARLOTTE, NORTH CAROLINA

Project No. 2001.01.07.10

The Kelly-Buck Company
2130 Superior Avenue #3-A
Cleveland, Ohio 44114
(216) 861-1716

KELLY-BUCK

THIS SURVEY IS CERTIFIED TO ONLY ELECTROLUX HOME PRODUCTS, INC.:
STATE OF NORTH CAROLINA, Mecklenburg County
This is to certify that this map or plat and the survey on which it is based were made in accordance with "Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys," jointly established and adopted by ALTA, ACSM and NSPS in 1999, and includes items 1–4, 6, 7a, 8–10, and 11a of Table A thereof. Pursuant to the Accuracy Standards as adopted by ALTA, NSPS, and ACSM and in effect on the date of this certification, undersigned further certifies that proper field procedures, instrumentation, and adequate survey personnel were employed in order to achieve results comparable to those outlined in the "Minimum Angle, Distance, and Closure Requirements for Survey Measurements Which Control Land Boundaries for ALTA/ACSM Land Title Surveys.

I, Andrew G. Zoutewelle, do hereby certify that this map was drawn from an actual field survey performed under my supervision; that the precision is 1:15,000; that the angular precision is less than 7.5 seconds per angle; that this map meets GS-47 recording requirements.

Andrew G. Zoutewelle L-3098

LEGEND

ch.	chord
L,R	curve length & radius
s.f.	square feet (by coordinates)
I.PIN/I.PIPE	iron survey stake
conc.	concrete
a/c	air conditioner
MB, DB	record map and deed references
SSMH	Sanitary Sewer Manhole
MH	Manhole
PM	Power meter
NIP	New Iron Pin/Pipe set
	Light Pole
	Power Pole
	Ground light
	Catch basin
GAS	Gas valve
	Water valve
	Water meter
	Fire Hydrant
	Underground water line
GAS	Underground gas line
T	Underground Telephone line
	monitoring well (see detail)
	soil boring location
x	spot elevation
	surface water/sediment sample

This plat is not subject to the provisions of the City of Charlotte Subdivision Ordinance and does not require the approval of the Charlotte–Mecklenburg Planning Commission. Further subdivision of this property may be subject to these provisions.

Planning Commission Staff Date

I, _____, Review Officer of City of Charlotte, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

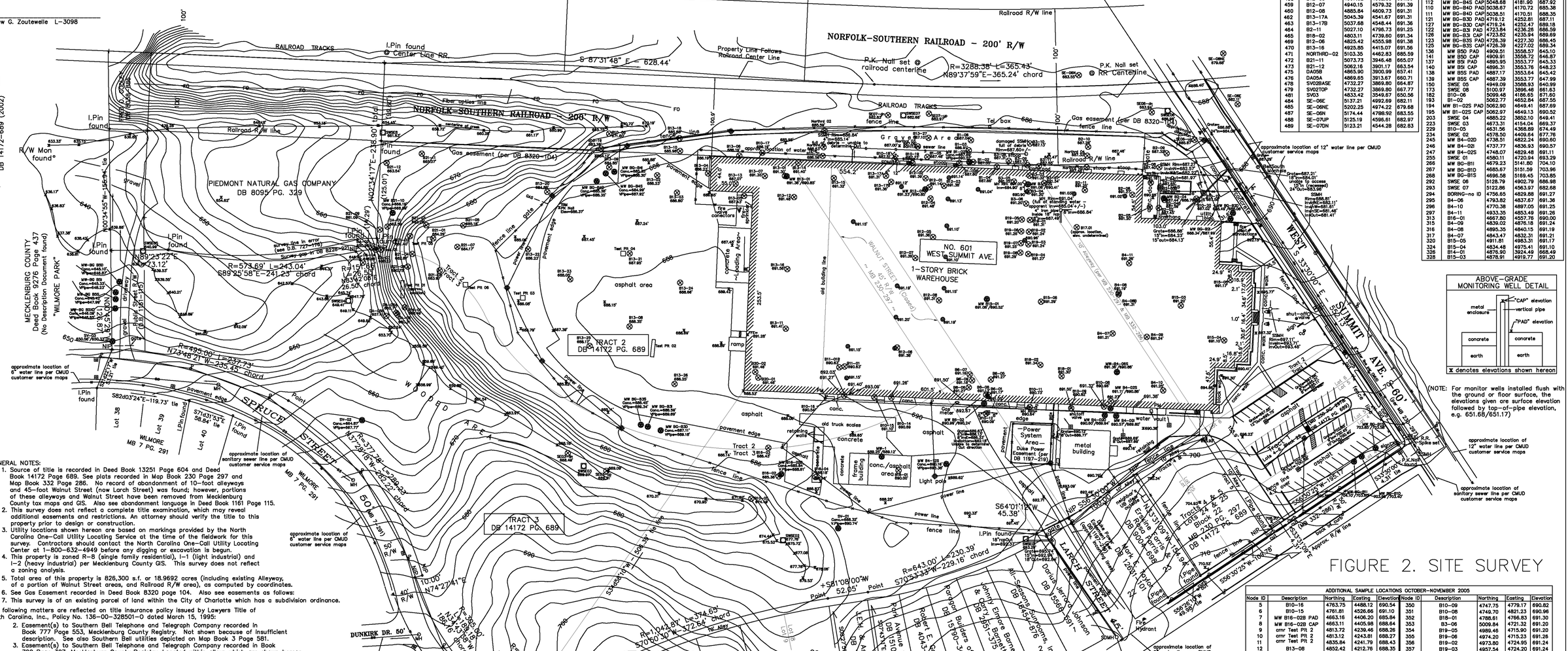
Review Officer Date

COPYRIGHT 2006

PHYSICAL SURVEY OF 601 WEST SUMMIT AVENUE

CHARLOTTE, MECKLENBURG COUNTY, N.C.
for ELECTROLUX HOME PRODUCTS, Inc.
Survey Date: March 25, 2004

