Prepared for:
Steel Treaters, Inc.
Troy, New York

Prepared By:
ENVIRON Engineers of North Carolina, PC

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02-39035A

REMEDIAL DESIGN REPORT

STEEL TREATERS, INC. SITE
520 CAMPBELL AVENUE
TROY, NEW YORK
NEW YORK STATE VOLUNTARY CLEANUP PROGRAM
SITE NO. V00578

ENVIRON

SIGNATURE AND PROFESSIONAL ENGINEER STATEMENT

I, Russell Kemp, certify that I am currently a NYS registered professional engineer and that this Remedial Design Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Signature

11 December 2017

Date

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1. INTRODUCTION

1.1 Purpose

On behalf of Steel Treaters, Inc. (STI), ENVIRON Engineers of North Carolina, PC (ENVIRON) has prepared this Remedial Design Report for the STI site located at 520 Campbell Avenue in the Troy Industrial Park in Troy, Rensselaer County, New York (hereinafter referred to as "the site"). The site entered into a Voluntary Cleanup Agreement (VCA) with the New York State Department of Environmental Conservation (NYSDEC) on September 19, 2003 (VCA No. V00578). This report details the activities that will be performed to implement the remedial action which will satisfy all Remedial Action Objectives (RAOs) defined by NYSDEC for the site in accordance with the NYSDEC Remedial Action Work Plan approval and Decision Document, both dated October 13, 2017.

1.2 Site Description and Background

1.2.1 Site Location

The 1.13-acre site is located in a suburban area, less than 2 miles southeast of the main area of Troy (see Figure 1). The site was previously developed with an approximately 8,400-square-foot building, which was located in the northern portion of the site. The single story building was damaged by a fire in 2005 and, as required by the City of Troy Bureau of Code Enforcement, was demolished in April 2017; all that remains currently is the building slab. The southern portion of the site is wooded and undeveloped (see Figure 2).

The site is currently vacant, and is zoned for industrial use. It is located in a mixed commercial/industrial and residential land use area. The nearest residential area is located upslope and adjacent to the site to the southwest. The site is also bordered by commercial/industrial properties to the west; Campbell Avenue to the north, beyond which are additional commercial properties; undeveloped land to the east; and a butcher shop to the south.

1.2.2 Site History

STI acquired the site, which consisted of vacant land, in 1965 from Charles E. Weber & Son. Starting in 1966, STI utilized the facility to heat treat metal machine parts, which were received from various manufacturers. The majority of the work conducted at the site involved tempering and case hardening of metal parts, as well as annealing of metal parts. Air and vacuum furnaces were used at the facility, and some parts were cooled using quench oil. Anhydrous ammonia was also used onsite during the heat treatment process to generate atmosphere for the furnaces.

Past site activities were believed to have included the use of solvents, including 1,1,1-trichloroethane (TCA) and trichloroethylene (TCE), which were stored in 55-gallon drums and used for vapor degreasing of metal parts. The solvents were reportedly reclaimed following use. STI reportedly believed that usage of these solvents ended in approximately 1991. STI's operations ceased following the 2005 fire and ESCO Portland (ESCO) acquired the STI site on October 23, 2012.

1.2.3 Site Geology and Hydrogeology

The area of the site is underlain by sedimentary bedrock of the Schodack and Nassau formations, and the Normanskill Shale. Surficial geologic mapping indicates deposits of "Lake Albany clays" (clays and silts) in the vicinity of the site, overlain in some areas by greater than 4 feet of sand, as well as bedrock outcropping. Also in the vicinity of the site are recent alluvial deposits associated with the Wynantskill, which is the nearest surface water body and is located less than 500 feet north of the site.

Exposed bedrock is present upslope, bordering the site to the east and south. Bedrock surface mapping indicates a surface sloping from south and southwest to the north and northeast, generally mimicking site topography. A gray silty clay layer generally 2 to 5 feet in thickness appears to be present across most of the site just above bedrock. A sequence containing fine sands with variable amounts of clay and silt sits above the gray silty clay layer. A layer of brown silty clay is present on top of this previous layer, at least within the general footprint of the former site building. Finally, a layer of silty sand is present near the surface throughout the site, in variable thickness.

Recent groundwater monitoring (December 2015 and May 2016) indicates that the water table in the overburden generally rests between 8 and 10 feet below ground surface. Groundwater elevation data confirm that there are two distinct hydraulic units: (a) overburden and (b) bedrock. Groundwater in the overburden aquifer generally flows to the north, towards the Wynantskill. Groundwater in the shallow bedrock zone appears to mimic the overburden groundwater and also generally flows to the north. An upward gradient exists between water in the overburden aquifer and water in the bedrock zone.

1.2.4 Interim Remedial Measures

As discussed above, the site entered into a Voluntary Cleanup Agreement with NYSDEC on September 19, 2003 (VCA No. V00578). Since 2003, STI has completed various investigation and interim remedial measures at the site. The interim remedial measures can be summarized as follows:

- In Situ Chemical Oxidation – In March and April 2007, approximately 8,000 pounds of a proprietary chemical oxidant (RegenOX^{TM}) were injected into three zones in the subsurface in the vicinity of a former degreaser pit located in the southeast portion of the former building (identified as the primary source of contamination).
- Soil Vapor Extraction – From 2008 through mid-June 2010, soil vapor was extracted from the subsurface via several temporary monitoring points located near the former degreaser pit.
- Soil Excavation and Off-site Disposal – In December 2010, the floor of the former building in the vicinity of the former degreaser pit was removed and unsaturated soils from beneath the base of the degreaser pit, approximately four feet below the floor surface, were excavated to a depth of 8 feet. The excavation was backfilled with material that had previously been used to fill the degreaser pit and additional clean fill from an off-site source.

In 2017, the building that occupied most of the site and was damaged by the 2005 fire was demolished and the holes and depressions in the concrete slab were filled to provide a level surface.

Characterization following the interim remedial actions identified remaining soil and groundwater contamination despite the prior remedial actions at the site. In coordination with NYSDEC, ESCO undertook a pre-remedy design investigation in 2015 to provide design parameters and remedy information to aid in the selection of an appropriate remedial alternative for the site. The results of this investigation were presented in the Pre-Design Investigation Report and Remedial Action Workplan (PDI/RAWP) submitted to NYSDEC on July 19, 2017 (ENVIRON 2017). The PDI/RAWP was subsequently used to support the issuance of the NYSDEC Decision Document dated October 13, 2017.

1.3 Remedial Objectives

The remedial action must satisfy all RAOs defined by NYSDEC for the site, which are listed below. The RAOs are medium- or operable unit-specific objectives for the protection of public health and the environment and are developed based on contaminant-specific standards, criteria, and guidance (SCGs) to address contamination identified at the site.

Groundwater RAOs:

RAO 1: Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.

RAO 2: Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAO 3: Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.

RAO 4: Remove the source of groundwater contamination to the extent feasible.

Soil RAOs:

RAO 5: Prevent ingestion/direct contact with contaminated soil.

RAO 6: Prevent inhalation exposure to contaminants volatilizing from soil.

RAO 7: Prevent migration of contaminants that would result in groundwater contamination

Soil Vapor RAOs:

RAO 8: Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into future buildings at a site.

Further, the remediation goals for the site include attaining to the extent practicable:

- Ambient groundwater quality objectives meeting New York’s Ambient Water Quality Standards for Class GA water (AWQS-GA) in accordance with 6 NYCRR Part 703-6 Groundwater Effluent Limitations for Discharges to Class GA Waters; and

- Soil quality objectives meeting the NYSDEC restricted commercial or industrial soil cleanup objectives (SCOs) in accordance with 6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives.

1.4 Selected Response Action

The selected response action for the STI site will comprise the following elements:

- Construction of a permeable reactive barrier (PRB) to reduce concentrations in groundwater in-situ and mitigate, to the extent practicable, offsite migrations of impacted groundwater. The PRB will include a "funnel" of sealed sheetpile walls along the eastern and western portions of the site to direct groundwater towards a "gate" of reactive material (i.e., zero-valent iron) on the northern portion of the site. The PRB will be approximately 250 linear feet in length (including 220 linear feet of steel sheetpile) and installed to a depth between approximately 17 and 30 feet below grade surface (bgs) and keyed into the underlying bedrock formation.
- Construction of a treatment zone immediately downgradient of the former degreasing pit, where TCA and TCE concentrations are highest, to reduce concentrations in groundwater in-situ within the former building, improve the effectiveness of the PRB and reduce remedial timeframes. The treatment zone will be approximately 25 linear feet in length and installed to a depth between approximately 18 and 22 feet below grade surface (bgs) and keyed into the underlying bedrock formation.
- Installation of engineering controls (i.e., a cover system) to address soil exceedances of the SCOs and prevent direct contact with underlying soils. As discussed above, following demolition of the former building in April 2017, holes and depressions in the remaining concrete slab were filled to provide a level surface. Currently paved areas will be milled and repaved to create a continuous paved surface. Currently landscaped areas around the former building will be capped with a demarcation layer and one foot of coarse aggregate. All imported soil cover material will meet the SCOs for cover material as set forth in 6 NYCRR Part 375-6.7(d).
- Establishing institutional controls in the form of an environmental easement which will: (a) define inspection and reporting requirements in accordance with Part 375-1.8(h)(3); (b) limit use and redevelopment of the site to commercial and industrial purposes as defined by Part 375-1.8(g) and the City of Troy's zoning determination; (c) restrict groundwater as a source of potable or process water without pre-treatment as determined by the New York State Department of Health (NYSDOH) or County DOH; and (d) require compliance with the Site Management Plan to be developed for the site.
- Long term monitoring consisting of quarterly groundwater sampling from wells upgradient, within, and downgradient of the PRB for the first year and annually thereafter to ensure that the treated groundwater complies with New York's AWQS-GA and RAO 3 has been met.

2. PRE-DESIGN INVESTIGATIONS

The results of the pre-design investigation activities summarized in the PDI/RAWP provided design parameters and remedy information to aid in the selection of an appropriate remedial alternative for the site (ENVIRON 2017). Additional pre-design activities were concurrently performed to gather supplementary information in support of the design of the selected response action. The results of these activities are summarized in the following subsections.

2.1 Treatability Testing

Bench-scale tests to evaluate reactive media of the PRB were performed between December 9, 2016 and March 16, 2017. Specifically, site groundwater was collected on December 8, 2016 and was used to conduct a multi-port column test to confirm the degradation rates of chlorinated ethenes and ethanes by zero-valent iron (ZVI) from Peerless Metal Powders in Detroit, Michigan, and evaluate the effectiveness of the treatment.

A report presenting the results of this study is provided as **Attachment A**. The study found that ZVI destroyed TCE (half-life between 13 and 462 minutes for fresh and aged ZVI, respectively), TCA (half-life between 24 and 3.6 minutes for fresh and aged ZVI, respectively) and cis-dichloroethene[1] (cis-1,2-DCE). Evidence of the destruction of these chlorinated compounds was provided by the reduction in concentrations of these chemicals and the increased concentrations of chloride, ethane and ethane.

The study also found that ZVI had little effect on 1,1-dichloroethane (DCA) destruction and that DCA did not account for all the TCA lost, implying that 1,1-DCA is not the only end-product of 1,1,1-TCA reduction by ZVI. These increases, may need to be monitored to determine whether alternate treatment is warranted[2]. The study also concluded that the loss of total and dissolved iron along the length of the ZVI bed suggested that the loss of reactivity may be due to precipitation of iron minerals.

Based on the results of this study, it was concluded that ZVI should be considered for use at the site. ZVI was effective toward both TCE and 1,1,1-TCA, though the half-life for transformation of TCE increased as the iron aged.

2.2 Baseline Site Elevations

Baseline site elevations were established from a 1-meter DEM LIDAR obtained from the NY State Website (www.orthos.dhses.ny.gov). These elevations were compared to elevations of wells and borings surveyed by NMB Land Surveying on February 4, 2016 to verify the baseline site topography. The baseline site elevations were used to develop the Design Drawings included as **Attachment B**.

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1 cis-DCE concentrations decreased in tests with sufficiently long contact times, but with shorter contact time (1.5 hours) concentrations increased because cis-DCE is a reactive intermediate of TCE transformation and TCE transformation was incomplete.

2 As presented in the isoconcentration maps included in the 2017 PDI/RAWP, 1,1-DCA was generally only detected above the applicable New York's Ambient Water Quality Standards for Class GA water within the property limits, indicating that natural processes are completing the reductive dechlorination of 1,1-DCA.

3. REMEDIAL DESIGN

3.1 Remedy Description

As discussed in Section 1.4, the proposed remedy for the STI site includes construction of a PRB and ZVI treatment zone to address groundwater contamination and placement of a cover system to address surface soil contamination. Construction activities will be performed by an experienced remedial contractor and overseen by ENVIRON to ensure that construction activities conform to requirements of the Design Drawings and Technical Specifications (**Attachments B** and **C**, respectively). As part of the remedy, institutional controls in the form of an environmental easement and long-term groundwater monitoring will also be implemented. The following sections detail the major components of the remedial design.

3.1.1 Groundwater Modeling

In accordance with the Interstate Technology & Regulatory Council's guidance titled *Permeable Reactive Barrier: Technology Update* (ITRC, 2011), a one-layer steady-state MODFLOW groundwater flow model was constructed and calibrated to average historical groundwater elevations measured at the Site. This model was used to simulate groundwater flow conditions for various PRBs and treatment zone configurations to optimize their alignment and define the hydraulic properties of the treatment media such that: (a) minimal groundwater mounding occurred upgradient of the PRB; (b) it limited offsite plume migration (in the case of the PRM only); (c) it prevented groundwater plume flow around the PRB or treatment zone; and (d) the greatest contaminant mass would be captured and eventually treated by the reactive media of the PRB.

As presented in **Attachment D**, following various groundwater simulations under various alignments and hydraulic conductivities, the optimal configuration of the PRB and southern treatment zone was selected. The modelling also concluded that the reactive media in both PRB and the treatment zone should have a horizontal hydraulic conductivity of at least 5 ft/day (1.76 x 10^{-3} cm/s).

3.1.2 ZVI PRB Design

As presented in **Attachment E**, the ZVI dosage for the PRB and ZVI treatment zone required to reduce CVOC concentrations in groundwater to below applicable AWQS-GA was calculated in accordance with the California Department of Toxic Substances Control Office of Pollution Prevention and Technology Development report titled "*An Assessment of Zero Valence Iron Permeable Reactive Barrier Projects in California*" (Muegge, 2008), the groundwater modeling results and the treatability testing results. Based on the analysis, the minimum width of a pure ZVI barrier required for the PRB and southern treatment zone was determined to be 1.0 foot and 0.57 foot, respectively. Groundwater flow simulations conducted indicated that to achieve the required residence time, the ZVI treatment areas need to have a horizontal hydraulic conductivity of at least 5 ft/day (2 x 10^{-3} cm/sec).

Considering that the ZVI treatment areas will be installed within 3-foot trenches, the equivalent minimum ZVI content for the PRB and southern treatment zone was determined to be 35% and 20% by volume, respectively. To meet the hydraulic conductivity requirements, the balance would consist of washed sand.

The treatability test results suggested that ZVI might not be able to effectively dechlorinate 1,1-DCA. However, review of groundwater monitoring data from December 2015 and May 2016 sampling events revealed that: (1) at monitoring wells where 1,1-DCA was detected, the concentrations from the May 2016 event are lower than those from the December 2016 event, indicating possible occurrence of natural degradation; and (2) the 1,1-DCA concentration in monitoring well MW-10 (located 17 feet upgradient of the proposed PRB) from the December 2015 sampling event is 24 µg/L, less than 5 times the AWQS-GA (5 µg/L). Therefore, to ensure degradation of the 1,1-DCA concentration below the AWQS-GA, ZVI backfill with a higher organic content was specified to promote the ongoing natural degradation processes.

Based on ZVI manufacturer product sheets, Connelly-GPM's CC-1190 was the selected ZVI as it met the hydraulic conductivity requirement and it provides the highest total carbon content (2.5%).

3.1.3 Sheetpile Wall Design

As shown on the Design Drawings (**Attachment B**), an impermeable hydraulic barrier (i.e., sheetpile wall) will be installed on either side of the PRB with a total combined length of 210 linear feet. As presented in **Attachment F**, the sheetpile wall is intended to route groundwater towards the permeable section containing the reactive media and located between the two sheetpile wall spans. Since this sheetpile will not support any excavations and has no structural purpose, a structural analysis was not required.

The sheetpile wall design focused on corrosion protection considering a 100-year design life. A conservatively assumed sheetpile wall thickness loss of 0.045 mm/year was assumed given its proposed installation in "polluted natural soils or industrial ground" as defined in the 2008 Piling Handbook (ArcelorMittal, 2008). While all ASTM A572 Grade 50/60 steel sheetpile sections evaluated provided a service life of more than one hundred years without the need for coatings or cathodic protection, for additional protection the sheetpiles will be coated with Carboline Bitumastic® 300 M, a high build coal tar epoxy manufactured by Carboline Company (or Engineer-approved equivalent). The PZC-13 steel sheetpile sections as manufactured by LB Foster Company (or Engineer-approved equivalent) were selected as they are the lighter sections and will require smaller cranes for their installation. The steel sheetpile sections will have ball and socket interlocks which will be sealed with WADIT®, a non-toxic hot cast sealant distributed by PilePro® (or Engineer-approved equivalent) to impermeabilize the interlocks.

3.2 General Site Work

3.2.1 Mobilization

The selected remedial contractor will be responsible for mobilizing to the site all necessary equipment, supplies, materials, and personnel required to implement the proposed remedy in accordance with the design documents. The selected remedial contractor will mobilize, and set up the necessary temporary facilitates and utilities in accordance with federal, State, or local law, regulation, or code. Requirements for mobilization are discussed further in the Technical Specifications (**Attachment C**).

3.2.2 Site Preparation and Control

The site is presently vacant and the former building was demolished. Thus, minimal removal of vegetation and debris from within the limits of the proposed remedial work will be required. Other site preparation activities shall include, but not be limited to: establishing a decontamination area and establishing material and equipment staging area. Site preparation requirements are further detailed in the Technical Specifications (**Attachment C**).

3.2.3 Temporary Facilities

Temporary facilities will be limited to the previously identified construction trailers, utilities, and a decontamination area. No electrical power, water, gas, or other utility connections are available onsite. Access roads beyond what current exists at the site are not anticipated to be required for this effort. To prevent unauthorized access to the site, the remedial contractor will install and maintain temporary 6-foot high chain link fence with a privacy screen around the perimeter of the site and may provide overnight security during remedy implementation. Requirements for temporary facilities are further detailed in the Technical Specifications (**Attachment C**).

3.2.4 Soil Erosion and Sediment Control

Although state and federal permits will not be required, soil erosion and sediment control measures are still required to prevent site run-off. Therefore, prior to commencement of construction activities, temporary soil erosion and sediment control measures will be installed. These controls will consist of silt fencing and/or similar control devices. As discussed in the Technical Specifications (**Attachment C**), the remedial action shall be carried out so as to minimize erosion and silting in accordance with the New York Guidelines for Urban Soil and Sediment Control. In addition, remedial activities will be performed so as to limit the potential for fugitive odor and dust emissions. Dust control measures will consist of water spraying or approved equivalent.

During construction activities, erosion and sediment control measures will be inspected and maintained on an at least weekly basis, immediately following each rainfall event, and at least daily during prolonged rainfall. Accumulated sediment will be removed from the control measures as needed and managed in accordance with the Technical Specifications (**Attachment C**).

3.2.5 HASP/CAMP

A site-specific health and safety plan (HASP) for the construction activities associated with the remedy is included as **Attachment G**. The selected remedial contractor will be required to prepare its own HASP and to conduct all work in accordance with that plan. The remedial contractor's HASP will conform to all applicable OSHA standards governing the work as well as the minimum requirements established in the site-specific HASP developed by ENVIRON. Health and safety requirements are further defined in the Technical Specifications (**Attachment C**).

During construction activities, air monitoring will be conducted for particulates and organic vapors in accordance with the Community Air Monitoring Plan (CAMP) included as

Attachment H. The CAMP incorporates the dust and vapor monitoring and control requirements defined in the Technical Specifications (**Attachment C**).

3.2.6 Equipment Decontamination

The selected remedial contractor will establish a decontamination area within the work area to decontaminate all construction equipment and tools including, but not limited to, excavators, backhoes and trucks, which come in contact with contaminated soil or water before they are (a) used to manage non-contaminated materials, and/or (b) demobilized from the site. In accordance with the Technical Specifications (**Attachment C**), the decontamination area will include a temporary truck wash system consisting of a pre-fabricated drive-through berm enclosure.

Decontamination activities will include pressure washing the exterior of construction equipment and tools to remove all contaminated materials. Physical/mechanical agitation (i.e., scraping with hand tools) of residual soils may also be used to minimize decontamination water generation. Decontamination water and accumulated soils will be managed in accordance with State and Federal regulations and the Technical Specifications (**Attachment C**). Standing water will not be allowed to accumulate within the decontamination area.

3.3 Permeable Reactive Barrier and ZVI Treatment Zone

As shown on the Design Drawings (**Attachment B**), a PRB will be installed around the northern side of the former building to reduce concentrations of contaminants in groundwater in-situ and mitigate, to the extent practicable, offsite migrations of impacted groundwater. Two treatment areas are proposed for the site: (a) a granular ZVI and hydraulic routing system between the northern side of the former building and Campbell Avenue (PRB); and (b) a ZVI treatment zone in the vicinity of the former pit (southern treatment zone).

The proposed PRB includes an approximately 35 foot pervious ZVI treatment barrier and impermeable hydraulic barriers on either side of the PRB with a total combined length of 220 linear feet. The PRB will be approximately three (3) feet wide, installed to a depth between approximately 17 and 30 feet bgs, and keyed into the underlying bedrock. As detailed in **Section 3.1.3**, the impermeable hydraulic barriers of the proposed PRB will consist of PZC-13 steel sheetpile sections as manufactured by LB Foster Company (or Engineer-approved equivalent) and will serve to route groundwater towards the permeable section containing the reactive media and located between the two sheetpile wall spans. To protect against corrosion, the sheetpiles will be made of Grade 50 steel and will be coated with Carboline Bitumastic® 300 M (or Engineer-approved equivalent). The steel sheetpile sections will have ball and socket interlocks which will be sealed with WADIT® (or Engineer-approved equivalent) to impermeabilize the interlocks. As detailed in **Section 3.1.2**, to meet the horizontal hydraulic conductivity requirement of at least 5 ft/day (2 x 10^{-3} cm/sec), the ZVI treatment barrier will consist of 20% ZVI, and 80% washed sand with a D50 of 0.6 millimeters and meeting the gradation requirements of the Technical Specifications (**Attachment C**). The ZVI will consist of Connelly-GPM's CC-1190 ZVI (or Engineer-approved equivalent), which has a 2.5% carbon content.

In addition, as shown on the Design Drawings (**Attachment B**), a ZVI treatment zone will be installed immediately downgradient of the former degreasing pit, where TCA and TCE concentrations are highest. The main goals of this ZVI treatment zone are to reduce concentrations in groundwater in-situ within the former building, improve the effectiveness of the PRB and reduce remedial timeframes. The treatment zone will be approximately three (3) feet wide, 25 feet long and installed to a depth of approximately 18 and 22 feet bgs and keyed into the underlying bedrock. As detailed in **Section 3.1.2**, to meet the horizontal hydraulic conductivity requirement of at least 5 ft/day (2 x 10^{-3} cm/sec), the ZVI reactive zone will consist of 35% Connelly-GPM's CC-1190 ZVI (or Engineer-approved equivalent), and 65% washed sand with a D50 of 0.6 millimeters and meeting the gradation requirements of the Technical Specifications (**Attachment C**).

The barrier system and treatment zone will be installed by the selected remedial contractor in accordance with the Technical Specifications (**Attachment C**).

3.3.1 Soil Management

It is expected that approximately 190 tons of soils will need to be excavated to allow the construction of the reactive zone of the PRB (i.e., sheetpiling is not expected to require pre-excavation) and ZVI treatment zone. Excavated soils will be managed in accordance with the Technical Specifications (**Attachment C**). Prior to mobilization, the selected remedial contractor will be required to prepare a Waste Materials Management Plan detailing the material segregation and handling and transportation methods that will be utilized. Excavated materials may either be directly loaded into trucks for off-site disposal or temporarily stored on-site in designated storage areas. All stockpiled and containers will be labeled as to their waste classification and source identification. All temporary stockpiles and/or roll-off containers used for soil management will be covered at the end of each working day and when not in active use.

3.3.2 Waste Management

Based on available investigation results and considering the historical use of TCE in the former degreasing operations at the site, it is expected that both hazardous and non-hazardous waste could be generated as a result of remedy implementation. Prior to initiating construction activities, ENVIRON will submit a sampling and waste management plan to NYSDEC in support of a contained-in determination for potentially hazardous materials that may be generated as a result of remedy implementation.

ENVIRON will collect waste characterization samples in accordance with this sampling plan during remedy implementation and following its approval by NYSDEC. Waste classification samples will be analyzed by a New York State-certified laboratory. The characterization sampling results will be used to determine appropriate off-site disposal facilities for the waste materials.

Additional requirements for transportation and off-site disposal of waste materials and documentation of waste management activities are defined in the Technical Specifications (**Attachment C**).

3.4 Cover System

As discussed above, an engineering control in the form of a cover system will be installed to address soil exceedances of the SCOs and prevent direct contact with underlying soils. As shown in the Design Drawings (**Attachment B**), the cover system will consist of (1) the concrete slab of the former building, (2) asphalt paved areas, and (3) stone capped areas.

Following construction of the PRB and ZVI treatment zone, approximately 4,500 SF of currently landscaped area around the former building will be capped. As indicated in the Design Drawings (**Attachment B**), the cap will consist of a demarcation layer and one foot of coarse aggregate. All imported soil cover material will meet the SCOs for cover material as set forth in 6 NYCRR Part 375-6.7(d). In addition, approximately 8,300 SF of currently paved area around the former building will be milled and repaved.

The cover system will be installed by the selected remedial contractor in accordance with the Technical Specifications (**Attachment C**).

3.5 Construction Quality Control

The selected remedial contractor will be required to implement construction quality control measures in accordance with the Technical Specifications (**Attachment C**) for each component of the remedy. For the PRB and ZVI treatment zone, the contractor's construction quality control will include a combination of measures such as (1) precision weight measurement and metering of the ZVI and sand backfill mixing; (2) soundings along the trench centerline to document as-built elevations, slopes, and profiles; (3) hydraulic pulse interference tests prior to and after PRB construction to verify that the hydraulic conductivity of the surrounding formation has not been reduced; (4) geophysical imaging tests or inclined profiling using a driven electrical conductivity probe along the entire length of the to verify the width and depth of the PRB; and (5) angled cores through the PRB to confirm its thickness. For areas to be repaved, construction quality control measures will include subjecting the asphalt pavement to field and laboratory testing to ensure conformance with the requirements for thickness, smoothness, and in-place density. For the aggregate cap, construction quality control measures will at a minimum include analytical and geotechnical testing of all imported materials to ensure conformance with 6 NYCRR Part 375-6.7(d) and the Technical Specifications (**Attachment C**).

3.6 Site Management Plan

As part of the selected remedy and in accordance with DER-10, a Site Management Plan (SMP) will be prepared to maintain the components of the selected remedy to eliminate potential contact with contaminated groundwater and soils which remain onsite and to monitor future redevelopment and/or reuse of the site. The SMP will be submitted for NYSDEC approval following completion of the onsite remedial activities, in conjunction with the submittal of the Final Engineering Report. The SMP will subsequently be linked to the Environmental Easement (see Section 3.8 below) to assure implementation by any future property owner.

In accordance with DER-10, at a minimum, the SMP will include separate plans for the institutional and engineering controls and monitoring. An operation and maintenance plan is not required for either the PRB or ZVI treatment zone, as they do not include any components requiring operation or maintenance. However, a maintenance plan for the cover system will be developed. At a minimum, this plan will include annual inspections of the cover system for the duration of the monitoring period.

3.7 Performance Monitoring

The performance and effectiveness of the remedy will be monitored through groundwater sampling. Prior to implementation of the remedy, groundwater sampling from site wells will be conducted to establish baseline conditions. Following implementation of the remedy, groundwater sampling from wells upgradient, within, and downgradient of the PRB will be conducted quarterly for the first year and annually thereafter to demonstrate the performance of the groundwater treatment system until the treated groundwater complies with New York's AWQS-GA and RAO 3 has been met. The monitoring plan to be included with the SMP will include additional details regarding the long-term groundwater monitoring proposed for the site (e.g., identification of sampling locations, sampling collection protocols, frequency of reporting to NYSDEC, etc.); a HASP for the monitoring activities; and provisions for inspection, maintenance, and decommissioning of groundwater monitoring wells once no longer required as part of the remedial program.

3.8 Engineering and Institutional Controls

Engineering and institutional controls will be implemented as part of the selected remedy to protect human health and the environment from contamination that will remain in the subsurface at the site. As discussed in Section 3.4 above, the engineering control for the site will consist of a cover system to address soil exceedances of the SCOs and prevent direct contact with underlying soils.

Institutional controls are intended to prevent exposure to constituents remaining on the site following remedy implementation and to prevent actions that would interfere with the effectiveness of the remedial program or with the effectiveness and/or integrity of operation, maintenance, or monitoring activities. Institutional controls for the site will be in the form of an environmental easement which will: (a) define inspection and reporting requirements in accordance with Part 375-1.8(h)(3); (b) limit use and redevelopment of the site to commercial and industrial purposes as defined by Part 375-1.8(g) and the City of Troy's zoning determination; (c) restrict groundwater as a source of potable or process water without pre-treatment as determined by the New York State Department of Health (NYSDOH) or County DOH; and (d) require compliance with the Site Management Plan to be developed for the site (refer to Section 3.6).

The institutional and engineering control (IEC) plan to be included in the SMP will identify all use restrictions and engineering controls for the site and detail the steps and media-specific requirements necessary to assure the IEC remain in place and effective. At a minimum, the IEC plan will include:

- an excavation and material management plan, which will detail the provisions for management future excavations at the site;
- a provision to ensure no soil exceeding the protection of groundwater SCOs will remain beneath retention basins or infiltration structures that may be proposed as part of future redevelopment of the site;

- descriptions of the provisions of the institutional controls, including land use and/or groundwater use restrictions;
- a plan for the installation, operation, and monitoring of a subslab vapor mitigation system at the site, if necessary;
- a provision to implement actions to address soil vapor intrusion in occupied buildings in neighboring properties;
- a provision for replacement of engineering controls that may be disturbed as a result of site redevelopment, such that similar engineering controls will be installed post-development to preclude contact with the underlying soil;
- remedy-specific plans for the inspection and maintenance of the engineering controls;
- inspection and reporting requirements for the institutional and engineering controls in accordance with Part 375-1.8(h)(3);
- a HASP; and
- a CAMP.

3.9 Environmental Sustainability

The selected remedy incorporates the fundamental aspects of NYSDEC Program Policy DER-31 / Green Remediation, in which NYSDEC defines "green remediation" (or greener cleanups) as "*the practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprint of cleanup actions*." The selected remedy was designed to meet remedial goals, while minimizing the generation of waste requiring off-site disposal, limiting operational and maintenance requirements, preventing disturbance of previously undisturbed areas, and avoiding interference with potential site redevelopment plans. Specifically,

- by implementing an in-situ remedy where groundwater is conveyed to a target treatment area, excavation and of-site disposal of impacted soils is minimized. This results in reduced truck traffic to and from the site (and associated emissions and transportation related risks, and minimizes the consumption of available airspace in the disposal facilities.
- the in-situ groundwater treatment system does not have any mechanical components requiring power, maintenance or operation, thereby optimizing the use of resources and minimizing energy demands and potential shutdowns for equipment failure, which is particularly important in a site that is currently vacant and de-energized.
- implementation of the remedy will not result in the disturbance of areas not previously altered by prior site improvements, thereby minimizing impacts to the surrounding habitat (i.e., the southern wooded/undeveloped portion of the site).
- Since the remedy is an in-situ technology with no above ground structures (other than monitoring wells), it will not interfere with potential redevelopment of the site.

In addition, the following environmentally-sustainable practices will be implemented to the maximum extent practicable:

- Ensuring that equipment is operating at peak efficiency, thereby minimizing fossil fuel usage, air emission, and waste generation;
- Using low-sulfur fuel or biodiesels in lieu of diesel to reduce air emissions and greenhouse gas contributions;
- Using mufflers and sound attenuation equipment, where possible (e.g., pump enclosures) to reduce noise; and
- Evaluating, as part of the site management plan, the possibility of incorporating passive sampling devices for long-term monitoring.

4. PERMITS AND APPROVALS

In accordance with Voluntary Cleanup Program (VCP) guidelines and as confirmed with NYSDEC, no permit, consent, approval, or other authorization under other NYSDEC regulatory program is required for the proposed remedial activities at the STI site because proposed remedial activities are being performed under a VCA with the NYSDEC VCP (VCA No. V00578). Therefore, while a soil erosion and sediment control plan has been prepared in accordance with local requirements, its approval will not be required for the proposed remedial action activities. Nonetheless, the contractor performing the remedial activities will be required to conform to the soil erosion and sediment control requirements specified in the Design Drawings (**Attachment B**) and Technical Specifications (**Attachment C**).

In addition, per the City of Troy, a building permit will be required to implement the proposed remedy. The contractor will be responsible for obtaining and performing the work in accordance with this permit.

5. SCHEDULE

Solicitation of proposals for the procurement of a remedial contractor will begin in November 2017. The implementation of the remedy is anticipated to begin in December 2017 or January 2018. Once a contractor is selected to perform the work and prior to the commencement of construction activities, a more detailed schedule will be provided to NYSDEC. Installation of the PRB and cover system are expected to take one to two months. The Final Engineering Report will be prepared upon completion of construction activities and is expected to be submitted in the March 2018, with the Certificate of Completion to follow in the spring of 2018.

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FIGURES

LEGEND:

PROPERTY BOUNDARY (APPROXIMATE)

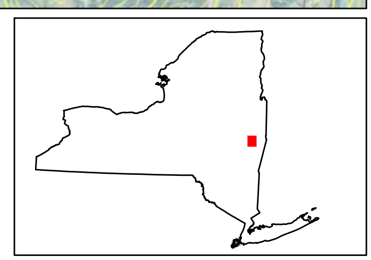
0 1/2 1

SCALE IN MILES

2000 0 2000 4000

SCALE IN FEET

SOURCE:
USGS 2016 TROY SOUTH, NY 7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLE.
MAP SCALE: 1:24,000. SITE LOCATION: N: 42.706999° W: 73.677401° WGS84.



QUADRANGLE KEY MAP

ENVIRON

ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

DRAFTED BY: KPM	DATE: 06/15/2017

SITE LOCATION MAP

520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

FIGURE
1

PROJECT: 0239035A

KMAUGHAN 6/16/17 F:\0239035_ESCO STEEL_PDI_RAWP < SITE LOCATION_0239035 >

ENVIRON

ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

DRAFTED BY: KPM | DATE: 6/15/2017

SITE LAYOUT MAP

520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

FIGURE
2

PROJECT:0239035A

KMAUGHAN 6/16/17 F:\0239035_ESCO STEEL_PDI_RAWP < SITE LAYOUT_0239035 >

ATTACHMENT A
TREATABILITY STUDY

PRIMA ENVIRONMENTAL INC.

August 23, 2017

Jose Sananes, P.E.
Ramboll Environ
101 Carnegie Center, Suite 200
Princeton, NJ 08540

RE: Report of Findings "Bench-Scale Evaluation of Zero-Valent Iron for Destruction of COCs", Steel Treaters, Inc., Troy, NY

Dear Mr. Sananes:

Enclosed is the report of findings "Bench-Scale Evaluation of Zero-Valent Iron for Destruction of COCs" that describes bench testing conducted on soil and groundwater from the Steel Treaters, Inc. site located in Troy, New York. If you have any questions, please contact Cindy Schreier at (916) 939-7300 or cschreier@primaenvironmental.com. Thank you for the opportunity to be of service.

Sincerely,
PRIMA Environmental, Inc.

Cindy G. Schreier, Ph.D.
President and Chief Scientist

5070 Robert J. Mathews Parkway, Suite 300, El Dorado Hills, CA 95762
Ph (916) 939-7300 • Fax (916) 939-7398
www.primaenvironmental.com

Report of Findings

Bench-Scale Evaluation of Zero-Valent Iron for Destruction of COCs

Steel Treaters, Inc.
Troy, New York

August 23, 2017

Submitted to

Jose Sananes, P.E.
Ramboll Environ
101 Carnegie Center, Suite 200
Princeton, NJ 08540

Submitted by

PRIMA Environmental Inc.

5070 Robert J Mathews Parkway, Suite 300
El Dorado Hills, CA 95762

Cindy G. Schreier
Cindy G. Schreier, Ph.D., President

Aug 23, 2017
Date

EXECUTIVE SUMMARY

Bench-scale treatability testing was conducted on groundwater collected from the Steel Treaters, Inc. site located in Troy, New York to evaluate the ability of zero-valent iron (ZVI) to destroy chemicals of concern (COCs). The primary COCs at this site are trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA), though lesser chlorinated compounds may also be present and are of interest. A multi-port column test using ZVI from Peerless Metal Powders (http://www.peerlessmetal.com/) was run to assess COC removal and to obtain rate constants that can be used to design a permeable reactive barrier.

ZVI destroyed TCE, 1,1,1-TCA and cis-DCE, as expected, but had little effect on 1,1-DCA. The half-life for TCE removal increased over time, ranging from < 13 minutes when the iron was fresh (about 8 pore volumes put through) to 43 minutes after 37 pore volumes, 51 minutes after 69 pore volumes, and 462 minutes after 80 pore volumes. Loss of total and dissolved iron along the length of the ZVI bed suggests that the loss of reactivity may be due to precipitation of iron minerals.

1,1,1-TCA degradation was rapid with the rate increasing with the age of the column. The half-life for 1,1,1-TCA removal was 24 minutes when the iron was fresh, but less than 3.6 minutes after 69 pore volumes were put through. 1,1,1-TCA was partially transformed to 1,1-DCA, but 1,1-DCA did not account for all of the 1,1,1-TCA lost.

cis-DCE decreased in tests with sufficiently long contact times (about 3 hours or 3 days), but small increases were seen with shorter contact time (1.5 hours) because cis-DCE is a reactive intermediate of TCE transformation and TCE transformation was incomplete.

Chloride, ethene, and ethane increased, confirming that at least some of the observed VOC losses were due to destruction.

Based on the results of this study, PRIMA recommends that ZVI be considered for use at this site. ZVI was effective toward both TCE and 1,1,1-TCA, though the half-life for transformation of TCE increased as the iron aged. In addition, 1,1-DCA concentrations increased due to transformation of 1,1,1-TCA, which may need to be managed since 1,1-DCA is not readily transformed by ZVI.

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ACRONYMS and ABBREVIATIONS

1,1-DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
Fe	iron
g	grams
L	liters
mg	milligrams
mL	milliliters
mV	millivolts
μg	micrograms
ORP	oxidation reduction potential
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
VC	vinyl chloride
ZVI	zero-valent iron

CHEMICAL FORMULAE

C_2H_4	ethene
C_2H_3Cl	vinyl chloride
$C_2H_2Cl_2$	dichloroethene
C_2HCl_3	trichloroethene
$C_2H_4Cl_2$	dichloroethane
$C_2H_3Cl_3$	trichloroethane
Cl^-	chloride
CO_2	carbon dioxide
Fe^0	zero-valent iron
Fe^{2+}	ferrous iron
H_2O	water

1.0 INTRODUCTION

Bench-scale treatability testing was conducted on groundwater collected from the Steel Treaters, Inc. site located in Troy, New York to evaluate the ability of zero-valent iron (ZVI) to destroy chemicals of concern (COCs). The primary COCs at this site are trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA), though lesser chlorinated compounds may also be present and are of interest. A multi-port column test using ZVI from Peerless Metal Powders (http://www.peerlessmetal.com/) was run to assess COC removal and to obtain rate constants that can be used to design a permeable reactive barrier.

1.1 Background

Zero-valent iron (Fe^0) is an established technology for the dechlorination of TCE, 1,1,1-TCA, and other chlorinated compounds. It is most commonly applied in a permeable reactive barrier, in fractures, or mixed with sand or native material. The primary mechanism of TCE removal is step-wise reductive chlorination to ethene (**Equations 1a-d**), though other mechanisms resulting in ethane and other completely dechlorinated compounds also occur. Intermediates such as dichloroethene (DCE) and vinyl chloride (VC) may be observed, but these compounds are also susceptible to reduction by ZVI. 1,1,1-TCA may be dechlorinated to 1,1-dichloroethane (1,1-DCA) or to 1,1-DCE (**Equation 2**). 1,1-DCE is susceptible to dechlorination (**Equation 1b**), while 1,1-DCA does not readily degrade.

$$\underset{TCE}{C_2HCl_3} + Fe^0 + H_2O \rightarrow \underset{DCE}{C_2H_2Cl_2} + Fe^{2+} + Cl^- + OH^- \qquad \text{Eqn. 1a}$$

$$\underset{DCE}{C_2H_2Cl_2} + Fe^0 + H_2O \rightarrow \underset{VC}{C_2H_3Cl} + Fe^{2+} + Cl^- + OH^- \qquad \text{Eqn. 1b}$$

$$\underset{VC}{C_2H_3Cl} + Fe^0 + H_2O \rightarrow \underset{ethene}{C_2H_4} + Fe^{2+} + Cl^- + OH^- \qquad \text{Eqn. 1c}$$

$$\underset{TCE}{C_2Cl_4} + 3Fe^0 + 3H_2O \rightarrow \underset{ethene}{C_2H_4} + 3Fe^{2+} + 3Cl^- + 3OH^- \qquad \text{Eqn. 1d}$$

$$\underset{1,1,1\text{-}TCA}{C_2H_3Cl_3} \xrightarrow{Fe^0} \underset{1,1\text{-}DCE}{C_2H_2Cl_2} + \underset{1,1\text{-}DCA}{C_2H_4Cl_2} \qquad \text{Eqn. 2}$$

Treatment of groundwater with ZVI may affect secondary water quality. The most common changes are decreased dissolved oxygen (due to reactions with ZVI), increased pH and ferrous iron, and decreased nitrate (due to reduction of nitrate by ZVI). The magnitude and significance of these changes is site-specific, though changes in pH and ferrous iron are likely to attenuate quickly upon contact with site soil.

1.2 Study Objectives

A column test was conducted to evaluate the ability of ZVI. Specific goals were to:

- confirm that COCs can be removed as expected
- measure the rate constant for destruction of COCs by ZVI

Tests to achieve these goals are described in **Section 2.0**. Results are presented and discussed in **Section 3.0** while conclusions are given in **Section 4.0.** PRIMA has evaluated the effectiveness of ZVI based on the results of the bench test. However, it is the responsibility of Ramboll Environ to review this report and use its knowledge and expertise to determine whether any of this technology should be applied at the site.

2.0 MATERIALS and METHODS

2.1 Materials

Zero-valent Iron, ZVI. Peerless 8/50 zero-valent iron was used in this study. It may be obtained from Peerless Metal Powders (www.peerlessmetal.com).

2.2 Preparation and Characterization of Groundwater

Three 6 gallon carboys of groundwater were received on December 9, 2016. The groundwater was composited by pumping it into an open top drum fitted with a Teflon liner and floating lid. The floating lid minimized losses due to volatilization as well as exposure of the water to air. Composited water was analyzed for volatile organic compounds (VOCs), alkalinity, dissolved oxygen (DO), ferrous iron, nitrates, oxidation reduction potential (ORP) and pH. Because the concentration of TCE was lower than expected (see **Section 3.1**), water was spiked with a methanolic solution of TCE and 1,1,1-TCA to target concentrations of 5,000 μg/L and 500 μg/L, respectively, then reanalyzed for VOCs.

2.3 Evaluation of ZVI

2.3.1 Column Construction

A multiport column was constructed from 2 inch diameter clear PVC pipe. The column was approximately 30 inches tall. The ZVI bed height was 17 inches with approximately 3 inches of clean, coarse sand on the top and bottom. The influent port was located immediately prior to the column. Three sampling ports were located along the length of the column at 4.5 inches above the base of the ZVI bed, 9 inches above the base, and 13.5 inches above the bed. A fourth sampling port (Effluent) was located within the sand layer at the top (effluent end) of the column. All sampling ports extended halfway into the column, allowing water to be collected from the center of the bed. The column is shown in **Figure 1.** Column parameters are given in **Table 1**.

2.3.2 Column Operation

Spiked groundwater (see **Section 2.2)**, was pumped up flow through the column at 2.3 mL/min, resulting in a total contact time of 3 hours. After 24 hours (8 pore volumes), influent and effluent samples were collected and analyzed for VOCs. All effluent samples were collected from the effluent port within the sand bed. Samples were collected by pumping water out of the port at a flowrate approximately equal to the flowrate entering the column. Each sample was collected in a Tedlar bag to prevent VOC loss during sampling, then distributed into appropriate sample containers. Immediately after sample collection was complete, the flowrate was reduced to 0.1 mL/min until VOC results could be reviewed. After 11 days, the flowrate was increased to 4.7 mL/min (1.5 hour contact time). After 26 pore volumes and after 57 pore volumes were put through at the increased flowrate, samples were collected from each port as described above, starting with the effluent port and working down to the influent. All samples were analyzed for VOCs, MEE (methane/ethane/ethene), chloride, DO, ferrous iron, ORP, and pH. Once sampling was complete, the flowrate was reduced to 0.1 mL/min. After 34 days at the reduced flowrate, influent and effluent samples were collected and analyzed for VOC, ORP and pH. Column operations are summarized in **Table 1**. The sampling procedure is shown in **Figure 2**

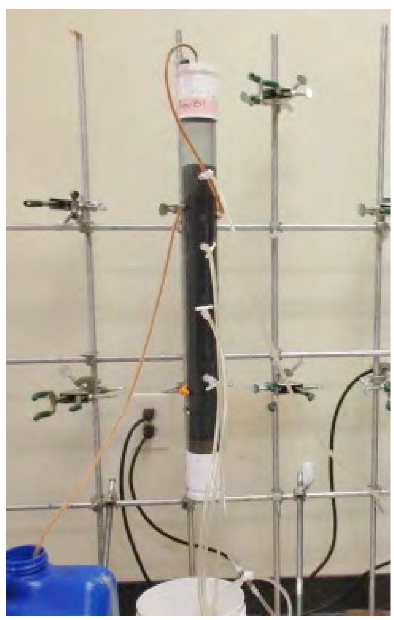

Figure 1. Multi-port ZVI Column.

Table 1. Column Parameters and Operating Conditions.

Parameter	Units	Value
Inner diameter	in	2.0
	cm	5.1
Bed Height	in	17
	cm	43
Bed volume	mL	875
Sand height (top, bottom)	in	3
ZVI	g	2950
Bulk density	g/cm3	3.37
Pore volume*	mL	420
Direction of flow	--	upflow
First Sample Event (Prelim test)		
Flowrate	mL/min	2.3
Residence Time**	hours	3.0
Test duration	days	1.0
Pore volumes put through	#	7.9
Interim		
Flowrate	mL/min	0.1
Residence Time**	hours	70.0
Time at this flowrate	days	11.1
Cummulative Pore volumes	#	12
Second Sample Event		
Flowrate	mL/min	4.7
Residence Time**	hours	1.5
Time at this flowrate	days	1.58
Cummulative Pore volumes	#	37
Third Sample Event		
Flowrate	mL/min	4.7
Residence Time**	hours	1.5
Time at this flowrate	days	1.96
Cummulative Pore volumes	#	69
Fourth Sample Event		
Flowrate	mL/min	0.1
Residence Time**	hours	70.0
Time at this flowrate	days	34.0
Cummulative Pore volumes	#	80

* Pore volume was determined in a separate test by tightly packing a known mass of ZVI into to a beaker, then measuring the amount of water needed to fill the void space.

** At effluent port.

Figure 2. Sample Collection into Tedlar Bag.

2.4 Analytical Methods

The methods for each analysis and the laboratory that performed the analyses are summarized in **Table 2**.

Table 2. Analytical Methods.

Analyte	Method	Lab performing test*
VOCs	EPA 8260B	Alpha Analytical
Methane/ethane/ethene	RSK 175	Alpha Analytical
Alkalinity	EPA SM2320B	Alpha Analytical
Anions (chloride, nitrate)	EPA 300	Alpha Analytical
Dissolved Oxygen	Probe	PRIMA
Ferrous iron	Hach	PRIMA
ORP	Probe	PRIMA
pH	Probe	PRIMA

* Alpha Analytical (Sparks, NV)

** Hach DR 2800 Spectrophotometer and appropriate Hach kit reagents

2.5 Calculations

Transformation of TCE and 1,1,1-TCA by ZVI is assumed to be a pseudo first order reaction. Thus, the rate is given by

$$C = C_0 e^{k_{obs} t} \qquad \text{Eqn. 3a}$$

$$k_{obs} = -\frac{ln\left({}^{C}/_{C_0}\right)}{t} \qquad \text{Eqn. 3b}$$

where

- C is the concentration of TCE or TCA at time, *t*, in µg/L
- C_0 is the influent concentration of TCE or TCA in µg/L
- k_{obs} is the observed pseudo first order rate constant in hr^{-1}
- t is time, in hours

The half-life, $t_{1/2}$, is given by

$$t_{1/2} = \frac{ln2}{k_{obs}} \qquad \text{Eqn. 4}$$

3.0 RESULTS and DISCUSSION

3.1 Untreated Groundwater

The concentrations of VOCs and other parameters in untreated groundwater are shown in **Table 3**. Complete analytical reports are provided in **Appendix A**. Unspiked groundwater contained 750 µg/L TCE, 97 µg/L 1,1,1-TCA, 93 µg/L cis-DCE, 64 µg/L 1,1-DCA, and 11 µg/L 1,1-DCE. Spiking groundwater yielded 5,800 µg/L TCE and 450 µg/L 1,1,1-TCA. Alkalinity of site water was high—360 mg/L as $CaCO_3$; chloride was 9.2 mg/L, DO was 7.7 mg/L, ORP was 227 mV and pH was 7.7. Neither nitrate nor ferrous iron was detected.

Table 3. COCs and Other Parameters in Untreated Water.

Analyte	Units	Untreated GW (as received)	Untreated GW (Spiked)
COCs			
vinyl chloride	µg/L	< 8.0	< 100
1,1-dichloroethene	µg/L	11	< 100
1,1-dichloroethane	µg/L	64	< 100
cis-dichloroethene	µg/L	93	< 100
1,1,1-trichloroethane	µg/L	97	450
trichloroethene	µg/L	750	5,800
Other Parameters			
Alkalinity	mg/L CaCO3	360	not measured
Chloride	mg/L	9.2	not measured
Dissolved Oxygen	mg/L	not measured	7.7
Ferrous Iron	mg/L	not measured	< 0.01
Nitrate	mg/L - N	< 0.25	not measured
ORP	mV	not measured	227
pH	-	not measured	7.7

3.3 ZVI Column Tests

The concentrations of VOCs in the influent and effluent ports from the preliminary test are shown in **Table 4**. Concentrations of VOCs and other parameters for the second and third sample events are given in **Table 5**, while results of the final sample event are given in **Table 6**. Rate constants and half-lives, calculated per **Section 2.5**, are provided in **Table 7**. Complete analytical reports are given in **Appendix A**.

3.3.1 VOC Removal

ZVI reduced concentrations of TCE, 1,1,1-TCA, and cis-DCE, as expected. TCE decreased from 5,300 μg/L to < 1.0 μg/L at the effluent port for the first (prelim) sample event, from 5,000 μg/L to 1,100 μg/L for the second sample event, from 5,200 μg/L to 1,500 μg/L for the third sample event and from 1,000 μg/L to 1.7 μg/L for the final sample event. The corresponding half-lives are less than 13 minutes, 43 minutes, 51 minutes and 462 minutes for the first, second, third, and fourth sample events, respectively. These data suggest that the ZVI becomes less reactive toward TCE as it ages. In contrast, 1,1,1-TCA removal improved over time. 1,1,1-TCA decreased from 500 μg/L to 2.9 μg/L at the effluent port for the first (prelim) sample event but was not detected by Port 1 (24 minutes) in either the second or third sample events, though it should be noted that reporting limits were higher in those cases. The half-life for 1,1,1-TCA in the first sample event was 24 minutes, but was estimated to be under 3.6 minutes for the second and third events.

cis-DCE decreased in first and fourth sample events and increased somewhat in the second and third events. This behavior was expected because cis-DCE is a reactive intermediate of TCE transformation. Decreases were seen in the first and fourth events because the amount of cis-DCE generated by reaction of TCE was smaller than the amount transformed by ZVI. Increases were seen in the second and third events (from 61-67 μg/L in the influent to 85-97 μg/L at the effluent port) because the amount of cis-DCE generated was greater than the amount transformed due the shorter contact time associated with these events.

1,1-DCA increased in the first, second, and third sample events due to transformation of 1,1,1-TCA. The concentration increased from 43-52 μg/L in the influent to 100-110 μg/L by Port 1 in the second and third events, after which it remained nearly constant, implying that it is not readily transformed by ZVI. However, a small decrease was observed in the fourth sample event (1,1-DCA decreased from 29 μg/L at the influent to 20 μg/L in the effluent) indicating that it can be transformed given a long enough contact time (at least 4,200 minutes).

Table 4. Column Test Results – First Sample Event (Preliminary Test).

Analyte	Units	Influent	Effluent (3 hr contact time)
COCs			
vinyl chloride	μg/L	< 30	< 1.0
1,1-dichloroethene	μg/L	< 30	78
cis-dichloroethene	μg/L	78	13
trichloroethene	μg/L	5,300	< 1.0
chloroethane	μg/L	< 30	1.2
1,1-dichloroethane	μg/L	51	78
1,1,1-trichloroethane	μg/L	500	2.9
Other VOCs			
Benzene	μg/L	< 15	0.84

Table 5a. Column Test Results – Second Sample Event.

Port		Influent	P1	P2	P3	Effluent *
Distance along column, cm		**0**	**4.5**	**9**	**13.5**	**17**
Time, min		**0**	**24**	**47**	**71**	**89**
Pore volume		**0**	**111**	**222**	**334**	**420**
Total Pore volumes put through				**38**		
COCs						
vinyl chloride	µg/L	< 20	< 20	< 10	< 8.0	< 5.0
1,1-dichloroethene	µg/L	< 20	< 20	< 10	< 8.0	< 5.0
1,1-dichloroethane	µg/L	43	100	100	100	100
cis-dichloroethene	µg/L	61	69	81	94	92
1,1,1-trichloroethane	µg/L	330	< 20	< 10	< 8.0	< 5.0
trichloroethene	µg/L	5000	3400	2600	1800	1100
MEE						
Methane	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethane	mg/L	< 0.01	0.023	0.031	0.031	0.016
Ethene	mg/L	< 0.01	0.056	0.08	0.093	0.06
Other Parameters						
Chloride	mg/L	9.27	9.91	10.2	10.4	10.7
Dissolved Oxygen	mg/L	8.2	2.0	2.6	2.7	5.4
Ferrous Iron	mg/L	< 0.01	0.39	0.08	< 0.01	0.01
Total Fe (Hach)	mg/L	0.05	11.1	8.3	6.7	3.3
ORP	mV	247	-103	-166	-161	-74
pH	-	7.82	7.49	7.68	7.8	8.02

* Effluent port is located sand layer 1 inch atop the ZVI bed. Total ZVI bed height is 17 inches. Distance to Effluent port is 18 inches.

Table 5b. Column Test Results – Third Sample Event.

Port		Influent	P1	P2	P3	Effluent *
Distance along column, cm		**0**	**4.5**	**9**	**13.5**	**17**
Time, min		**0**	**0**	**0**	**0**	**0**
Pore volume		**0**	**0**	**0**	**0**	**0**
Pore volumes put through				**69**		
COCs						
vinyl chloride	µg/L	< 30	< 50	< 50	< 20	< 8.0
1,1-dichloroethene	µg/L	< 30	< 50	< 50	< 20	< 8.0
1,1-dichloroethane	µg/L	52	110	110	100	90
cis-dichloroethene	µg/L	67	67	82	81	85
1,1,1-trichloroethane	µg/L	350	< 50	< 50	< 20	< 8.0
trichloroethene	µg/L	5200	2900	2300	1900	1500
MEE						
Methane	mg/L	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Ethane	mg/L	< 0.010	0.017	0.03	0.035	0.028
Ethene	mg/L	< 0.010	0.041	0.075	0.11	0.096
Other Parameters						
Chloride	mg/L	9.20	9.86	10.1	10.4	11.6
Dissolved Oxygen	mg/L	7.8	1.8	1.8	1.5	4.2
Ferrous Iron	mg/L	< 0.01	1.1	0.92	0.55	< 0.02
Total Fe (Hach)	mg/L	< 0.01	9.2	5.7	4.2	2.4
ORP	mV	101	-176	-210	-263	-48
pH	-	7.9	7.45	7.7	7.87	8.15

* Effluent port is located sand layer 1 inch atop the ZVI bed. Total ZVI bed height is 17 inches. Distance to Effluent port is 18 inches.

Table 6. Column Test Results – Fourth Sample Event.

Port		Influent	P1	P2	P3	Effluent *
Distance along column, cm		**0**	**4.5**	**9**	**13.5**	**17**
Time, min		**0**	**1112**	**2224**	**3335**	**4200**
Pore volume		**0**	**111**	**222**	**334**	**420**
Pore volumes put through				**~80**		
COCs						
vinyl chloride	µg/L	< 8.0		not measured		< 1.0
chloroethane	µg/L	< 8.0				1.1
1,1-dichloroethene	µg/L	< 8.0				< 1.0
1,1-dichloroethane	µg/L	29				20
cis-dichloroethene	µg/L	36				1.2
1,1,1-trichloroethane	µg/L	180				< 1.0
trichloroethene	µg/L	1000				1.7
MEE						
Methane	mg/L			not measured		
Ethane	mg/L					
Ethene	mg/L					
Other Parameters						
Chloride	mg/L	n.m.		not measured		n.m.
Dissolved Oxygen	mg/L	n.m.				n.m.
Ferrous Iron	mg/L	n.m.				n.m.
Total Fe (Hach)	mg/L	n.m.				n.m.
ORP	mV	210				-131
pH	-	7.88				9.83

* Effluent port is located sand layer 1 inch atop the ZVI bed. Total ZVI bed height is 17 inches. Distance to Effluent port is 18 inches.

Table 7. Rate Constants and Half-Lives.

Analyte	Contact Time	Total Pore Volumes Put Through	k_{obs}	R^2	$t_{1/2}$
	min		min-1	-	min
First Sample Event					
TCE	*180*	*8*	> 0.052*	1*	< 13*
1,1,1-TCA	*180*	*8*	0.029	1	24
Second Sample Event					
TCE	*89*	*37*	0.0162	0.9795	43
1,1,1-TCA	*89*	*37*	> 0.20*	1*	< 3.5*
Third Sample Event					
TCE	*89*	*69*	0.0135	0.9366	51
1,1,1-TCA	*89*	*69*	> 0.19*	1*	< 3.6*
Fourth Sample Event					
TCE	4200	80	0.0015	1	462
1,1,1-TCA	4200	80	0.0014*	1*	< 495*

** Estimated value. Analyte was not detected in any measured sample except influent. A concentration of 1/2 the reporting limit and a time equal to the contact time in the first port for which the analyte was not detected, was used to estimate kobs.*

3.3.2 Daughter Products/End Products

The primary end-products for reduction of TCE and 1,1,1-TCA by ZVI are ethene and ethane, but ethene and ethane did not account for all of the TCE and 1,1,1-TCA lost in these systems. **Table 8** indicates that up to 31 µmoles/L of chlorinated VOCs were removed by the effluent port in the second and third sample events, but only 2.7-4.4 µmoles/L of ethene and ethane were produced. The discrepancy is probably due primarily to the difficulty of obtaining a representative sample for ethene and ethane analysis since ethene and ethane are highly volatile. However, it is also possible that incomplete dechlorination occurred since the increase in chloride concentration was lower than expected due to the loss of chlorinated VOCs (**Table 9**).

The concentration of 1,1-DCA increased in the both the first, second and third sampling events due to dechlorination of 1,1,1-TCA,but it did not account for all of the 1,1,1-TCA removed. As shown in **Table 10**, 2.5-2.6 µmole/L of 1,1,1-TCA were lost, but only 0.58 µmoles/L 1,1-DCA were produced. Since 1,1-DCA concentration was stable once 1,1,1-

TCA was removed, this implies that 1,1-DCA is not the only end-product of 1,1,1-TCA reduction by ZVI.

3.3.3 Secondary Parameters

Chloride, DO, ferrous iron, ORP and/or pH were measured for most sampling events and are included in **Tables 4-6**. Chloride increased from about 9.2 mg/L to up to 11.6 mg/L in the second and third sample events, due to dechlorination of TCE and 1,1,1-TCA, though the amount did not account for all of the TCE and 1,1,1-TCA lost (see **Section 3.3.2**). Possibly dechlorination was incomplete and/or some chloride sorbed onto iron or was incorporated into iron minerals. DO and ORP decreased within the ZVI bed. Iron (ferrous and total) initially increased in Port 1 then slowly decreased along the columns. Ferrous iron was present at 0.01 mg/L in effluent from the second sample event and not detected in effluent from the third event. Total iron was present at 3.3 mg/L in effluent from the second event and at 2.4 mg/L from the third event. The decrease in iron along the length of the column implies that dissolved iron is precipitating, which in turn is consistent with reduced reactivity associated with aging of the ZVI. **Figure 3** shows the samples from the third sampling event – the samples are colored due to oxidation of ferrous iron to ferric iron. The pH initially dropped then increased slightly – from 7.8-7.9 in the influent to 7.5 by Port 1, then to 8.02-8.15 in the effluent – in the second and third sample events. The increase was low due to the short (1.5 hour) contact time. The pH increased to 9.83 in the fourth sample event where the contact time was much longer (about 3 days).

Table 8. VOC/MEE Mass Balance.

VOC/MEE Balance	Concentration, umole/L			
	P1	P2	P3	Effluent
37 pore volumes (Second Sample Event)				
VOCs Lost				
1,1-DCA	-0.57	-0.57	-0.57	-0.57
cis-DCE	-0.08	-0.21	-0.34	-0.32
1,1,1-TCA	2.5	2.5	2.5	2.5
TCE	12	18	24	30
Total	*14*	*20*	*26*	*31*
Ethane/Ethene Produced				
Ethane	0.76	1.0	1.0	0.53
Ethene	2.0	2.9	3.3	2.1
Total	*2.8*	*3.9*	*4.3*	*2.7*
69 pore volumes (Third Sample Event)				
VOCs Lost				
1,1-DCA	-0.58	-0.58	-0.48	-0.38
cis-DCE	0.00	-0.15	-0.14	-0.19
1,1,1-TCA	2.6	2.6	2.6	2.6
TCE	18	22	25	28
Total				
Ethane/Ethene Produced				
Ethane	0.57	1.0	1.2	0.93
Ethene	1.5	2.7	3.9	3.4
Total	*2.0*	*3.7*	*5.1*	*4.4*

Table 9. Chloride Mass Balance.

Chloride Increase	Chloride Concentration, mg/L			
	P1	P2	P3	Effluent
37 pore volumes (Second Sample Event)				
Expected*				
1,1-DCA	-0.041	-0.041	-0.041	-0.041
cis-DCE	-0.006	-0.015	-0.024	-0.023
1,1,1-TCA	0.26	0.26	0.26	0.26
TCE	1.3	1.9	2.6	3.2
total, mg/L	*1.5*	*2.2*	*2.8*	*3.4*
Observed	0.64	0.93	1.1	1.4
69 pore volumes (Third Sample Event)				
Expected*				
1,1-DCA	-0.041	-0.041	-0.034	-0.027
cis-DCE	0.000	-0.011	-0.010	-0.013
1,1,1-TCA	0.28	0.28	0.28	0.28
TCE	1.9	2.3	2.7	3.0
total, mg/L	2.1	2.6	2.9	3.2
Observed	0.66	0.90	1.2	2.4

*Expected due to VOC loss

Table 10. 1,1,1-TCA/1,1-DCA Mass Balance.

Analyte	Concentration, umole/L			
	P1	P2	P3	Effluent
37 pore volumes (Second Sample Event)				
1,1-DCA produced	0.57	0.57	0.57	0.57
1,1,1-TCA lost	2.5	2.5	2.5	2.5
69 pore volumes (Third Sample Event)				
1,1-DCA produced	0.58	0.58	0.48	0.38
1,1,1-TCA lost	2.6	2.6	2.6	2.6

Figure 3. Iron in Samples from Third Sample Event. *From left: Effluent, Port 3, Port 2, Port 1, and Influent.*

4.0 SUMMARY and CONCLUSIONS

ZVI destroyed TCE, 1,1,1-TCA and cis-DCE, as expected, but had little effect on 1,1-DCA. The half-life for TCE removal increased over time, ranging from < 13 minutes when the iron was fresh (about 8 pore volumes put through) to 43 minutes after 37 pore volumes, 51 minutes after 69 pore volumes, and 462 minutes after 80 pore volumes. Loss of total and dissolved iron along the length of the ZVI bed suggests that the loss of reactivity may be due to precipitation of iron minerals.

1,1,1-TCA degradation was rapid with the rate increasing with the age of the column. The half-life for 1,1,1-TCA removal was 24 minutes when the iron was fresh, but less than 3.6 minutes after 69 pore volumes were put thought. 1,1,1-TCA was partially transformed to 1,1-DCA, but 1,1-DCA did not account for all of the 1,1,1-TCA lost.

cis-DCE decreased in tests with sufficiently long contact times (about 3 hours or 3 days), but small increases were seen with shorter contact time (1.5 hours) because cis-DCE is a reactive intermediate of TCE transformation and TCE transformation was incomplete.

Chloride, ethene, and ethane increased, confirming that at least some of the observed VOC losses were due to destruction.

Based on the results of this study, PRIMA recommends that ZVI be considered for use at this site. ZVI was effective toward both TCE and 1,1,1-TCA, though the half-life for transformation of TCE increased as the iron aged. In addition, 1,1-DCA concentrations increased due to transformation of 1,1,1-TCA, which may need to be managed since 1,1-DCA is not readily transformed by ZVI.

APPENDIX A
(Analytical Reports)

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: RAM-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES16121320-01A
Client I.D. Number: RAM-ZVI GW

Sampled: 12/12/16 16:15
Received: 12/13/16
Extracted: 12/13/16 20:11
Analyzed: 12/13/16 20:11

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	32 µg/L
2	Vinyl chloride	ND	8.0 µg/L
3	Chloroethane	ND	8.0 µg/L
4	Bromomethane	ND	32 µg/L
5	Trichlorofluoromethane	ND	8.0 µg/L
6	Acetone	ND	160 µg/L
7	1,1-Dichloroethene	11	8.0 µg/L
8	Dichloromethane	ND	32 µg/L
9	trans-1,2-Dichloroethene	ND	8.0 µg/L
10	1,1-Dichloroethane	64	8.0 µg/L
11	cis-1,2-Dichloroethene	93	8.0 µg/L
12	Chloroform	ND	8.0 µg/L
13	1,2-Dichloroethane	ND	8.0 µg/L
14	1,1,1-Trichloroethane	97	8.0 µg/L
15	Carbon tetrachloride	ND	8.0 µg/L
16	Benzene	ND	4.0 µg/L
17	1,2-Dichloropropane	ND	8.0 µg/L
18	Trichloroethene	750	8.0 µg/L
19	Bromodichloromethane	ND	8.0 µg/L
20	cis-1,3-Dichloropropene	ND	8.0 µg/L
21	trans-1,3-Dichloropropene	ND	8.0 µg/L
22	1,1,2-Trichloroethane	ND	8.0 µg/L
23	Toluene	ND	4.0 µg/L
24	Dibromochloromethane	ND	8.0 µg/L
25	Tetrachloroethene	ND	8.0 µg/L
26	Chlorobenzene	ND	8.0 µg/L
27	Ethylbenzene	ND	4.0 µg/L
28	m,p-Xylene	ND	4.0 µg/L
29	Bromoform	ND	8.0 µg/L
30	o-Xylene	ND	4.0 µg/L
31	1,1,2,2-Tetrachloroethane	ND	8.0 µg/L
32	1,3-Dichlorobenzene	ND	8.0 µg/L
33	1,4-Dichlorobenzene	ND	8.0 µg/L
34	1,2-Dichlorobenzene	ND	8.0 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com

Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.

Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered in any way.

Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

ACLASS ACCREDITED DoD ELAP

12/14/16
Report Date

Alpha Analytical, Inc.
255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

VOC Sample Preservation Report

Work Order: PES16121320 **Job:** RAM-ZVI

Alpha's Sample ID	Client's Sample ID	Matrix	pH
16121320-01A	RAM-ZVI GW	Aqueous	2

12/14/16
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *16-Dec-16*

QC Summary Report

Work Order: 16121320

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**
File ID: **2** Batch ID: **MS09W1213A** Analysis Date: **12/13/2016 10:56**
Sample ID: **MBLK MS09W1213A** Units : **µg/L** Run ID: **MANUAL_161213A** Prep Date: **12/13/2016 10:56**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	8.91		10		89	70	130			
Surr: Toluene-d8	9.6		10		96	70	130			
Surr: 4-Bromofluorobenzene	9.83		10		98	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**
File ID: **1** Batch ID: **MS09W1213A** Analysis Date: **12/13/2016 10:08**
Sample ID: **LCS MS09W1213A** Units : **µg/L** Run ID: **MANUAL_161213A** Prep Date: **12/13/2016 10:08**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	10	1	10		100	70	130			
Benzene	9.72	0.5	10		97	70	130			
Trichloroethene	9.5	1	10		95	68	138			
Toluene	9.41	0.5	10		94	70	130			
Chlorobenzene	8	1	10		80	70	130			
Ethylbenzene	9.43	0.5	10		94	70	130			
m,p-Xylene	9.12	0.5	10		91	65	139			
o-Xylene	8.7	0.5	10		87	70	130			
Surr: 1,2-Dichloroethane-d4	8.04		10		80	70	130			
Surr: Toluene-d8	9.9		10		99	70	130			
Surr: 4-Bromofluorobenzene	10.1		10		101	70	130			

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *16-Dec-16*

QC Summary Report

Work Order: 16121320

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**
File ID: **8** Batch ID: **MS09W1213A** Analysis Date: **12/13/2016 18:35**
Sample ID: **1612016-08AMS** Units : **µg/L** Run ID: **MANUAL_161213A** Prep Date: **12/13/2016 18:35**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	57.5	2.5	50	0	115	62	133			
Benzene	61	1.3	50	0	122	67	134			
Trichloroethene	56.5	2.5	50	0	113	68	138			
Toluene	58.4	1.3	50	0	117	38	130			
Chlorobenzene	45.7	2.5	50	0	91	70	130			
Ethylbenzene	53.6	1.3	50	0	107	70	130			
m,p-Xylene	50	1.3	50	0	100	65	139			
o-Xylene	48.9	1.3	50	0	98	69	130			
Surr: 1,2-Dichloroethane-d4	52.6		50		105	70	130			
Surr: Toluene-d8	44.7		50		89	70	130			
Surr: 4-Bromofluorobenzene	45.9		50		92	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**
File ID: **9** Batch ID: **MS09W1213A** Analysis Date: **12/13/2016 19:00**
Sample ID: **1612016-08AMSD** Units : **µg/L** Run ID: **MANUAL_161213A** Prep Date: **12/13/2016 19:00**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	61.3	2.5	50	0	123	62	133	57.52	6.4(35)	
Benzene	61.2	1.3	50	0	122	67	134	61.01	0.2(21)	
Trichloroethene	62.7	2.5	50	0	125	68	138	56.5	10.5(20)	
Toluene	60.9	1.3	50	0	122	38	130	58.44	4.1(20)	
Chlorobenzene	52	2.5	50	0	104	70	130	45.71	12.9(20)	
Ethylbenzene	58.6	1.3	50	0	117	70	130	53.63	8.8(20)	
m,p-Xylene	56.6	1.3	50	0	113	65	139	50	12.3(20)	
o-Xylene	54.9	1.3	50	0	110	69	130	48.85	11.6(20)	
Surr: 1,2-Dichloroethane-d4	52.1		50		104	70	130			
Surr: Toluene-d8	46.1		50		92	70	130			
Surr: 4-Bromofluorobenzene	39.2		50		78	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

CA RUSH

Billing Information :

WORK ORDER SUMMARY

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES16121320
Report Due By : 5:00 PM On : 14-Dec-16

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : No

Sampled by : Cindy Schreier

Cooler Temp	Samples Received	Date Printed
3 °C	13-Dec-16	13-Dec-16

PO :

Client's COC # : 6208 Job : RAM-ZVI

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests VOC_W								Sample Remarks
PES16121320-01A	RAM-ZVI GW	AQ	12/12/16 16:15	3	0	1	8260/ Acetone_Cs								

Comments: 24 HR TAT. No security seals. Frozen ice. Chain split into two separate work orders due to different TATs. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	12/13/16 1035

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other) Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Billing Information:

Company: PRIMA Env
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.

Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 — Phone: 775-355-1044 Fax: 775-355-0406

Satellite Service Centers:

Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 — Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 — Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 — Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 — Phone: 702-281-4848

6208

Page # 1 of 1

Consultant/ Client Info:

Company: PRIMA Env
Address:
City, State, Zip:

Job and Purchase Order Info:

Job #: RAM-ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:

Name: Cindy Schreier
Email Address: data@primaenvironmental.com
Phone #: 916-939-7300
Cell #:

QC Deliverable Info:

EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	VOCs 8260	Alkalinity	Chloride	Nitrate							Remarks
1615	12/12	AQ	PES16121320-01	RAM. ZVI GW	24hr	3V		X	X										~~FEEZ~~
↓	↓	↓	—	↓	5d	1P		X		X	X	X							

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By:

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
PRIMA	12/12/16	~1700	FedEx		
			K Murray	12/13/16	1030

* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398
Date Received : 12/13/16

Job: RAM-ZVI

Anions by IC
EPA Method 300.0

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **RAM-ZVI GW**					
Lab ID : PES16121321-01A	Chloride	9.2	0.50 mg/L	12/13/16 11:24	12/13/16 16:35
Date Sampled 12/12/16 16:15	Nitrate (NO3) - N	ND	0.25 mg/L	12/13/16 11:24	12/13/16 16:35

Roger Scholl Randy Gardner

ACLASS ACCREDITED
DoD ELAP

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com
Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.
Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.
Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

12/20/16
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398
Date Received : 12/13/16

Job: RAM-ZVI

Alkalinity
SM2320B

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **RAM-ZVI GW**					
Lab ID : PES16121321-01A	Alkalinity, Total (As CaCO3 at pH 4_5)	360	10 mg/L	12/14/16	12/14/16
Date Sampled 12/12/16 16:15					

Roger Scholl   Randy Gardner

ACLASS ACCREDITED DoD ELAP

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com
Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.
Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.
Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

12/20/16
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
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Date: 16-Dec-16

QC Summary Report

Work Order: 16121321

Method Blank

Type **MBLK** Test Code: **EPA Method 300.0**
File ID: **16** Batch ID: **37621** Analysis Date: **12/13/2016 14:07**
Sample ID: **MBLK-37621** Units : **mg/L** Run ID: **MANUAL_161214E** Prep Date: **12/13/2016 10:14**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	ND	0.5								
Nitrate (NO3) - N	ND	0.25								

Laboratory Fortified Blank

Type **LFB** Test Code: **EPA Method 300.0**
File ID: **17** Batch ID: **37621** Analysis Date: **12/13/2016 14:26**
Sample ID: **LFB-37621** Units : **mg/L** Run ID: **MANUAL_161214E** Prep Date: **12/13/2016 10:14**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	48.6	0.5	50		97	90	110			
Nitrate (NO3) - N	5.07	0.25	5		101	90	110			

Sample Matrix Spike

Type **LFM** Test Code: **EPA Method 300.0**
File ID: **20** Batch ID: **37621** Analysis Date: **12/13/2016 15:21**
Sample ID: **16121301-01ALFM** Units : **mg/L** Run ID: **MANUAL_161214E** Prep Date: **12/13/2016 10:14**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	259	1.3	250	19.9	96	80	120			
Nitrate (NO3) - N	26.2	0.63	25	1.08	100	80	120			

Sample Matrix Spike Duplicate

Type **LFMD** Test Code: **EPA Method 300.0**
File ID: **21** Batch ID: **37621** Analysis Date: **12/13/2016 15:40**
Sample ID: **16121301-01ALFMD** Units : **mg/L** Run ID: **MANUAL_161214E** Prep Date: **12/13/2016 10:14**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	261	1.3	250	19.9	96	80	120	259.3	0.5(15)	
Nitrate (NO3) - N	26.4	0.63	25	1.08	101	80	120	26.2	0.8(15)	

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Alpha Analytical, Inc.

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Date: *16-Dec-16*

QC Summary Report

Work Order: 16121321

Laboratory Control Spike

File ID: 1

Type **LCS** Test Code: **SM2320B**

Batch ID: **W1214AL** Analysis Date: **12/14/2016 00:00**

Sample ID: **WC160520-01** Units : **mg/L** Run ID: **MANUAL_161214H** Prep Date: **12/14/2016 00:00**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Alkalinity, Total (As CaCO3 at pH 4_5)	264	10	250		105	80	120			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Billing Information :

WORK ORDER SUMMARY

CA

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES16121321
Report Due By : 5:00 PM On : 20-Dec-16

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : No

Sampled by : Cindy Schreier

Cooler Temp	Samples Received	Date Printed
3 °C	13-Dec-16	13-Dec-16

PO :

Client's COC # : 6208 Job : RAM-ZVI

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests: 300_0_W	Requested Tests: ALKALINITY_W							Sample Remarks
PES16121321-01A	RAM-ZVI GW	AQ	12/12/16 16:15	1	0	5	Cl, NO3	Alk							

Comments: No security seals. Frozen ice. Chain split into two separate work orders due to different TATs. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	12/13/16 1115

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.
The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.
Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other) Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Billing Information:

Company: PRIMA Env
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.

Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 Phone: 775-355-1044 Fax: 775-355-0406

Satellite Service Centers:

Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 Phone: 702-281-4848

6208

Page # 1 of 1

Consultant/ Client Info:
Company: PRIMA Env
Address:
City, State, Zip:

Job and Purchase Order Info:
Job # RAM-ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:
Name: Cindy Schreier
Email Address: data@primaenvironmental.com
Phone #: 916-939-7300
Cell #:

QC Deliverable Info:
EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	VOCs 8260	Alkalinity	Chloride	Nitrate	Remarks
1615	12/12	AQ	-	RAM-ZVI GW	24hr	3V		X	X				~~[illegible]~~
↓	↓	↓	PES1612132I-01	↓	5d	1P		X		X	X	X	

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By: [signature]

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
[signature] PRIMA	12/12/16	~1700	FedEx		
			K Murray	12/13/16	1055

* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Alpha Analytical, Inc.