Revised: July 21, 2004 (additional scope: spots, borings, etc.)
Revised: August 25, 2004 (additional boring, drain info.)
Revised: September 7, 2004 (additional mon. well/utility info)
Revised: October 8, 2004 (overlay city topo information)
Revised: November 11, 2005 (additional borings, pits, etc)
Revised: May 18, 2006 (additional borings information)
Revised: June 2/6, 2006 (address client comments)



ADDITIONAL SAMPLE LOCATIONS APRIL – MAY 2006								
Node ID	Description	Northing	Easting	Elevation	Node ID	Description	Northing	Easting	Elevation
426	B13–26	4778.63	4270.55	688.25	1	MW B12–01	5028.10	4592.13	691.23
427	B16–03	4696.84	4390.79	686.43	8	MW B2–04	5016.63	4897.90	687.44
428	B16–04	4659.30	4451.27	686.18	23	MW BG–B2D	4997.88	4985.54	688.49
429	SV01 BASE	4593.92	4480.32	688.32	24	MW BG–B2E	4990.52	4991.20	688.34
430	SV01 TOP	4593.63	4480.15	690.74	37	B12–01	5030.94	4597.48	691.14
436	B13–25	4827.52	4161.65	688.17	39	MW B15–01	4887.50	4671.02	691.06
437	B13–23	4912.86	4136.74	688.05	42	MW B3–02S	5035.55	4722.19	691.08
438	B13–21	4945.91	4212.90	687.95	43	MW B13–01	5044.90	4414.29	691.36
439	B13–24	4908.46	4277.66	688.66	44	B13–07	4936.39	4412.11	691.30
442	B13–18	5093.61	4278.93	685.65	56	B6–01	4784.32	4673.45	691.17
443	B13–19	5050.32	4176.26	683.75	57	B8–05	4764.67	4669.98	691.13
445	B13–22	4951.30	4082.72	686.23	58	B6–08	4784.34	4676.15	691.19
446	NORTHRD–01	5082.10	4461.71	686.63	59	B6–06	4774.31	4647.81	691.19
447	NORTHRD–03	5083.10	4582.49	687.09	60	B6–07	4790.73	4648.90	691.16
448	B13–27	5094.02	4596.27	687.10	61	B6–09	4783.18	4652.08	691.18
450	NORTHRD–04	5071.16	4799.76	687.33	65	MW–1	4885.57	4536.15	689.24
451	B2–10	5082.55	4800.92	687.28	69	B11–01	4801.08	4485.61	690.63
452	NORTHRD–05	5056.38	4798.92	687.48	74	MW B6–02	4753.81	4667.34	690.99
453	B2–09	5074.19	4901.53	687.32	90	B15–02	4860.30	4404.04	685.38
455	B13–20	5024.84	4107.27	684.88	95	MW B4–12S PAD	4676.08	4618.83	690.16
458	B12–05	4987.02	4602.00	691.56	96	MW B4–12S CAP	4676.05	4618.94	693.38
459	B12–07	4940.15	4579.32	691.39	108	MW BG–B4I PAD	5050.55	4193.40	685.35
460	B12–08	4885.84	4609.73	691.31	113	MW BG–B4I CAP	5050.67	4193.13	688.30
462	B13–17A	5045.39	4541.67	691.31	109	MW BG–B4S PAD	5048.53	4182.29	684.99
463	B13–17B	5037.68	4548.44	691.36	112	MW BG–B4S CAP	5048.68	4181.90	687.92
464	B2–11	5027.10	4798.73	691.25	110	MW BG–B4D PAD	5035.57	4170.72	685.36
465	B18–02	4803.11	4739.60	691.34	111	MW BG–B4D CAP	5038.51	4170.51	688.35
469	B12–06	4825.42	4355.98	691.38	121	MW BG–B3D PAD	4719.12	4252.81	687.11
470	B13–16	4925.85	4415.07	691.56	127	MW BG–B3D CAP	4719.24	4252.47	689.18
471	NORTHRD–02	5103.35	4462.83	685.59	122	MW BG–B3I PAD	4723.84	4236.26	686.59
472	B21–11	5073.73	3946.48	665.07	126	MW BG–B3I CAP	4723.82	4235.94	689.69
473	B21–12	5062.16	3901.17	663.54	123	MW BG–B3S PAD	4726.39	4227.30	686.45
475	DA02S8	4865.90	3900.99	657.41	125	MW BG–B3S CAP	4726.39	4227.02	689.34
476	DA05A	4869.65	3913.67	660.71	136	MW B5D PAD	4909.51	3558.57	645.10
478	SV02BASE	4732.27	3869.80	664.87	141	MW B5D CAP	4909.91	3558.72	646.87
479	SV02TOP	4732.27	3869.80	667.77	137	MW B5I PAD	4895.95	3553.77	645.33
481	SV03	4833.42	3549.67	650.56	140	MW B5I CAP	4896.31	3553.76	648.23
484	SE–06E	5137.21	4992.69	682.11	138	MW B5S PAD	4887.17	3553.54	645.42
485	SE–06INE	5202.25	4974.22	679.68	139	MW B5S CAP	4887.39	3553.77	647.99
487	SE–06N	5174.44	4788.92	683.55	150	SWSE 05	4949.09	3588.93	640.99
488	SE–07UP	5125.19	4596.51	682.97	173	SWSE 08	5100.97	3696.46	661.63
489	SE–07DN	5123.21	4544.26	682.83	182	B10–06	5099.48	4186.65	671.60
					193	B1–02	5062.77	4652.84	687.55
					194	MW B1–02S PAD	5062.90	4649.41	687.59
					195	MW B1–02S CAP	5062.97	4649.13	690.52
					203	SWSE 04	4885.22	3852.10	649.41
					223	SWSE 03	4673.31	4154.04	669.37
					229	B10–05	4631.56	4368.89	674.49
					234	SWSE 02	4576.50	4409.54	677.76
					245	MW B4–02D	4738.51	4822.24	690.60
					246	MW B4–02I	4737.77	4836.93	690.57
					247	MW B4–02S	4748.07	4829.48	691.11
					255	SWSE 01	4580.11	4720.94	693.29
					266	MW BG–B1I	4679.23	5141.80	704.10
					267	MW BG–B1D	4685.67	5151.59	703.96
					268	MW BG–B1S	4696.58	5169.45	703.85
					292	SWSE 06	5128.79	4557.67	686.98
					293	SWSE 07	5122.86	4563.97	682.68
					294	BORING–no ID	4756.65	4829.88	691.27
					295	B4–06	4793.82	4837.67	691.36
					296	B4–10	4770.38	4897.05	691.25
					297	B4–11	4933.35	4853.49	691.26
					313	B16–01	4667.80	4557.76	690.00
					315	B4–09	4839.02	4876.18	691.24
					316	B4–08	4895.35	4840.15	691.19
					317	B4–07	4943.47	4832.31	691.21
					320	B15–05	4911.81	4983.31	691.17
					324	B15–04	4834.48	4975.41	691.10
					326	B14–01	4876.90	3924.49	668.49
					328	B15–03	4878.91	4919.77	691.20