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(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES16122120-01A
Client I.D. Number: RAM-ZVI

Sampled: 12/20/16 17:50
Received: 12/21/16
Extracted: 12/23/16 20:44
Analyzed: 12/23/16 20:44

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	400 µg/L
2	Vinyl chloride	ND	100 µg/L
3	Chloroethane	ND	100 µg/L
4	Bromomethane	ND	400 µg/L
5	Trichlorofluoromethane	ND	100 µg/L
6	Acetone	ND	2,000 µg/L
7	1,1-Dichloroethene	ND	100 µg/L
8	Dichloromethane	ND	400 µg/L
9	trans-1,2-Dichloroethene	ND	100 µg/L
10	1,1-Dichloroethane	ND	100 µg/L
11	cis-1,2-Dichloroethene	ND	100 µg/L
12	Chloroform	ND	100 µg/L
13	1,2-Dichloroethane	ND	100 µg/L
14	1,1,1-Trichloroethane	450	100 µg/L
15	Carbon tetrachloride	ND	100 µg/L
16	Benzene	ND	50 µg/L
17	1,2-Dichloropropane	ND	100 µg/L
18	Trichloroethene	5,800	100 µg/L
19	Bromodichloromethane	ND	100 µg/L
20	cis-1,3-Dichloropropene	ND	100 µg/L
21	trans-1,3-Dichloropropene	ND	100 µg/L
22	1,1,2-Trichloroethane	ND	100 µg/L
23	Toluene	ND	50 µg/L
24	Dibromochloromethane	ND	100 µg/L
25	Tetrachloroethene	ND	100 µg/L
26	Chlorobenzene	ND	100 µg/L
27	Ethylbenzene	ND	50 µg/L
28	m,p-Xylene	ND	50 µg/L
29	Bromoform	ND	100 µg/L
30	o-Xylene	ND	50 µg/L
31	1,1,2,2-Tetrachloroethane	ND	100 µg/L
32	1,3-Dichlorobenzene	ND	100 µg/L
33	1,4-Dichlorobenzene	ND	100 µg/L
34	1,2-Dichlorobenzene	ND	100 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com

RG
12/28/16
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *29-Dec-16*

QC Summary Report

Work Order: 16122120

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**

File ID: **2** Batch ID: **MS15W1223A** Analysis Date: **12/23/2016 12:52**

Sample ID: **MBLK MS15W1223A** Units : **µg/L** Run ID: **MANUAL_161223E** Prep Date: **12/23/2016 12:52**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	9.75		10		98	70	130			
Surr: Toluene-d8	11.3		10		113	70	130			
Surr: 4-Bromofluorobenzene	9.21		10		92	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**

File ID: **1** Batch ID: **MS15W1223A** Analysis Date: **12/23/2016 11:37**

Sample ID: **LCS MS15W1223A** Units : **µg/L** Run ID: **MANUAL_161223E** Prep Date: **12/23/2016 11:37**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	9.54	1	10		95	70	130			
Benzene	8.93	0.5	10		89	70	130			
Trichloroethene	9.85	1	10		99	68	138			
Toluene	10	0.5	10		100	70	130			
Chlorobenzene	9.84	1	10		98	70	130			
Ethylbenzene	9.48	0.5	10		95	70	130			
m,p-Xylene	9.29	0.5	10		93	65	139			
o-Xylene	8.91	0.5	10		89	70	130			
Surr: 1,2-Dichloroethane-d4	9.61		10		96	70	130			
Surr: Toluene-d8	11.5		10		115	70	130			
Surr: 4-Bromofluorobenzene	10.2		10		102	70	130			

Alpha Analytical, Inc.

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Date: *29-Dec-16*

QC Summary Report

Work Order: 16122120

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**

File ID: **3**

Batch ID: **MS15W1223A** Analysis Date: **12/27/2016 13:38**

Sample ID: **16122202-01AMS** Units : **µg/L** Run ID: **MANUAL_161223E** Prep Date: **12/27/2016 13:38**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	52.6	2.5	50	0	105	62	133			
Benzene	51.2	1.3	50	0	102	67	134			
Trichloroethene	56	2.5	50	0	112	68	138			
Toluene	53.7	1.3	50	0	107	38	130			
Chlorobenzene	54	2.5	50	0	108	70	130			
Ethylbenzene	50.6	1.3	50	0	101	70	130			
m,p-Xylene	50.1	1.3	50	0	100	65	139			
o-Xylene	48.8	1.3	50	0	98	69	130			
Surr: 1,2-Dichloroethane-d4	54.3		50		109	70	130			
Surr: Toluene-d8	54.8		50		110	70	130			
Surr: 4-Bromofluorobenzene	45.4		50		91	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**

File ID: **4**

Batch ID: **MS15W1223A** Analysis Date: **12/27/2016 14:02**

Sample ID: **16122202-01AMSD** Units : **µg/L** Run ID: **MANUAL_161223E** Prep Date: **12/27/2016 14:02**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	53.1	2.5	50	0	106	62	133	52.63	0.9(35)	
Benzene	51.8	1.3	50	0	104	67	134	51.24	1.1(21)	
Trichloroethene	57	2.5	50	0	114	68	138	56	1.7(20)	
Toluene	55	1.3	50	0	110	38	130	53.67	2.5(20)	
Chlorobenzene	55.2	2.5	50	0	110	70	130	53.96	2.3(20)	
Ethylbenzene	51.8	1.3	50	0	104	70	130	50.64	2.3(20)	
m,p-Xylene	51.1	1.3	50	0	102	65	139	50.14	1.9(20)	
o-Xylene	50.2	1.3	50	0	100	69	130	48.78	2.9(20)	
Surr: 1,2-Dichloroethane-d4	50.1		50		100	70	130			
Surr: Toluene-d8	55.4		50		111	70	130			
Surr: 4-Bromofluorobenzene	46.7		50		93	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Billing Information :

WORK ORDER SUMMARY

CA

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES16122120

Report Due By : 12:00 P On : 28-Dec-16

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

PO :

Client's COC # : 6207 Job : Ram-ZVI

EDD Required : No

Sampled by : Cindy Schreier

Cooler Temp	Samples Received	Date Printed
3 °C	21-Dec-16	21-Dec-16

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests: VOC_W								Sample Remarks
PES16122120-01A	RAM-ZVI	AQ	12/20/16 17:50	3	0	5	8260/ Acetone_Cs								TCE=5000ug/L; 1,1,1-TCA=500 ug/L.

Comments: No security seals. Frozen ice. Report J value for TCA if it is ND due to high TCE. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	12/21/16 1125

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other) Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

6207

Billing Information:

Company: PRIMA Env
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.
Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 Phone: 775-355-1044 Fax: 775-355-0406

Satellite Service Centers:
Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 Phone: 702-281-4848

Page # 1 of 1

Consultant/ Client Info:
Company: PRIMA Env
Address:
City, State, Zip:

Job and Purchase Order Info:
Job #: Ram-ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:
Name: Cindy Schreier
Email Address:
Phone #: 916-939-7300
Cell #:

QC Deliverable Info:
EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	Analysis Requested: 8260										Remarks
1730	12/20	AQ	PES16122120-01	RAM-ZVI		3V		X	X										

ADDITIONAL INSTRUCTIONS: Need data by 12/28/16 - noon; TCE ~ 5000 µg/L; 1,1,1-TCA ~ ~~to~~ 500 µg/L. Please report J-value for TCA if it is ND due to high TCE.

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By: CS

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
CS /PRIMA	12/20/16	~1830	FedEx		
			K. Murray	12/21/16	1120

* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental		Attn:	Cindy Schreier
5070 Robert J. Mathews Parkway		Phone:	(916) 939-7300
El Dorado Hills, CA 95762		Fax:	(916) 393-7398
Job:	Ram-ZVI		

Alpha Analytical Number: PES16123021-01A
Client I.D. Number: Prelim-eff

Sampled: 12/29/16 15:55
Received: 12/30/16
Extracted: 01/03/17 11:58
Analyzed: 01/03/17 11:58

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	4.0 µg/L
2	Vinyl chloride	ND	1.0 µg/L
3	Chloroethane	1.2	1.0 µg/L
4	Bromomethane	ND	4.0 µg/L
5	Trichlorofluoromethane	ND	1.0 µg/L
6	Acetone	ND	20 µg/L
7	1,1-Dichloroethene	ND	1.0 µg/L
8	Dichloromethane	ND	4.0 µg/L
9	trans-1,2-Dichloroethene	ND	1.0 µg/L
10	1,1-Dichloroethane	78	1.0 µg/L
11	cis-1,2-Dichloroethene	13	1.0 µg/L
12	Chloroform	ND	1.0 µg/L
13	1,2-Dichloroethane	ND	1.0 µg/L
14	1,1,1-Trichloroethane	2.9	1.0 µg/L
15	Carbon tetrachloride	ND	1.0 µg/L
16	Benzene	0.84	0.50 µg/L
17	1,2-Dichloropropane	ND	1.0 µg/L
18	Trichloroethene	ND	1.0 µg/L
19	Bromodichloromethane	ND	1.0 µg/L
20	cis-1,3-Dichloropropene	ND	1.0 µg/L
21	trans-1,3-Dichloropropene	ND	1.0 µg/L
22	1,1,2-Trichloroethane	ND	1.0 µg/L
23	Toluene	ND	0.50 µg/L
24	Dibromochloromethane	ND	1.0 µg/L
25	Tetrachloroethene	ND	1.0 µg/L
26	Chlorobenzene	ND	1.0 µg/L
27	Ethylbenzene	ND	0.50 µg/L
28	m,p-Xylene	ND	0.50 µg/L
29	Bromoform	ND	1.0 µg/L
30	o-Xylene	ND	0.50 µg/L
31	1,1,2,2-Tetrachloroethane	ND	1.0 µg/L
32	1,3-Dichlorobenzene	ND	1.0 µg/L
33	1,4-Dichlorobenzene	ND	1.0 µg/L
34	1,2-Dichlorobenzene	ND	1.0 µg/L

Some Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.

Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.

Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

1/3/17

Report Date

Alpha Analytical, Inc.

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES16123021-02A
Client I.D. Number: Prelim-inf

Sampled: 12/29/16 17:20
Received: 12/30/16
Extracted: 01/03/17 12:45
Analyzed: 01/03/17 12:45

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	120 µg/L
2	Vinyl chloride	ND	30 µg/L
3	Chloroethane	ND	30 µg/L
4	Bromomethane	ND	120 µg/L
5	Trichlorofluoromethane	ND	30 µg/L
6	Acetone	ND	600 µg/L
7	1,1-Dichloroethene	ND	30 µg/L
8	Dichloromethane	ND	120 µg/L
9	trans-1,2-Dichloroethene	ND	30 µg/L
10	1,1-Dichloroethane	51	30 µg/L
11	cis-1,2-Dichloroethene	78	30 µg/L
12	Chloroform	ND	30 µg/L
13	1,2-Dichloroethane	ND	30 µg/L
14	1,1,1-Trichloroethane	500	30 µg/L
15	Carbon tetrachloride	ND	30 µg/L
16	Benzene	ND	15 µg/L
17	1,2-Dichloropropane	ND	30 µg/L
18	Trichloroethene	5,300	30 µg/L
19	Bromodichloromethane	ND	30 µg/L
20	cis-1,3-Dichloropropene	ND	30 µg/L
21	trans-1,3-Dichloropropene	ND	30 µg/L
22	1,1,2-Trichloroethane	ND	30 µg/L
23	Toluene	ND	15 µg/L
24	Dibromochloromethane	ND	30 µg/L
25	Tetrachloroethene	ND	30 µg/L
26	Chlorobenzene	ND	30 µg/L
27	Ethylbenzene	ND	15 µg/L
28	m,p-Xylene	ND	15 µg/L
29	Bromoform	ND	30 µg/L
30	o-Xylene	ND	15 µg/L
31	1,1,2,2-Tetrachloroethane	ND	30 µg/L
32	1,3-Dichlorobenzene	ND	30 µg/L
33	1,4-Dichlorobenzene	ND	30 µg/L
34	1,2-Dichlorobenzene	ND	30 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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RS
1/3/17
Report Date

Date: *11-Jan-17*

QC Summary Report

Work Order: 16123021

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**
File ID: **1** Batch ID: **MS15W0103A** Analysis Date: **01/03/2017 11:35**
Sample ID: **MBLK MS15W0103A** Units : **µg/L** Run ID: **MANUAL_170103B** Prep Date: **01/03/2017 11:35**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	10.2		10		102	70	130			
Surr: Toluene-d8	10.9		10		109	70	130			
Surr: 4-Bromofluorobenzene	8.99		10		90	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**
File ID: **2** Batch ID: **MS15W0103A** Analysis Date: **01/03/2017 09:55**
Sample ID: **LCS MS15W0103A** Units : **µg/L** Run ID: **MANUAL_170103B** Prep Date: **01/03/2017 09:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	9.74	1	10		97	70	130			
Benzene	9.1	0.5	10		91	70	130			
Trichloroethene	10.1	1	10		101	68	138			
Toluene	9.32	0.5	10		93	70	130			
Chlorobenzene	9.37	1	10		94	70	130			
Ethylbenzene	8.98	0.5	10		90	70	130			
m,p-Xylene	8.69	0.5	10		87	65	139			
o-Xylene	8.56	0.5	10		86	70	130			
Surr: 1,2-Dichloroethane-d4	11.1		10		111	70	130			
Surr: Toluene-d8	10.8		10		108	70	130			
Surr: 4-Bromofluorobenzene	9.84		10		98	70	130			

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Date: 11-Jan-17

QC Summary Report

Work Order: 16123021

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**
File ID: **3** Batch ID: **MS15W0103A** Analysis Date: **01/03/2017 21:00**
Sample ID: **16123002-05AMS** Units : **µg/L** Run ID: **MANUAL_170103B** Prep Date: **01/03/2017 21:00**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	42.5	2.5	50	0	85	62	133			
Benzene	45.9	1.3	50	0	92	67	134			
Trichloroethene	49.2	2.5	50	0	98	68	138			
Toluene	42	1.3	50	0	84	38	130			
Chlorobenzene	42.1	2.5	50	0	84	70	130			
Ethylbenzene	39.3	1.3	50	0	79	70	130			
m,p-Xylene	37.7	1.3	50	0	75	65	139			
o-Xylene	38.5	1.3	50	0	77	69	130			
Surr: 1,2-Dichloroethane-d4	57		50		114	70	130			
Surr: Toluene-d8	50.7		50		101	70	130			
Surr: 4-Bromofluorobenzene	48.2		50		96	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**
File ID: **1** Batch ID: **MS15W0103A** Analysis Date: **01/04/2017 21:36**
Sample ID: **16123002-05AMSD** Units : **µg/L** Run ID: **MANUAL_170103B** Prep Date: **01/04/2017 21:36**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	47.5	2.5	50	0	95	62	133	42.53	11.0(35)	
Benzene	47.1	1.3	50	0	94	67	134	45.87	2.7(21)	
Trichloroethene	52.1	2.5	50	0	104	68	138	49.19	5.7(20)	
Toluene	53.6	1.3	50	0	107	38	130	42.02	24.1(20)	R5
Chlorobenzene	51.2	2.5	50	0	102	70	130	42.14	19.5(20)	
Ethylbenzene	50.1	1.3	50	0	100	70	130	39.25	24.2(20)	R5
m,p-Xylene	49.4	1.3	50	0	99	65	139	37.7	26.8(20)	R5
o-Xylene	48.3	1.3	50	0	97	69	130	38.46	22.7(20)	R5
Surr: 1,2-Dichloroethane-d4	43.9		50		88	70	130			
Surr: Toluene-d8	58		50		116	70	130			
Surr: 4-Bromofluorobenzene	56.2		50		112	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

R5 = MS/MSD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.

Billing Information :

WORK ORDER SUMMARY

CARUSH

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES16123021
Report Due By : 5:00 PM On : 03-Jan-17

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : No

Sampled by : CL

PO :

Client's COC # : 6487 Job : Ram-ZVI

Cooler Temp	Samples Received	Date Printed
3 °C	30-Dec-16	30-Dec-16

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests: VOC_W								Sample Remarks
PES16123021-01A	Prelim-eff	AQ	12/29/16 15:55	3	0	1	8260/ Acetone_Cs								
PES16123021-02A	Prelim-inf	AQ	12/29/16 17:20	3	0	1	8260/ Acetone_Cs								

Comments: 24 HR TAT. No security seals. Frozen ice. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	12/30/16 1040

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other) Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

PRIMA ENVIRONMENTAL, Inc.
5070 Robert J. Mathews Pkwy, Ste 300
El Dorado Hills, CA 95762
PH: 916-939-7300 FAX: 916-939-7398
data@primaenvironmental.com

Alpha Analytical, Inc. Environmental Lab

Alpha Analytical, Inc.
Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 — Phone: 775-355-1044, Fax: 775-355-0406

Satellite Service Centers:
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Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 — Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 — Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 — Phone: 702-281-4848

6487

Page # 1 of 1

Consultant/ Client Info:
Company:
Address:
City, State, Zip:

Job and Purchase Order Info:
Job #
Job Name: Ram-ZVI
P.O. #:

Report Attention/Project Manager:
Name:
Email Address:
Phone #:
Cell #:

QC Deliverable Info:
EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	Analysis Requested: 8260-VOCs										Remarks
1555	12/29/16	AQ	PES1612-3021-01	Prelim-eff	24hr	3V		X	X										
1720	12/29/16	AQ	02	Prelim-inf	↓	3V		X	X										

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By: CL

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
[signature]	12/29/14	1800	Fed Ex		
			K Murray	12/30/16	1040

*Key: AQ - Aqueous OT - Other So-Soil WA - Waste **B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Alpha Analytical, Inc.

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398
Date Received : 01/13/17

Job: Ram-ZVI

Anions by IC
EPA Method 300.0

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **Ram-ZVI In-A** Lab ID : PES17011325-01A Date Sampled 01/11/17 15:30	Chloride	9.27	0.50 mg/L	01/17/17 17:55	01/18/17 17:21
Client ID: **Ram-ZVI P1-A** Lab ID : PES17011325-02A Date Sampled 01/11/17 14:10	Chloride	9.91	0.50 mg/L	01/17/17 17:55	01/18/17 17:39
Client ID: **Ram-ZVI P2-A** Lab ID : PES17011325-03A Date Sampled 01/11/17 12:50	Chloride	10.2	0.50 mg/L	01/17/17 17:55	01/18/17 17:58
Client ID: **Ram-ZVI P3-A** Lab ID : PES17011325-04A Date Sampled 01/11/17 11:30	Chloride	10.4	0.50 mg/L	01/17/17 17:55	01/18/17 18:16
Client ID: **Ram-ZVI Eff-A** Lab ID : PES17011325-05A Date Sampled 01/11/17 09:40	Chloride	10.7	0.50 mg/L	01/17/17 17:55	01/18/17 18:35

This replaces the report signed 1/20/17 due to a change in the sig figs, per client request.

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
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Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

ACLASS ACCREDITED DoD ELAP

1/23/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental	Attn: Cindy Schreier
5070 Robert J. Mathews Parkway	Phone: (916) 939-7300
El Dorado Hills, CA 95762	Fax: (916) 393-7398
	Date Received : 01/13/17
Job: Ram-ZVI	

Dissolved Gases
Modified Method RSK-175 GC/FID

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **Ram-ZVI In-A**					
Lab ID : PES17011325-01A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 18:06
Date Sampled 01/11/17 15:30	Ethene	ND	0.010 mg/L	01/19/17 15:28	01/19/17 18:06
	Ethane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 18:06
Client ID: **Ram-ZVI P1-A**					
Lab ID : PES17011325-02A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 19:08
Date Sampled 01/11/17 14:10	Ethene	0.056	0.010 mg/L	01/19/17 15:28	01/19/17 19:08
	Ethane	0.023	0.010 mg/L	01/19/17 15:28	01/19/17 19:08
Client ID: **Ram-ZVI P2-A**					
Lab ID : PES17011325-03A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 19:29
Date Sampled 01/11/17 12:50	Ethene	0.080	0.010 mg/L	01/19/17 15:28	01/19/17 19:29
	Ethane	0.031	0.010 mg/L	01/19/17 15:28	01/19/17 19:29
Client ID: **Ram-ZVI P3-A**					
Lab ID : PES17011325-04A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 19:50
Date Sampled 01/11/17 11:30	Ethene	0.093	0.010 mg/L	01/19/17 15:28	01/19/17 19:50
	Ethane	0.031	0.010 mg/L	01/19/17 15:28	01/19/17 19:50
Client ID: **Ram-ZVI Eff-A**					
Lab ID : PES17011325-05A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 20:10
Date Sampled 01/11/17 09:40	Ethene	0.060	0.010 mg/L	01/19/17 15:28	01/19/17 20:10
	Ethane	0.016	0.010 mg/L	01/19/17 15:28	01/19/17 20:10

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.

Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.

Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

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1/20/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011325-01A
Client I.D. Number: Ram-ZVI In-A

Sampled: 01/11/17 15:30
Received: 01/13/17
Extracted: 01/18/17 15:31
Analyzed: 01/18/17 15:31

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	80 µg/L
2	Vinyl chloride	ND	20 µg/L
3	Chloroethane	ND	20 µg/L
4	Bromomethane	ND	80 µg/L
5	Trichlorofluoromethane	ND	20 µg/L
6	Acetone	ND	400 µg/L
7	1,1-Dichloroethene	ND	20 µg/L
8	Dichloromethane	ND	80 µg/L
9	trans-1,2-Dichloroethene	ND	20 µg/L
10	1,1-Dichloroethane	43	20 µg/L
11	cis-1,2-Dichloroethene	61	20 µg/L
12	Chloroform	ND	20 µg/L
13	1,2-Dichloroethane	ND	20 µg/L
14	1,1,1-Trichloroethane	330	20 µg/L
15	Carbon tetrachloride	ND	20 µg/L
16	Benzene	ND	10 µg/L
17	1,2-Dichloropropane	ND	20 µg/L
18	Trichloroethene	5,000 *	20 µg/L
19	Bromodichloromethane	ND	20 µg/L
20	cis-1,3-Dichloropropene	ND	20 µg/L
21	trans-1,3-Dichloropropene	ND	20 µg/L
22	1,1,2-Trichloroethane	ND	20 µg/L
23	Toluene	ND	10 µg/L
24	Dibromochloromethane	ND	20 µg/L
25	Tetrachloroethene	ND	20 µg/L
26	Chlorobenzene	ND	20 µg/L
27	Ethylbenzene	ND	10 µg/L
28	m,p-Xylene	ND	10 µg/L
29	Bromoform	ND	20 µg/L
30	o-Xylene	ND	10 µg/L
31	1,1,2,2-Tetrachloroethane	ND	20 µg/L
32	1,3-Dichlorobenzene	ND	20 µg/L
33	1,4-Dichlorobenzene	ND	20 µg/L
34	1,2-Dichlorobenzene	ND	20 µg/L

*This compound slightly exceeded the instrument's calibration range and is an estimated value.
Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
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Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.

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Alpha Analytical, Inc.

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011325-02A
Client I.D. Number: Ram-ZVI P1-A

Sampled: 01/11/17 14:10
Received: 01/13/17
Extracted: 01/18/17 15:55
Analyzed: 01/18/17 15:55

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	80 µg/L
2	Vinyl chloride	ND	20 µg/L
3	Chloroethane	ND	20 µg/L
4	Bromomethane	ND	80 µg/L
5	Trichlorofluoromethane	ND	20 µg/L
6	Acetone	ND	400 µg/L
7	1,1-Dichloroethene	ND	20 µg/L
8	Dichloromethane	ND	80 µg/L
9	trans-1,2-Dichloroethene	ND	20 µg/L
10	1,1-Dichloroethane	100	20 µg/L
11	cis-1,2-Dichloroethene	69	20 µg/L
12	Chloroform	ND	20 µg/L
13	1,2-Dichloroethane	ND	20 µg/L
14	1,1,1-Trichloroethane	ND	20 µg/L
15	Carbon tetrachloride	ND	20 µg/L
16	Benzene	ND	10 µg/L
17	1,2-Dichloropropane	ND	20 µg/L
18	Trichloroethene	3,400	20 µg/L
19	Bromodichloromethane	ND	20 µg/L
20	cis-1,3-Dichloropropene	ND	20 µg/L
21	trans-1,3-Dichloropropene	ND	20 µg/L
22	1,1,2-Trichloroethane	ND	20 µg/L
23	Toluene	ND	10 µg/L
24	Dibromochloromethane	ND	20 µg/L
25	Tetrachloroethene	ND	20 µg/L
26	Chlorobenzene	ND	20 µg/L
27	Ethylbenzene	ND	10 µg/L
28	m,p-Xylene	ND	10 µg/L
29	Bromoform	ND	20 µg/L
30	o-Xylene	ND	10 µg/L
31	1,1,2,2-Tetrachloroethane	ND	20 µg/L
32	1,3-Dichlorobenzene	ND	20 µg/L
33	1,4-Dichlorobenzene	ND	20 µg/L
34	1,2-Dichlorobenzene	ND	20 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
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Report Date

Alpha Analytical, Inc.

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011325-03A
Client I.D. Number: Ram-ZVI P2-A

Sampled: 01/11/17 12:50
Received: 01/13/17
Extracted: 01/18/17 15:06
Analyzed: 01/18/17 15:06

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration		Reporting Limit
1	Chloromethane	ND		40 µg/L
2	Vinyl chloride	ND		10 µg/L
3	Chloroethane	ND		10 µg/L
4	Bromomethane	ND		40 µg/L
5	Trichlorofluoromethane	ND		10 µg/L
6	Acetone	ND		200 µg/L
7	1,1-Dichloroethene	ND		10 µg/L
8	Dichloromethane	ND		40 µg/L
9	trans-1,2-Dichloroethene	ND		10 µg/L
10	1,1-Dichloroethane	100		10 µg/L
11	cis-1,2-Dichloroethene	81		10 µg/L
12	Chloroform	ND		10 µg/L
13	1,2-Dichloroethane	ND		10 µg/L
14	1,1,1-Trichloroethane	ND		10 µg/L
15	Carbon tetrachloride	ND		10 µg/L
16	Benzene	ND		5.0 µg/L
17	1,2-Dichloropropane	ND		10 µg/L
18	Trichloroethene	2,600	*	10 µg/L
19	Bromodichloromethane	ND		10 µg/L
20	cis-1,3-Dichloropropene	ND		10 µg/L
21	trans-1,3-Dichloropropene	ND		10 µg/L
22	1,1,2-Trichloroethane	ND		10 µg/L
23	Toluene	ND		5.0 µg/L
24	Dibromochloromethane	ND		10 µg/L
25	Tetrachloroethene	ND		10 µg/L
26	Chlorobenzene	ND		10 µg/L
27	Ethylbenzene	ND		5.0 µg/L
28	m,p-Xylene	ND		5.0 µg/L
29	Bromoform	ND		10 µg/L
30	o-Xylene	ND		5.0 µg/L
31	1,1,2,2-Tetrachloroethane	ND		10 µg/L
32	1,3-Dichlorobenzene	ND		10 µg/L
33	1,4-Dichlorobenzene	ND		10 µg/L
34	1,2-Dichlorobenzene	ND		10 µg/L

Reporting Limits were increased due to high concentrations of target analytes.
*This compound slightly exceeded the instrument's calibration range and is an estimated value.
ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
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Report Date

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011325-04A
Client I.D. Number: Ram-ZVI P3-A

Sampled: 01/11/17 11:30
Received: 01/13/17
Extracted: 01/18/17 14:18
Analyzed: 01/18/17 14:18

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration		Reporting Limit
1	Chloromethane	ND		32 µg/L
2	Vinyl chloride	ND		8.0 µg/L
3	Chloroethane	ND		8.0 µg/L
4	Bromomethane	ND		32 µg/L
5	Trichlorofluoromethane	ND		8.0 µg/L
6	Acetone	ND		160 µg/L
7	1,1-Dichloroethene	ND		8.0 µg/L
8	Dichloromethane	ND		32 µg/L
9	trans-1,2-Dichloroethene	ND		8.0 µg/L
10	1,1-Dichloroethane	100		8.0 µg/L
11	cis-1,2-Dichloroethene	94		8.0 µg/L
12	Chloroform	ND		8.0 µg/L
13	1,2-Dichloroethane	ND		8.0 µg/L
14	1,1,1-Trichloroethane	ND		8.0 µg/L
15	Carbon tetrachloride	ND		8.0 µg/L
16	Benzene	ND		4.0 µg/L
17	1,2-Dichloropropane	ND		8.0 µg/L
18	Trichloroethene	1,800	*	8.0 µg/L
19	Bromodichloromethane	ND		8.0 µg/L
20	cis-1,3-Dichloropropene	ND		8.0 µg/L
21	trans-1,3-Dichloropropene	ND		8.0 µg/L
22	1,1,2-Trichloroethane	ND		8.0 µg/L
23	Toluene	ND		4.0 µg/L
24	Dibromochloromethane	ND		8.0 µg/L
25	Tetrachloroethene	ND		8.0 µg/L
26	Chlorobenzene	ND		8.0 µg/L
27	Ethylbenzene	ND		4.0 µg/L
28	m,p-Xylene	ND		4.0 µg/L
29	Bromoform	ND		8.0 µg/L
30	o-Xylene	ND		4.0 µg/L
31	1,1,2,2-Tetrachloroethane	ND		8.0 µg/L
32	1,3-Dichlorobenzene	ND		8.0 µg/L
33	1,4-Dichlorobenzene	ND		8.0 µg/L
34	1,2-Dichlorobenzene	ND		8.0 µg/L

Reporting Limits were increased due to high concentrations of target analytes.
*This compound slightly exceeded the instrument's calibration range and is an estimated value.
This replaces the report signed 1/20/17 due to a change in the concentration, due to lab error.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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Report Date

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011325-05A
Client I.D. Number: Ram-ZVI Eff-A

Sampled: 01/11/17 09:40
Received: 01/13/17
Extracted: 01/18/17 13:54
Analyzed: 01/18/17 13:54

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	20 µg/L
2	Vinyl chloride	ND	5.0 µg/L
3	Chloroethane	ND	5.0 µg/L
4	Bromomethane	ND	20 µg/L
5	Trichlorofluoromethane	ND	5.0 µg/L
6	Acetone	ND	100 µg/L
7	1,1-Dichloroethene	ND	5.0 µg/L
8	Dichloromethane	ND	20 µg/L
9	trans-1,2-Dichloroethene	ND	5.0 µg/L
10	1,1-Dichloroethane	100	5.0 µg/L
11	cis-1,2-Dichloroethene	92	5.0 µg/L
12	Chloroform	ND	5.0 µg/L
13	1,2-Dichloroethane	ND	5.0 µg/L
14	1,1,1-Trichloroethane	ND	5.0 µg/L
15	Carbon tetrachloride	ND	5.0 µg/L
16	Benzene	ND	2.5 µg/L
17	1,2-Dichloropropane	ND	5.0 µg/L
18	Trichloroethene	1,100 *	5.0 µg/L
19	Bromodichloromethane	ND	5.0 µg/L
20	cis-1,3-Dichloropropene	ND	5.0 µg/L
21	trans-1,3-Dichloropropene	ND	5.0 µg/L
22	1,1,2-Trichloroethane	ND	5.0 µg/L
23	Toluene	ND	2.5 µg/L
24	Dibromochloromethane	ND	5.0 µg/L
25	Tetrachloroethene	ND	5.0 µg/L
26	Chlorobenzene	ND	5.0 µg/L
27	Ethylbenzene	ND	2.5 µg/L
28	m,p-Xylene	ND	2.5 µg/L
29	Bromoform	ND	5.0 µg/L
30	o-Xylene	ND	2.5 µg/L
31	1,1,2,2-Tetrachloroethane	ND	5.0 µg/L
32	1,3-Dichlorobenzene	ND	5.0 µg/L
33	1,4-Dichlorobenzene	ND	5.0 µg/L
34	1,2-Dichlorobenzene	ND	5.0 µg/L

Reporting Limits were increased due to high concentrations of target analytes.
*This compound slightly exceeded the instrument's calibration range and is an estimated value.
This replaces the report signed 1/20/17 due to a change in the concentration, due to lab error.

ND = Not Detected

Roger Scholl Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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Report Date

Alpha Analytical, Inc.

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Date: 20-Jan-17

QC Summary Report

Work Order: 17011325

Method Blank

Type **MBLK** Test Code: **EPA Method 300.0**
File ID: **16** Batch ID: **37725** Analysis Date: **01/18/2017 01:54**
Sample ID: **MBLK-37725** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	ND	0.5								

Laboratory Fortified Blank

Type **LFB** Test Code: **EPA Method 300.0**
File ID: **17** Batch ID: **37725** Analysis Date: **01/18/2017 02:12**
Sample ID: **LFB-37725** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	50.7	0.5	50		101	90	110			

Sample Matrix Spike

Type **LFM** Test Code: **EPA Method 300.0**
File ID: **16** Batch ID: **37725** Analysis Date: **01/19/2017 15:19**
Sample ID: **17011721-02ALFM** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	550	2.5	500	48.46	100	80	120			*

Sample Matrix Spike Duplicate

Type **LFMD** Test Code: **EPA Method 300.0**
File ID: **17** Batch ID: **37725** Analysis Date: **01/19/2017 15:38**
Sample ID: **17011721-02ALFMD** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	552	2.5	500	48.46	101	80	120	550.2	0.4(15)	*

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Alpha Analytical, Inc.

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Date: *20-Jan-17*

QC Summary Report

Work Order: 17011325

Method Blank

Type **MBLK** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **1** Batch ID: **37734** Analysis Date: **01/19/2017 17:24**
Sample ID: **MBLK-37734** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	ND	0.01								
Ethene	ND	0.01								
Ethane	ND	0.01								

Laboratory Control Spike

Type **LCS** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **2** Batch ID: **37734** Analysis Date: **01/19/2017 17:45**
Sample ID: **LCS-37734** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	0.344	0.01	0.452		76	54	138			
Ethene	0.305	0.01	0.396		77	53	130			
Ethane	0.357	0.01	0.424		84	70	130			

Sample Matrix Spike

Type **MS** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **4** Batch ID: **37734** Analysis Date: **01/19/2017 18:27**
Sample ID: **17011325-01AMS** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	1.46	0.01	1.81	0	81	43	138			
Ethene	1.31	0.01	1.58	0	83	44	130			
Ethane	1.52	0.01	1.7	0	90	22	149			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **5** Batch ID: **37734** Analysis Date: **01/19/2017 18:47**
Sample ID: **17011325-01AMSD** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	1.59	0.01	1.81	0	88	43	138	1.463	8.4(27)	
Ethene	1.42	0.01	1.58	0	90	44	130	1.307	8.2(26)	
Ethane	1.66	0.01	1.7	0	97	22	149	1.522	8.4(37)	

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Alpha Analytical, Inc.

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(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *20-Jan-17*

QC Summary Report

Work Order: 17011325

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**

File ID: **2** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 09:52**

Sample ID: **MBLK MS09W0118A** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 09:52**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	9.34		10		93	70	130			
Surr: Toluene-d8	9.38		10		94	70	130			
Surr: 4-Bromofluorobenzene	9.85		10		99	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**

File ID: **1** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 09:04**

Sample ID: **LCS MS09W0118A** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 09:04**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	10.2	1	10		102	70	130			
Benzene	10.7	0.5	10		107	70	130			
Trichloroethene	10.2	1	10		102	68	138			
Toluene	11.4	0.5	10		114	70	130			
Chlorobenzene	9.38	1	10		94	70	130			
Ethylbenzene	9.97	0.5	10		99.7	70	130			
m,p-Xylene	9.2	0.5	10		92	65	139			
o-Xylene	9.12	0.5	10		91	70	130			
Surr: 1,2-Dichloroethane-d4	9.57		10		96	70	130			
Surr: Toluene-d8	8.96		10		90	70	130			
Surr: 4-Bromofluorobenzene	9.47		10		95	70	130			

Alpha Analytical, Inc.
255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: 20-Jan-17

QC Summary Report

Work Order: 17011325

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**

File ID: **23** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 18:19**

Sample ID: **1701022-01AMS** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 18:19**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	51.2	2.5	50	0	102	62	133			
Benzene	56.6	1.3	50	0	113	67	134			
Trichloroethene	74.4	2.5	50	26.72	95	68	138			
Toluene	62.2	1.3	50	0	124	38	130			
Chlorobenzene	48.1	2.5	50	0	96	70	130			
Ethylbenzene	52.1	1.3	50	0	104	70	130			
m,p-Xylene	46.5	1.3	50	0	93	65	139			
o-Xylene	47	1.3	50	0	94	69	130			
Surr: 1,2-Dichloroethane-d4	52.9		50		106	70	130			
Surr: Toluene-d8	41.3		50		83	70	130			
Surr: 4-Bromofluorobenzene	47.5		50		95	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**

File ID: **24** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 18:43**

Sample ID: **1701022-01AMSD** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 18:43**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	47.5	2.5	50	0	95	62	133	51.24	7.5(35)	
Benzene	52.1	1.3	50	0	104	67	134	56.57	8.3(21)	
Trichloroethene	69	2.5	50	26.72	85	68	138	74.37	7.5(20)	
Toluene	56.9	1.3	50	0	114	38	130	62.19	8.9(20)	
Chlorobenzene	44.2	2.5	50	0	88	70	130	48.11	8.5(20)	
Ethylbenzene	48	1.3	50	0	96	70	130	52.05	8.1(20)	
m,p-Xylene	43.4	1.3	50	0	87	65	139	46.52	6.9(20)	
o-Xylene	44.1	1.3	50	0	88	69	130	47.03	6.4(20)	
Surr: 1,2-Dichloroethane-d4	52.1		50		104	70	130			
Surr: Toluene-d8	42.4		50		85	70	130			
Surr: 4-Bromofluorobenzene	47.2		50		94	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Billing Information :

CHAIN-OF-CUSTODY RECORD

CA

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES17011325
Report Due By : 5:00 PM On : 20-Jan-17

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : **No**

Sampled by : Cindy Schreier

PO :

Client's COC # : 6489   Job : Ram-ZVI

Cooler Temp	Samples Received	Date Printed
3 °C	13-Jan-17	13-Jan-17

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests: 300_0_W	METHANE_W	VOC_W						Sample Remarks
PES17011325-01A	Ram-ZVI In-A	AQ	01/11/17 15:30	6	0	5	Cl	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011325-02A	Ram-ZVI P1-A	AQ	01/11/17 14:10	6	0	5	Cl	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011325-03A	Ram-ZVI P2-A	AQ	01/11/17 12:50	6	0	5	Cl	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011325-04A	Ram-ZVI P3-A	AQ	01/11/17 11:30	6	0	5	Cl	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011325-05A	Ram-ZVI Eff-A	AQ	01/11/17 09:40	6	0	5	Cl	CH4, C2H4, C2H6	8260/ Acetone_Cs						

Comments: No security seals. Frozen ice. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	1/13/17 1315

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.
The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.
Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other)   Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Billing Information:

Company: PRIMA Env
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.
Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 Phone: 775-355-1044 Fax: 775-355-0406

Satellite Service Centers:
Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 Phone: 702-281-4848

6489

Page # 1 of 1

Consultant/ Client Info:
Company: PRIMA Env
Address:
City, State, Zip:

Job and Purchase Order Info:
Job # Ram-ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:
Name: Cindy Schreier
Email Address: data@primaenvironmental.com
Phone #: 916-939-7300
~~Cell #:~~

QC Deliverable Info:
EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	VOCs - 8260	RSK-175 Ethene, Methane, Ethane,	Chloride							Remarks
1530	1/11	AQ	PES1701325-01	Ram-ZVI In-A	5d	5V 1P		X	X	X	X							
1410	↓	↓	02	Ram-ZVI P1-A	↓	↓		X	X	X	X							
1250	↓	↓	03	Ram-ZVI P2-A	↓	↓		X	X	X	X							
1130	↓	↓	04	Ram-ZVI P3-A	↓	↓		X	X	X	X							
0940	↓	↓	05	Ram-ZVI Eff-A	↓	↓		X	X	X	X							

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By: [signature]

Relinquished by: (Signature/Affiliation):	Date:	Time:	Received by: (Signature/Affiliation):	Date:	Time:
[signature] PRIMA	1/12/17	~1800	FedEx		
			K Murray	1/13/17	1305

* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

Alpha Analytical, Inc.

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(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398
Date Received : 01/14/17

Job: Ram-ZVI

Anions by IC
EPA Method 300.0

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **RamZVI Eff-B** Lab ID : PES17011620-01A Date Sampled 01/13/17 08:40	Chloride	11.6	0.50 mg/L	01/17/17 17:55	01/18/17 20:07
Client ID: **RamZVI P3-B** Lab ID : PES17011620-02A Date Sampled 01/13/17 10:03	Chloride	10.4	0.50 mg/L	01/17/17 17:55	01/18/17 20:26
Client ID: **RamZVI P2-B** Lab ID : PES17011620-03A Date Sampled 01/13/17 11:32	Chloride	10.1	0.50 mg/L	01/17/17 17:55	01/18/17 20:44
Client ID: **RamZVI P1-B** Lab ID : PES17011620-04A Date Sampled 01/13/17 13:10	Chloride	9.86	0.50 mg/L	01/17/17 17:55	01/18/17 21:03
Client ID: **RamZVI In-B** Lab ID : PES17011620-05A Date Sampled 01/13/17 14:30	Chloride	9.20	0.50 mg/L	01/17/17 17:55	01/18/17 21:21

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com
Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.
Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.
Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

ACLASS ACCREDITED DoD ELAP

1/23/17
Report Date

Alpha Analytical, Inc.
255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398
Date Received : 01/14/17

Job: Ram-ZVI

Dissolved Gases
Modified Method RSK-175 GC/FID

	Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: **RamZVI Eff-B**					
Lab ID : PES17011620-01A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 20:31
Date Sampled 01/13/17 08:40	Ethene	0.096	0.010 mg/L	01/19/17 15:28	01/19/17 20:31
	Ethane	0.028	0.010 mg/L	01/19/17 15:28	01/19/17 20:31
Client ID: **RamZVI P3-B**					
Lab ID : PES17011620-02A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 20:52
Date Sampled 01/13/17 10:03	Ethene	0.11	0.010 mg/L	01/19/17 15:28	01/19/17 20:52
	Ethane	0.035	0.010 mg/L	01/19/17 15:28	01/19/17 20:52
Client ID: **RamZVI P2-B**					
Lab ID : PES17011620-03A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 21:12
Date Sampled 01/13/17 11:32	Ethene	0.075	0.010 mg/L	01/19/17 15:28	01/19/17 21:12
	Ethane	0.030	0.010 mg/L	01/19/17 15:28	01/19/17 21:12
Client ID: **RamZVI P1-B**					
Lab ID : PES17011620-04A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 21:33
Date Sampled 01/13/17 13:10	Ethene	0.041	0.010 mg/L	01/19/17 15:28	01/19/17 21:33
	Ethane	0.017	0.010 mg/L	01/19/17 15:28	01/19/17 21:33
Client ID: **RamZVI In-B**					
Lab ID : PES17011620-05A	Methane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 21:54
Date Sampled 01/13/17 14:30	Ethene	ND	0.010 mg/L	01/19/17 15:28	01/19/17 21:54
	Ethane	ND	0.010 mg/L	01/19/17 15:28	01/19/17 21:54

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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1/23/17
Report Date

Alpha Analytical, Inc.