ABOVE–GRADE MONITORING WELL DETAIL

(NOTE: For monitor wells installed flush with the ground or floor surface, the elevations given are surface elevation followed by top–of–pipe elevation, e.g. 651.66/651.17)

GENERAL NOTES:

1. Source of title is recorded in Deed Book 13251 Page 604 and Deed Book 14172 Page 689. See plats recorded in Map Book 230 Page 297 and Map Book 332 Page 286. No record of abandonment of 10–foot alleyways and 45–foot Walnut Street (now Larch Street) was found; however, portions of these alleyways and Walnut Street have been removed from Mecklenburg County tax maps and GIS. Also see abandonment language in Deed Book 1161 Page 115.
2. This survey does not reflect a complete title examination, which may reveal additional easements and restrictions. An attorney should verify the title to this property prior to design or construction.
3. Utility locations shown hereon are based on markings provided by the North Carolina One–Call Utility Locating Service at the time of the fieldwork for this survey. Contractors should contact the North Carolina One–Call Utility Locating Center at 1–800–632–4949 before any digging or excavation is begun.
4. This property is zoned R–8 (single family residential), I–1 (light industrial) and I–2 (heavy industrial) per Mecklenburg County GIS. This survey does not reflect a zoning analysis.
5. Total area of this property is 826,300 s.f. or 18.9692 acres (including existing Alleyway, of a portion of Walnut Street areas, and Railroad R/W area), as computed by coordinates.
6. See Gas Easement recorded in Deed Book 8320 page 104. Also see easements as follows:
7. This survey is of an existing parcel of land within the City of Charlotte which has a subdivision ordinance.

The following matters are reflected on title insurance policy issued by Lawyers Title of North Carolina, Inc., Policy No. 136–00–328501–0 dated March 15, 1995:

2. Easement(s) to Southern Bell Telephone and Telegraph Company recorded in Book 777 Page 553, Mecklenburg County Registry. Not shown because of insufficient description. See also Southern Bell utilities depicted on Map Book 3 Page 581.
3. Easement(s) to Southern Bell Telephone and Telegraph Company recorded in Book 790 Page 307, Mecklenburg County Registry. Located within alleys which are shown hereon.
4. Easement(s) to Southern Bell Telephone and Telegraph Company recorded in Book 1091 Page 429, Mecklenburg County Registry. Not shown because of insufficient description; easement is far 1 pole another.
5. Easement(s) to Duke Power Company recorded in Book 1197 Page 219, Mecklenburg County Registry. Shown hereon.
7. Deed recorded in Book 1161 Page 115, Mecklenburg County Registry, dedicates a strip of land at the westerly margin of the subject property to public use. Shown hereon.

FLOOD NOTES:
* The subject property is not located within a Special Flood Hazard Area as per FIRM Panel No. 370159 0186E dated February 4, 2004.

TOPO NOTE:
* The contour lines shown hereon were taken from City of Charlotte topographic map which is based upon aerial photography and should be considered approximate NAVD 1988 datum.

LEGAL DESCRIPTION

BEING all that certain tract or parcel of land located within the City of Charlotte, Mecklenburg County, N.C. and being more particularly described as follows:

BEGINNING at a new pk nail located at the intersection of the southwesterly margin of West Summit Avenue, said right of way having a width of 60 feet as recorded in Map Book 230 Page 297 of the Mecklenburg County Registry, and the northwesterly right of way margin of Merriman Avenue, said right of way having a width of 50 feet as recorded in Map Book 332 Page 286 of the Mecklenburg County Registry, and running thence from said point and place of BEGINNING along the southerly margin of the said Merriman Avenue South 56–30–25 West 195.17 feet to an existing iron pipe; thence South 33–31–09 East 4.31 feet to a new iron pipe located on the northwesterly right of way margin of the said Merriman Avenue as it narrows in width to 40 feet as recorded in Map Book 230 Page 297; thence continuing with the northwesterly margin of the said Merriman Avenue South 56–30–25 West 109.78 feet to an existing iron pipe; thence following the northeasterly boundary of Lot 23 of Wilmore Section #2 as recorded in the said Map Book 230 Page 297 of the Mecklenburg County Registry North 33–31–09 West 154.94 feet to a new iron pipe located in the northwesterly margin of a 10–foot alley as shown on the said Map Book 230 Page 297 of the Mecklenburg County Registry; thence following the northwesterly margin of the said 10–foot alley the following five (6) calls: (1) South 56–30–00 West 100.00 feet to a new iron pipe, (2) South 64–01–12 West 45.38 feet to an existing iron pin, (3) following the arc of a circular curve to the right having a radius of 643.00 feet and an arc length of 230.39 feet (chord bearing South 70–53–33 West 229.16 feet) to a point, (4) South 81–08–00 West 52.05 feet to a point, (5) following the arc of a circular curve to the left having a radius of 1,042.87 feet and an arc length of 374.65 feet (chord bearing South 70–50–30 West 372.64 feet) to a point and (6) South 60–33–00 West 52.63 feet to an existing iron pin; thence following the northwesterly right of way margin of Spruce Street, said right of way having a width of 40 feet as recorded in the said Map Book 230 Page 297, the following two (2) calls: (1) following the arc of a circular curve to the left having a radius of 430.00 feet and an arc length of 33.95 feet (chord bearing North 49–37–34 West 33.94 feet) to an existing iron pin and (2) following the arc of a circular curve to the right having a radius of 305.00 feet and an arc length of 189.18 feet (chord bearing North 34–43–38 West 186.16 feet) to a new iron