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(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011620-01A
Client I.D. Number: RamZVI Eff-B

Sampled: 01/13/17 08:40
Received: 01/14/17
Extracted: 01/18/17 14:42
Analyzed: 01/18/17 14:42

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	32 µg/L
2	Vinyl chloride	ND	8.0 µg/L
3	Chloroethane	ND	8.0 µg/L
4	Bromomethane	ND	32 µg/L
5	Trichlorofluoromethane	ND	8.0 µg/L
6	Acetone	ND	160 µg/L
7	1,1-Dichloroethene	ND	8.0 µg/L
8	Dichloromethane	ND	32 µg/L
9	trans-1,2-Dichloroethene	ND	8.0 µg/L
10	1,1-Dichloroethane	90	8.0 µg/L
11	cis-1,2-Dichloroethene	85	8.0 µg/L
12	Chloroform	ND	8.0 µg/L
13	1,2-Dichloroethane	ND	8.0 µg/L
14	1,1,1-Trichloroethane	ND	8.0 µg/L
15	Carbon tetrachloride	ND	8.0 µg/L
16	Benzene	ND	4.0 µg/L
17	1,2-Dichloropropane	ND	8.0 µg/L
18	Trichloroethene	1,500	8.0 µg/L
19	Bromodichloromethane	ND	8.0 µg/L
20	cis-1,3-Dichloropropene	ND	8.0 µg/L
21	trans-1,3-Dichloropropene	ND	8.0 µg/L
22	1,1,2-Trichloroethane	ND	8.0 µg/L
23	Toluene	ND	4.0 µg/L
24	Dibromochloromethane	ND	8.0 µg/L
25	Tetrachloroethene	ND	8.0 µg/L
26	Chlorobenzene	ND	8.0 µg/L
27	Ethylbenzene	ND	4.0 µg/L
28	m,p-Xylene	ND	4.0 µg/L
29	Bromoform	ND	8.0 µg/L
30	o-Xylene	ND	4.0 µg/L
31	1,1,2,2-Tetrachloroethane	ND	8.0 µg/L
32	1,3-Dichlorobenzene	ND	8.0 µg/L
33	1,4-Dichlorobenzene	ND	8.0 µg/L
34	1,2-Dichlorobenzene	ND	8.0 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

1/23/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011620-02A
Client I.D. Number: RamZVI P3-B

Sampled: 01/13/17 10:03
Received: 01/14/17
Extracted: 01/18/17 16:19
Analyzed: 01/18/17 16:19

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	80 µg/L
2	Vinyl chloride	ND	20 µg/L
3	Chloroethane	ND	20 µg/L
4	Bromomethane	ND	80 µg/L
5	Trichlorofluoromethane	ND	20 µg/L
6	Acetone	ND	400 µg/L
7	1,1-Dichloroethene	ND	20 µg/L
8	Dichloromethane	ND	80 µg/L
9	trans-1,2-Dichloroethene	ND	20 µg/L
10	1,1-Dichloroethane	100	20 µg/L
11	cis-1,2-Dichloroethene	81	20 µg/L
12	Chloroform	ND	20 µg/L
13	1,2-Dichloroethane	ND	20 µg/L
14	1,1,1-Trichloroethane	ND	20 µg/L
15	Carbon tetrachloride	ND	20 µg/L
16	Benzene	ND	10 µg/L
17	1,2-Dichloropropane	ND	20 µg/L
18	Trichloroethene	1,900	20 µg/L
19	Bromodichloromethane	ND	20 µg/L
20	cis-1,3-Dichloropropene	ND	20 µg/L
21	trans-1,3-Dichloropropene	ND	20 µg/L
22	1,1,2-Trichloroethane	ND	20 µg/L
23	Toluene	ND	10 µg/L
24	Dibromochloromethane	ND	20 µg/L
25	Tetrachloroethene	ND	20 µg/L
26	Chlorobenzene	ND	20 µg/L
27	Ethylbenzene	ND	10 µg/L
28	m,p-Xylene	ND	10 µg/L
29	Bromoform	ND	20 µg/L
30	o-Xylene	ND	10 µg/L
31	1,1,2,2-Tetrachloroethane	ND	20 µg/L
32	1,3-Dichlorobenzene	ND	20 µg/L
33	1,4-Dichlorobenzene	ND	20 µg/L
34	1,2-Dichlorobenzene	ND	20 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager
Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com

1/23/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011620-03A
Client I.D. Number: RamZVI P2-B

Sampled: 01/13/17 11:32
Received: 01/14/17
Extracted: 01/18/17 17:31
Analyzed: 01/18/17 17:31

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	200 µg/L
2	Vinyl chloride	ND	50 µg/L
3	Chloroethane	ND	50 µg/L
4	Bromomethane	ND	200 µg/L
5	Trichlorofluoromethane	ND	50 µg/L
6	Acetone	ND	1,000 µg/L
7	1,1-Dichloroethene	ND	50 µg/L
8	Dichloromethane	ND	200 µg/L
9	trans-1,2-Dichloroethene	ND	50 µg/L
10	1,1-Dichloroethane	110	50 µg/L
11	cis-1,2-Dichloroethene	82	50 µg/L
12	Chloroform	ND	50 µg/L
13	1,2-Dichloroethane	ND	50 µg/L
14	1,1,1-Trichloroethane	ND	50 µg/L
15	Carbon tetrachloride	ND	50 µg/L
16	Benzene	ND	25 µg/L
17	1,2-Dichloropropane	ND	50 µg/L
18	Trichloroethene	2,300	50 µg/L
19	Bromodichloromethane	ND	50 µg/L
20	cis-1,3-Dichloropropene	ND	50 µg/L
21	trans-1,3-Dichloropropene	ND	50 µg/L
22	1,1,2-Trichloroethane	ND	50 µg/L
23	Toluene	ND	25 µg/L
24	Dibromochloromethane	ND	50 µg/L
25	Tetrachloroethene	ND	50 µg/L
26	Chlorobenzene	ND	50 µg/L
27	Ethylbenzene	ND	25 µg/L
28	m,p-Xylene	ND	25 µg/L
29	Bromoform	ND	50 µg/L
30	o-Xylene	ND	25 µg/L
31	1,1,2,2-Tetrachloroethane	ND	50 µg/L
32	1,3-Dichlorobenzene	ND	50 µg/L
33	1,4-Dichlorobenzene	ND	50 µg/L
34	1,2-Dichlorobenzene	ND	50 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

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ACLASS ACCREDITED DoD ELAP

1/23/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011620-04A
Client I.D. Number: RamZVI P1-B

Sampled: 01/13/17 13:10
Received: 01/14/17
Extracted: 01/18/17 17:55
Analyzed: 01/18/17 17:55

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	200 µg/L
2	Vinyl chloride	ND	50 µg/L
3	Chloroethane	ND	50 µg/L
4	Bromomethane	ND	200 µg/L
5	Trichlorofluoromethane	ND	50 µg/L
6	Acetone	ND	1,000 µg/L
7	1,1-Dichloroethene	ND	50 µg/L
8	Dichloromethane	ND	200 µg/L
9	trans-1,2-Dichloroethene	ND	50 µg/L
10	1,1-Dichloroethane	110	50 µg/L
11	cis-1,2-Dichloroethene	67	50 µg/L
12	Chloroform	ND	50 µg/L
13	1,2-Dichloroethane	ND	50 µg/L
14	1,1,1-Trichloroethane	ND	50 µg/L
15	Carbon tetrachloride	ND	50 µg/L
16	Benzene	ND	25 µg/L
17	1,2-Dichloropropane	ND	50 µg/L
18	Trichloroethene	2,900	50 µg/L
19	Bromodichloromethane	ND	50 µg/L
20	cis-1,3-Dichloropropene	ND	50 µg/L
21	trans-1,3-Dichloropropene	ND	50 µg/L
22	1,1,2-Trichloroethane	ND	50 µg/L
23	Toluene	ND	25 µg/L
24	Dibromochloromethane	ND	50 µg/L
25	Tetrachloroethene	ND	50 µg/L

	Compound	Concentration	Reporting Limit
26	Chlorobenzene	ND	50 µg/L
27	Ethylbenzene	ND	25 µg/L
28	m,p-Xylene	ND	25 µg/L
29	Bromoform	ND	50 µg/L
30	o-Xylene	ND	25 µg/L
31	1,1,2,2-Tetrachloroethane	ND	50 µg/L
32	1,3-Dichlorobenzene	ND	50 µg/L
33	1,4-Dichlorobenzene	ND	50 µg/L
34	1,2-Dichlorobenzene	ND	50 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

ACLASS ACCREDITED DoD ELAP

1/23/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram-ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17011620-05A
Client I.D. Number: RamZVI In-B

Sampled: 01/13/17 14:30
Received: 01/14/17
Extracted: 01/18/17 16:43
Analyzed: 01/18/17 16:43

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	120 µg/L
2	Vinyl chloride	ND	30 µg/L
3	Chloroethane	ND	30 µg/L
4	Bromomethane	ND	120 µg/L
5	Trichlorofluoromethane	ND	30 µg/L
6	Acetone	ND	600 µg/L
7	1,1-Dichloroethene	ND	30 µg/L
8	Dichloromethane	ND	120 µg/L
9	trans-1,2-Dichloroethene	ND	30 µg/L
10	1,1-Dichloroethane	52	30 µg/L
11	cis-1,2-Dichloroethene	67	30 µg/L
12	Chloroform	ND	30 µg/L
13	1,2-Dichloroethane	ND	30 µg/L
14	1,1,1-Trichloroethane	350	30 µg/L
15	Carbon tetrachloride	ND	30 µg/L
16	Benzene	ND	15 µg/L
17	1,2-Dichloropropane	ND	30 µg/L
18	Trichloroethene	5,200	30 µg/L
19	Bromodichloromethane	ND	30 µg/L
20	cis-1,3-Dichloropropene	ND	30 µg/L
21	trans-1,3-Dichloropropene	ND	30 µg/L
22	1,1,2-Trichloroethane	ND	30 µg/L
23	Toluene	ND	15 µg/L
24	Dibromochloromethane	ND	30 µg/L
25	Tetrachloroethene	ND	30 µg/L

	Compound	Concentration	Reporting Limit
26	Chlorobenzene	ND	30 µg/L
27	Ethylbenzene	ND	15 µg/L
28	m,p-Xylene	ND	15 µg/L
29	Bromoform	ND	30 µg/L
30	o-Xylene	ND	15 µg/L
31	1,1,2,2-Tetrachloroethane	ND	30 µg/L
32	1,3-Dichlorobenzene	ND	30 µg/L
33	1,4-Dichlorobenzene	ND	30 µg/L
34	1,2-Dichlorobenzene	ND	30 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl　　Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

ACLASS ACCREDITED DoD ELAP

1/23/17
Report Date

Alpha Analytical, Inc.

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(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *20-Jan-17*

QC Summary Report

Work Order: 17011620

Method Blank

Type **MBLK** Test Code: **EPA Method 300.0**
File ID: **16** Batch ID: **37725** Analysis Date: **01/18/2017 01:54**
Sample ID: **MBLK-37725** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	ND	0.5								

Laboratory Fortified Blank

Type **LFB** Test Code: **EPA Method 300.0**
File ID: **17** Batch ID: **37725** Analysis Date: **01/18/2017 02:12**
Sample ID: **LFB-37725** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	50.7	0.5	50		101	90	110			

Sample Matrix Spike

Type **LFM** Test Code: **EPA Method 300.0**
File ID: **16** Batch ID: **37725** Analysis Date: **01/19/2017 15:19**
Sample ID: **17011721-02ALFM** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	550	2.5	500	48.46	100	80	120			*

Sample Matrix Spike Duplicate

Type **LFMD** Test Code: **EPA Method 300.0**
File ID: **17** Batch ID: **37725** Analysis Date: **01/19/2017 15:38**
Sample ID: **17011721-02ALFMD** Units : **mg/L** Run ID: **MANUAL_170117G** Prep Date: **01/17/2017 17:55**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloride	552	2.5	500	48.46	101	80	120	550.2	0.4(15)	*

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

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Date: *20-Jan-17*

QC Summary Report

Work Order: 17011620

Method Blank

Type **MBLK** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **1** Batch ID: **37734** Analysis Date: **01/19/2017 17:24**
Sample ID: **MBLK-37734** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	ND	0.01								
Ethene	ND	0.01								
Ethane	ND	0.01								

Laboratory Control Spike

Type **LCS** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **2** Batch ID: **37734** Analysis Date: **01/19/2017 17:45**
Sample ID: **LCS-37734** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	0.344	0.01	0.452		76	54	138			
Ethene	0.305	0.01	0.396		77	53	130			
Ethane	0.357	0.01	0.424		84	70	130			

Sample Matrix Spike

Type **MS** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **4** Batch ID: **37734** Analysis Date: **01/19/2017 18:27**
Sample ID: **17011325-01AMS** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	1.46	0.01	1.81	0	81	43	138			
Ethene	1.31	0.01	1.58	0	83	44	130			
Ethane	1.52	0.01	1.7	0	90	22	149			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **Modified Method RSK-175 GC/FID**
File ID: **5** Batch ID: **37734** Analysis Date: **01/19/2017 18:47**
Sample ID: **17011325-01AMSD** Units : **mg/L** Run ID: **MANUAL_170119G** Prep Date: **01/19/2017 15:28**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Methane	1.59	0.01	1.81	0	88	43	138	1.463	8.4(27)	
Ethene	1.42	0.01	1.58	0	90	44	130	1.307	8.2(26)	
Ethane	1.66	0.01	1.7	0	97	22	149	1.522	8.4(37)	

Comments:

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Date: *20-Jan-17*

QC Summary Report

Work Order: 17011620

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**
File ID: **2** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 09:52**
Sample ID: **MBLK MS09W0118A** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 09:52**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	9.34		10		93	70	130			
Surr: Toluene-d8	9.38		10		94	70	130			
Surr: 4-Bromofluorobenzene	9.85		10		99	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**
File ID: **1** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 09:04**
Sample ID: **LCS MS09W0118A** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 09:04**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	10.2	1	10		102	70	130			
Benzene	10.7	0.5	10		107	70	130			
Trichloroethene	10.2	1	10		102	68	138			
Toluene	11.4	0.5	10		114	70	130			
Chlorobenzene	9.38	1	10		94	70	130			
Ethylbenzene	9.97	0.5	10		99.7	70	130			
m,p-Xylene	9.2	0.5	10		92	65	139			
o-Xylene	9.12	0.5	10		91	70	130			
Surr: 1,2-Dichloroethane-d4	9.57		10		96	70	130			
Surr: Toluene-d8	8.96		10		90	70	130			
Surr: 4-Bromofluorobenzene	9.47		10		95	70	130			

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Date: 20-Jan-17

QC Summary Report

Work Order: 17011620

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**
File ID: **23** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 18:19**
Sample ID: **1701022-01AMS** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 18:19**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	51.2	2.5	50	0	102	62	133			
Benzene	56.6	1.3	50	0	113	67	134			
Trichloroethene	74.4	2.5	50	26.72	95	68	138			
Toluene	62.2	1.3	50	0	124	38	130			
Chlorobenzene	48.1	2.5	50	0	96	70	130			
Ethylbenzene	52.1	1.3	50	0	104	70	130			
m,p-Xylene	46.5	1.3	50	0	93	65	139			
o-Xylene	47	1.3	50	0	94	69	130			
Surr: 1,2-Dichloroethane-d4	52.9		50		106	70	130			
Surr: Toluene-d8	41.3		50		83	70	130			
Surr: 4-Bromofluorobenzene	47.5		50		95	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**
File ID: **24** Batch ID: **MS09W0118A** Analysis Date: **01/18/2017 18:43**
Sample ID: **1701022-01AMSD** Units : **µg/L** Run ID: **MANUAL_170118D** Prep Date: **01/18/2017 18:43**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	47.5	2.5	50	0	95	62	133	51.24	7.5(35)	
Benzene	52.1	1.3	50	0	104	67	134	56.57	8.3(21)	
Trichloroethene	69	2.5	50	26.72	85	68	138	74.37	7.5(20)	
Toluene	56.9	1.3	50	0	114	38	130	62.19	8.9(20)	
Chlorobenzene	44.2	2.5	50	0	88	70	130	48.11	8.5(20)	
Ethylbenzene	48	1.3	50	0	96	70	130	52.05	8.1(20)	
m,p-Xylene	43.4	1.3	50	0	87	65	139	46.52	6.9(20)	
o-Xylene	44.1	1.3	50	0	88	69	130	47.03	6.4(20)	
Surr: 1,2-Dichloroethane-d4	52.1		50		104	70	130			
Surr: Toluene-d8	42.4		50		85	70	130			
Surr: 4-Bromofluorobenzene	47.2		50		94	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Billing Information :

CHAIN-OF-CUSTODY RECORD

CA

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES17011620
Report Due By : 5:00 PM On : 23-Jan-17

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : No

Sampled by : Cindy Schreier

Cooler Temp	Samples Received	Date Printed
3 °C	14-Jan-17	16-Jan-17

PO :

Client's COC # : 6205 Job : Ram-ZVI

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	Sub	TAT	Requested Tests 300_0_W	METHANE_W	VOC_W						Sample Remarks
PES17011620-01A	RamZVI Eff-B	AQ	01/13/17 08:40	6	0	5	Chloride	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011620-02A	RamZVI P3-B	AQ	01/13/17 10:03	6	0	5	Chloride	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011620-03A	RamZVI P2-B	AQ	01/13/17 11:32	6	0	5	Chloride	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011620-04A	RamZVI P1-B	AQ	01/13/17 13:10	6	0	5	Chloride	CH4, C2H4, C2H6	8260/ Acetone_Cs						
PES17011620-05A	RamZVI In-B	AQ	01/13/17 14:30	6	0	5	Chloride	CH4, C2H4, C2H6	8260/ Acetone_Cs						

Comments: No security seals. Frozen ice. Saturday delivery. Samples kept cold and secure until login on Monday. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K Murray	K Murray	Alpha Analytical, Inc.	1/16/17 1020

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.
The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.
Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other) Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Billing Information:

Company: PRIMA Env
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.

Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 — Phone: 775-355-1044 Fax: 775-355-0406

Satellite Service Centers:

Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 — Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 — Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 — Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 — Phone: 702-281-4848

6205

Page # 1 of 1

Consultant/ Client Info:
Company: PRIMA Env
Address:
City, State, Zip:

Job and Purchase Order Info:
Job #: Ram-ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:
Name: Cindy Schreier
Email Address:
Phone #: 916-939-7300
Cell #:

QC Deliverable Info:
EDD Required? Yes / No EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	VOCs - 8260	MEE-RSK 175	Chloride							Remarks
0840	1/13	AQ	PES17011620-01	Ram ZVI Eff-B	5d	5V,1P		X	X	X	X							
1003	↓	↓	02	Ram ZVI P3-B	↓	↓		X	X	X	X							
1132	↓	↓	03	Ram ZVI P2-B	↓	↓		X	X	X	X							
1310	↓	↓	04	Ram ZVI P1-B	↓	↓		X	X	X	X							
1430	↓	↓	05	Ram ZVI In-B	↓	↓		X	X	X	X							

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By: [signature]

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
[signature] PRIMA	1/13/17	~1700	FedEx		
			K Murray	1/16/17	1015

* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

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ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17022021-01A
Client I.D. Number: Ram ZVI-Eff

Sampled: 02/17/17 17:30
Received: 02/18/17
Extracted: 02/22/17 19:57
Analyzed: 02/22/17 19:57

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	2.0 µg/L
2	Vinyl chloride	ND	1.0 µg/L
3	Chloroethane	1.1	1.0 µg/L
4	Bromomethane	ND	2.0 µg/L
5	Trichlorofluoromethane	ND	1.0 µg/L
6	Acetone	ND	10 µg/L
7	1,1-Dichloroethene	ND	1.0 µg/L
8	Dichloromethane	ND	2.0 µg/L
9	trans-1,2-Dichloroethene	ND	1.0 µg/L
10	1,1-Dichloroethane	20	1.0 µg/L
11	cis-1,2-Dichloroethene	1.2	1.0 µg/L
12	Chloroform	ND	1.0 µg/L
13	1,2-Dichloroethane	ND	1.0 µg/L
14	1,1,1-Trichloroethane	ND	1.0 µg/L
15	Carbon tetrachloride	ND	1.0 µg/L
16	Benzene	0.51	0.50 µg/L
17	1,2-Dichloropropane	ND	1.0 µg/L
18	Trichloroethene	1.7	1.0 µg/L
19	Bromodichloromethane	ND	1.0 µg/L
20	cis-1,3-Dichloropropene	ND	1.0 µg/L
21	trans-1,3-Dichloropropene	ND	1.0 µg/L
22	1,1,2-Trichloroethane	ND	1.0 µg/L
23	Toluene	ND	0.50 µg/L
24	Dibromochloromethane	ND	1.0 µg/L
25	Tetrachloroethene	ND	1.0 µg/L
26	Chlorobenzene	ND	1.0 µg/L
27	Ethylbenzene	ND	0.50 µg/L
28	m,p-Xylene	ND	0.50 µg/L
29	Bromoform	ND	1.0 µg/L
30	o-Xylene	ND	0.50 µg/L
31	1,1,2,2-Tetrachloroethane	ND	1.0 µg/L
32	1,3-Dichlorobenzene	ND	1.0 µg/L
33	1,4-Dichlorobenzene	ND	1.0 µg/L
34	1,2-Dichlorobenzene	ND	1.0 µg/L

ND = Not Detected

ACLASS ACCREDITED DoD ELAP

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com

2/27/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Prima Environmental
5070 Robert J. Mathews Parkway
El Dorado Hills, CA 95762
Job: Ram ZVI

Attn: Cindy Schreier
Phone: (916) 939-7300
Fax: (916) 393-7398

Alpha Analytical Number: PES17022021-02A
Client I.D. Number: Ram ZVI-In

Sampled: 02/17/17 17:30
Received: 02/18/17
Extracted: 02/22/17 20:20
Analyzed: 02/22/17 20:20

Volatile Organics by GC/MS
EPA Method 624/8260

	Compound	Concentration	Reporting Limit
1	Chloromethane	ND	32 µg/L
2	Vinyl chloride	ND	8.0 µg/L
3	Chloroethane	ND	8.0 µg/L
4	Bromomethane	ND	32 µg/L
5	Trichlorofluoromethane	ND	8.0 µg/L
6	Acetone	ND	160 µg/L
7	1,1-Dichloroethene	ND	8.0 µg/L
8	Dichloromethane	ND	32 µg/L
9	trans-1,2-Dichloroethene	ND	8.0 µg/L
10	1,1-Dichloroethane	29	8.0 µg/L
11	cis-1,2-Dichloroethene	36	8.0 µg/L
12	Chloroform	ND	8.0 µg/L
13	1,2-Dichloroethane	ND	8.0 µg/L
14	1,1,1-Trichloroethane	180	8.0 µg/L
15	Carbon tetrachloride	ND	8.0 µg/L
16	Benzene	ND	4.0 µg/L
17	1,2-Dichloropropane	ND	8.0 µg/L
18	Trichloroethene	1,000	8.0 µg/L
19	Bromodichloromethane	ND	8.0 µg/L
20	cis-1,3-Dichloropropene	ND	8.0 µg/L
21	trans-1,3-Dichloropropene	ND	8.0 µg/L
22	1,1,2-Trichloroethane	ND	8.0 µg/L
23	Toluene	ND	4.0 µg/L
24	Dibromochloromethane	ND	8.0 µg/L
25	Tetrachloroethene	ND	8.0 µg/L

	Compound	Concentration	Reporting Limit
26	Chlorobenzene	ND	8.0 µg/L
27	Ethylbenzene	ND	4.0 µg/L
28	m,p-Xylene	ND	4.0 µg/L
29	Bromoform	ND	8.0 µg/L
30	o-Xylene	ND	4.0 µg/L
31	1,1,2,2-Tetrachloroethane	ND	8.0 µg/L
32	1,3-Dichlorobenzene	ND	8.0 µg/L
33	1,4-Dichlorobenzene	ND	8.0 µg/L
34	1,2-Dichlorobenzene	ND	8.0 µg/L

Reporting Limits were increased due to high concentrations of target analytes.

ND = Not Detected

Roger Scholl   Randy Gardner

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager

Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com

Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.

Statement of Data Authenticity : Alpha Analytical, Inc. attests that the data reported has not been altered an any way.

Alpha Analytical, Inc. currently holds appropriate and available California (#2019) and NELAC (01154CA) certifications for the data reported. Test results relate only to reported samples.

ACLASS ACCREDITED DoD ELAP

2/27/17
Report Date

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: 27-Feb-17

QC Summary Report

Work Order: 17022021

Method Blank

Type **MBLK** Test Code: **EPA Method SW8260B**
File ID: **2** Batch ID: **MS15W0222A** Analysis Date: **02/22/2017 11:54**
Sample ID: **MBLK MS15W0222A** Units : **µg/L** Run ID: **MANUAL_170222A** Prep Date: **02/22/2017 11:54**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
Chloromethane	ND	2								
Vinyl chloride	ND	1								
Chloroethane	ND	1								
Bromomethane	ND	2								
Trichlorofluoromethane	ND	1								
Acetone	ND	10								
1,1-Dichloroethene	ND	1								
Dichloromethane	ND	2								
trans-1,2-Dichloroethene	ND	1								
1,1-Dichloroethane	ND	1								
cis-1,2-Dichloroethene	ND	1								
Chloroform	ND	1								
1,2-Dichloroethane	ND	1								
1,1,1-Trichloroethane	ND	1								
Carbon tetrachloride	ND	1								
Benzene	ND	0.5								
1,2-Dichloropropane	ND	1								
Trichloroethene	ND	1								
Bromodichloromethane	ND	1								
cis-1,3-Dichloropropene	ND	1								
trans-1,3-Dichloropropene	ND	1								
1,1,2-Trichloroethane	ND	1								
Toluene	ND	0.5								
Dibromochloromethane	ND	1								
Tetrachloroethene	ND	1								
Chlorobenzene	ND	1								
Ethylbenzene	ND	0.5								
m,p-Xylene	ND	0.5								
Bromoform	ND	1								
o-Xylene	ND	0.5								
1,1,2,2-Tetrachloroethane	ND	1								
1,3-Dichlorobenzene	ND	1								
1,4-Dichlorobenzene	ND	1								
1,2-Dichlorobenzene	ND	1								
Surr: 1,2-Dichloroethane-d4	10.2		10		102	70	130			
Surr: Toluene-d8	11.5		10		115	70	130			
Surr: 4-Bromofluorobenzene	9.57		10		96	70	130			

Laboratory Control Spike

Type **LCS** Test Code: **EPA Method SW8260B**
File ID: **1** Batch ID: **MS15W0222A** Analysis Date: **02/22/2017 11:04**
Sample ID: **LCS MS15W0222A** Units : **µg/L** Run ID: **MANUAL_170222A** Prep Date: **02/22/2017 11:04**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	9.76	1	10		98	70	130			
Benzene	8.92	0.5	10		89	70	130			
Trichloroethene	9.95	1	10		100	68	138			
Toluene	9.97	0.5	10		99.7	70	130			
Chlorobenzene	9.96	1	10		99.6	70	130			
Ethylbenzene	9.58	0.5	10		96	70	130			
m,p-Xylene	9.2	0.5	10		92	65	139			
o-Xylene	9.02	0.5	10		90	70	130			
Surr: 1,2-Dichloroethane-d4	10.7		10		107	70	130			
Surr: Toluene-d8	11.4		10		114	70	130			
Surr: 4-Bromofluorobenzene	10.5		10		105	70	130			

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

Date: *27-Feb-17*

QC Summary Report

Work Order: 17022021

Sample Matrix Spike

Type **MS** Test Code: **EPA Method SW8260B**

File ID: **3** Batch ID: **MS15W0222A** Analysis Date: **02/22/2017 21:31**

Sample ID: **17022025-01AMS** Units : **µg/L** Run ID: **MANUAL_170222A** Prep Date: **02/22/2017 21:31**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	44.4	2.5	50	0	89	62	133			
Benzene	47.8	1.3	50	0	96	67	134			
Trichloroethene	48.2	2.5	50	0	96	68	138			
Toluene	51.2	1.3	50	1.98	98	38	130			
Chlorobenzene	50.1	2.5	50	0	100	70	130			
Ethylbenzene	44.2	1.3	50	0	88	70	130			
m,p-Xylene	43.6	1.3	50	1.33	85	65	139			
o-Xylene	44.5	1.3	50	0	89	69	130			
Surr: 1,2-Dichloroethane-d4	49		50		98	70	130			
Surr: Toluene-d8	56.3		50		113	70	130			
Surr: 4-Bromofluorobenzene	52.2		50		104	70	130			

Sample Matrix Spike Duplicate

Type **MSD** Test Code: **EPA Method SW8260B**

File ID: **4** Batch ID: **MS15W0222A** Analysis Date: **02/22/2017 21:54**

Sample ID: **17022025-01AMSD** Units : **µg/L** Run ID: **MANUAL_170222A** Prep Date: **02/22/2017 21:54**

Analyte	Result	PQL	SpkVal	SpkRefVal	%REC	LCL(ME)	UCL(ME)	RPDRefVal	%RPD(Limit)	Qual
1,1-Dichloroethene	47.2	2.5	50	0	94	62	133	44.43	6.0(35)	
Benzene	50	1.3	50	0	100	67	134	47.83	4.5(21)	
Trichloroethene	50.2	2.5	50	0	100	68	138	48.16	4.2(20)	
Toluene	53	1.3	50	1.98	102	38	130	51.19	3.5(20)	
Chlorobenzene	52	2.5	50	0	104	70	130	50.11	3.6(20)	
Ethylbenzene	45.3	1.3	50	0	91	70	130	44.21	2.5(20)	
m,p-Xylene	45.1	1.3	50	1.33	88	65	139	43.61	3.3(20)	
o-Xylene	46.1	1.3	50	0	92	69	130	44.51	3.6(20)	
Surr: 1,2-Dichloroethane-d4	47.9		50		96	70	130			
Surr: Toluene-d8	56.6		50		113	70	130			
Surr: 4-Bromofluorobenzene	51.8		50		104	70	130			

Comments:

Calculations are based off of raw (non-rounded) data. However, for reporting purposes, all QC data is rounded to three significant figures. Therefore, hand calculated values may differ slightly.

Billing Information :

CHAIN-OF-CUSTODY RECORD

CA

Alpha Analytical, Inc.
255 Glendale Avenue, Suite 21 Sparks, Nevada 89431-5778
TEL: (775) 355-1044 FAX: (775) 355-0406

WorkOrder : PES17022021
Report Due By : 5:00 PM On : 27-Feb-17

Client:
Prima Environmental
5070 Robert J. Mathews Parkway
Suite 300
El Dorado Hills, CA 95762

Report Attention	Phone Number	EMail Address
Cindy Schreier	(916) 939-7300 x	data@primaenvironmental.com

EDD Required : No

Sampled by : Cindy Schreier

Cooler Temp	Samples Received	Date Printed
2 °C	18-Feb-17	20-Feb-17

PO :

Client's COC # : 6494   Job : Ram ZVI

QC Level : S3 = Final Rpt, MBLK, LCS, MS/MSD With Surrogates

Alpha Sample ID	Client Sample ID	Matrix	Collection Date	No. of Bottles Alpha	No. of Bottles Sub	TAT	Requested Tests: VOC_W								Sample Remarks
PES17022021-01A	Ram ZVI-Eff	AQ	02/17/17 17:30	2	0	5	8260/ Acetone_Cs								
PES17022021-02A	Ram ZVI-In	AQ	02/17/17 17:30	2	0	5	8260/ Acetone_Cs								

Comments: No security seals. Frozen ice. Saturday delivery. Sample kept cold and secure until login on Monday. :

	Signature	Print Name	Company	Date/Time
Logged in by:	K. Murray	K Murray	Alpha Analytical, Inc.	2/20/17 1050

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.
The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.
Matrix Type : AQ(Aqueous) AR(Air) SO(Soil) WS(Waste) DW(Drinking Water) OT(Other)   Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

Billing Information:

Company: PRIMA
Attn:
Address:
City, State, Zip:
Phone Number: Fax:

Alpha Analytical, Inc.

Main Laboratory: 255 Glendale Ave, Suite 21 Sparks, NV 89431 — Phone: 775-355-1044, Fax: 775-355-0406

Satellite Service Centers:

Northern CA: 9891 Horn Road, Suite C, Rancho Cordova, CA 95827 — Phone: 916-366-9089
Southern CA: 1007 E. Dominguez St., Suite O, Carson, CA 90746 — Phone: 714-386-2901
Northern NV: 1250 Lamoille Hwy., #310, Elko, NV 89801 — Phone: 775-388-7043
Southern NV: 6255 McLeod Ave, Suite 24, Las Vegas, NV 89120 — Phone: 702-281-4848

6494

Page # 1 of 1

Consultant/ Client Info:
Company: PRIMA
Address:
City, State, Zip:

Job and Purchase Order Info:
Job #: Ram ZVI
Job Name:
P.O. #:

Report Attention/Project Manager:
Name: Cindy Schreier
Email Address:
Phone #: 916-~~9~~937-7300
Cell #:

QC Deliverable Info:
EDD Required? Yes / No
EDF Required? Yes / No
Global ID:
Data Validation Packages: III or IV

Samples Collected from which State? (circle one) AR CA KS NV OR WA DOD Site Other

Time Sampled (HHMM)	Date Sampled (MM/DD)	Matrix* (See Key Below)	Lab ID Number (For Lab Use Only)	Sample Description	TAT	# Containers** (See Key Below)	Field Filtered? Yes	Field Filtered? No	8260										Remarks
1730	2/17	AQ	PES17022021-01	Ram ZVI-Eff	5d	2		X	X										
1730	2/17	AQ	02	Ram ZVI-In	5d	2		X	X										

ADDITIONAL INSTRUCTIONS:

I (field sampler) attest to the validity and authenticity of this sample(s). I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action. NAC 445.0636 (c) (2).

Sampled By:

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
PRIMA	2/17/17	1800	FedEx		
			K Murray	2/20/17	1050

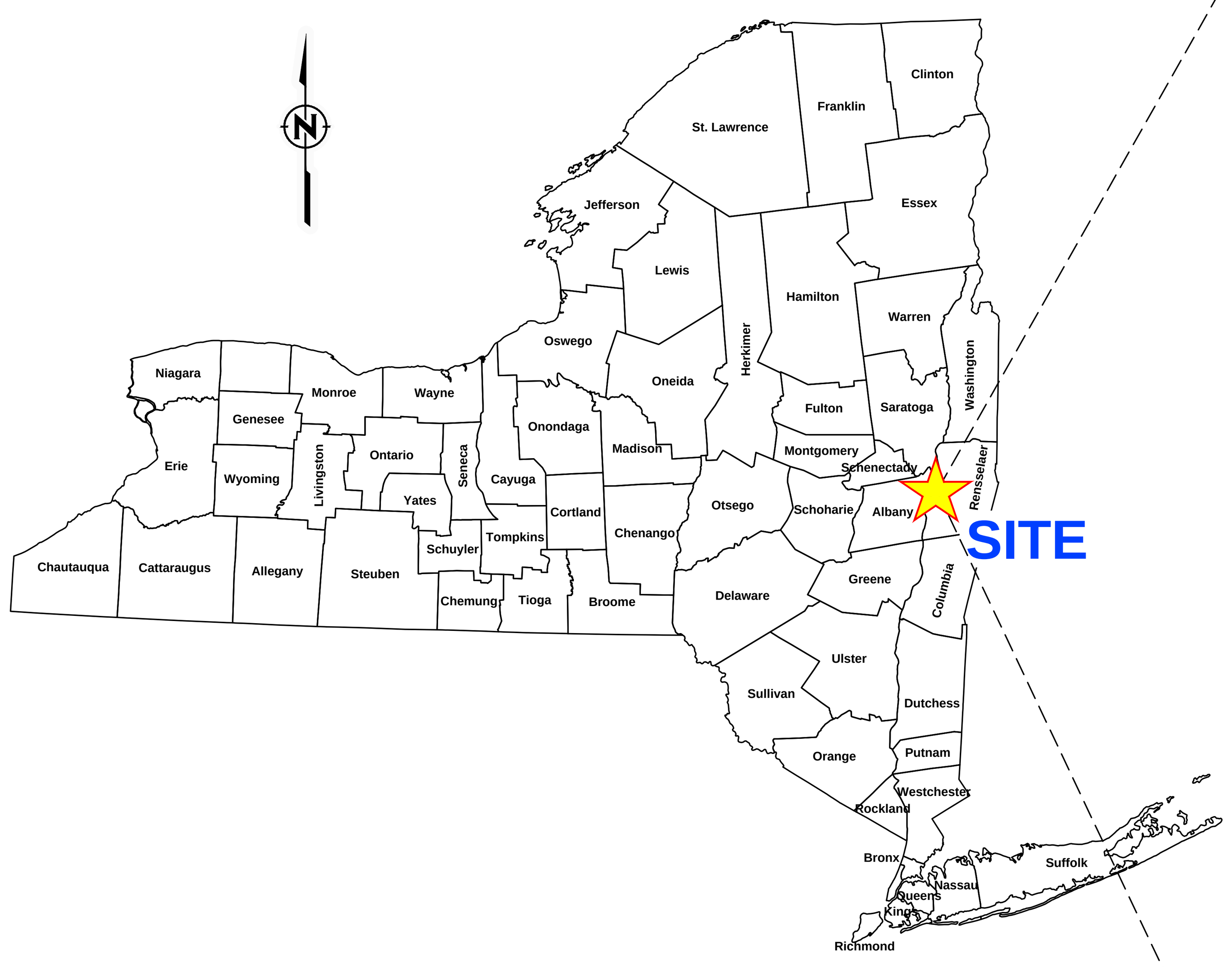
* Key: AQ - Aqueous OT - Other So-Soil WA - Waste ** B - Brass L - Liter O - Orbo OT - Other P - Plastic S-Soil Jar T - Tedlar V - VOA

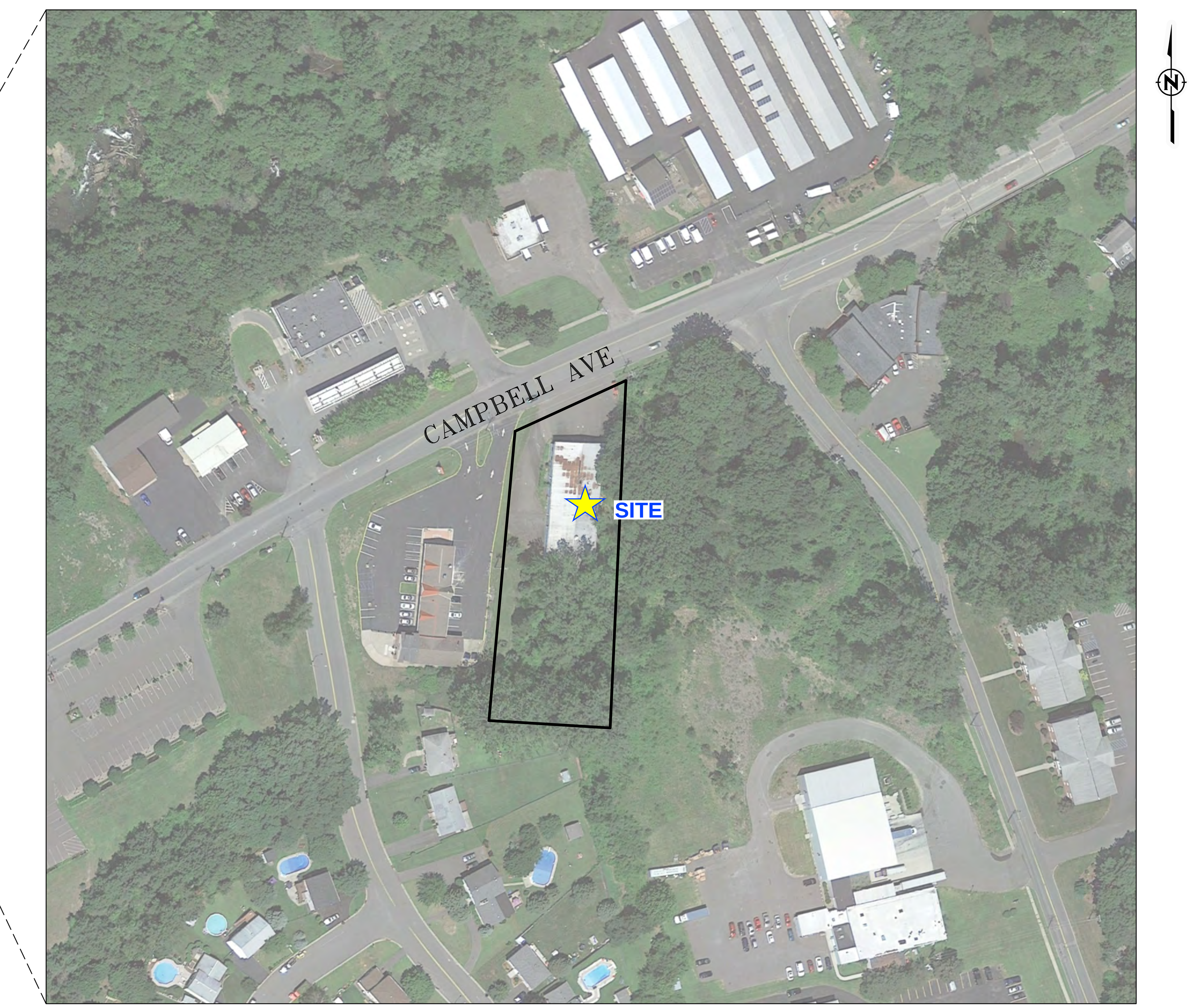
NOTE: Samples are discarded 60 days after sample receipt unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense. The report for the analysis of the above samples is applicable only to those samples received by the laboratory with this COC. The liability of the laboratory is limited to the amount paid for the report.