(continued above)

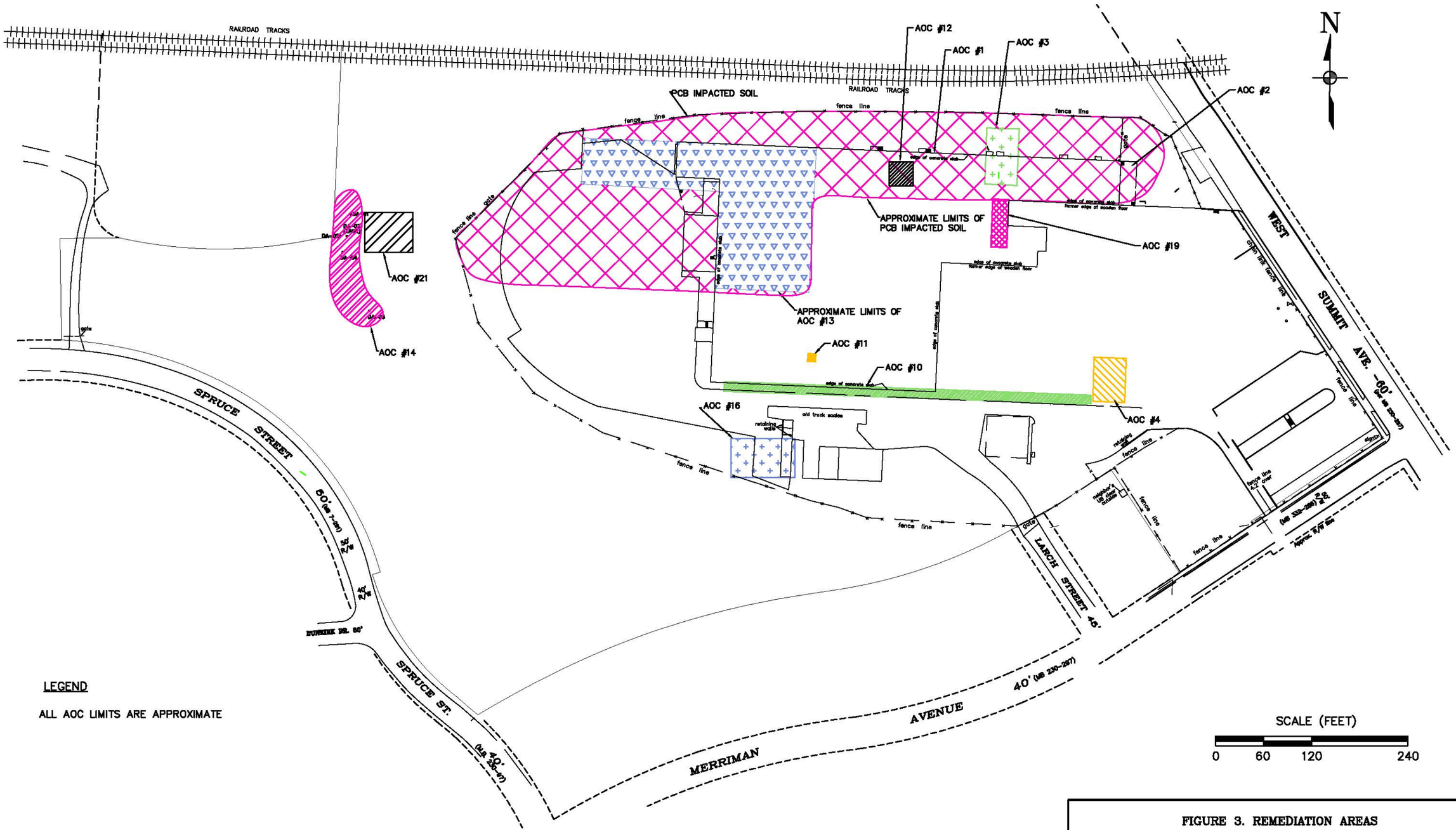
(Legal Description continued)

pipe; thence North 74–27–41 East 10.00 feet to a new iron pipe; thence following the northeasterly right of way margin of the said Spruce Street as it has been widened to 50 feet in width as recorded in Map Book 7 Page 291 of the Mecklenburg County Registry the following two (2) calls: (1) following the arc of a circular curve to the left having a radius of 377.78 feet and an arc length of 289.23 feet (chord bearing North 37–28–18 West 282.22 feet) to a point and (2) following the arc of a circular curve to the left having a radius of 495.00 feet and an arc length of 237.73 feet (chord bearing North 73–48–21 West 235.45 feet) to a new iron pipe; thence along the easterly boundary of the Mecklenburg County property as recorded in Deed Book 9276 Page 437 of the Mecklenburg County Registry and along the westerly boundary of a Public Street Right of Way as recorded in Deed Book 1161 Page 115 of the Mecklenburg County Registry North 00–45–29 West 126.87 feet to an existing iron pin; thence along the southerly and easterly boundaries of Piedmont Natural Gas Company as recorded in Deed Book 8095 Page 329 the following four (4) calls: (1) North 89–23–22 East 73.12 feet to an existing iron pin, (2) following the arc of a circular curve to the left having a radius of 573.69 feet and an arc length of 243.04 feet (chord bearing South 89–25–58 East 241.23 feet) to a new iron pipe, (3) following the arc of a circular curve to the right having a radius of 151.66 feet and an arc length of 26.53 feet (chord bearing North 83–42–08 East 26.50 feet to a new iron pipe and (4) North 02–34–17 East (passing existing iron pins at 14.29 feet and an additional 125.01 feet) a total distance of 238.90 feet to an existing iron pin located in the centerline of the Norfolk–Southern Railway Southbound track; thence following the centerline of the said Norfolk–Southern Railway Southbound track the following two (2) calls: (1) South 87–31–48 East 628.44 feet and (2) following the arc of a circular curve to the left having a radius of 3,288.38 feet and an arc length of 365.71 feet (chord bearing North 89–37–59 East 365.24 feet) to a new iron pipe set at the intersection of the centerline of the said Norfolk–Southern Railway and the southwesterly right of way margin of the aforesaid West Summit Avenue; thence along the southwesterly right of way margin of the said West Summit Avenue South 33–30–00 East 552.13 feet to the point and place of BEGINNING, containing 18.9692 acres as shown on a survey prepared by Andrew G. Zoutewelle dated March 25, 2004.

FIGURE 2. SITE SURVEY

ADDITIONAL SAMPLE LOCATIONS OCTOBER–NOVEMBER 2005								
Node ID	Description	Northing	Easting	Elevation	Node ID	Description	Northing	Easting	Elevation
5	B10–16	4763.75	4488.12	690.54	350	B10–09	4747.75	4779.17	690.82
6	B10–15	4761.81	4526.66	691.10	351	B10–08	4749.70	4821.23	690.96
7	MW B16–02B PAD	4663.11	4406.20	685.84	352	B15–01	4786.61	4766.43	691.30
8	MW B16–02B CAP	4663.11	4405.98	688.64	353	B3–06	5009.84	4721.32	691.20
9	cmr Test Pit 2	4813.72	4239.46	688.26	354	B19–05	4989.46	4715.90	691.20
10	cmr Test Pit 2	4813.12	4243.81	688.27	355	B19–06	4974.20	4715.23	691.25
11	cmr Test Pit 2	4835.84	4241.79	688.43	356	B19–02	4973.80	4724.95	691.24
12	B13–08	4852.42	4212.78	688.35	357	B19–03	4957.54	4724.20	691.24
14	centerline Test Pit 4	4945.95	4204.95	688.01	358	B19–07	4958.92	4714.31	691.25
15	centerline Test Pit 3	4889.03	4075.86	685.96	359	B19–08	4946.90	4713.96	691.29
16	B13–09	5056.44	4186.61	684.85	360	B19–04	4945.12	4724.03	691.27
17	B13–02	5046.15	4248.25	686.23	361	B15–06	4884.15	4740.51	691.29
18	B13–10	5077.58	4277.83	685.98	362	B20–02	4786.50	4377.83	691.48
19	B13–04	5048.55	4314.12	686.23	363	B20–02	4794.07	4374.12	691.46
20	B13–03	5023.89	4273.55	686.80	364	B13–11	4849.50	4413.14	691.41
21	B13–05	5019.59	4359.93	687.43	365	B13–12	5018.14	4423.84	691.48
24	B13–06	5071.19	4353.42	686.19	366	B12–04	5016.43	4598.74	691.48
25	B10–17	5074.88	4362.96	686.19	367	B12–02	5042.30	4592.43	691.39
26	B10–21	5079.49	4435.38	686.56	368	B13–15	5042.85	4474.75	691.36
27	B10–18	5066.13	4553.43	687.51	369	B13–14	5062.09	4429.45	691.40
28	B10–19	5061.37	4575.72	687.73	370	B13–07	5045.19	4386.32	691.31
29	B1–05	5069.71	4594.64	687.48	371	B13–13	5035.50	4348.91	687.07
30	B1–02	5063.14	4652.69	687.63	372	B12–03	5032.57	4616.11	691.38
31	B1–03	5078.24	4647.55	686.91	373	B3–05	5038.10	4705.73	691.25
32	B1–06	5090.93	4650.66	687.04	374	B3–04	5025.37	4724.44	691.20
33	B1–04	5057.09	4683.66	687.66	375	B19–01	4988.77	4726.12	691.31
34	B3–08	5064.76	4699.06	687.31	376	B3–03	5045.58	4725.74	691.32
35	B3–10	5086.76	4726.42	687.13	377	B3–07	5036.23	4744.61	691.34
36	B3–09	5058.99	4723.09	687.37	378	B2–06	5021.12	4857.60	691.27
37	B3–11	5057.73	4737.59	687.55	379	B2–05	5005.11	4879.93	691.20
329	centerline Test Pit 6	4906.10	4002.20	683.07	380	B2–07	5036.75	4881.25	691.16
330	B21–08	4924.18	3969.20	683.97	381	B4–08B	4893.62	4839.93	691.31
331	B21–04	4945.16	3934.09	682.87	382	B2–02	5004.30	4891.43	687.45
332	B21–06	4928.04	3928.55	680.75	383	B2–03B	5029.45	4893.22	687.65
333	B21–05	4981.95	3999.59	685.18	384	B2–03	5031.74	4893.44	687.65
334	B21–07	4954.35	3991.97	684.17	385	B2–08	5056.38	4892.15	687.40
335	B21–01	5005.30	3960.97	684.29	386	B10–22	5023.35	4949.12	687.58
336	centerline Test Pit 5	4964.19	3956.41	683.13	387	B10–20	5016.21	4939.65	687.02
337	B21–03	4982.10	3952.10	682.28	388	B2–04B	5014.55	4898.74	687.59
338	B21–02	4968.25	3931.46	681.40	389	SE06–up	5061.51	4937.46	688.87
339	DA–05	4969.69	3915.06	680.31	390	SE06–dn	5126.83	4882.59	683.94
340	B21–09	4976.41	3892.46	681.09	391	SE07–up	5127.41	4673.31	682.86
341	DA–01	4980.27	3902.41	663.59	392	SE07–dn	5129.34	4544.98	682.92
342	MW BG8S0D PAD	4875.48	3553.24	648.69	421	SE03–up	5067.31	4683.17	689.31
342	MW BG8S0D CAP	4875.48	3553.24	648.65	422	SE03–dn	4890.09	4133.63	668.49
343	MW B21–10 PAD	4997.98	3908.96	666.19	405	MW–BG8TD PAD	4831.86	2600.75	642.02
343	MW B21–10 CAP	4997.98	3908.98	668.09	406	MW–BG8TD CAP	4831.67	2600.41	645.27
344	DA–02	4953.47	3882.07	650.99	408	MW–BG8ED PAD	3385.33	1792.83	630.67
345	DA–03	4950.82	3887.30	655.23	409	MW–BG8ED CAP	3385.29	1793.04	633.25
346	DA–04	4934.25	3870.99	648.86	–	B1–02B	5062.77	4652.84	687.60
347	B10–14	4761.27	4548.60	690.69	–	B11–01B	4800.04	4481.77	690.63
348	B10–12	4740.61	4569.97	690.09	–	centerline Test Pit 1	4900.08	3921.71	671.50
349	B10–11	4749.21	4726.08	690.73	–	Tank 01	4950.70	3894.00	659.20