ATTACHMENT B
DESIGN DRAWINGS

DESIGN DRAWINGS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK





SOURCE:

Google Earth™ Pro. MAPPING SERVICE. IMAGE DATE: 07/15/2015.

LOCATION MAP

0 100 200

Scale in Feet

INDEX TO DRAWINGS

PREPARED BY

ENVIRON

ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED FOR:
ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

MBLEI 9/19/17
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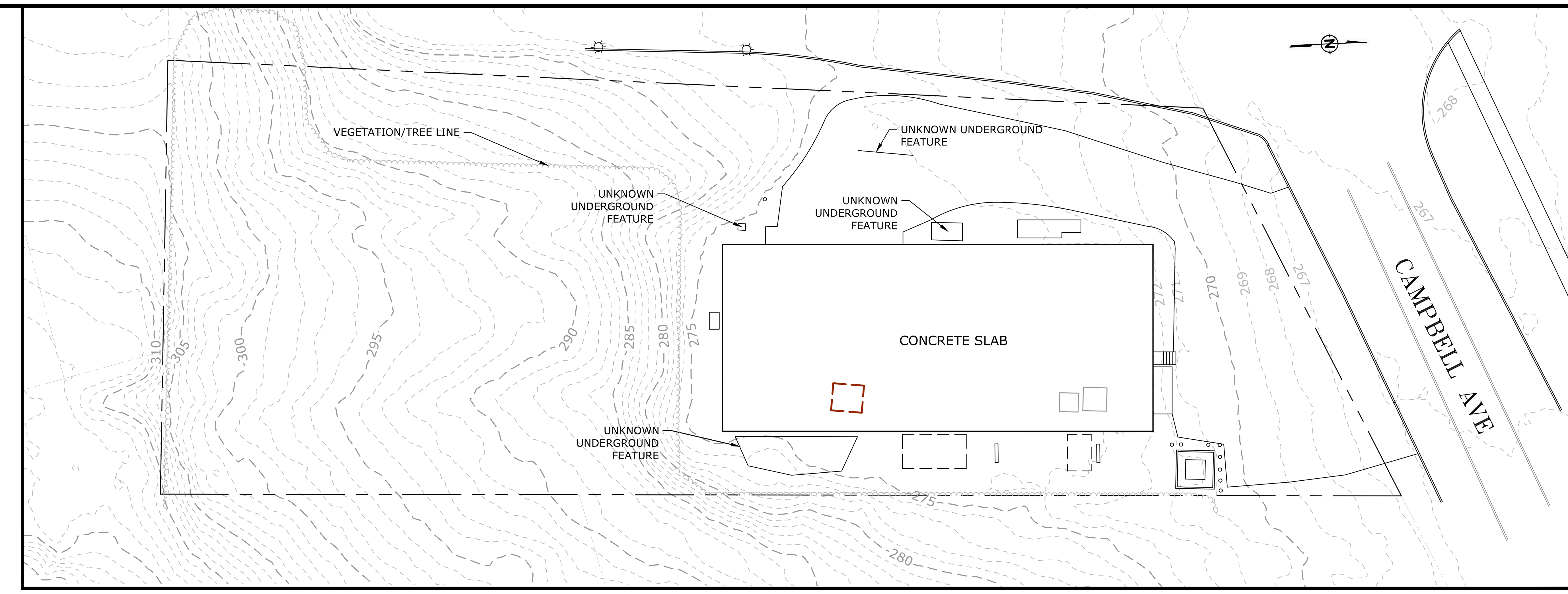
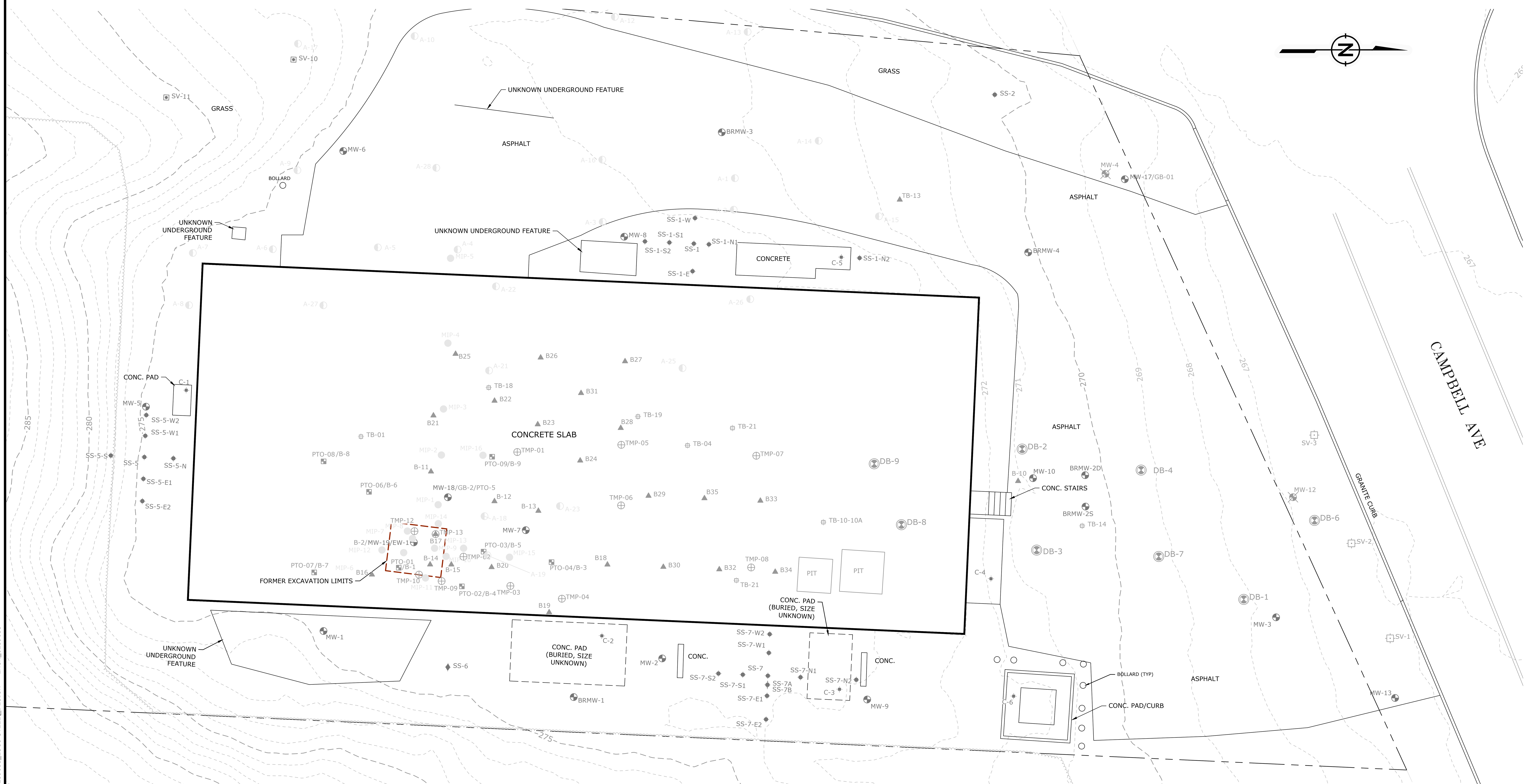


OVERALL SITE
1" = 20'



LEGEND

- PROPERTY BOUNDARY
- EXISTING GRADE CONTOUR
- APPROXIMATE TREE LINE
- DB-2 BORING LOCATION
- MW MONITORING WELL LOCATION
- SV-5 SOIL VAPOR SAMPLING POINTS
- B-10 BORING LOCATION (ENVIRON 2015 & 2016)
- PTO-04 PUMP TEST OBSERVATION POINT (ENVIRON 2015)
- TMP-06 TEMPORARY MONITORING POINT
- TB-21 TEST BORING LOCATION
- MIP-4 MEMBRANE INTERFACE PROBE (08/10)
- A-3 MEMBRANE INTERFACE PROBE (09/12)
- MW-4 WELL NO LONGER SUITABLE FOR SAMPLING
- MW-15 WELL REMOVED DURING DEC. 2010 EXCAVATION IRM
- SS-7A SURFACE SOIL SAMPLE (0 TO 2 INCHES) (REH 2016 & 2017)
- SS-7 SOIL COVER SAMPLE (REH 2016 & 2017)
- SV-10 SOIL GAS SAMPLE (REH 2016 & 2017)

SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
2. RENSSELAER COUNTY, CITY OF TROY TAX MAP 112
3. "LANDS OF ESCO CORPORATION", NMB SURVEY: NB16-001 520 Campbells Ave 020416.dwg DATED FEB. 4, 2016.
4. ALL SAMPLE LOCATIONS SHOWN IN LIGHT GRAY ARE APPROXIMATE. LOCATIONS BASED ON "SITE MAP SHOWING SOIL AND GROUNDWATER SAMPLING LOCATIONS" PREPARED BY BARTON & LOGUIDICE, P.C. AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
5. "UNKNOWN UNDERGROUND FEATURE" REFERS TO SUBSURFACE METALLIC ANOMALIES IDENTIFIED DURING THE GEOPHYSICAL SURVEY COMPLETED BY NAEVA GEOPHYSICS ON NOVEMBER 24, 2015.
6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

10 0 10 20
SCALE IN FEET

REV.	DATE	DR.	CH.	REVISION

EXISTING CONDITIONS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 10/06/2017	DRAWING
DRAFTED BY: MSB	SCALE: AS SHOWN	1
APPROVED BY: JS	PROJECT: 0239035A	

MBLE1 10/6/17
F:\0239035_ESCO STEEL_DESIGN < EXCN_0239035 >

SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
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6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

REV.	DATE	DR.	CH.	REVISION

REMEDIATION PLAN

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	DRAWING 2
DRAFTED BY: MSB	SCALE: AS SHOWN	
APPROVED BY: JS	PROJECT: 0239035A	

DBLANCHARD 11/6/17
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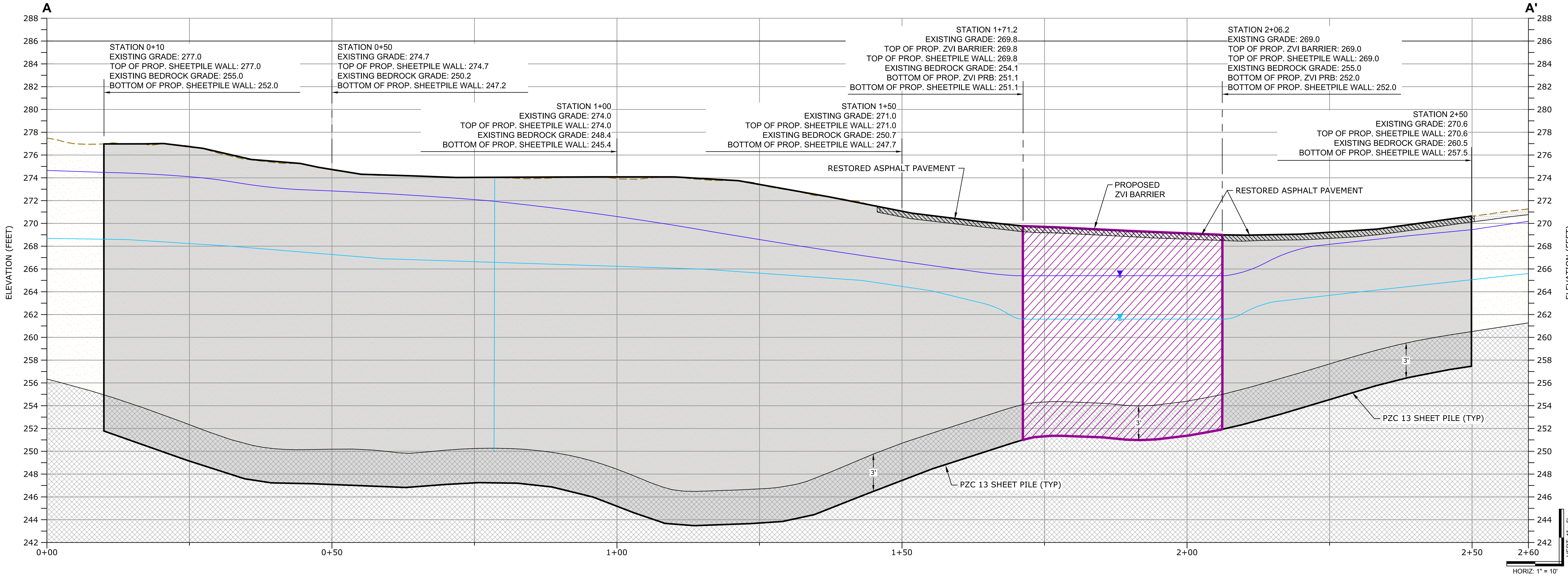
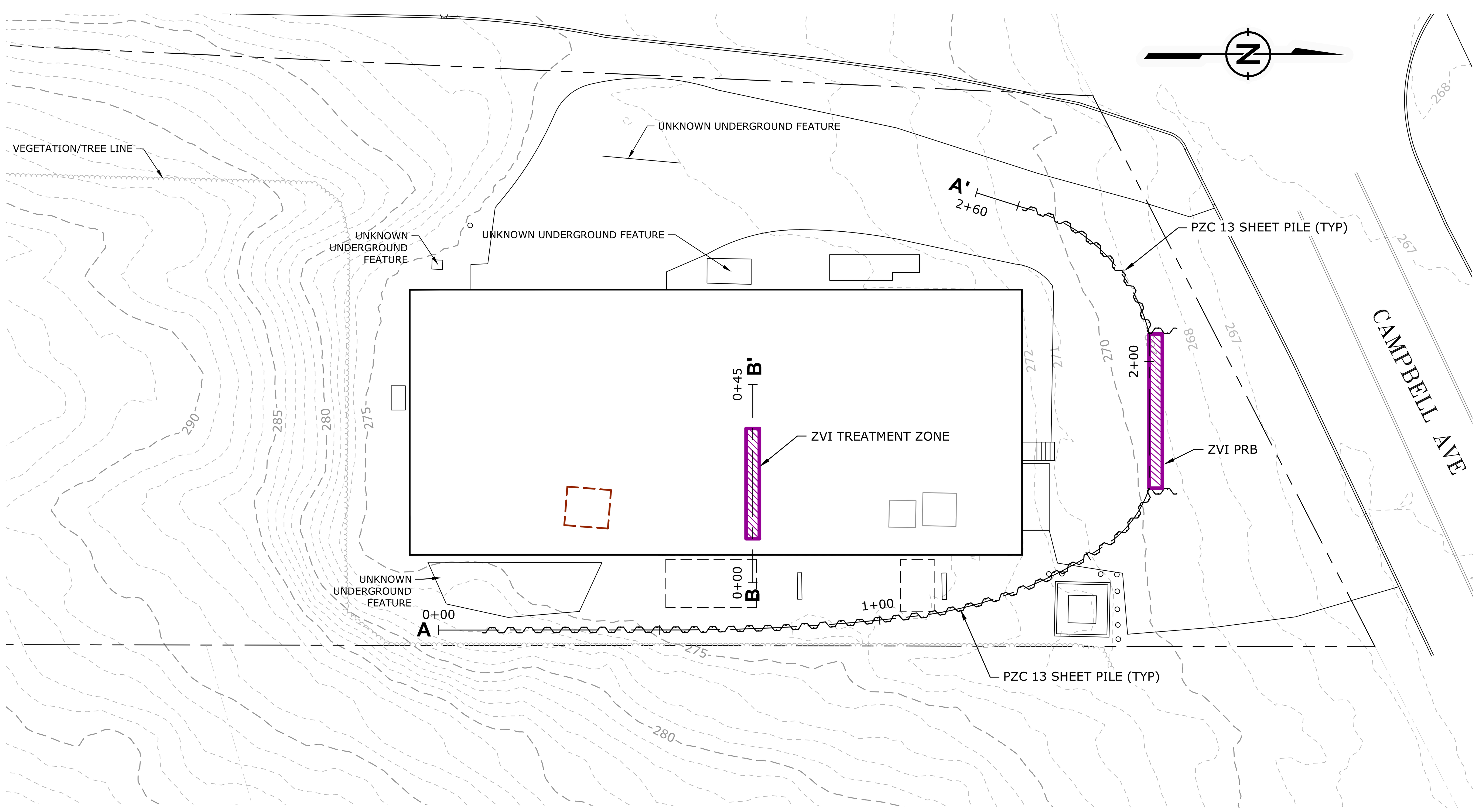


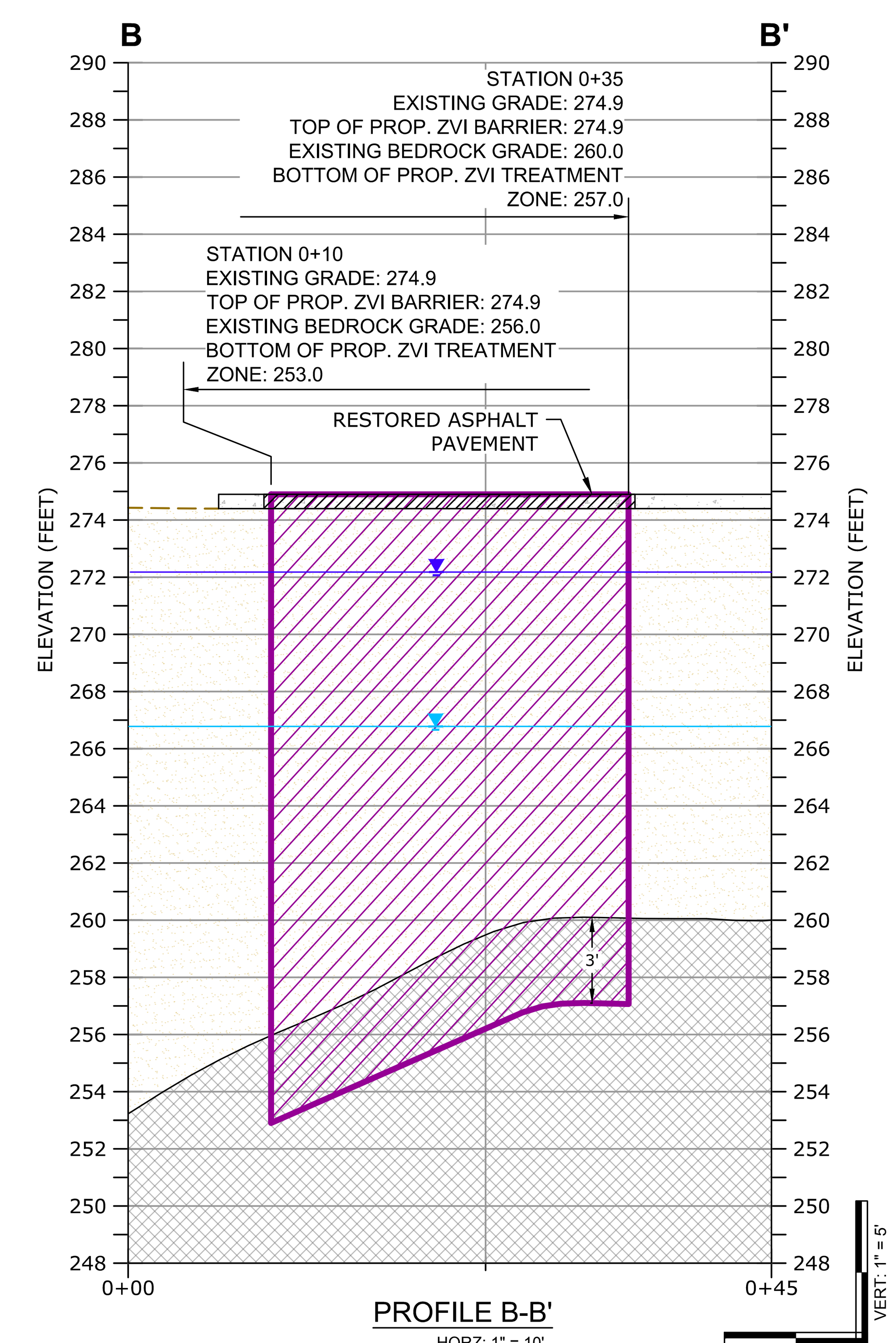
PROFILE A-A'

SCALE: HORZ: 1" = 10'
VERT: 1" = 5'



PLAN

1" = 20'



PROFILE B-B'

SCALE: HORZ: 1" = 10'
VERT: 1" = 5'

LEGEND

- CONCRETE
- ASPHALT
- SAND AND SILT
- BEDROCK
- HIGH WATER LEVEL
- LOW WATER LEVEL

NOTES:

1. THE TOP OF BEDROCK IS CONSIDERED APPROXIMATE AND WAS INTERPRETED FROM THE INDIVIDUAL BOREHOLE LOCATIONS. THE TOP OF ROCK WILL BE VERIFIED IN THE FIELD BY THE ENGINEER.
2. ALL SHEET PILE SHALL BE INSTALLED TO HAVE A MINIMUM OF 3 FEET PENETRATION INTO THE BEDROCK.

SOURCES:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
2. RENSSELAER COUNTY, CITY OF TROY TAX MAP 112
3. "LANDS OF ESCO CORPORATION", NMB SURVEY: NB16-001 520 Campbells Ave 020416.dwg DATED FEB. 4, 2016.
4. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

10 0 10 20

SCALE IN FEET

REV.	DATE	DR.	CH.	REVISION

SHEET PILE AND ZVI PROFILE

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 10/06/2017	DRAWING 3
DRAFTED BY: MSB	SCALE: AS SHOWN	
APPROVED BY: JS	PROJECT: 0239035A	

MBLE1 10/6/17
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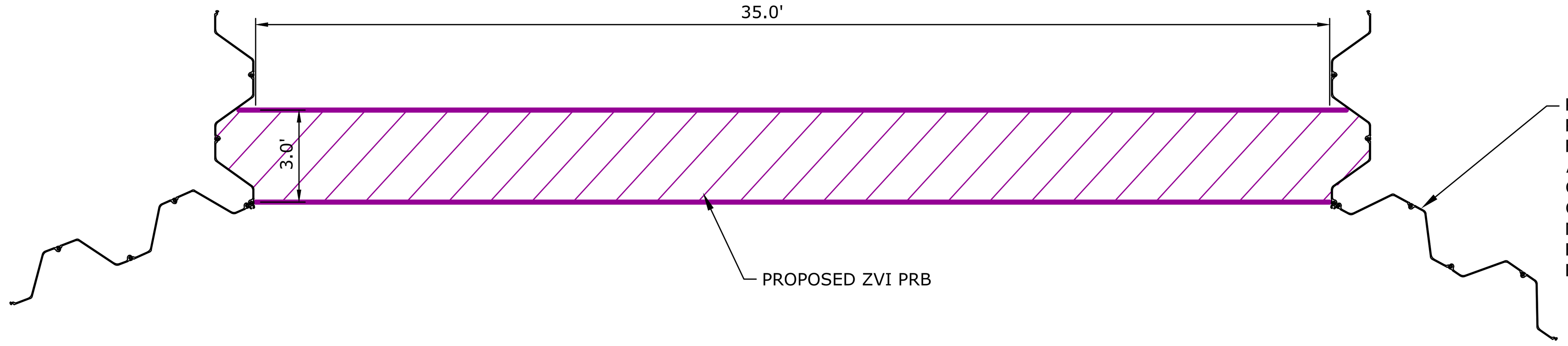
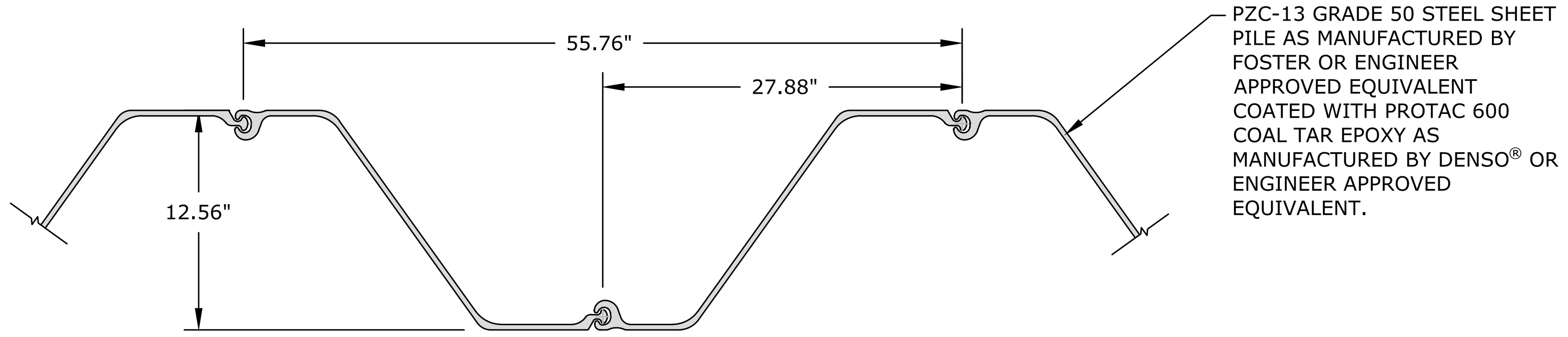
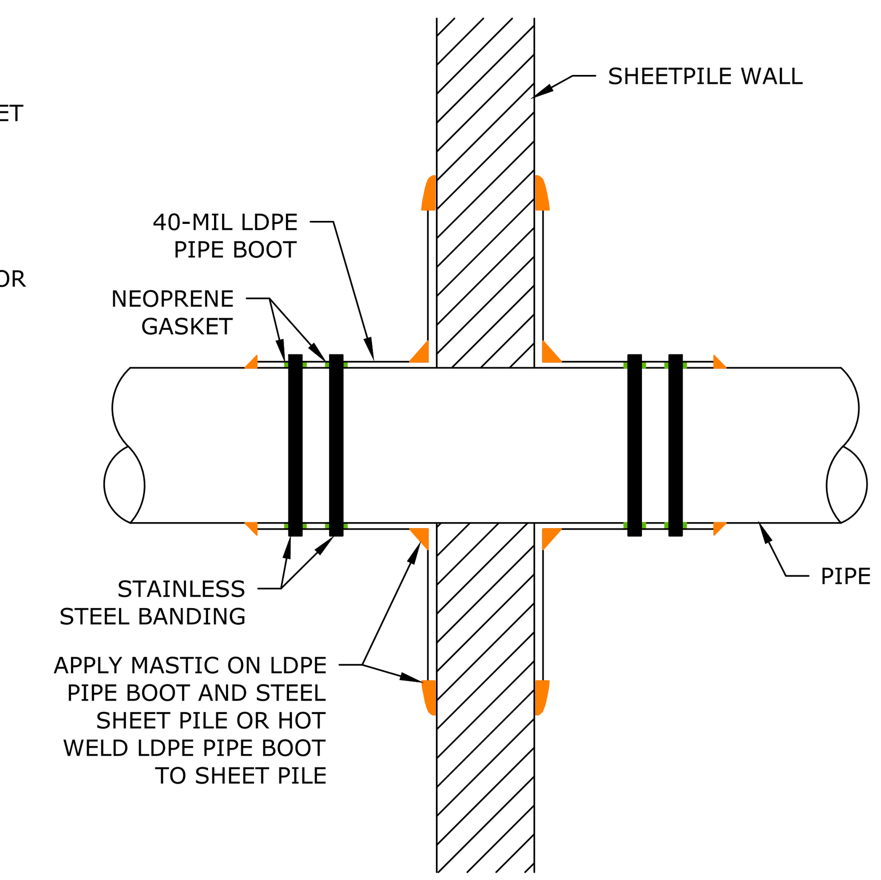
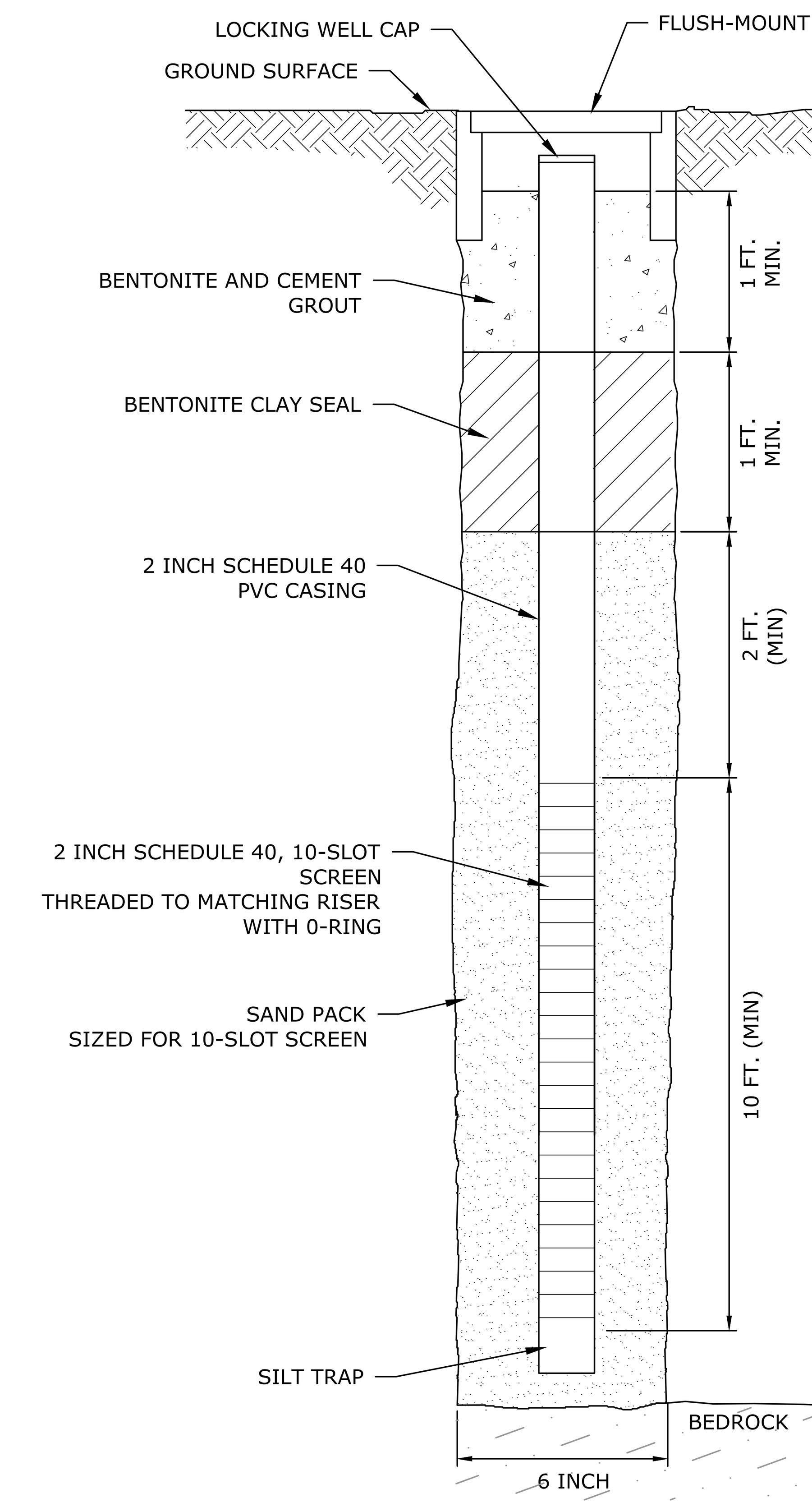




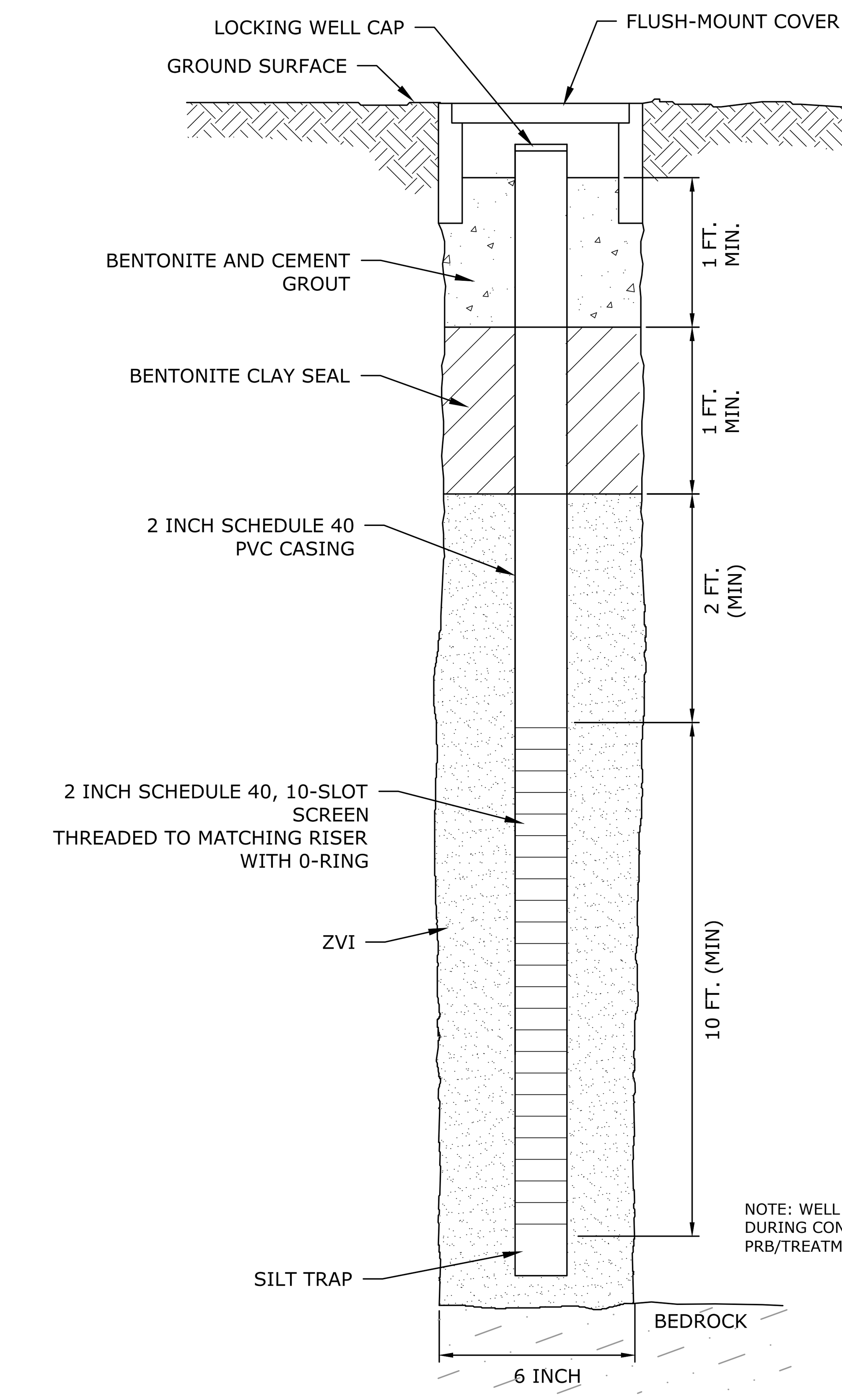
SHEET PILE DETAIL
N.T.S.



PIPE BOOT DETAIL
N.T.S.

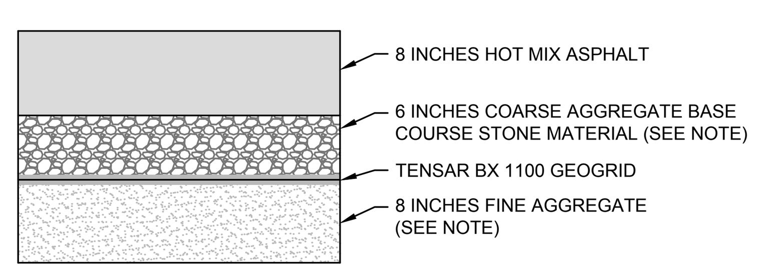


PROPOSED MONITORING WELL DETAIL
N.T.S.



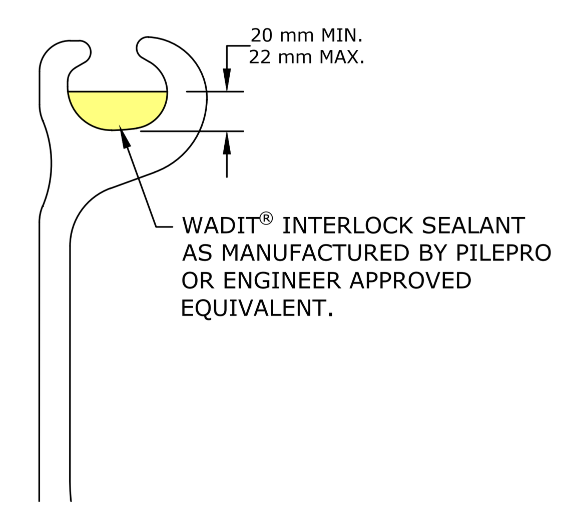
NOTE: WELL TO BE INSTALLED DURING CONSTRUCTION OF THE ZVI PRB/TREATMENT ZONE, NOT AFTER.

PROPOSED MONITORING WELL DETAIL
FOR WELLS WITHIN ZVI PRB/TREATMENT ZONE
N.T.S.