A.G. ZOUTEWELLE SURVEYORS
1418 East Fifth St. Charlotte, NC 28204
Phone: 704–372–9444 Fax: 704–372–9555



LEGEND

ALL AOC LIMITS ARE APPROXIMATE

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FIGURE 3. REMEDIATION AREAS

FORMER COPES–VULCAN FACILITY
REMEDIAL ACTION PLAN – STEP TWO
601 WEST SUMMIT AVENUE
CHARLOTTE, NC

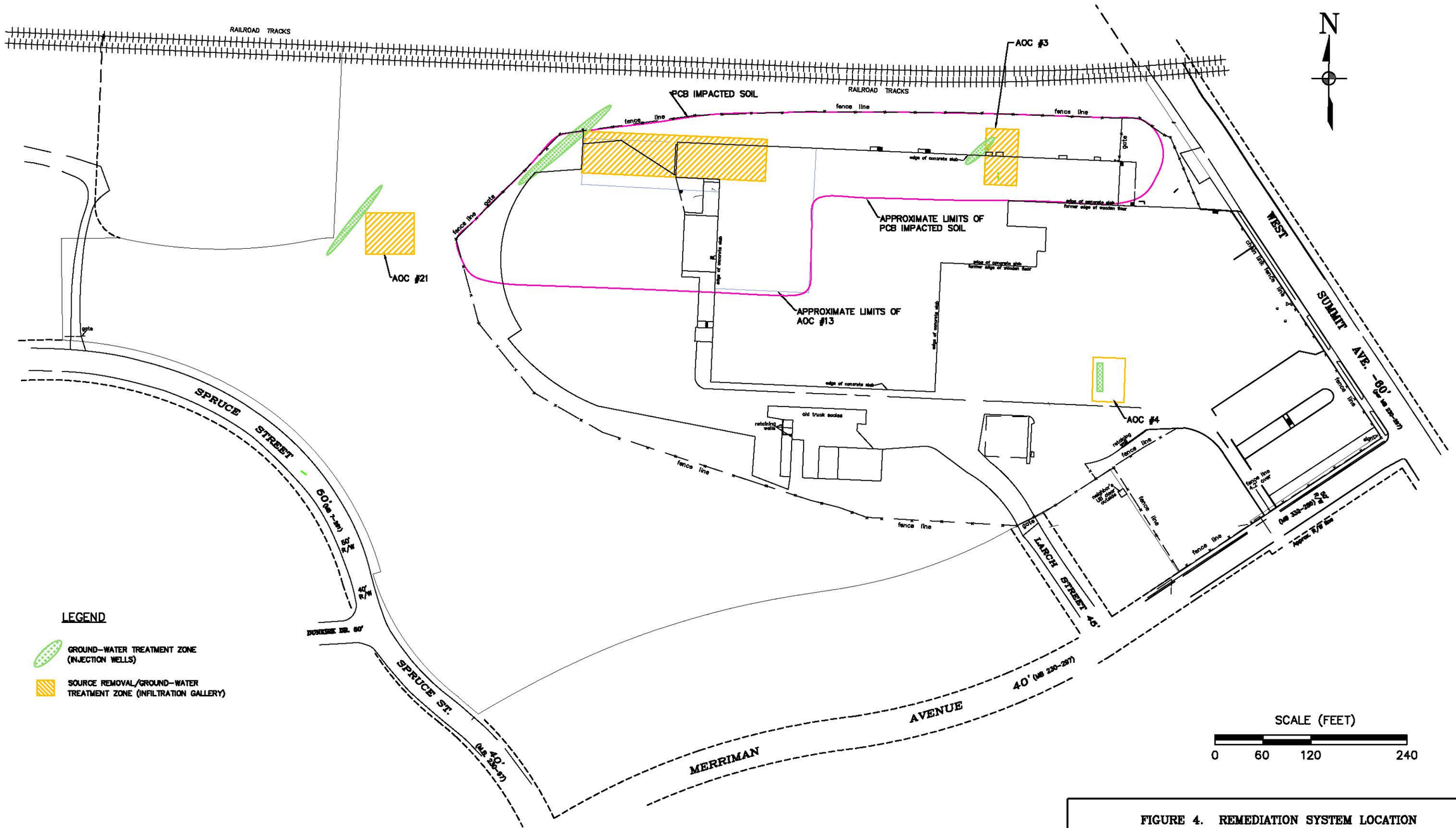

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FIGURE 4. REMEDIATION SYSTEM LOCATION

FORMER COPES-VULCAN FACILITY
REMEDIAL ACTION PLAN – STEP TWO
601 WEST SUMMIT AVENUE
CHARLOTTE, NC

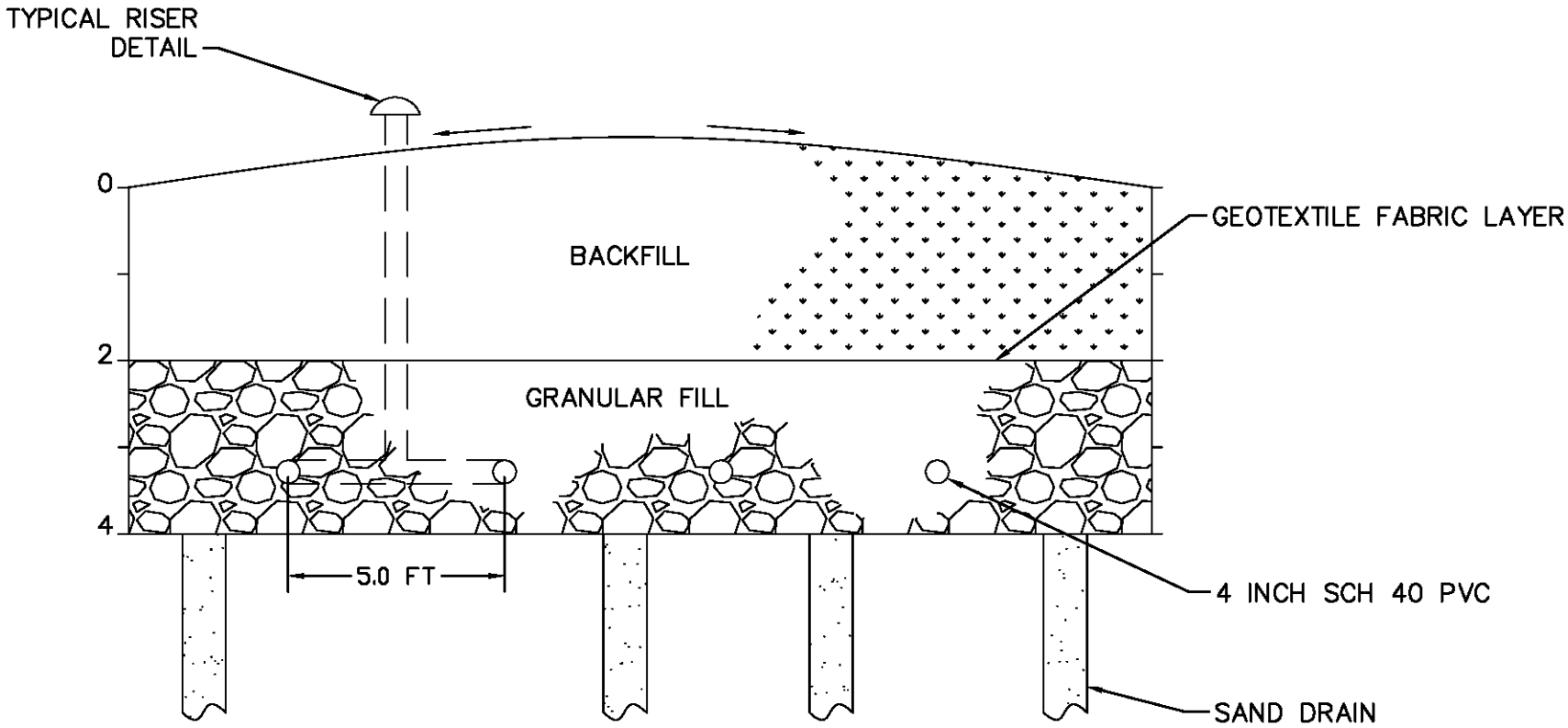

FIGURE 5. TYPICAL DETAIL
INFILTRATION GALLERY

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FOMER COPES-VULCAN FACILITY
REMEDIAL ACTION PLAN – STEP TWO
601 WEST SUMMIT AVENUE
CHARLOTTE, NC

KELLY-BUCK COMPANY O:/MY DOCUMENTS/PROJECTS/2000/MLF714 RAP Step Two Development/Infiltration Gallery Detail