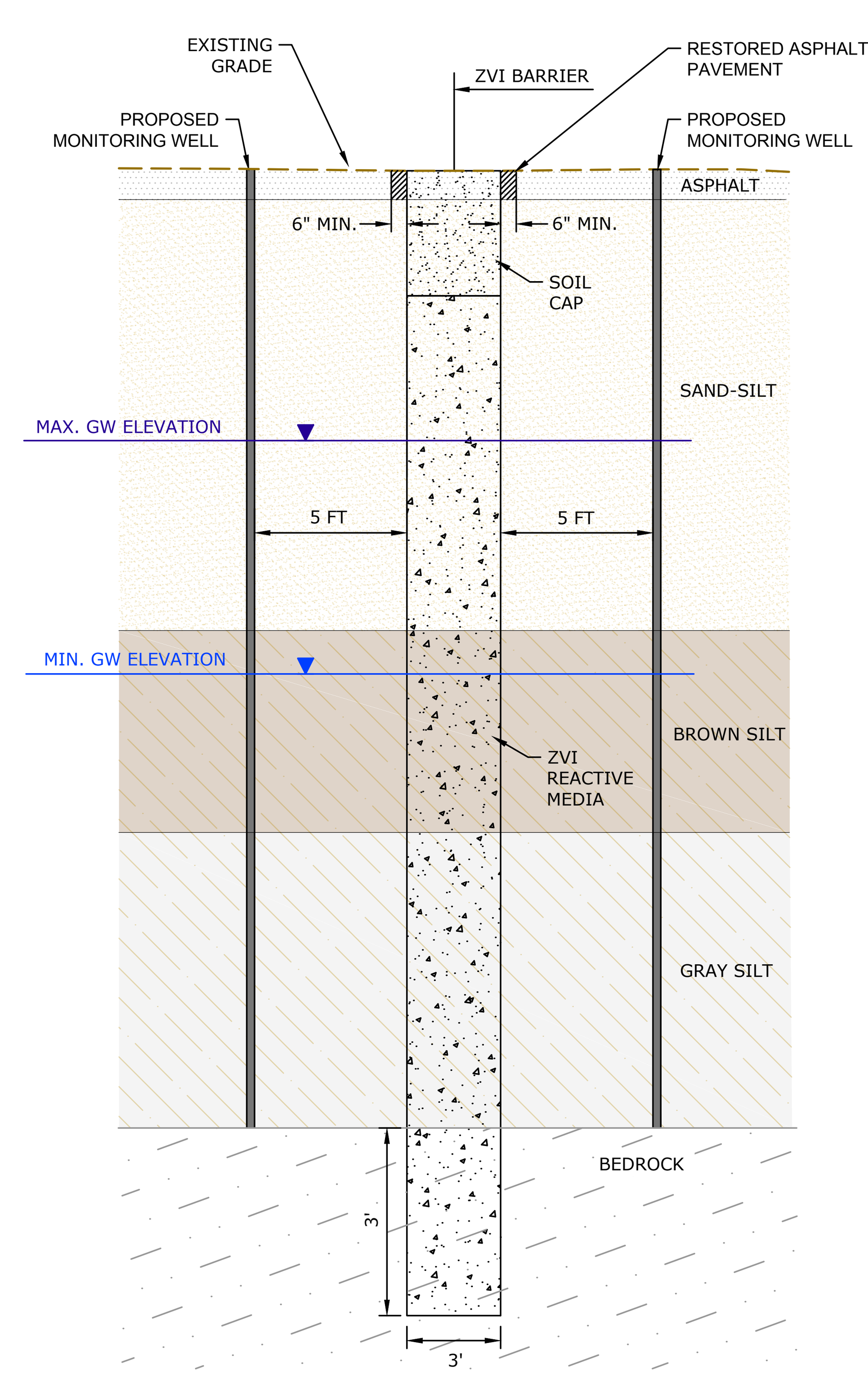


PAVEMENT
N.T.S.

NOTE: CONTRACTOR TO DEFINE PROFILE OF EXISTING PAVEMENT TO DEFINE THICKNESS OF PAVEMENT SECTION AND ADJUST DIMENSIONS SHOWN AS NEEDED.



INTERLOCK SEALANT INSTALLATION DETAILS
N.T.S.



ZVI PRB DETAIL
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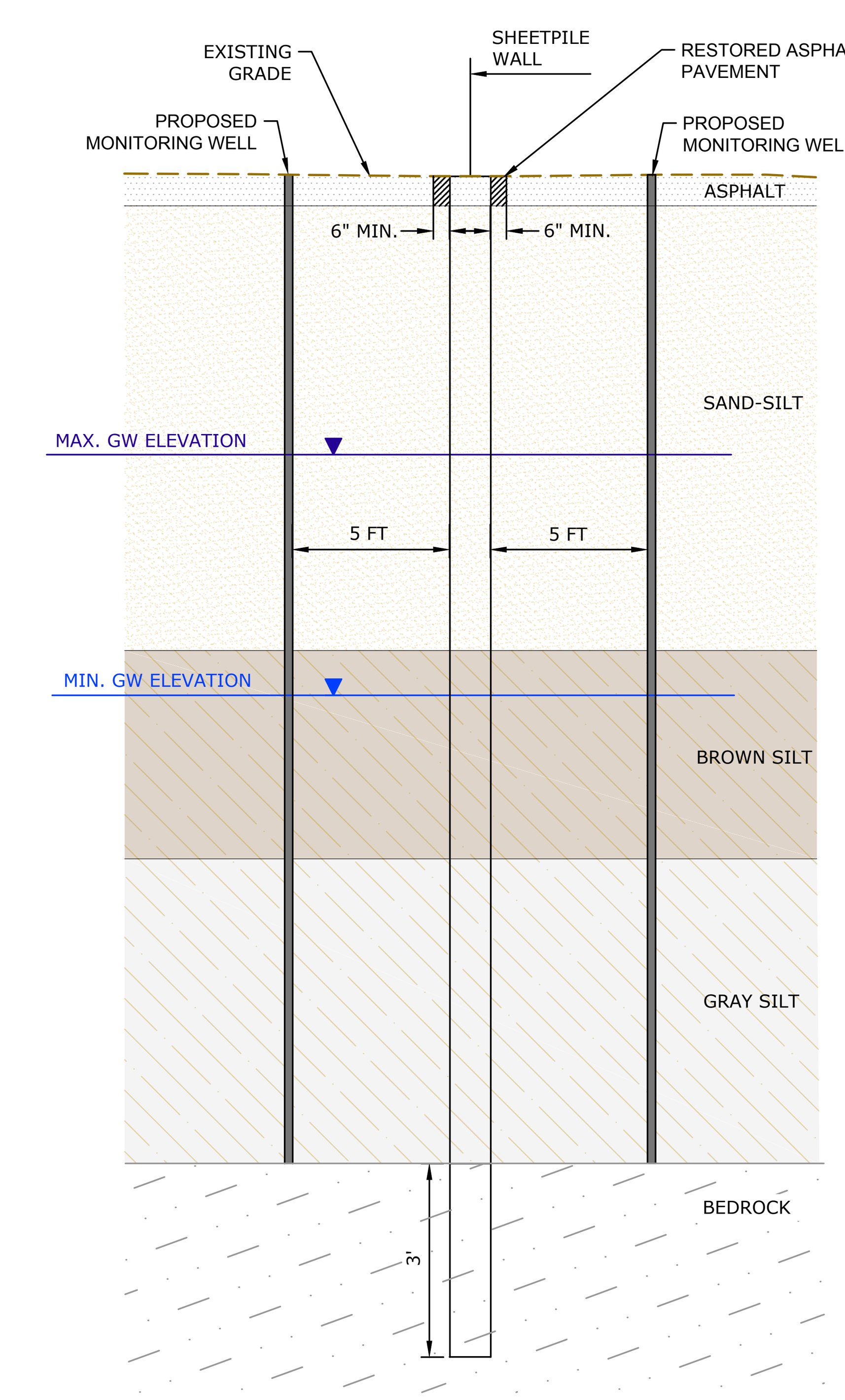
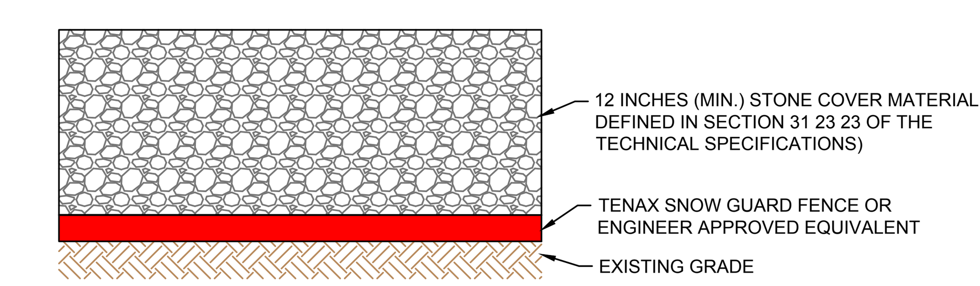
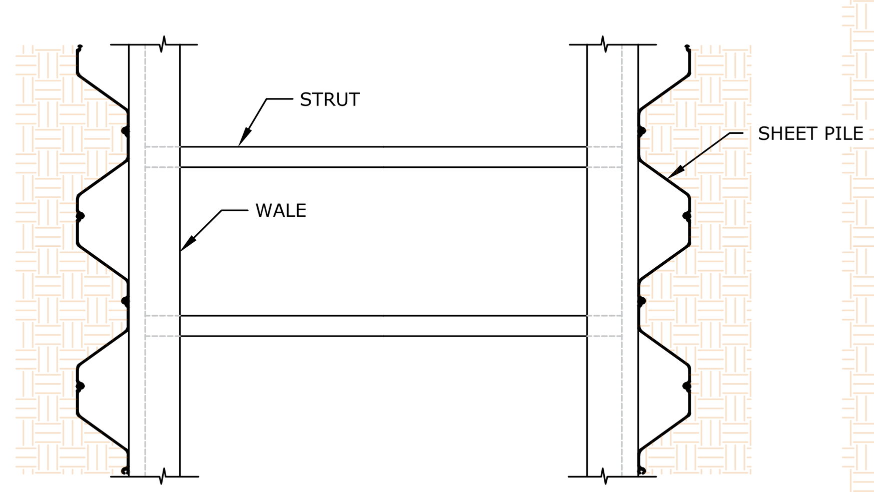


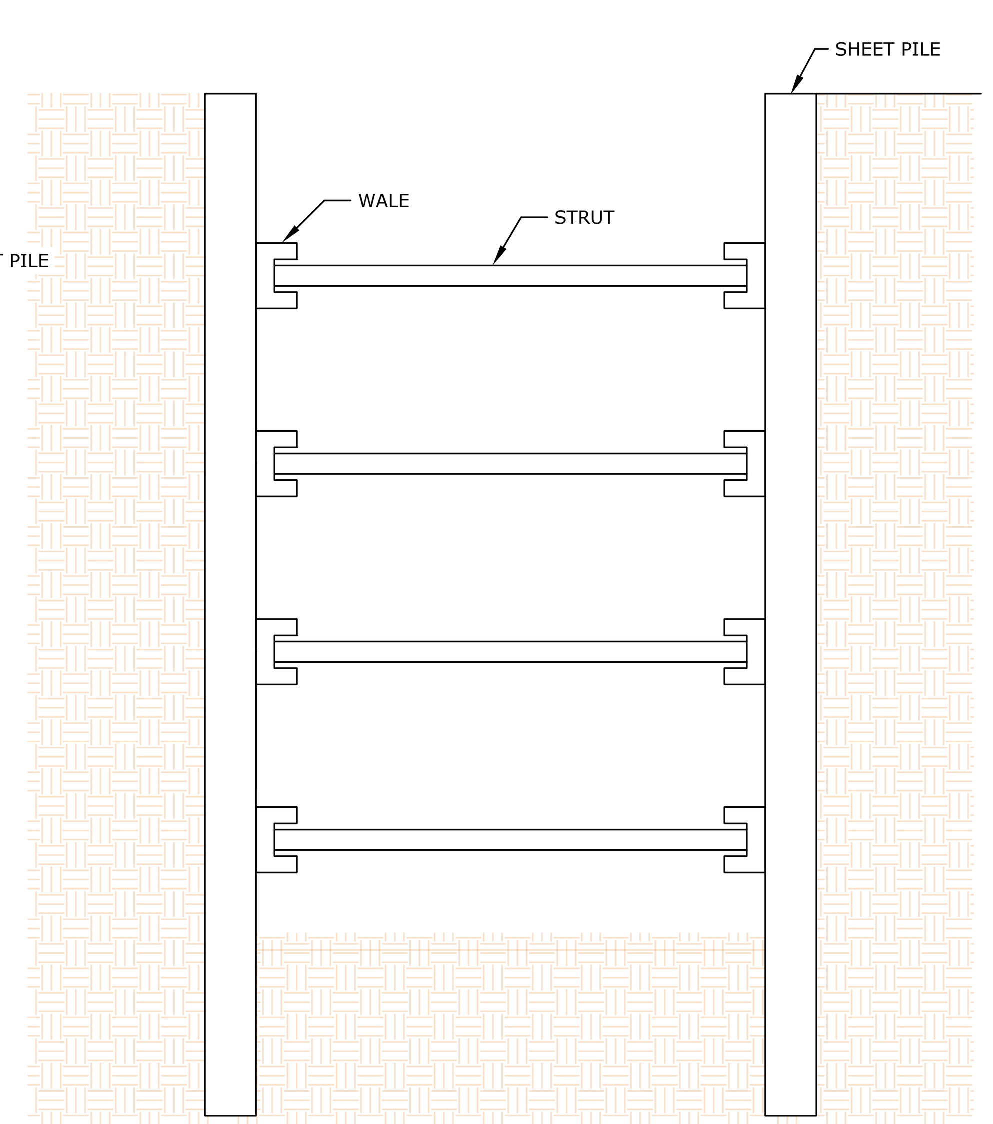
SHEETPILE WALL DETAIL
N.T.S.



SOIL CAP DETAIL
N.T.S.



PLAN VIEW
N.T.S.



ELEVATION
N.T.S.

NOTES:

1. SHEET PILES SHALL MEET THE REQUIREMENTS OF ASTM A572 GRADE 50 WITH TIE RODS, WALES, & STRUTS AS NECESSARY.
2. THE SHEET PILES AND BRACING FOR TEMPORARY SHEETING INCLUDING TIE-RODS, WALES, AND STRUTS SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NEW YORK ON BEHALF OF THE CONTRACTOR.

SCHEMATIC OF TEMPORARY SHEET PILE SHORING
N.T.S.

REV.	DATE	DR.	CH.	REVISION
1	11/21/17	MB	JS	Revised sheetpile detail and added pipe boot detail

SHEET PILE AND ZVI DETAILS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	DRAWING
DRAFTED BY: MSB	SCALE: AS SHOWN	4
APPROVED BY: JS	PROJECT: 0239035A	

MBLEI 11/21/17
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SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
2. RENSSELAER COUNTY, CITY OF TROY TAX MAP 112
3. "LANDS OF ESCO CORPORATION", NMB SURVEY: NB16-001 520 Campbells Ave 020416.dwg DATED FEB. 4, 2016.
4. ALL SAMPLE LOCATIONS SHOWN IN LIGHT GRAY ARE APPROXIMATE. LOCATIONS BASED ON "SITE MAP SHOWING SOIL AND GROUNDWATER SAMPLING LOCATIONS" PREPARED BY BARTON & LOGUIDICE, P.C. AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
5. "UNKNOWN UNDERGROUND FEATURE" REFERS TO SUBSURFACE METALLIC ANOMALIES IDENTIFIED DURING THE GEOPHYSICAL SURVEY COMPLETED BY NAEVA GEOPHYSICS ON NOVEMBER 24, 2015.
6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

REV.	DATE	DR.	CH.	REVISION

SOIL EROSION AND SEDIMENT CONTROL PLAN

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	DRAWING
DRAFTED BY: MSB	SCALE: AS SHOWN	5
APPROVED BY: JS	PROJECT: 0239035A	

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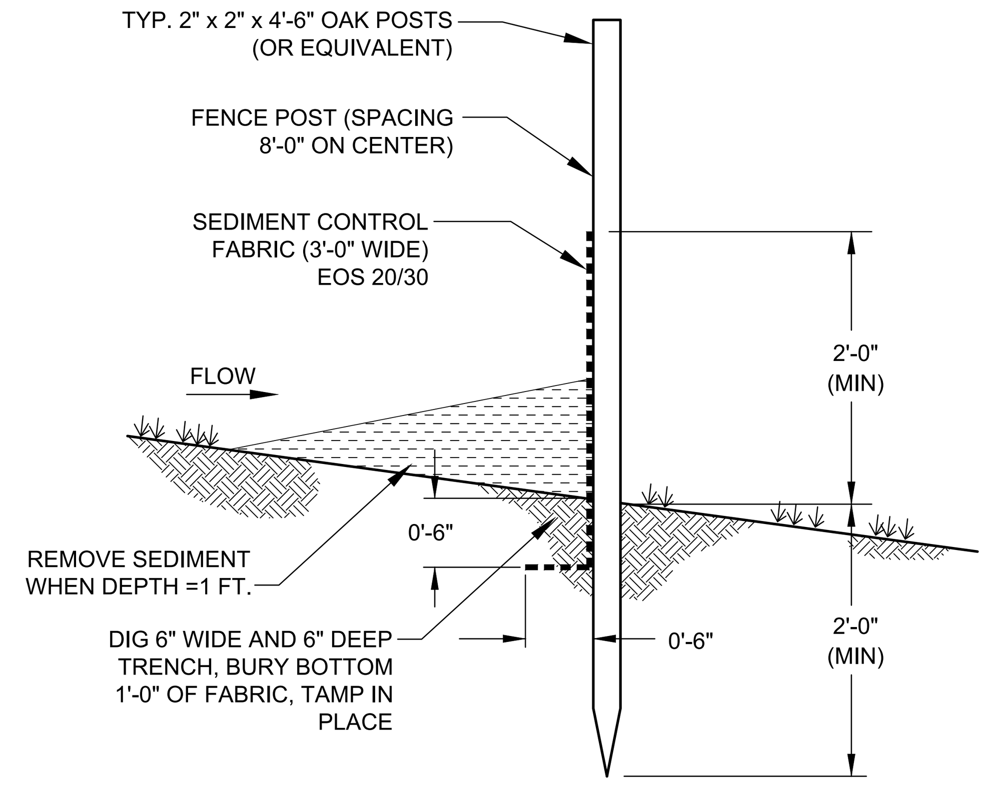
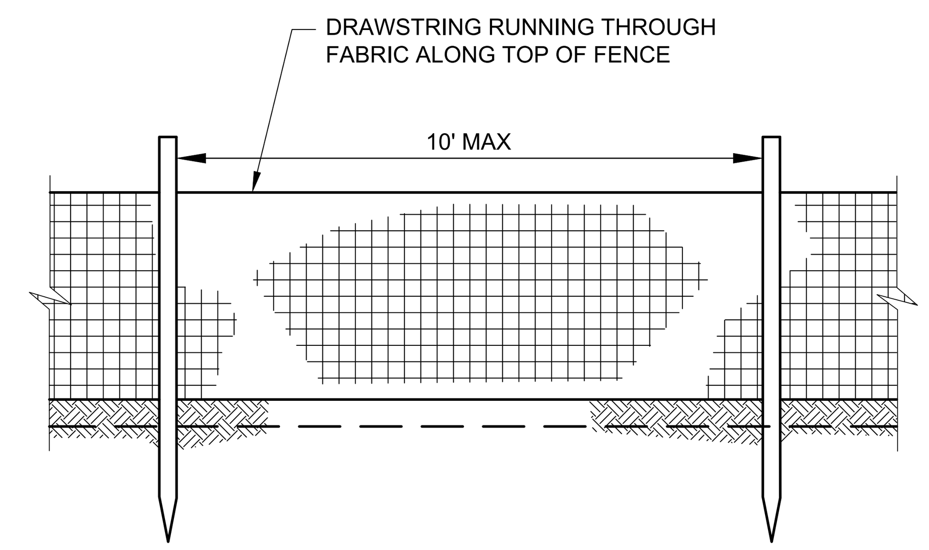




Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lb)	90	ASTM D 1682
Elongation at Failure (%)	50	ASTM d1682
Mullen Burst Strength (PSI)	190	ASTM D3786
Puncture Strength (lbs)	40	ASTM D751 (modified)
Slurry Flow Rate (gal/min/sf)	0.3	
Equivalent Opening Size	40-80	US Std Sieve CW-02215
Ultraviolet Radiation Stability (%)	90	ASTM G-26

STANDARD AND SPECIFICATIONS FOR SILT FENCE

A silt fence shall be used subject to the following conditions:

1. Maximum allowable slope lengths contributing runoff to a silt fence placed on a slope are:

Slope Maximum	Steepness Length (ft.)
2:1	25
3:1	50
4:1	75
5:1 or flatter	100

2. Maximum drainage area for overland flow to a silt fence shall not exceed ¼ acre per 100 feet of fence, with maximum ponding depth of 1.5 feet behind the fence; and
3. Erosion would occur in the form of sheet erosion; and
4. There is no concentration of water flowing to the barrier.

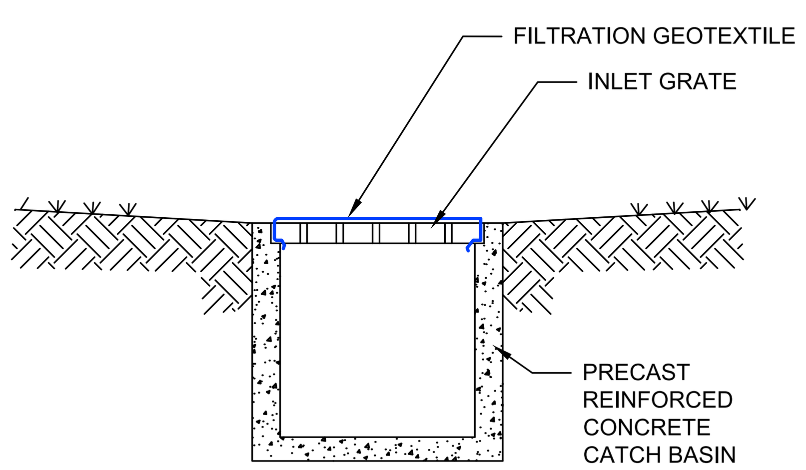
Design Criteria

- Design computations are not required for installations of 1 month or less. Longer installation periods should be designed for expected runoff. All silt fences shall be placed as close to the areas as possible, but at least 10 feet from the toe of a slope to allow for maintenance and roll down. The area beyond the fence must be undisturbed or stabilized.
- Sensitive areas to be protected by silt fence may need to be reinforced by using heavy wire fencing for added support to prevent collapse
- Where ends of filter cloth come together, they shall be overlapped, folded and stapled to prevent sediment bypass.

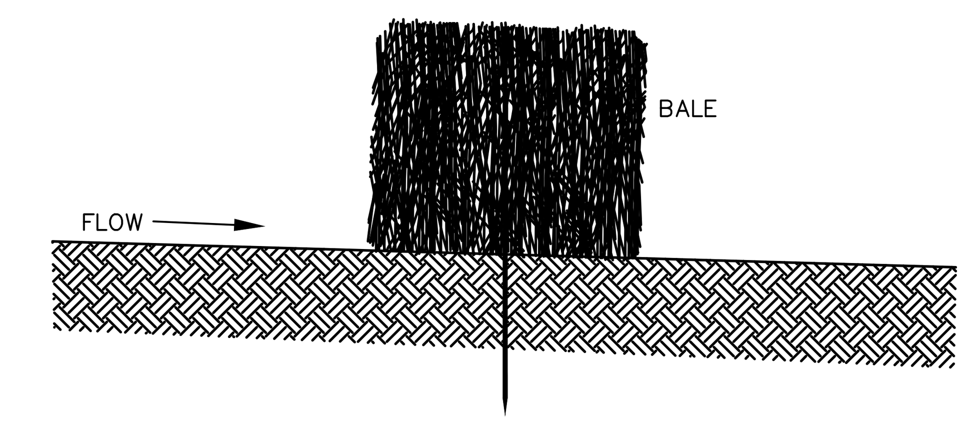
Criteria for Silt Fence Materials

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority. Such approval shall not constitute statewide acceptance.
2. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.0 square inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot.
3. Wire Fence (for fabricated units): Wire fencing shall be a minimum 14 gage with a maximum 6 in. mesh opening, or as approved.
4. Prefabricated Units: Envirofence, Geofab, or approved equal, may be used in lieu of the above method providing the unit is installed per details shown.

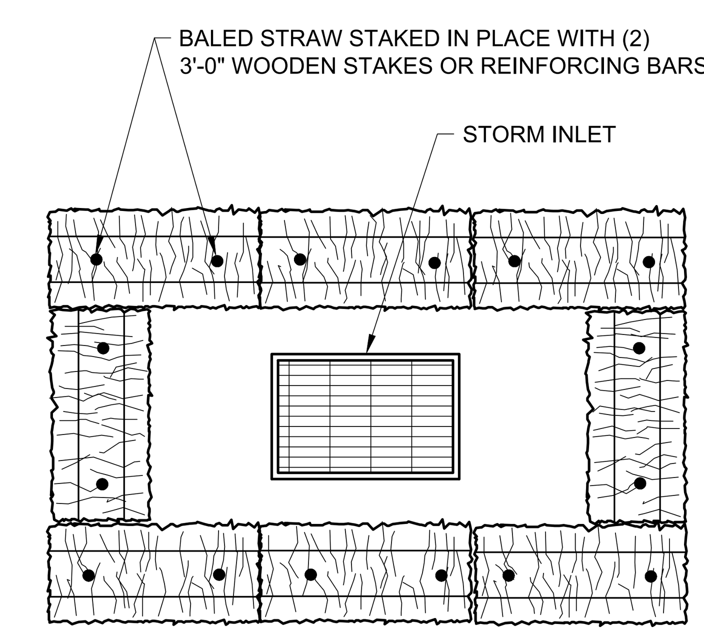
SILT FENCE
N.T.S



CATCH BASIN INLET PROTECTION DETAIL
N.T.S

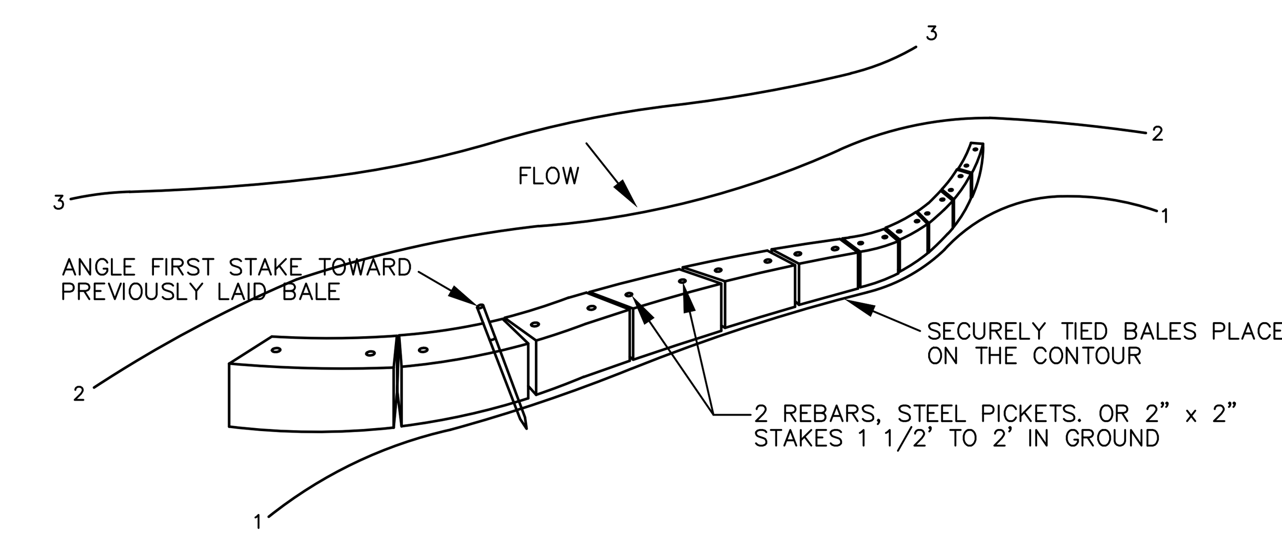


ANCHORING DETAIL
N.T.S.



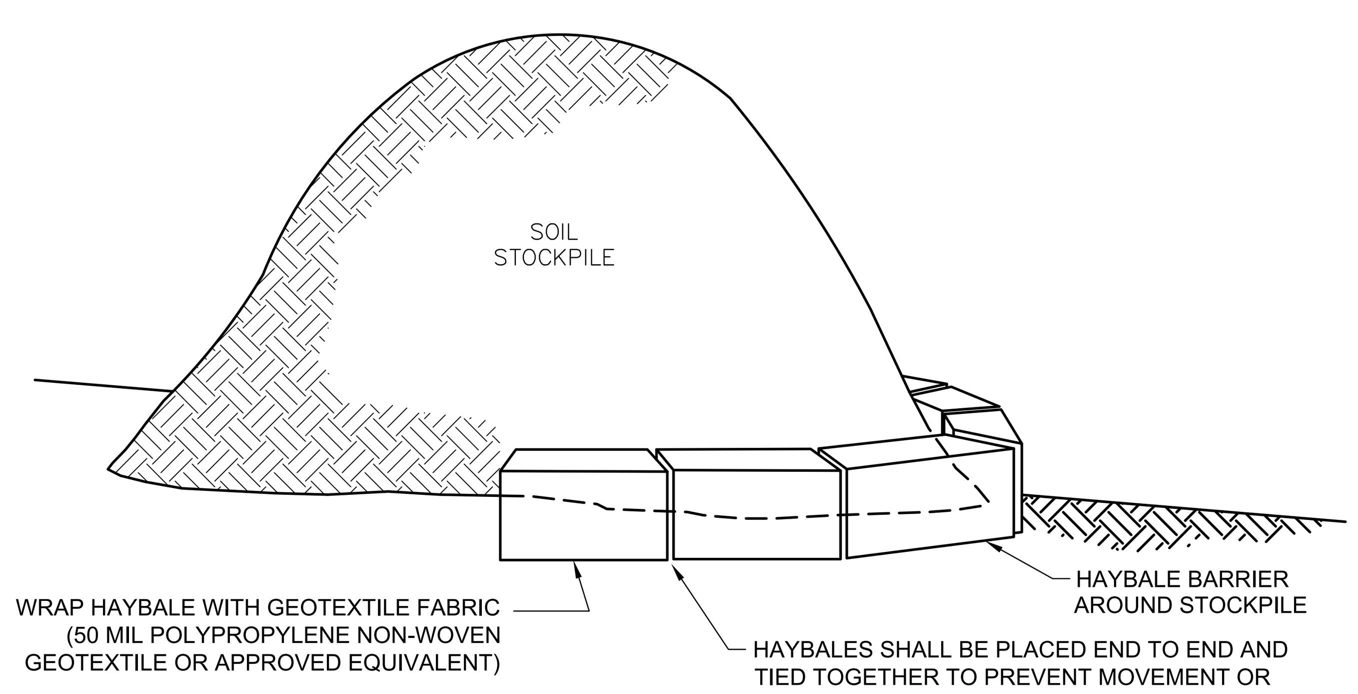
1. STRAW BALES SHALL BE PLACED AROUND STORM DRAINS AS INLET PROTECTION DURING CONSTRUCTION
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE–BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
3. STRAW BALE SHALL BE INSPECTED FREQUENTLY AND AFTER EACH RAIN EVENT AND MAINTENANCE PERFORMED AS NECESSARY.
4. ALL BALES SHALL BE REMOVED WHEN THE SITE HAS BEEN STABILIZED.

STRAW BALES FOR INLET PROTECTION
N.T.S.



1. STRAW BALES SHALL BE PLACED FOR SESC TO LIMIT OFFSITE SEDIMENT TRANSFER.
2. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE–BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
3. STRAW BALE SHALL BE INSPECTED FREQUENTLY AND AFTER EACH RAIN EVENT AND MAINTENANCE PERFORMED AS NECESSARY.
4. ALL BALES SHALL BE REMOVED WHEN THE SITE HAS BEEN STABILIZED.

STRAW BALES FOR SESC
N.T.S.



NOTES:
1. STOCKPILE HEIGHT MUST NOT EXCEED 35 FT.
2. STOCKPILE SLOPE MUST BE 2:1 OR FLATTER.
3. FOR STOCKPILES LOCATED IN PAVED AREAS, THE CONTRACTOR SHALL USE GRAVEL BAGS (ULTRA-GRAVEL BAGS® OR APPROVED EQUIVALENT).
4. FOR POTENTIALLY CONTAMINATED SOIL, TWO LAYERS OF 8 MIL POLY SHEETING SHALL BE PLACED BENEATH AND OVER EACH SOIL STOCKPILE.

TYPICAL SOIL STOCKPILE WITH HAYBALES
N.T.S.

REV.	DATE	DR.	CH.	REVISION

SOIL EROSION AND
SEDIMENT CONTROL DETAILS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 10/06/2017	DRAWING
DRAFTED BY: MSB	SCALE: AS SHOWN	6
APPROVED BY: JS	PROJECT: 0239035A	

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STANDARD AND SPECIFICATIONS FOR DUST CONTROL

- Construction operations shall be scheduled to minimize the amount of area disturbed at one time.
- Buffer areas of vegetation shall be left where practical.
- Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.
- Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the local permitting authority.

Construction Specifications

A. Non-driving Areas - These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

- **Maintenance-** Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.
- **Vegetative Cover -** For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control.
- **Mulch** (including gravel mulch) - Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

B. Driving Areas - These areas utilize water and barriers to prevent dust movement from the traffic surface into the air.

- **Sprinkling -** The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access routes.
- **Barriers -** Woven geotextiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.
- **Windbreak -** A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height.
- Preserve existing wind barrier vegetation as much as practical.

STANDARD AND SPECIFICATIONS FOR LANDGRADING

1. Fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris, and other objectionable material. It should be free of stones over two (2) inches in diameter where compacted by hand or mechanical tampers or over eight (8) inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.
2. All graded or disturbed areas, including slopes, shall be protected during clearing and construction in accordance with the erosion and sediment control plan until they are adequately stabilized.
3. Areas to be filled shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material.
4. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence, or other related problems. Fill intended to support buildings, structures, and conduits, etc., shall be compacted in accordance with local requirements or codes.
5. Fill material shall be free of frozen particles, brush, roots, sod, or other foreign objectionable materials that would interfere with, or prevent, construction of satisfactory fills.
6. Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills.
7. Fill shall not be placed on saturated or frozen surfaces.
8. All benches shall be kept free of sediment during all phases of development.
9. All graded areas shall be permanently stabilized immediately following finished grading.
10. All fill to be placed and compacted in layers not to exceed 9 inches in thickness.

STANDARD AND SPECIFICATIONS FOR PROTECTING VEGETATION DURING CONSTRUCTION

1. Limit soil placement over existing tree and shrub roots to a maximum of 3 inches. Soils with loamy texture and good structure shall be used.
2. Use retaining walls and terraces to protect roots of trees and shrubs when grades are lowered.
3. Construct study fences, or barriers, of wood, steel, or other protective material around valuable vegetation for protection from construction equipment. Place barriers far enough away from trees, but not less than the specifications in 2 above, so that tall equipment such as backhoes and dump trucks do not contact tree branches.
4. Construction limits shall be identified and clearly marked to exclude equipment.
5. Avoid spills of oil/gas and other contaminants.
6. Obstructive and broken branches shall be pruned properly. The branch collar on all branches whether living or dead shall not be damaged. The 3 or 4 cut method shall be used on all branches larger than two inches at the cut. First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 shall be from the underside of the limb, on the outside of the branch collar. Cut 4 shall be from the top and in alignment with the 3rd cut. Cut 3 shall be ¼ to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

REV.	DATE	DR.	CH.	REVISION

SOIL EROSION AND
SEDIMENT CONTROL NOTES

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 09/19/2017	DRAWING 7
DRAFTED BY: MSB	SCALE: AS SHOWN	
APPROVED BY: JS	PROJECT: 0239035A	

ATTACHMENT C
TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION 01 31 19.13

PRECONSTRUCTION CONFERENCE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Within 30 calendar days after the Contract Award and at least 15 calendar days prior to mobilization, a Preconstruction Conference will be held between the Contractor, the Owner, and the Engineer at the site. Attendance by the Contractor's superintendent, quality control personnel, safety personnel, and any major subcontractor's superintendents is required. To the maximum extent practicable, the Contractor will assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work. The purpose of this conference is to review submittals, health and safety matters, environmental protection, project schedules and payment, and procurement of materials.

B. Prior to the Preconstruction Conference, the Contractor shall submit all submittals required herein to the Engineer.

C. As part of the Preconstruction Conference, quality control procedures to be used for all on-site and off-site work will be discussed, and the interrelationship of the Contractor’s Management and the Engineer will be defined.

D. As part of the Preconstruction Conference, the Contractor shall meet with the Engineer to discuss how work will be implemented, including, but not limited to, work procedures, safety considerations associated with those work procedures, heavy equipment to be used, training to operate equipment, and safety requirements, such as training and safety equipment.

1.02 SUBMITTALS

The Contractor shall submit the following at least five (5) days prior to the preconstruction conference:

A. Preliminary construction/critical path schedule;

B. Traffic control plan;

C. Schedule of values;

D. List of subcontractors;

E. List of material suppliers, preliminary data submittals, and submittals/shop drawings for material items identified in the construction specifications;

F. Identification of Contractor's Personnel: Project Manager, Superintendent, and other key personnel;

G. List of required submittals / Shop Drawings from these Specifications.

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

3.01 GENERAL

The Contractor shall schedule and administer the Preconstruction Conference, as specified in Paragraph 1.01.

3.02 GENERAL CONFERENCE MEETING REQUIREMENTS

The Contractor shall administer the following general requirements for the conference meetings:

A. Prepare agenda for conferences.

B. Make physical arrangements for conferences.

C. Preside at conferences.

D. Record the minutes including a detailed description of proceedings, action items and decisions.

3.03 GENERAL CONFERENCE MEETING AGENDA

At a minimum, the following items shall be reviewed at the meeting:

A. Lines and methods of communication between the Owner, the Engineer and the Contractor.

B. Contract Compliance.

C. Coordination of Project.

a. Engineer’s inspections.
b. Construction Inspection Plan.
c. Special inspections/testing and QA/QC procedures.
d. Working hours.
e. Date, time and location for weekly construction meetings.

f. Safety.
g. Traffic control.
h. Sound restrictions.
i. Verification of schedule compliance and remaining construction days.

D. Control surveys.

E. Contractor submittals to be provided prior to the meeting.

F. Procedures for invoice submittal.

G. Procedures and examples of Design Clarification, Field Directives, Modification Proposals (MP) and Change Orders submitted to the Engineer.

H. Procedures for submitting submittals/shop drawings and requesting substitutions to the Engineer.

I. Responsibility of Contractor to maintain record documents.

J. Procedures and sample Daily Construction Report form.

K. Emergency Telephone List.

L. Special Items:

a. MSDS Data.
b. Work Limits/Security and safety-first aid procedures and confined spaces procedure.
c. Adjoining Work (if any) in progress.
d. Permits.
e. Staging, deliveries and contractor/employee parking.
f. Waste management.

M. Verification of Engineering Drawings and Specifications by Contractor.

N. Notice to Proceed date.

O. Other.

END OF SECTION

SECTION 01 31 19.23

PROJECT PROGRESS MEETINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section describes the minimum requirements for conducting Project Progress Meetings during execution of the remedial action.

B. The Contractor shall schedule and administer Project Progress Meetings at a minimum frequency of <u>once per week</u> (i.e., every Friday at 10 am). Additional meetings shall be scheduled and administered when requested by either the Engineer or the Contractor during any stage of the project to address any significant questions, establish new guidelines, introduce a new aspect to the project, or any other items that will affect the progress of work. A suggested meeting agenda is provided within this section.

1.02 SUBMITTALS

A. Project Progress Meeting Minutes: The Contractor shall be responsible for recording the minutes of Project Progress Meetings and detail any significant proceedings, action items and decisions. The Contractor shall distribute copies of the meeting minutes, within 2 working days of the meeting, to each meeting participant. Regardless of participation, the Contractor shall distribute copies of the meeting minutes to the Project Manager, Project Engineer, and Site Superintendent.

B. Revisions to minutes: Unless the minutes, as distributed, are challenged in writing prior to the next regularly scheduled Project Progress Meeting, they will be deemed to accurately state the activities, action items and decisions of the meeting. Any person who challenges the distributed minutes shall distribute copies of the challenge to all indicated recipients of the particular set of minutes. Challenge to minutes shall be settled in the priority portion of "old business," at the next regularly scheduled meeting.

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall schedule and administer Project Progress Meetings at a minimum frequency of <u>once per week</u> and additional meetings as required, and if requested by the Engineer or the Contractor.

B. The meeting shall be held at the site, and the Contractor shall notify the Engineer of the meeting date and time.

C. The Contractor shall administer the following general requirements for the Project Progress Meetings:

a. Prepare agenda for meetings;

b. Make physical arrangements for meetings;

c. Preside at meetings; and,

d. Record the minutes including a detailed description of proceedings, action items and decisions.

3.02 AGENDA

A. The following items will be considered and discussed at each Project Progress Meeting:

a. Review and approve minutes of previous meeting.

b. Review of Health and Safety issues;

c. Review of work completed in the prior week and compare against schedule. Identify issues, conflicts and problems that may have resulted in delays and corrective actions.

d. Review status, progress, and issues related to compliance with the overall construction schedule; identify construction days used and days remaining under the Contract, consider any request for time extensions, determine if the schedule needs to be updated to reflect any changes, and, develop and maintain a work item schedule status report.

e. Review status, and identify issues, conflicts and problems of pending work and proposed corrective actions.

f. Review new work that has started prior to the last meeting and/or will be started before the next meeting and identify any issues, concerns, or problems requiring action.

g. Review projected three-week schedule.

h. Establish and maintain a submittal/shop drawing log showing status for all items identified in the specifications. Review status of long-lead time items that may require expedited review.

i. Establish and maintain log and status of Design Clarifications, Field Directives and Change Orders. Review status of pending actions, degree of completion, and the need for processing change orders. Review pending changes and substitutions.

j. Review status of special testing, if required, and implementation of inspection schedule.

k. Review changes to record documents.

l. Review status of work in progress and pending pay requests.

m. Review other issues affecting implementation of project.

B. Meetings for the Pre-Final and/or Final Inspections shall include a walk-through of the project site, review of any punch-list items, scheduling of the As-Built submittals and inspection of the completed construction.

END OF SECTION

SECTION 01 32 00

PROJECT SCHEDULE AND PROGRESS REPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to prepare project schedules using a critical path method (CPM), and prepare daily progress reports for review by the Engineer.

1.02 SUBMITTALS

A. Project Schedule:

a. The anticipated Project Schedule shall be submitted with the Bid for approval. The final baseline Project Schedule in Microsoft Project shall be submitted within ten (10) days after the Notice to Proceed (NTP) is provided.

b. The baseline schedule shall itemize all major Work items consistent with the Contractor's Proposal and shall establish baseline milestone dates for completion of major Work items. At a minimum, the Contractor shall furnish an itemized bar chart schedule that:

i. Provides a sequence of activities for completion of the entire Scope of Work.

ii. Allows for all Work activities, meetings, regulatory permit acquisition, and incidental and temporary Work activities.

iii. Allows for normal inclement weather at the jobsite location during the progress of the Work.

iv. Itemizes schedule tasks in sufficient detail to accurately track the Work as it progresses.

v. Names each schedule task as indicated in the Scope of Work.

vi. Names and groups schedule tasks or subtasks not specifically identified in the Scope of Work.

vii. Identifies long-term delivery items that will adversely affect Project Schedule.

c. The baseline schedule shall be submitted in Microsoft Project format as well as PDF format.

d. The Contractor shall submit an updated Construction Progress Schedule with each invoice to comply with the requirements listed under Paragraph 1.03A(a) above. If milestone dates or previously accepted completion dates will be affected, the Contractor shall obtain written approval from the Engineer prior to implementing the new schedule.

e. The Owner and/or Engineer reserve the right to accept or reject the Contractor's updated schedule.

B. Daily Activity Reports: The Contractor shall submit a Daily Activity Report to the Engineer by 9:00 a.m. on the next regularly scheduled workday. The Daily Activity Report shall, at a minimum, include:

a. A unique and consecutive Daily Activities Report number.

b. Identification of all personnel on-site, including Contractor's subcontractors (e.g., copies of sign-in/sign-out sheets).

c. A list of equipment onsite by type and number and equipment utilized.

d. Documentation of any problems/foreseeable problems.

e. Description of areas worked and Work accomplished.

f. Daily totals of construction progress indicators/metrics, such as in-place cubic yards of materials excavated or backfilled.

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The approved Project Schedule shall be used to: measure the progress of the Work, aid in evaluating time extensions, provide the basis for all progress payments, and inform Agencies in a timely manner of any deviations from the original schedule.

B. Dates shall be shown on the diagram for the start of project, and any contract completion dates.

3.02 ACTIVITY DURATIONS

(Reserved)

3.03 REQUESTS FOR TIME EXTENSIONS

A. In the event the Contractor requests an extension of a contract completion date, the Contractor shall furnish the following for a determination as to whether the Contractor is entitled to an extension of time under the provisions of the contract: justification; Project Schedule data; and supporting evidence as requested by the Engineer.

B. The Project Schedule shall clearly demonstrate that the Contractor has used, in full, all the float time available for the work involved with its request. The Engineer’s determination as to the number of allowable days of contract extension shall be based upon the Project Schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions or omissions, which result in the request for an extension of the schedule, shall not be a cause for a time extension to the contract completion date.

C. The Engineer will not grant weather-related schedule extensions unless unusually abnormal weather occurs that can be documented.

D. The Contractor shall be responsible for any additional costs incurred due to scheduling alterations that were not approved in writing by the Engineer. Approval of a modified schedule is not an approval of reimbursement for additional costs.

END OF SECTION

SECTION 01 35 29

HEALTH AND SAFETY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall prepare the Contractor's Health and Safety Plan (HASP) to address all activities to be performed during the Work. The Contractor shall furnish all labor, materials, equipment, and incidentals required to implement the Contractor's Health and Safety Plan. The Contractor shall also perform dust monitoring and provide controls necessary to minimize the creation and dispersion of dust, and implement dust control measures, if deemed necessary by the Engineer.

B. The Contractor shall conduct daily safety meetings with all Contractor personnel, subcontractors, and the Engineer. At the daily safety meeting, the Contractor shall provide the Engineer in attendance all relevant information on the Work to be performed, its location, and the equipment to be used.

C. The Contractor shall review the minimum requirements established in the site-specific HASP prepared by the Engineer. The Contractor's HASP shall, at a minimum, meet the requirements of the site-specific HASP.

1.02 SUBMITTALS

A. Contractor's HASP specific to Site conditions and the proposed activities.

B. Copies of the 40-hour OSHA Hazardous Incident Response Operations Training and current 8-hour refresher training in accordance with 29 CFR 1910.120 for all Contractor and Subcontractor personnel directly involved in the Work.

C. Contractor Dust Control Plan describing techniques and methods proposed to control dust during the project.

D. The following information shall be provided (where applicable) for all materials imported to the Site:

a. Chemical composition of material and MSDS;

b. Description of the method of application; and,

c. Manufacturer's catalog data for equipment required for use and storage.

E. The Contractor shall conduct a subsurface utility survey and document the location of all utilities onsite, confirming their status. The results of the survey shall be incorporated into the Contractor's HASP.

F. Certification: Certification that all materials proposed by the Contractor meet all Federal, State, and local statutes and regulations.

1.03 REFERENCES

A. Federal Standards, Occupational Safety and Health Administration (OSHA):

a. Title 29 Code of Federal Regulations Section 1910 Hazardous Waste Site Worker Operations.

b. Title 29 Code of Federal Regulations Section 1926 Excavations.

B. New York State Standards and Specifications for Erosion and Sediment Control, November 2016, New York State Department of Environmental Conservation.

C. DER-10 Technical Guidance for Site Investigation and Remediation, New York State Department of Environmental Conservation, May 2010.

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

A. Dust monitor shall be PDR Dataram or approved equal.

B. Organic vapor monitoring shall be a Photo-Ionization Detector or approved equal.

C. Foam used for odor control and organic vapor suppression shall be Rusmar AC-645 Long Duration Foam or approved equal.

D. Pneumatic Foam Equipment used to apply foam shall be a Rusmar PFU 400/25 or approved equal.

E. Neutralizers, if used, shall be non-toxic and biodegradable. Neutralizers shall comply with the Toxic Substances Control Act and be approved for use by the USEPA and USDA. Neutralizers shall not affect the level of personal protection equipment (PPE) required on site, causing the use of a higher level of PPE.

PART 3 EXECUTION

3.01 HEALTH AND SAFETY

A. The Contractor shall be solely responsible for the health and safety of its employees, agents, and lower-tier subcontractors for the duration of the services. The Contractor shall assign a Health and Safety Officer and shall ensure that each Subcontractor designates a Subcontractor's Health and Safety Officer. Each Health and Safety Officer (HSO) shall:

a. Be capable of identifying all hazards and have the authority to stop work and take immediate action to correct a hazard.

b. Resolve safety-related issues raised by the Owner, including the Owner's Safety Observer, or the Engineer.

c. Be present on the job site whenever the Owner's Safety Observer is present on the site.

d. Identify himself or herself to the Engineer and the Owner's Safety Observer at the briefing/tailgate conference.

e. Verify that all work is performed in accordance with the HASP.

B. The Engineer will not act as the HSO for the Contractor or its Subcontractors. However, should the Engineer observe conditions that would warrant action, the Engineer will inform the Contractor's HSO and may interrupt operations until such conditions are addressed.

C. The Engineer will review and comment upon the HASP prepared by the selected Contractor, but will not approve the HASP. Any information provided by the Engineer is without warranty or representation as to its completeness or suitability. The Contractor shall indemnify and hold the Engineer, the Owner, any subsidiary related and affiliated companies of each, and the officers, directors, agents, employees, and assigns of each, harmless from and against any and all claims, demands, suits, judgments, losses, or expenses of any nature whatsoever arising directly or indirectly from the Contractor's noncompliance with the Contractor's development or implementation of health and safety programs and plans for its employees, agents and subcontractors.

D. The Contractor shall comply with all applicable Federal, State, and local Health and Safety requirements and standards relating to job site and employer safety, including, but not limited to, the Occupational Safety and Health Act of 1970, as amended, and the standards and regulations issued thereunder.

E. At a minimum, Contractor and Subcontractor personnel directly involved in the Work shall have training in:

a. Facility-specific health and safety requirements which will be provided by the Owner;

b. First aid, provided however, such workers shall be exempt from this requirement if each Contractor and Subcontractor HSO has such training;

c. Confined space work, if the employees will be working in and around confined spaces;

d. Shoring and trenching, if work will be in excavations; and

e. The Contractor's procedures for confined space rescues.

F. The Contractor shall provide a fire watch, and necessary safety equipment (welding screen/blankets, agreed to fire extinguishers, fire hoses, firewater etc.), while performing any HOT WORK.

G. The Contractor shall provide necessary barricades, covers, guards, and other protective measures to keep all personnel that can enter the affected areas during the course of their normal activities, safe from all construction hazards.

H. The Engineer reserves the right to restrict the Contractor's use of products or materials that represent an unreasonable risk to workers or the public based upon MSDS, Manufacturer information or Governmental Guidelines.

I. Neither the Owner nor the Engineer shall be responsible for the creation, content, or implementation of the Contractor’s HASP, nor are the Owner or the Engineer responsible for the health and safety of the Contractor’s employees, agents, and Subcontractors.

3.02 ACCIDENT REPORTING

A. Serious accidents such as those resulting in treatment of an injury at a medical facility, response to the site by emergency medical personnel or damage to property other than that of the Contractor shall be reported to the Owner and the Engineer within twenty-four (24) hours of the occurrence.

B. A copy of each accident report, which the Contractor or Subcontractors have submitted to their insurance carriers, shall be forwarded to the Engineer as soon as possible, but in no event later than seven (7) calendar days after the occurrence.

3.03 DUST MONITORING

A. The Contractor shall collect background dust level data with the use of a hand-held total dust monitor prior to beginning work activities. If the background dust readings are greater than the maximum allowable dust levels specified herein or in the Contractor’s site-specific HASP, the background dust levels will be used as the maximum allowable.

B. The Contractor shall implement any personal air monitoring which the Contractor may deem necessary for the protection of their work force.

C. The Contractor shall conduct continuous real time total dust monitoring during earthwork activities and at other times as requested by the Owner or the Engineer.

D. The Contractor shall calculate Time-Weighted Average (TWA) dust concentrations at least twice per working day using a hand-held total dust monitor. The monitoring shall be used to measure total dust concentrations in the vicinity of the work activities (i.e., within the worker breathing zone) and along the nearest downwind property boundary. One complete set of measurements shall be made in the morning, followed by another set of measurements in the afternoon. Monitoring shall also be performed when significant changes in weather occur, such as significant change in wind speed, change in wind direction, or at the request of the Owner or the Engineer. At each location, a 15 minute-average reading shall be obtained. The two 15 minute-average readings shall be combined to estimate an eight hour TWA concentration. At the time of readings, the wind direction and speed should be recorded.

E. The Contractor shall immediately notify the Engineer and propose methods to reduce dust levels if the TWA exceeds:

a. 0.15 mg/m^3 at the downwind property boundary or background level, whichever is greatest, or

b. 5 mg/m^3 in the immediate vicinity of the work.

F. The portable total dust monitor shall be calibrated at the beginning of each workday in accordance with the manufacturer's specifications. The unit shall be programmed to measure average particulate levels over 15-minute intervals. The monitoring shall then be conducted at each sampling location, in turn, according to the predetermined schedule. At each location, the unit shall be activated to measure a 15 minute-average time. The value obtained from the digital read-out shall be noted on the field data sheet.

G. This monitoring is not intended to be a substitute for any personal air monitoring which the Contractor may deem necessary for the protection of their workers.

H. The Contractor shall furnish to the Engineer a daily report presenting the results of the previous day's air monitoring.

3.04 DUST CONTROL

A. The Contractor shall conduct all operations and maintain the work area so as to minimize creation and dispersion of dust. Dust is to be controlled by an approved method according to the New York State Standards and Specifications for Erosion and Sediment Control and may include watering with a solution of calcium chloride and water. Severe dust problems shall be controlled with mulch, gravel and other temporary restoration methods subject to the approval of the Owner or the Engineer.

B. The Contractor shall implement dust control procedures (e.g., application of water) to prevent dust from leaving the work area based on the results of airborne particulate visual observations. The Contractor shall prepare and submit a plan describing techniques and methods proposed to control dust during the project.

C. In the event that it becomes necessary, in the opinion of the Owner or the Engineer and based on the results of airborne particulate visual observations, to provide additional measures to control the release of dust, such measures shall be immediately implemented, at no additional cost to the Owner.

D. The Owner and the Engineer shall reserve the right to suspend Work at any time if necessary due to dust generation which causes a safety or air quality problem or which may cause contamination of adjacent areas. The Contractor shall not be entitled to any additional compensation for suspension of Work under such conditions.

E. Visible dust shall not be permitted to leave the Site.

3.05 ORGANIC VAPOR MONITORING

A. The Contractor shall collect background organic vapor level data prior to beginning excavation activities. The background reading will be taken in an area removed and upwind of the site.

B. The Contractor shall calculate the TWA at least twice per working day with the use of an organic vapor monitor. The monitoring shall be used to measure organic vapor concentrations in the vicinity of the earthwork activities and along the nearest downwind property boundary. One complete set of measurements shall be made in the morning, followed by another set of measurements in the afternoon. Monitoring shall also be performed at the request of the Engineer. At each location, 15-minute average readings shall be combined to estimate an eight-hour TWA concentration.

C. If organic vapor levels exceed 1 ppm above background readings, volatile organic compounds must then be continuously monitored at the downwind perimeter of the work area.

D. If the ambient air concentration of organic vapors exceeds 5 ppm above background at the perimeter of the work area, the Contractor shall implement measures to suppress the organic vapor concentrations and continue monitoring.

E. If the organic vapor levels are greater than 5 ppm over background, but less than 25 ppm over background, at the perimeter of the work area, activities can continue provided the organic vapor level half the distance to the nearest residential or commercial structure is below 5 ppm over background.

F. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down. When work shutdown occurs, downwind air monitoring as directed by the HSO shall be implemented to ensure that vapor emission does not impact, the nearest residential or commercial structure at levels exceeding those specified below.

G. If any organic levels greater than 5 ppm over background are identified at half the distance to the nearest residential or commercial property, all work activities must be halted. If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm at half the distance to the nearest residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure.

H. The portable organic vapor monitor shall be calibrated at the beginning of each workday in accordance with manufacturer’s instructions. The monitoring shall then be carried to each sampling location, in turn, according to the predetermined schedule. At each location, the unit shall be activated to measure a 15-minute average time. The value obtained shall be noted on the field data sheet.

I. This monitoring is not intended to be a substitute for any personal air monitoring which the Contractor may deem necessary for the protection of his work force.

J. The Contractor shall furnish to the Engineer a daily report presenting the results of the previous day's air monitoring.

3.06 ODOR CONTROL AND ORGANIC VAPOR SUPPRESSION

A. The Contractor shall conduct all operations and maintain the work area to minimize odors associated with the work activities.

B. The Contractor shall implement odor control procedures (e.g., application of neutralizer or Rusmar foam), if necessary, to suppress organic vapor concentrations or objectionable odors in the work area.

C. When the organic vapor level is 5 ppm above background level or above the Contractor's Health and Safety Plan's action levels, the Contractor shall halt work activities and apply foam or approved equivalent to open excavation area in accordance with manufacturer's recommendations. The Contractor shall continue organic vapor monitoring.

D. After the application of the foam or approved equivalent, if monitoring indicates a decrease in organic vapor levels to below 5 ppm, the Contractor shall resume work activities and continue monitoring.

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall use the most recent revision of all regulatory documents identified in the Specifications in effect at the time of bid opening.

B. In case of conflict between codes, reference standards, the Engineering Drawings and these Specifications, the most stringent requirements shall govern. Any such conflict is the responsibility of the Contractor to call to the attention of the Engineer for clarification and directions before proceeding with execution of the Work.

1.02 SUBMITTALS

(Reserved)

1.03 APPLICABLE REGULATIONS

On-site material handling, waste material transportation, off-site disposal of solid waste, land use, and waterway use regulations and requirements shall include, but not necessarily be limited to, the following:

A. Administration of Clean Air Act and Federal Water Pollution Control Act with respect to Federal Contracts, Grants, and Loans (Executive Order 11738, 1973).

B. Code of Federal Regulations (CFR):

- a. All applicable parts of Title 29 – Labor, including but not limited to:
    - i. 29 CFR 1910 – Occupational Safety and Health Standards, in particular:
        1. 1910.120 – Hazardous Waste Operations and Emergency Response
        2. 1910.134 – Respiratory Protection
        3. 1910.146 – Permit-Required Confined Spaces
    - ii. 29 CFR 1926 – Safety and Health Regulations for Construction
- b. All applicable parts of Title 40 – Protection of Environment, including but not limited to:
    - i. 40 CFR 121 – State Certification of Activities Requiring a Federal License or Permit
    - ii. 40 CFR 122 – EPA Administered Permit Programs: The National Pollutant Discharge Elimination System

iii. 40 CFR 123 – State Program Requirements

iv. 40 CFR 124 – Procedures for Decision-making

v. 40 CFR 260 – Hazardous Waste Management System: General

vi. 40 CFR 261 – Identification and Listing of Hazardous Waste

vii. 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

viii. 40 CFR 265 – Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

ix. 40 CFR 266 – Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities

x. 40 CFR 268 – Land Disposal Restrictions

xi. 40 CFR 302 – Designation, Reportable Quantities, and Notification

xii. 40 CFR 761 – Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

1. Subpart D – Storage and Disposal

c. All applicable parts of Title 49 – Transportation, including but not limited to:

i. 49 CFR 172 – Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans

ii. 49 CFR 176 – Carriage by Vessel

iii. 49 CFR 177 – Carriage by Public Highway

iv. 49 CFR 390 – Federal Motor Carrier Safety Regulations (General)

v. 49 CFR 391 – Qualifications of Drivers and Longer Combination Vehicle (LCV) Driver Instructors

vi. 49 CFR 392 – Driving of Commercial Motor Vehicles

vii. 49 CFR 393 – Parts and Accessories Necessary for Safe Operation

viii. 49 CFR 395 – Hours of Service of Drivers

ix. 49 CFR 396 – Inspection, Repair, and Maintenance

x. 49 CFR 397 – Transportation of Hazardous Materials; Driving and Parking Rules

C. New York Codes, Rules and Regulations (NYCRR):

a. 6 NYCRR Chapter 4, Subchapter B – Solid Wastes

D. New York State Department of Environmental Conservation (NYSDEC):

a. DER-10 / Technical Guidance for Site Investigation and Remediation

b. New York State Standards and Specifications for Erosion and Sediment Control

E. United States Code (USC):

a. 15 USC Subchapter I (2601-2629) – Toxic Substances Control Act (TSCA)

b. 33 USC 1251 – Clean Water Act

c. 42 USC 4901 – Noise Control Act of 1972

d. 42 USC 6901 – Resource Conservation and Recovery Act (RCRA)

i. Subtitle C – Hazardous Waste Management

ii. Subtitle D – Non-Hazardous Waste Landfill

e. 42 USC 7401 – Clean Air Act

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

(Reserved)

END OF SECTION

SECTION 01 42 00

REFERENCES, ABBREVIATIONS AND DEFINITIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work performed by the Contractor under this contract shall meet the requirements and recommendations of all Standards, Institutes, Associations, etc. referred to throughout the documents and specifications as if they were fully reproduced herein. Unless otherwise noted, the latest editions shall apply.

1.02 STANDARDS/REGULATIONS

ACRONYM	STANDARDS/REGULATIONS
AASHTO	American Association of State Highway and Transportation Officials
AMS	Agricultural Marketing Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	Department of Transportation
EM	Engineering Manual
ER	Engineering Regulation
FWS	United States Fish and Wildlife Services
HSO	Health and Safety Officer
IEEE	Institute of Electrical and Electronics Engineers
MUTCD	Manual on Uniform Traffic Control Devices
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation International
NIOSH	National Institute for Occupational Safety and Health
NEMA	National Electrical Manufacturers Association
NPDES	National Pollution Discharge Elimination System
NPS	United States National Park Services
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
NLUR	Notice of Land Use Restrictions
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
RCRA	Resource Conservation and Recovery Act

TSCA	Toxic Substances Control Act
USC	United States Code
USACE	Unites States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOD	United States Depart of Defense
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1.03 ACRONYM/ABBREVIATIONS

AAQS	Ambient Air Quality Standards
BOD	Biochemical Oxygen Demand
CDQC	Chemical Data Quality Control
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
COC	Chain of Custody
COA	Consent Order and Agreement
CPM	Critical Path Method
CQA	Construction Quality Assurance
CQC	Contractor Quality Control
DQO	Data Quality Objective
DO	Dissolved Oxygen
EMP	Environmental Monitoring Plan
ERP	Emergency Response Plan
ERT	Emergency Response Team
EZ	Exclusion Zone
FALC	Fish and Aquatic Life Criteria
FID	Flame Ionization Detector
FSP	Field Sampling Plan
LDR	Land Disposal Regulations
LEL	Lower Explosive Limit
MCL	Maximum Contaminant Levels
MSDS	Material Safety Data Sheet
NCA	Noise Control Act
NPL	National Priorities List
NTP	Notice to Proceed
NOI	Notice of Intent
PID	Photoionization Detector
PPE	Personal Protective Equipment
PRB	Permeable Reactive Barrier
PVC	Poly Vinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
ROW	Right-of-Way
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SVOC	Semi Volatile Organic Compound
TAL	Target Analyte List
TCA	Tetrachloroethane

TCL	Target Compound List
TCE	Trichloroethylene
TDC	Transportation and Disposal Coordinator
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TSDF	Treatment, Storage and Disposal Facility
VOC	Volatile Organic Compound
ZVI	Zero Valent Iron

1.04 REFERENCES

(Reserved)

1.05 DEFINITIONS

A. Addenda: Written documents issued prior to the opening of Bids which clarify, correct, or change the Bidding Documents or the Contract Documents.

B. As-built or Record Drawings: The drawings, diagrams, and details which are prepared by Contractor or his subcontractors to record actual construction, are updated concurrent with construction progress, and are converted to a final set of documents to be submitted to Owner's Representative with a claim for final Application for Payment. As-built or Record Drawings shall include necessary survey information, field changes of dimension and detail, details not on original Engineering Drawings, and any other information as required by the Contract Documents. As-built or record drawings shall be provided in AutoCAD format.

C. Bid: The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices and the Work to be performed.

D. Bidder: One who submits a Bid directly to the Owner's Representative, as distinct from a sub-bidder, who submits a bid to Bidder.

E. Bidding Documents: Includes the General Information, Summary of Work, General Construction Requirements, Engineering Drawings, Specifications and Supporting Documentation (including all Addenda issued prior to receipt of Bids).

F. Bonds: Bid, performance, payment and maintenance bonds and other instruments of security.

G. Change Order: An order approved by the Owner's Representative and signed by the Contracting Party and/or the Owner for Changed Work, as defined herein.

H. Changed Work: Work which is deleted or omitted from or different from the original Scope of Work. Changed Work does not include work that, based on industry standards, reasonably should have been assumed to be present in a complete and correct Scope of Work such that the Work meets the requirements and intent of the Contract Documents, as defined herein, and any further amendments thereto, and any and all applicable rules, regulations, guidelines, and policies of all Federal, State, and local regulatory agencies.

I. Contract: The written agreement between the Contracting Party with Contractor covering the Work to be performed; other Contract Documents are attached to the Contract and made a part thereof as provided therein.

J. Contract Documents: Includes all plans, construction specifications, details, reports, Health and Safety Plan, executed agreements, insurances, change orders, addenda or other information made part of this Contract.

K. Contractor: The person, firm or corporation with whom the Contracting Party has entered into the Contract.

L. Defective Work: Any portion of the Work which is not performed strictly in accordance with the express requirements of the Contract Documents.

M. Design Drawings: Refer to Engineering Drawings.

N. Effective Date of the Contract: The date indicated in the Contract on which it becomes effective, but if no such date is indicated it means the date on which the Contract is signed and delivered by the last of the two parties to sign and deliver.

O. Engineering Drawings: The Drawings, which show the character and scope of the Work to be performed and which, are referenced in the Contract Documents.

P. Laws and Regulations; Laws or Regulations: Laws, rules, regulations, ordinances, codes, and/or orders of any governmental entity having jurisdiction over the Work which apply to the Work.

Q. Material: Any tangible item to be incorporated into the Work, including, but not limited to, all materials, equipment, machinery, and parts, whether furnished by Contractor, its subcontractor or by others.

R. NYSDEC or NYSDEC Representative: A representative from the New York State Department of Environmental Conservation assigned to this project.

S. Notice of Award: The written notice by the Owner’s Representative to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, with the time specified, the Contracting Party will sign and deliver the Agreement.

T. Notice to Proceed: A written notice given by the Owner’s Representative to Contractor fixing the date on which the contract time will commence to run and on which Contractor shall start to perform Contractor’s obligations under the Contract Documents.

U. Provide: Indicates to furnish and install.

V. Schedule of Values: Contractor’s itemized listing of activities of the Work, setting forth in a form acceptable to the Contracting party. The same activities shall be incorporated into the Contractor’s progress schedule.

W. Shop Drawings: All drawings, diagrams, illustrations, schedules, vendor catalogs, and other data which are specifically prepared by or for the Contractor to illustrate some portion of the Work; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by the Contractor to illustrate materials or equipment for some portion of the Work.

X. Subcontractor: An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

Y. Supplier: An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the supply of equipment or materials as part of the Work at the Site.

Z. Technical Specifications (Specifications): Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

AA. Will or Shall: Indicates must.

BB. Work: The totality of duties and obligations imposed upon and that are required to be observed, performed, and fulfilled by the Contractor, whether directly or indirectly through other contractors, subcontractors, persons or entities under this Agreement and the other Contract Documents to achieve final completion of the transactions contemplated hereby and thereby, including, among other things, all labor, supervision, work, supplies, fixtures, furnishings, equipment, services, tools, materials, computers, transportation, utility, storage, remediation, removal, cleanup, items, documents, instruments, records, papers, and things to achieve the Project’s objectives under the Agreement and the other Contract Documents.

CC. Written Amendment: A written amendment of the Contract Documents, signed by Contracting Party with the Contractor on or after the Effective Date of the Contract and normally dealing with the non-engineering or nontechnical rather than strictly work-related aspects of the Contract.

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

(Reserved)

END OF SECTION

SECTION 01 52 00

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Construction facilities (i.e. support zone) shall be constructed in the area designated in the Engineering Drawings and shall conform to this Specification. The Contractor shall be responsible for arranging and providing all temporary construction facilities required to successfully complete the Work in hot, cold, wet, or other inclement weather. The Contractor shall pay all costs for such facilities and controls, unless otherwise specified, until such facilities and controls are removed from the Site. Construction facilities and temporary controls shall include the following activities:

   a. Establishing equipment and materials staging, storage, and laydown areas;

   b. Providing field facilities for necessary Contractor storage facilities; and

   c. Providing fire protection, lighting, safety equipment, and equipment decontamination as required by OSHA, local regulations, and the specifications herein.

B. The Contractor shall provide field office facilities for Contractor use during Site construction activities. No electrical power, water, gas, or other utility connections are available onsite. The Contractor shall arrange for electrical hook-up from the nearest electrical pole to the field office.

C. The Contractor shall provide temporary sanitary facilities during the course of the Site operations for all Site personnel.

D. The Contractor shall obtain all required permits and connections for temporary utility service. The National Electrical Code and all local, State, and Federal codes, laws, and regulations remain in full effect.

1.02 SUBMITTALS

(Reserved)

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

2.01 MATERIALS

A. The temporary construction facilities shall be of adequate size and content for the administration of the contract, storage of materials required for installation, and provision for personnel shelter.

B. Equipment required for the personal safety of workers shall be furnished in full compliance with specific safety requirements of local and federal agencies including OSHA.

2.02 FIELD OFFICES

A. Any field office space required shall be supplied, installed, and maintained by the Contractor.

B. The Contractor shall provide all utility hook-ups to the Contractor's trailer and shall be responsible for all associated charges.

C. The Contractor shall provide field office space for the Engineer.

2.03 STORAGE

A. The Contractor shall furnish, as necessary, temporary buildings or trailers required for the storage and protection of Owner- and Contractor-supplied products.

B. All products and materials shall be stored neatly and in such a way to allow for Contractor's Work and others authorized to access the Site to proceed in a safe and orderly manner.

C. The Contractor shall provide facilities to store and protect materials or products received on-site and maintain adequate cover and other protection in accordance with industry best practice, MSDS, or manufacturer's guidelines, as may be applicable.

D. The Contractor shall establish adequate exterior storage (lay-down) area as may be applicable for efficient materials handling throughout project duration.

E. The Contractor shall cover with impermeable sheet covering, provide ventilation to prevent condensation, and prevent contact with ground for materials or products subject to degradation or weather / moisture damage, or fabricated products stored outside.

F. The Contractor shall store loose granular materials on solid flat surfaces in a well-drained area, with adequate cover and stormwater run-off and run-on controls.

G. The Contractor shall provide off-site storage and protection when Site does not permit adequate on-site storage or protection.

H. Machinery stored for 1 month or more shall be maintained in accordance with industry best practices and manufacturer guidelines. Maintenance shall include, but is not limited to the following requirements:

a. Lubrication of non-painted or exposed carbon steel surfaces;

b. Lubrication of bearings and shaft rotation;

c. Maintaining a moisture and dirt-free environment for air movers, compressors, pumps, etc.

d. The Contractor shall include necessary details for these machinery maintenance items in the Operations Plan and record all maintenance activities on monthly Inspection Log.

e. The Contractor shall inspect to verify products are undamaged and in acceptable condition at least monthly and Maintain detailed Inspection Log for all products.

2.04 POTABLE WATER

A. The Contractor shall provide and maintain an adequate supply of clean potable water for construction, testing, decontamination, cleanup, dust control, safety, equipment, and domestic consumption, as well as any facilities needed to convey or store the water.

2.05 TEMPORARY SANITARY FACILITIES

A. The Contractor shall provide and maintain an adequate number of sanitary, chemical-type, temporary toilets for the use of all personnel employed by the Contractor, subcontractors, the Engineer, and authorized visitors. These facilities shall conform to the requirements of all State, County, and local laws, rules, and/or regulations and shall be kept clean and maintained in good working order at all times. The Contractor shall remove such facilities at the completion of the Work.

2.06 TEMPORARY FENCING

A. The Contractor shall install and maintain as needed temporary 6-foot high chain link fence with a privacy screen around the perimeter of the site to prevent unauthorized access.

2.07 OTHER FACILITIES

A. All structures other than storage sheds installed under this Specification shall be provided with, as a minimum, the following services:

a. Potable bottled water;

b. Fire Extinguisher. Non-toxic, dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B, and Class C fires with a minimum rating of 2A: lOB: lOC;

c. First Aid Kit. As a minimum the kit shall include antiseptic kit, eyewash solution, bandages, insect sting medication, aspirin and acetaminophen, and cold pack;

d. First aid medications appropriate for the initial treatment of burns, abrasions, fractures, and ingestion or dermal contact with on-site hazardous waste; and

e. A separate or partitioned equipment storage area with an access through a lockable door.

PART 3 EXECUTION

3.01 LOCATION

A. Field offices and storage trailers shall be located or constructed in the designated area as shown in the Engineering Drawings and properly set up for all anticipated weather conditions.

B. The Engineer will designate areas for construction trailers or offices, parking, laydown, and storage of products, materials, and equipment.

3.02 FIRST AID FACILITIES

A. The Contractor shall provide and maintain first aid equipment in the various work areas and provide for the treatment of minor injuries to its employees. The Contractor shall designate personnel with qualifications to administer first aid. The Contractor shall be responsible for transportation and treatment of employees with injuries in accordance with its Health and Safety Plan.

3.03 MAINTENANCE

A. The Contractor shall maintain all temporary construction facilities and shall perform all necessary repairs, replacement, cleaning and any other maintenance required as directed by the Engineer.

B. Maintenance shall include sweeping and any other cleaning necessary to keep the project area neat at all times and free of objectionable soil, dust, scrap, trash, rubbish, and debris.

C. The Contractor shall maintain Work areas, passageways, and stairs, in and around buildings or other structures in a clear, unobstructed, and orderly manner.

D. Every day, the Contractor shall collect and place in designated areas within the Work zone, all soil, rubbish, debris, waste material, etc. on right of ways, roadways, and in support areas.

E. The Contractor shall promptly remove debris from Work Areas during the course of construction as it is generated.

F. The Contractor shall inspect such Work areas daily before Work begins, as the workday ends and whenever working conditions change, to ensure housekeeping practices are observed.

G. The Contractor shall maintain all parking areas, roadways, and traffic areas impacted by Site Work free of spilled materials, tracked soil, and debris on a daily basis.

H. The Contractor shall immediately clean up any spillage and return it to its originally intended use, if appropriate, or dispose of in accordance with the Contract Documents.

END OF SECTION

SECTION 01 57 13

SOIL EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to install and maintain all temporary soil erosion and sediment control devices as required by these Specifications, the Engineering Drawings, and in general accordance with the New York State Department of Environmental Conservation's best management practices and standards.

B. This section includes requirements, procedures, and methods related to implementation of soil erosion and sediment control (SESC) measures for activities that may result in soil erosion from water, wind, or movement of sediments into State waters or onto State lands, including but not limited to transport, clearing, grubbing, stripping, grading, excavating, and related activities, and covering of land with impermeable material.

C. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to prevent sediment transport outside project areas, steep slopes, and construction entrances/exits. Stormwater shall be diverted away from work areas to limit contact with contaminated materials.

D. All required stormwater management and soil erosion and sediment control devices shall be in place prior to initiating any construction activities and shall be maintained throughout the duration of the remedial activities.

1.02 SUBMITTALS

A. The Contractor shall submit a construction phasing plan describing the intended sequence of construction activities.

B. All materials and devices to be used for SESC and stormwater control shall be available to the Engineer for inspection and approval upon request.

C. The Contractor shall submit certified reports of required inspections and laboratory tests, prepared by an independent testing agency. Each report shall be properly identified and test methods used and compliance with recognized test standards shall be described.

1.03 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. ASTM International (ASTM):

a. ASTM D 5034 – Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

b. ASTM D 5035 – Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

c. ASTM D 3786 – Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method

d. ASTM D 4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus

e. ASTM D 4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity

f. ASTM D 4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles

g. ASTM D 4571 – Standard Test Methods for Rubber Compounding Materials – Determination of Volatile Material

h. ASTM D 4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

i. ASTM D 4635 – Standard Specification for Polyethylene Films Made from Low-Density Polyethylene for General Use and Packaging Applications

j. ASTM D 4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile

k. ASTM D 4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products

l. ASTM G 155 –Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

B. New York State Department of Environmental Conservation (NYSDEC)

a. *New York State Standards and Specifications for Erosion and Sediment Control* (November 2016)

1.04 DEFINITIONS

(Reserved)

PART 2 – PRODUCTS

2.01 GENERAL

A. As shown in the Engineering Drawings, soil erosion and sediment control measures may include temporary berms, diversions, or other barriers including waddles, hay or straw bales, stone, silt fences, or other agreed to materials that are constructed to retain sediment on-site by retarding and filtering storm runoff and prevent migration of silts and sediment to receiving waters.

2.02 TEMPORARY SILT FENCES AND POSTS

A. Silt fences shall be made of synthetic filtration fabric supported by steel or wood posts. The fabric and posts shall meet the requirements of NYSDEC's *New York State Standards and Specifications for Erosion and Sediment Control* (November 2016) for silt fences.

B. Silt fence shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post or roll the fabric together and fasten to one post to create a stronger joint. Where joints are necessary, plan the roll layout so as not to have joints at low points.

C. Fence posts shall be a minimum length of 36 inches long, composed of sound quality hardwood with a minimum cross sectional area of 3.0 square inches. They shall be free of knots, splits, and other visible imperfections which would weaken the posts. Steel posts may be utilized in place of wood provided the geotextile can be adequately secured to the post and that the steel posts are standard T and U section weighing not less than 1.00 pound per linear foot.

D. The silt fence fabric shall conform to the requirements listed in Table 1 of this Specification.

E. The fasteners for the silt fences shall conform to the requirements listed in Table 2 of this Specification.

TABLE 1 – REQUIREMENTS FOR SILT FENCE FABRIC

Fabric Property	**Test Method**	**Minimum Acceptable Value**
Grab Tensile Strength (lbs)	ASTM D 4632	110
Elongation at Failure (%)	ASTM D 4632	20
Mullen Burst Strength (psi)	ASTM D 3786	300
Puncture Strength (lbs)	ASTM D 4833	60
Minimum Trapezoidal Tear Strength (lbs)	ASTM D 4533	50
Flow Through Rate (gal/min/sf)	ASTM D 4491	25
Equivalent Opening Size	US Std. Sieve ASTM D 4751	40-80
Minimum UV Residual (%)	ASTM D 4355	70

TABLE 2 – REQUIREMENTS FOR FASTENERS FOR WOOD POSTS

Fastener Type	Minimum Gauge/Strength	Crown	Length	Minimum Fasteners/Post
Wire Staples (Hardwood posts)	17	¾ inch wide	½ inch (legs)	5 (3 in upper 8”)
Wire/Plastic Zip Ties (Steel posts)	50 lb tensile strength	--	--	5 (diagonally, 3 in upper 8”)

2.03 TEMPORARY TRUCK WASH

A. The Contractor shall provide a temporary truck wash system. The temporary truck wash system shall consist of a drive-through berm enclosure such as a “CONLINE 400MC” or approved equivalent, the pressure washing system and associated generator, pumps and storage tanks for clean and waste water.

2.04 STRAW OR HAY BALES

A. Straw or hay bales shall be bound with wire or nylon string and 30 inches in height.

B. Bales shall be either hay or straw containing 5 C.F. (0.15 m^3) or more of material.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall inspect all control measures at least weekly, immediately following each rainfall event, and at least daily during prolonged rainfall.

B. The Contractor shall minimize land disturbance and implement restabilization immediately after any disturbance, as is practicable.

C. Applicable erosion and sediment control practices shall be left in place until construction is completed and/or the area is stabilized.

D. The Contractor shall repair any failed control measure immediately and perform maintenance as needed.

E. If work is suspended for an extended period of time, the Contractor shall be responsible for controlling erosion, pollution, sedimentation and runoff during the shutdown period.

F. The Contractor shall perform all work, furnish all materials and install all measures required to reasonably control soil erosion resulting from construction operations and prevent excessive flow of sediment from the Site.