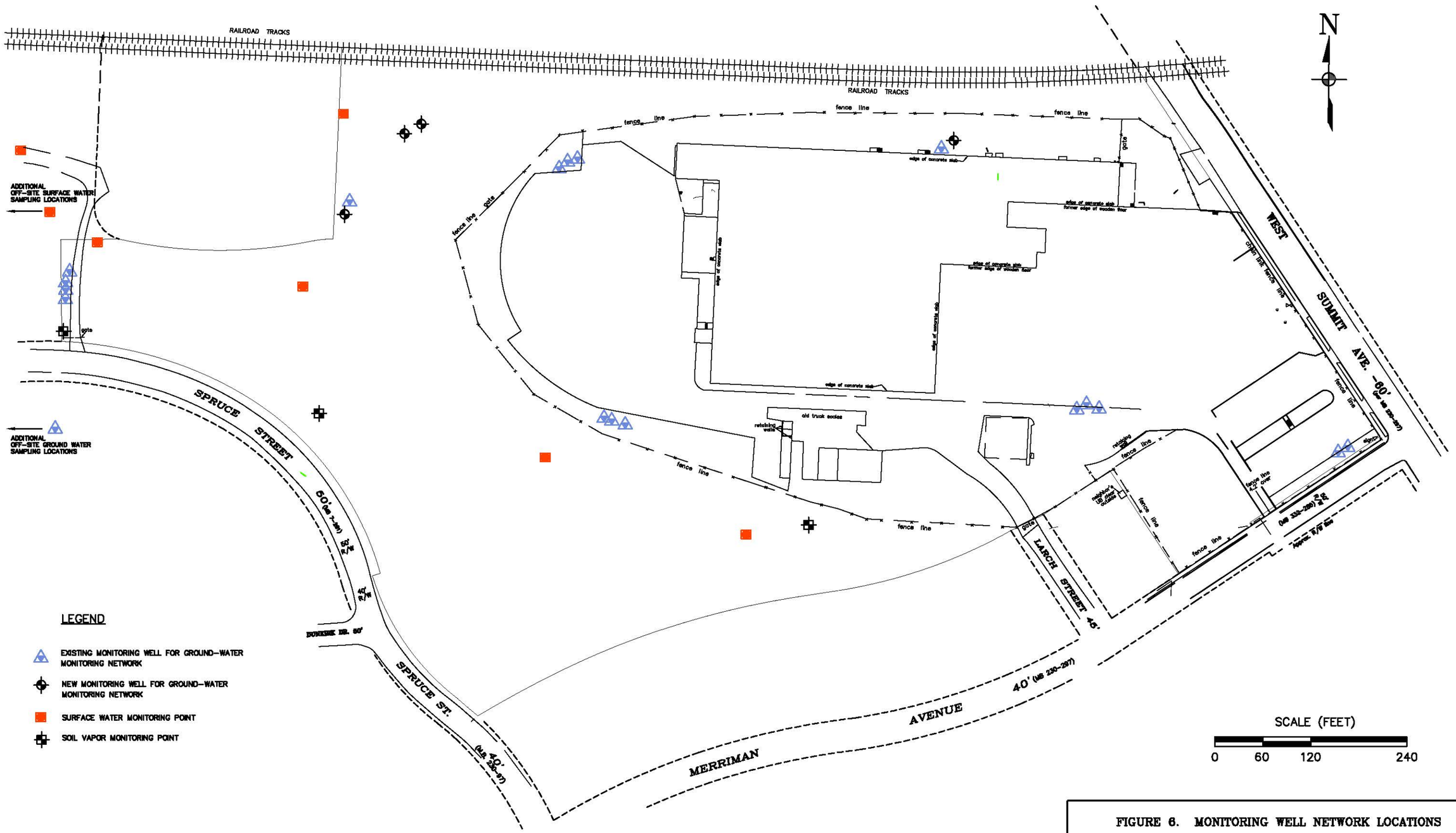

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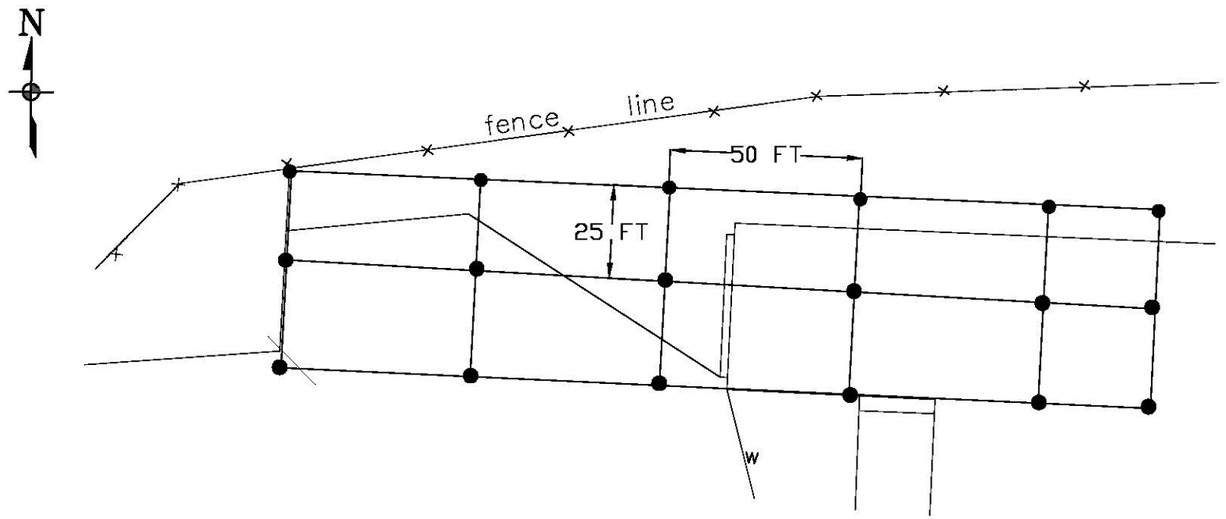
FIGURE 6. MONITORING WELL NETWORK LOCATIONS

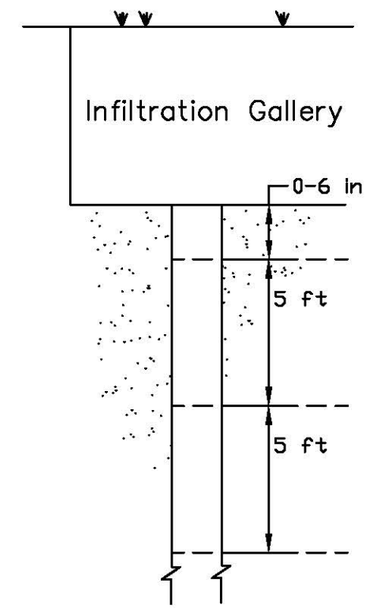
FORMER COPES-VULCAN FACILITY
REMEDIAL ACTION PLAN – STEP TWO
601 WEST SUMMIT AVENUE
CHARLOTTE, NC



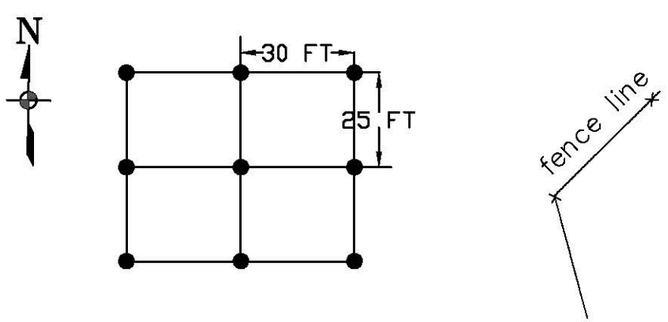
AOC #13 Post Remediation Sampling Grid

● SAMPLING LOCATION (VOCs)

SCALE
0 20 40 80 120



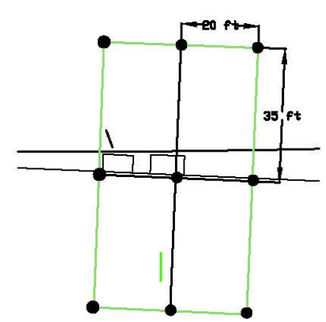
Typical Grid Point Sampling Depth



AOC #21 Sampling Grid

● SAMPLING LOCATION (VOCs)

SCALE
0 10 20 40 60



AOC #3 Sampling Grid

SCALE
0 10 20 40 60

● SAMPLING LOCATION (Cr(VI))

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FIGURE 7. POST-REMEDIATION SAMPLING LOCATIONS

FORMER COPES-VULCAN FACILITY
REMEDIAL ACTION PLAN - STEP TWO
601 WEST SUMMIT AVENUE
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