G. Off-site disturbance may require additional control measures to be determined by the NYSDEC Division of Water erosion control inspector.

H. The NYSDEC Division of Water erosion control inspector may require that additional soil erosion measures be installed by the Contractor.

I. The Engineer has the authority to limit the surface area of erodible earth material exposed by grubbing, excavation and fill operations and to direct the Contractor to provide immediate, permanent or temporary control measures to prevent contamination of adjacent properties or water bodies. Such work may involve the use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be protected as necessary or as directed by the Engineer.

J. The Engineer has the authority to limit the work area in progress commensurate with the Contractor's ability in keeping the progress of the work and the maintenance of the temporary SESC measures current, in accordance within the approved project schedule.

K. The Contractor shall remove all sedimentation and erosion control barriers after completion of construction activities and permanent control measures, as applicable, are installed.

L. The Contractor shall immediately adjust or institute additional control measures if planned control measures are not effective or satisfactorily to the regulatory agencies having jurisdiction. In the event of conflict between these requirements and pollution control laws, rules or regulations or other Federal, State or local agencies, the more restrictive laws, rules or regulations shall prevail.

3.02 STORMWATER MANAGEMENT

A. The Contractor shall prevent surface runoff from areas uphill of the excavation and staging areas using earthen berms or other suitable means. Contaminated materials shall not be used to divert stormwater.

B. The Site shall be graded and maintained at all times such that all stormwater runoff is diverted to soil erosion and sediment control facilities.

C. The Contractor shall divert stormwater away from the excavation and staging areas through temporary drainage swales, temporary piping, or other suitable means. The Contractor shall not be permitted to divert extraneous water onto adjacent properties.

D. Within the construction area, areas which have been cleared of vegetation or regraded and areas where backfill and capping materials have been staged shall be surrounded by a temporary berm or sediment control device when weather forecasts call for rain.

E. Within the construction area, construction activities shall be phased and/or a temporary diversion system shall be provided such that precipitation which falls on an uncovered work area does not flow into adjacent non-contaminated areas.

3.03 SILTATION AND EROSION CONTROL

A. Siltation and erosion control practices shall be consistent with procedures outlined in the current *New York State Standards and Specifications for Erosion and Sediment Control*.

B. All stockpiled construction materials such as stone, backfill materials, topsoil etc., shall be surrounded with a silt fence or other sediment control measure.

C. The Contractor shall maintain all erosion control measures in a satisfactory condition for the duration of the project or until removal is approved by the Engineer. The erosion control measures become the property of the Contractor whenever they are removed.

D. Temporary Silt Fences

a. Silt fence shall be constructed before upslope land disturbance begins.

b. Silt fence shall be installed in accordance with the details in the Engineering Drawings.

c. All silt fence shall be placed as close to the contour as possible so that water will not concentrate at low points in the fence and so that small swales or depressions that may carry small concentrated flows to the silt fence are dissipated along its length.

d. Ends of the silt fences shall be brought upslope slightly so that water ponded by the silt fence will be prevented from flowing around the ends.

e. Silt fence shall be placed on the flattest area available.

f. Where possible, vegetation shall be preserved for 5 feet (or as much as possible) upslope from the silt fence. If vegetation is removed, it shall be re-established within 7 days from the installation of the silt fence.

g. The height of the silt fence shall be a minimum of 24 inches above the original ground surface.

h. The silt fence shall be placed in an excavated or sliced trench cut a minimum of 6 inches deep. The trench shall be made with a trencher, cable laying machine, slicing machine, or other suitable device that will ensure an adequately uniform trench depth.

i. The silt fence shall be placed with the stakes on the downslope side of the geotextile. A minimum of 12 inches of geotextile must be below the ground surface. Excess material shall lay on the bottom of the 6-inch deep trench. The trench shall be backfilled and compacted on both sides of the fabric.

j. Seams between sections of silt fence shall be spliced together only at a support post with a minimum 6-in. overlap prior to driving into the ground, (see details).

k. Silt fence shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post or roll the fabric together and fasten to one post to create a stronger joint. Where joints are necessary, plan the roll layout so as not to have joints at low points.

l. Fence posts shall be installed at an angle towards the potential silt load area and outside of the landfill cap and the limits of the lined pond.

m. Posts shall not be driven into the ground within the area of the landfill cap and the limits of the lined pond.

n. The Contractor shall maintain all erosion control measures (i.e., silt fencing and/or tubes) in a satisfactory condition for the duration of the project or until removal is approved by the Engineer. The erosion control measures become the property of the Contractor whenever they are removed.

o. Maintenance—Silt fence shall allow runoff to pass only as diffuse flow through the geotextile. If runoff overtops the silt fence, flows under the fabric or around the fence ends, or in any other way allows a concentrated flow discharge, one of the following shall be performed, as appropriate: 1) the layout of the silt fence shall be changed, 2) accumulated sediment shall be removed, or 3) other practices shall be installed. Sediment deposits shall be routinely removed when the deposit reaches approximately one-half of the height of the silt fence. Removed sediment shall be disposed off-site in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Material). Silt fences shall be inspected after each rainfall and at least daily during a prolonged rainfall. The location of existing silt fence shall be reviewed daily to ensure its proper location and effectiveness. If damaged, the silt fence shall be repaired immediately.

3.04 STABILIZED CONSTRUCTION ENTRANCE

(Reserved)

3.05 CONSTRUCTION ACCESS ROADS

(Reserved)

3.06 CONSTRUCTION SUPPORT AREA

A. Once a construction support area(s) has been defined, stormwater diversion and the soil erosion control measures shall be installed and the subgrade shall be conditioned to prevent its cross-contamination during the implementation of the project.

B. The Contractor shall provide all materials and incidentals needed for construction and continued operation of the temporary truck wash system and it shall be used by all equipment or vehicles exiting the work area. Decontamination water generated from the truck wash area shall be temporarily stored in a tank for eventual management in accordance with applicable local, State, and Federal laws and regulations.

C. The Contractor shall maintain the working surface of the work area in a satisfactory condition for the duration of the project or until removal is approved by the Engineer.

3.07 SEEDING, MULCHING, AND FERTILIZING

(Reserved)

3.08 INLET PROTECTION

A. The Contractor shall construct sediment barriers at storm drain sumps, across minor swales or ditches, and other low-strength temporary applications.

B. The Contractor shall protect catch basins (sumps) with silt fences, waddles, or hay bales throughout construction or until all disturbed areas are stabilized.

C. Straw or hay erosion controls shall be embedded in the ground 4 to 6 inches to prevent water from flowing under them.

D. The bales shall be anchored securely to the ground by wooden stakes driven through the bales into the ground as shown in the Engineering Drawings.

E. The bales shall be overlapped and staggered in a configuration to minimize the flow of water along the contour. Bales shall be removed after they have served their purpose, as determined by the Engineer.

F. The Contractor shall keep the hay bales in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris cleanout shall be considered routine maintenance.

END OF SECTION

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall be responsible for the mobilization and demobilization of equipment, supplies, and Contractor personnel necessary to complete work performed under this contract.

1.02 SUBMITTALS

A. The Contractor shall submit for review and approval by the Engineer a complete Material Stockpile and Staging Plan. If construction is to be undertaken in phases, the Contractor shall identify all areas to be used for access, staging, and stockpiling for each construction phase. At a minimum, the plan shall include:

   a. Method of cap material delivery to the Site.

   b. Means and methods for material stockpiling and staging.

   c. Proposed stockpile locations.

   d. Required soil erosion and sediment controls.

B. The Contractor shall submit a Notice of Substantial Completion to the Engineer prior to demobilization from the Site.

C. The Contractor shall submit as-built drawings and survey records to the Engineer within thirty (30) days of remediation completion.

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

3.01 MOBILIZATION

A. The Contractor shall be responsible for the following mobilization activities:

a. Procuring materials and equipment.

b. Arranging for such materials and equipment to be delivered to the Site in accordance with the approved Material Stockpile and Staging Plan.

c. Documenting (photo or video) existing site conditions.

d. Installing soil erosion and sediment control measures in accordance with the Engineering Drawings.

e. Scheduling the preconstruction meeting to review the project plan, permits, scheduling, and the site-specific Health and Safety Plan.

f. Attending the preconstruction meeting prior to the commencement of construction activities.

g. Identifying and marking underground utilities.

h. Verifying the existence of any overhead or underground obstructions.

i. Identifying on-site groundwater monitoring wells.

j. Coordinating the planned Site operations with the Engineer.

k. Verifying or arranging for utility hook-ups and toilet facilities.

B. Within ten (10) workdays after mobilizing to the site, the Contractor shall inspect any previous Work performed by others upon which the Contractor's subsequent Work will depend. The Contractor shall reject, or note exceptions to, all such previous Work through written notification to the Engineer.

3.02 DEMOBILIZATION

A. The Contractor shall be responsible for the following demobilization activities:

a. Removing materials and equipment from project limits.

b. Removing soil erosion and sediment control measures.

c. Scheduling the post-construction inspection to review completed work.

B. The Contractor shall remove all Temporary Work, facilities tools, and equipment at Work completion.

C. The Contractor shall dispose of all waste materials in accordance with the requirements set forth in these Specifications.

D. The Contractor shall provide the Engineer with an inventory listing all surplus materials.

E. The Contractor shall restore the site to pre-disturbance conditions in accordance with these Specifications and the Engineering Drawings. Unless otherwise noted in the Engineering Drawings, all surfaces disturbed during construction shall be restored in kind.

3.03 PERFORMANCE

A. The Contractor shall be responsible for any additional costs incurred due to scheduling alterations that were not approved in writing by the Engineer. Approval of a modified schedule is not approval of reimbursement for additional costs.

END OF SECTION

SECTION 02 01 00

MAINTENANCE AND PROTECTION OF EXISTING CONDITIONS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This section defines the requirements for protection of existing site conditions and the environment (land, air, water, and ecological resources).

B. The Contractor shall obtain and operate within required Local, State, and Federal permits and applicable requirements to implement the proposed Work.

C. The Contractor shall furnish all labor, equipment, and materials required for maintenance and protection of existing site conditions and the environment during and as the result of construction operations.

1.02 SUBMITTALS

A. Prior to any on-site construction activities, the Contractor shall complete an existing conditions survey, after which the Contractor shall submit a report indicating the condition of structures, equipment, vegetation (i.e., trees, shrubs, and grass areas) and other site features immediately adjacent to the work areas and adjacent to assigned storage areas and access routes, as applicable.

PART 2 – PRODUCTS

2.01 GENERAL

A. All materials used for maintenance and protection of existing conditions and the environment shall be in accordance with the Contractor's work plans and these Specifications.

PART 3 – EXECUTION

3.01 PROTECTION OF LAND AND WATER RESOURCES

A. The Contractor shall confine all activities to areas defined in the Engineering Drawings and Technical Specifications.

B. Prior to commencement of any construction activities, the Contractor shall identify with visible markers in the field any land, water or wetland resources designated to be preserved, maintained or protected within the work area as shown in the Engineering Drawings or as otherwise designated by the Engineer.

a. Protection areas shall be marked or fenced to restrict access.

b. Isolated protection areas within the general work area shall be marked or fenced with markers that are visible in the dark.

c. The Contractor's personnel shall be knowledgeable of the purpose for markings and/or protection.

C. Where construction equipment is to be mobilized from another site, the Contractor shall clean the equipment prior to mobilization to ensure that the equipment is free from soil and/or sediment residuals.

D. The Contractor shall provide effective protection for land, water, wetlands, wildlife and vegetation resources at all times. All work shall be performed in such a manner that objectionable conditions will not be created in land, wetlands, environmentally sensitive areas, and/or bodies of water adjacent to, or within the project area.

E. The Contractor shall monitor construction activities to prevent pollution of land, wetlands, surface water or groundwater with fuels, oils, or other harmful materials.

a. Measures shall be taken by the Contractor to prevent chemicals, fuels, oils, grease, waste washings, and other harmful materials from being released to land, wetlands, surface water or groundwater.

b. Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation.

c. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations.

d. The Contractor shall manage, store and dispose fuel, lubricants and oil in accordance with all Federal, State, and local laws and regulations.

e. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County, and Municipal laws concerning pollution of land, wetlands and/or bodies of water.

f. Disposal of any chemicals, fuels, oils, grease, waste washings, and other harmful materials in areas adjacent to the river or other waterways shall be strictly prohibited.

g. Should any spillage occur, the Contractor shall immediately notify the proper authorities and the Engineer.

h. The Contractor will be responsible for any and all cost associated with the cleanup of spillages, including but not limited to delineation, characterization, excavation, backfilling, and disposal.

F. The Contractor shall be prohibited from indiscriminate, arbitrary, or capricious operation of equipment in any surface water.

G. Except for areas indicated in the Engineering Drawings to be cleared, the Contractor shall not:

a. remove, cut, deface, injure, or destroy land or wetlands resources including trees, shrubs, vines, grasses, topsoil, and land forms without prior written approval by the Engineer.

b. fasten or attach ropes, cables, or guys to any trees for anchorage without prior written approval by the Engineer.

H. The Contractor shall not use site soils, on-site surface water or groundwater without prior written approval by the Engineer.

I. Surfaces within the construction limit shall be graded to control erosion, and shall comply with all requirements of the Soil Erosion and Sediment Control Plan included in the Engineering Drawings.

J. The Contractor shall remove any stone, soil, waste, or other materials displaced into areas to be preserved, maintained or protected, and restore the area to its original condition as shown in the Engineering Drawings or as otherwise directed by the Engineer.

K. Disturbed areas shall be graded and filled as required to prevent ponding of surface water. The disturbed area shall be fully restored to the satisfaction of the Engineer.

a. Damaged vegetation shall be replaced with viable vegetation of the same species, similar condition, and like size in accordance with the Engineering Drawings unless otherwise approved by the Engineer.

b. Any damages to trees and shrubs that are outside the work area and/or resulting from the Contractor's operations or neglect shall be corrected at the Contractor's expense.

L. The Contractor shall remove all markings and/or protection from the site prior to demobilization.

3.02 PROTECTION OF FISH AND WILDLIFE

A. The Contractor shall not alter water flows or otherwise disturb native habitat adjacent to the project area.

B. The Contractor shall take all required measures to prevent any interference or disturbance to fish and wildlife.

C. Wash waters and wastewaters shall be treated and managed in accordance with applicable permits prior to their release into the river or other waterways.

D. Should polluting or fouling of any watercourse occur, the Contractor shall immediately notify the proper authorities. The Contractor shall be responsible for any and all costs associated with the cleanup of polluted waters.

3.03 PROTECTION OF EXISTING FACILITIES

A. The Contractor shall take all necessary precautions to avoid damage to existing facilities or structures, including utilities, monitoring wells, and equipment, to remain in place, to be reused, or to remain the property of the Owner.

B. The Contractor shall notify the Engineer and any agencies responsible for existing facilities or structures at least three (3) days prior to work in the vicinity of any existing facilities. The representatives may be present during such work, at their own discretion.

C. The Contractor shall locate and confirm the status of all utilities on site, in conformance with **Section 01 35 29** (Health and Safety) of these Specifications.

D. In the event that the Contractor encounters existing utility lines not indicated on the Engineering Drawings or the locations of which are not known prior to the start of the Work, the Contractor shall immediately notify the Engineer and cease work in the area until a complete utility location survey of the area is performed and permission to proceed is issued.

E. The Contractor shall protect and shall not move any equipment or materials of any kind stored on property not owned by the Owner without written permission of the Owner to proceed.

F. The Contractor shall, to the satisfaction of the Engineer, repair or replace any and all damaged items, structures or facilities at no additional cost to the Owner.

3.04 PROTECTION OF GROUNDWATER MONITORING WELL NETWORK

A. The Contractor shall maintain all existing monitoring wells, and protect them from damage from equipment and vehicular traffic.

B. The Contractor shall immediately report to the Engineer of any damage to an existing well. The Contractor shall retain a New York-licensed driller to repair or reinstall damaged monitoring wells at the Contractor’s own expense.

3.05 NOISE AND VIBRATION CONTROL

A. The Contractor shall use every effort and means to minimize noise and vibration caused by the Contractor’s operations.

B. The Contractor shall provide working machinery equipped with adequate muffler systems.

C. Construction shall be limited to daytime hours or as restricted by municipal ordinances.

D. The Contractor is responsible for maintaining compliance with all applicable noise regulations and all provisions of the State of New York rules.

END OF SECTION

SECTION 02 21 00

SURVEYING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to provide surveying services during site activities. Surveying will be required to define the pre-construction, compliance, and as-built conditions of the site prior to demobilization.

B. Any special survey requirements and deliverables (e.g., GPS, data management formatted drawings and figures) will be stipulated in these Specifications. The Contractor shall verify surveyor meets all the requirements stipulated herein.

C. All surveying shall be performed by a Professional Land Surveyor licensed in the State of New York.

1.02 SUBMITTALS

A. Surveyor Information: Statement of qualifications and contact information for the surveyor shall be submitted by the Contractor to the Engineer before performing any survey work.

B. Survey Methods and Equipment: Submit survey methods and equipment to be used at least ten (10) workdays in advance of any survey work. Work done using methods or equipment not agreed to by the Engineer shall be subject to removal and replacement.

C. Survey Accuracy Documentation: Upon request, documentation verifying accuracy of survey work (e.g., calibration certificates) shall be submitted to the Engineer by the Contractor.

D. Field Notes: Copies of the surveyor's field notes, calculations, and graphical layouts.

E. Preconstruction Surveys: Submit surveys of all work areas.

F. Compliance Surveys: Submit compliance surveys of all excavation and backfill operations.

G. As-Built Drawings: As-Built Drawings shall be submitted, including existing topography and site features, final topography, monitoring wells, fence, and tree lines on the site and any areas disturbed by the Contractor.

1.03 REFERENCES

(Reserved)

PART 2 PRODUCTS

(Reserved)

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall verify locations of site reference and survey control points prior to starting work. The Engineer must be promptly notified of any discrepancies discovered.

B. The Contractor shall notify the Engineer at least two (2) workdays in advance of planned survey activities.

C. The Contractor shall sequence surveying in each designated area as may be appropriate for Work or as otherwise directed by the Engineer.

3.02 SURVEY REFERENCE POINTS

A. The surveyor shall establish survey control reference points prior to starting Work.

B. The Contractor shall take all reasonable measures to protect site reference points prior to initiating and throughout site work. Reference points shall not be relocated without prior written approval of the Engineer. The Engineer shall be immediately notified of loss, damage, or destruction of any reference point, or any relocation required because of changes in grade or other reasons.

C. The Contractor shall use the benchmarks and control points shown in the Engineering Drawings or install two permanent elevation benchmarks and two horizontal control points located in positions unlikely to be disturbed by vehicular traffic or construction operations throughout construction.

D. Horizontal coordinates (X and Y) of benchmarks and survey control points shall be determined and recorded with a maximum permissible error of 0.10 feet in any coordinate direction. Elevations (Z) shall be determined and recorded with a maximum permissible error of 0.01 feet.

E. The horizontal and vertical Control Datum shall be the North American Datum of 1983 (NAD83) and the National American Vertical Datum of 1988 (NAVD88), respectively.

F. The Contractor shall clearly identify benchmarks and record existing elevations and locate a reference datum level used to establish benchmark elevations sufficiently distant so as not to be affected by movement resulting from excavation operations. Elevations shall be verified from existing benchmarks by the Surveyor.

G. Off-site control monuments shall be used as a reference for on-site monuments.

H. On-site monuments (when specified) shall be checked not less than monthly against off-site monuments until project completion.

I. The Contractor shall replace dislocated, damaged, or destroyed survey control points as per the Pre-Construction survey.

3.03 SURVEY REQUIREMENTS

A. The Contractor shall establish the exact position or location of all work control points. All work shall be referenced to and established from the control points, re-established where necessary and maintained throughout the life of the contract.

B. The Contractor shall survey and stake out the limits of the wetlands prior to any work being performed within 200 feet of the mapped wetlands.

C. Surveys shall be performed prior to initiating any earthwork activities to determine pre-construction elevations and establish existing topography and site features.

D. Surveys shall also be performed to establish as-built conditions (i.e., the location, extent and elevation) of all proposed site improvements to be performed by the Contractor.

E. Surveys shall also be performed immediately after backfilling and regrading the work areas to document as-built surfaces.

3.04 PROJECT RECORD DOCUMENTS

A. A complete, accurate log of control and survey work as it progresses shall be maintained at the work site by the Contractor.

B. Upon completion of the work, all record documents must be submitted to the Engineer.

C. The Contractor shall prepare an as-built submittal which will include five sets of signed and sealed as-built drawings depicting the (a) the pre-construction grades; (b) the as-built conditions of all site improvements performed by the Contractor; and (c) site conditions after backfilling and site restoration.

D. The Contractor shall include site reference points and reference points to off-site control monuments, and record locations of all survey control points using the Control Datum on as-built drawings.

E. The Contractor shall also provide an electronic copy of all survey records in AutoCAD format.

END OF SECTION

SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF WASTE MATERIAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, material, equipment, and incidentals necessary for on-site removal and off-site transportation and disposal of the materials, including, but not limited to:

a. Solid waste generated by the Contractor, including office trash, packaging materials and other non-hazardous solid waste.

b. Decontamination water generated by the Contractor, including decontamination water, well development water, and waste.

c. Wastewater generated by the Contractor, including that generated from dewatering or well development activities, and contact water.

d. Excavation materials from removal areas as shown in the Engineering Drawings.

e. Investigation Derived Waste (IDW) likely to consist primarily of solid wastes such as used PPE.

f. Demolition materials (concrete slabs and asphalt millings).

B. Based on the available investigation results, other than the solid waste generated by the Contractor and the demolition materials described in Paragraph 1.01A of this Specification, all waste streams may be listed RCRA hazardous wastes (F001/F002) or exhibit hazardous toxicity (D040, among others). Dependent on a contained-in determination (refer to Paragraph 1.02J of this Specification), these materials may need to be disposed in Resource Conservation and Recovery Act (RCRA) Treatment Storage and Disposal Facilities (TSDFs) – RCRA Subtitle C landfill(s). The Engineer will seek a contained-in determination from NYSDEC to determine which of these materials, if any, will require management as hazardous waste.

C. The Engineer will collect waste characterization samples from excavated soils generated from the construction of the PRB. The contractor shall be responsible for all other waste material characterization required by the disposal facility.

D. The Contractor shall manage all wastes generated in performance of the Work, disposing of materials at the following Owner-approved facilities:

a. Hazardous solid waste: Clean Harbors El Dorado, LLC at 309 American Circle. El Dorado, AR 71732 (Telephone: 870 863 7173)

b. Hazardous wastewater: CWM Model City at 1550 Balmer Rd. Youngstown, NY 14107 (Telephone: 800-963-4776) or Clean Harbors El Dorado, LLC at 309 American Circle. El Dorado, AR 71732 (Telephone: 870 863 7173)

c. Non-hazardous solid waste: Colonie Town Landfill at 1319 New Loudon Rd, Cohoes, NY 12047 (Telephone: 518 783 2827) or Modern Disposal Services permitted landfill, Model City, NY 14107 (Telephone: 800-330-7107)

d. Non-hazardous wastewater: Refer to Paragraphs 1.02I through 1.02M of this Specification.

E. The Contractor may propose alternate disposal facilities.

F. Demolition materials generated from Site activities shall be disposed of at Owner-approved disposal facilities or beneficial reuse sites, including, but not limited to, asphalt recycling plants, municipal solid waste landfills, industrial waste landfills, or construction and demolition debris landfills or processing facilities.

G. The Contractor shall transport and handle materials in accordance with Federal, State, and local regulations.

H. All waste shall be managed, transported and disposed in accordance with the requirements of these Specifications and the Standard Contract Terms.

1.02 SUBMITTALS

A. The Contractor shall obtain letters of commitment from waste haulers and from the disposal facility or beneficial reuse site in advance of any transportation or off-site disposal facility or transporter agreeing to handle and dispose of waste materials from the Site. In the event that the facility is prohibited from issuing a letter of commitment without a sample of the waste, a conditional type letter will be acceptable. Such a conditional letter shall specifically state what types and quantities of waste the facility will accept.

B. For RCRA hazardous waste, letters from the disposal facility certifying that USEPA considers the facility to be used for all off-site disposal is acceptable in accordance with the Off-Site Policy in 40 CFR 300, Section 440. A Sample Off-Site Policy Compliance Certification Memo has been attached at the end of this section.

C. The letters of commitment from the proposed waste disposal facility or facilities to be used shall include:

a. Name and EPA or State identification number of Disposal Facility.

b. Facility address with name and responsible contact for the facility.

c. Telephone number for contact.

d. Signature.

e. A description of the proposed disposal facility.

f. Any and all necessary disposal permit authorizations for each type of waste stream.

g. Unit of measure utilized at facility for costing purposes.

D. The letters of commitment from the proposed waste hauler(s) to be used shall include:

   a. Name and EPA or State identification number of waste hauler(s).

   b. Waste hauler(s) address with name and responsible contact for the operations.

   c. Telephone number for contact.

   d. Signature.

   e. List of types and sizes of all transport vehicles (i.e., trucks) and equipment to be used by the waste hauler(s).

E. Prior to using a TSDF, the Contractor shall contact the USEPA Regional Off-Site Coordinator specified in 40 CFR 300.440 to determine the facility's status and document, using the enclosed form, all information necessary to satisfy the requirements of the USEPA Off-Site Policy and furnish this information to the Engineer.

F. For management of RCRA hazardous waste, the Contractor shall provide the date of the proposed facility's last compliance inspection under RCRA.

G. The Contractor shall:

   a. Provide a list of all active (unresolved) compliance orders (or agreements), enforcement notices or notices of violation issued to the proposed facility;

   b. State the source and nature of the cause of violation, if known; and,

   c. If groundwater contamination is noted, provide details of the facility's groundwater monitoring program.

H. Prior to mobilization, the Contractor shall submit the proposed truck route from the site to the disposal facility(ies). The route(s) to and from the disposal facility shall be in accordance with the disposal facility(ies) requirements and Federal, State, and local regulations, laws, and ordinances. The Contractor shall specify the weight limitations on all sections of the route(s) and indicate the maximum truck load/weight that will be maintained in accordance with route weight limits and any other applicable Federal, State, and local regulations.

I. Prior to mobilization, the Contractor shall submit to the Engineer its decontamination water and wastewater management plan. The contractor may opt to manage either or both of these waste streams as: (a) hazardous waste; (b) non-hazardous waste suitable for discharge to the City of Troy sewer system for treatment by the Publicly Owned Treatment Works (POTW); or (c) non-hazardous waste suitable for discharge to surface water.

J. If the Contractor opts to manage either or both of the wastewater streams as non-hazardous waste (options b and c in Paragraph 1.02I of this Specification), the Engineer will need to submit a request for a Contained-In Determination to the NYSDEC. The Contractor shall submit to the Engineer all information and data required by the NYSDEC for approval of the Contained-In Determination, including, but not limited to, estimated volumes, description of the pre-treatment system, pre-treatment design drawings and specifications, and waste characterization results.

K. If the Contractor, opts to manage either or both of these waste streams as hazardous waste, the Contractor shall

a. containerize this waste for off-site treatment and disposal as hazardous waste at a licensed facility.

b. perform all waste characterization sampling required by the disposal facility.

c. conform to the requirements for transportation and disposal of hazardous waste of this technical specification, and all federal, state, and local requirements.

L. If the Contractor, opts to manage either or both of these waste streams as non-hazardous waste suitable for discharge to the City of Troy sewer system for treatment by the POTW, the Contractor shall

a. quantify the volumes comprising each waste stream.

b. perform all waste characterization sampling required to define pre-treatment requirements.

c. procure the necessary permits from the City of Troy and/or the POTW.

d. Design, operate and maintain an onsite pre-treatment system that ensures that this waste will meet all permit requirements.

e. perform all required discharge monitoring sampling required by the City of Troy and/or POTW.

M. If the Contractor, opts to manage either or both of these waste streams as non-hazardous waste suitable for discharge to surface water, the Contractor shall

a. quantify the volumes comprising each waste stream.

b. perform all waste characterization sampling required to define pre-treatment requirements.

c. procure all necessary local, State and/or Federal permits required to allow discharge to surface water.

d. design, operate and maintain an onsite pre-treatment system that ensures that this waste will meet the drinking water standards.

e. perform all required discharge monitoring sampling required by the NYSDEC and in accordance with any permit requirements.

N. The Contractor shall maintain, and provide to the Engineer, records of all information required, including manifests, to file State annual and EPA biennial reports for any RCRA hazardous waste transported, treated, stored and/or disposed as part of the implementation of the work. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the Federal, State, or local regulatory agency having jurisdiction. A cover letter shall accompany the data including the project name, Contractor name and project location.

O. In the event that a manifest copy documenting receipt of wastes at the disposal facilities is not received within 20 calendar days of shipment initiation, the Contractor shall prepare and submit an exception report to the Engineer within 20 calendar days of shipment initiation.

P. The Contractor shall submit to the Engineer certificates documenting the ultimate disposal of wastes within 20 calendar days of initial shipment. Receipt of these certificates will be required for final payment.

Q. All transportation-related shipping documents, including draft waste manifests, draft bills of lading, lists of corresponding proposed labels, packages, marks, and placards to be used for shipment, waste profiles, and supporting waste analysis documents shall be submitted to the Engineer for review a minimum of 7 calendar days prior to the anticipated shipping date. Packaging assurances shall be furnished prior to transporting hazardous material. Generator copies of hazardous waste manifests, land disposal restriction notifications, bills of lading and supporting waste analysis documents shall be furnished when shipments are originated.

R. The Contractor shall submit certification that all operators and vehicles used to transport waste meet all existing Federal, State, and local regulations for vehicle operations.

S. The Contractor shall provide copies of notices of non-compliance or notices of violation issued by a Federal, State, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. The Contractor shall provide copies of such notices to the Engineer within 24 hours of receipt. The Contractor shall also furnish all relevant documents regarding the incident and any information requested by the Engineer, and shall coordinate its response to the notice with the Engineer prior to submission to the notifying authority. The Contractor shall also furnish a copy to the Engineer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

T. The Contractor shall not ship any wastes from the Site without written approval from the Engineer of the waste haulers and disposal facility or beneficial reuse site.

1.03 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

<u>CODE OF FEDERAL REGULATIONS (CFR)</u>

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities

40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 268	Code of Federal Regulations (CFR) - Land Disposal Restrictions
40 CFR 270	EPA administered permit programs: The Hazardous Waste Permit Program
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
49 CFR 100-179	Hazardous Materials Transportation Act

NEW YORK CODES, RULES AND REGULATIONS (NYCRR)

6 NYCRR Part 360	New York State Department of Environmental Conservation (NYSDEC) Solid Waste Management Regulations

OTHER PUBLICATIONS

"Revised Procedures for Implementing Off-Site Response Action," EPA OSWER Directive Number 9834.11, November 13, 1987

"Off-Site Policy; RFA or Equivalent Investigation Requirement at RCRA Treatment and Storage Facilities," EPA Memorandum from J.W. Porter to Waste Management Division Directors, January 4, 1988

1.04 DEFINITIONS

A. Contained-in Determination: USEPA policy that defines when some listed RCRA hazardous media or media exhibiting a RCRA characteristic of hazardous waste can be considered to no longer "contain" hazardous waste. This site-specific determination is made by the EPA or authorized State when concentrations of hazardous constituents in any given volume of environmental media are low enough to determine that the media does not "contain" hazardous waste. Until such determination is made, the materials should be managed as hazardous waste.

B. Hazardous Material: A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety and property when transported in commerce and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections 101 and 102 and materials that meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

C. Non-hazardous Waste: Any solid waste that does not meet the criteria of RCRA hazardous waste.

D. RCRA Hazardous Waste: A waste that meets criteria established in RCRA or specified by the EPA in 40 CFR 261.

1.05 QUALIFICATIONS

A. The Contractor shall designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters, and shall have overall responsibility for total environmental compliance at the Site including, but not limited to, accurate identification and classification of materials to be disposed of, determination of proper shipping names, identification of marking, labeling, packaging, and placarding requirements, completion of waste profiles, bills of lading, exception and discrepancy reports, and all other environmental documentation. In addition, the TDC responsibilities shall include maintaining any hazardous waste being stored in compliance with all applicable regulations (i.e., proper stockpiling) prior to shipment off-site. The TDC shall have, at a minimum, two years of specialized experience in the management and transportation of hazardous waste.

B. The Contractor's employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with RCRA and the Contractor’s Health and Safety Plan for the Site. The Contractor’s employees transporting hazardous wastes or preparing hazardous materials for transportation shall be trained, tested and certified in accordance with 49 CFR 172.

C. The Contractor and/or Subcontractors transporting hazardous wastes shall possess a current certificate issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall provide all of the materials required for the packaging, marking, labeling, placarding and transportation of RCRA hazardous wastes in conformance with Department of Transportation standards. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

B. The Contractor shall provide containers for packaging hazardous materials and wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section 101, Column 8.

C. The Contractor shall furnish appropriate containers (metal dumpsters with secure lids or covered roll off containers) for construction debris and/or uncontaminated non-hazardous waste as may be required.

D. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section 101.

E. Packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of Column 7 of the Hazardous Materials Table in 49 CFR 172, Section 101 and shall be compatible with the material to be packaged as required by 40 CFR 262.

F. The Contractor shall also provide other packaging related materials such as materials used to cushion or fill voids in over-packed containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section 314.

G. The Contractor shall provide markings for each hazardous material/waste package, freight container and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section 32. Markings shall be capable of withstanding, without deterioration or substantial color change, a 180-day exposure to conditions reasonably expected to be encountered during container storage and transportation.

H. The Contractor shall provide primary and subsidiary labels for hazardous materials and/or the Hazardous Materials Table in 49 CFR 172, Section 101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180-day exposure to conditions reasonably expected to be encountered during container storage and transportation.

I. For each off-site shipment of hazardous material/waste, the Contractor shall provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles and rail cars requiring such placards. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30-day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

J. Waste shall be disposed of at frequent and regular intervals as may be required to prevent the overfilling of such container(s). The Contractor shall place non-hazardous solid wastes, construction debris, and rubbish in containers in accordance with these Specifications, as may be appropriate.

2.02 EQUIPMENT AND FACILITIES

A. The Contractor shall utilize appropriate vehicles and other miscellaneous equipment and tools necessary to handle excavated material in a safe and environmentally sound manner. All trucks used for off-site transport of excavated material shall have lined truck beds to prevent drips and spills during transport.

B. The Contractor shall provide, install, and maintain any temporary loading facilities as required for the material handling operations.

C. All waste storage, staging, and loading areas shall be in a location determined by the Engineer.

2.03 SPILL RESPONSE MATERIALS

A. The Contractor shall provide spill control materials and equipment which are sufficient to meet the requirements described in the Site's Health and Safety Plan.

B. The Contractor shall provide appropriate response materials including, but not limited to, containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

C. The Contractor shall (1) visually inspect all containers of wastes for leaks or damage prior to being loaded for transportation and off-site disposal; (2) transfer contents of any leaking or damaged containers to another container or overpacks, and re-inspect prior to loading; (3) clean up, containerize, and label spilled materials for disposal in accordance with the Contract Documents.

D. Any material that spills out of containers shall be immediately cleaned and placed back into the waste containers and post-excavation samples collected and analysed by the Contractor from the spill area as required by the Engineer.

2.04 TEMPORARY TRUCK WASH

A. The temporary truck wash system shall consist of a drive-through berm enclosure "CONLINE 400MC" or approved equivalent.

B. The assembly shall consist of the drive through berm enclosure, the pressure washing system and associated generator, pumps and storage tanks for clean and wastewater.

2.05 ON-SITE PRE-TREATMENT SYSTEM

A. If the Contractor, opts to manage the decontamination water and/or the wastewater as non-hazardous waste suitable for discharge to the City of Troy sewer system for treatment by the POTW or discharge to surface water, the Contractor shall design, install, operate and maintain an onsite pre-treatment system that ensures that this waste will meet all permit and discharge requirements.

PART 3 EXECUTION

3.01 GENERAL

A. Uncontrolled off-site reuse of any waste material is prohibited. The Contractor shall segregate and characterize each type of removed material for proper disposal.

B. The Contractor is prohibited from burying any waste material on-site.

C. Trees and vegetation which have been cleared and grubbed shall be disposed at a licensed approved disposal/recycling facility or approved beneficial reuse site.

3.02 SEGREGATION

A. The Contractor shall manage all handling, segregation, stabilization, containerizing, storage, and loading for transportation of all waste materials resulting from the performance of the Work.

B. The Contractor shall handle collected silt and sediments from erosion control devices in accordance with **Section 31 23 16** (Excavation, Trenching, and Material Management) of these Specifications.

C. The Contractor shall segregate rubbish, construction debris, hazardous wastes and non-hazardous wastes.

D. The Contractor shall keep wastes of unknown classification separate from other wastes and manage as if they were hazardous until a waste determination or contained-in policy determination has been made.

E. Except for excavated soils generated from the construction of the PRB, the Contractor shall collect all waste classification samples to define disposal requirements. Waste classifications sampling and analyses shall conform to local, State, and Federal regulations and the approved disposal facility's requirements.

3.03 HAZARDOUS WASTE MANAGEMENT

A. The Contractor shall be responsible for compliance with all Federal, State and local hazardous waste laws and regulations and shall verify those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. The Contractor shall manage hazardous wastes in accordance with RCRA regulations.

B. The Contractor shall be responsible for complying with the emergency contact provisions in 49 CFR 177.604. Whenever the Contractor ships hazardous materials, it shall provide a 24-hour emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped. The designated person shall have comprehensive emergency response and incident mitigation information for that material, or have immediate access to a person who possesses such knowledge and information. The phone must be monitored on a 24-hour basis when the hazardous materials are in transportation, including during storage incidental to transportation. The Contractor shall ensure that information regarding this emergency contact and phone number is placed on all hazardous material shipping documents. The Contractor shall designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

a. The name of the emergency coordinator.

b. Phone number through which the emergency coordinator can be contacted on a 24-hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

C. Based on the available investigation results, hazardous wastes are the primary waste streams expected from the excavation areas. Unless a contained-in determination is obtained by the Engineer, soil materials shall be treated and disposed in accordance with Table 1 and liquid waste shall be managed in accordance with Paragraph 3.06 of this Specification.

Table 1

Hazardous Waste Treatment and Disposal Requirements

Waste Type RCRA Designation	Constituent Concentrations	Disposal Requirements
Waste classified as hazardous by the toxicity characteristic (i.e. D004-D043)	For soil with concentrations greater than 10 times the Universal Treatment Standards (refer to Table 1 and 40 CFR 268)	Dispose in a RCRA Subtitle C Landfill after treatment
	For soil with concentrations less than 10 times the Universal Treatment Standards	Dispose in a RCRA Subtitle C Landfill without treatment

D. The Contractor shall furnish itemized volumes estimates for hazardous wastes to be generated by Contractor's operations (decontamination waste, used PPE, emergency response waste, etc.).

E. When accumulating hazardous waste on-site, the Contractor shall comply with generator requirements in 40 CFR 262 and any applicable state or local law or regulations. On-site accumulation times shall be restricted to applicable time frames referenced in 40 CFR 262, Section 34 and any applicable state or local law or regulation.

F. Hazardous waste cannot be stored on site for more than 90 days per RCRA requirements. The hazardous waste shall be transported to a permitted hazardous waste treatment, storage, or disposal facility within 45 days from the accumulation start date on each container or stockpile. Accumulation start dates shall commence when waste is first generated (i.e. containerized or otherwise collected for disposal).

G. The Contractor, in consultation with the Engineer, shall identify all waste codes applicable to each hazardous waste based on requirements set forth in 40 CFR 261 and applicable state and local laws or regulations. The Contractor shall also identify all applicable treatment standards in 40 CFR 268 and state land disposal restrictions and shall make a determination as to whether or not the waste meets or exceeds the standards. Waste profiles, analyses, classification and treatment standards information shall be submitted to the Engineer for review and approval.

H. The Contractor shall use 49 CFR 172.101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped off site. Proper shipping names shall be submitted to the Engineer in the form of draft shipping documents for review.

I. The Contractor shall package, label and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. The Contractor shall mark each container of hazardous waste of 119 gallons or less with the following:

“HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.

Generator's name:

The U.S. Environmental Protection Agency, Region I

Manifest Document Number ___________________________.”

J. The Contractor shall be responsible for obtaining all permits and shipping documents to ship hazardous wastes off site. The Contractor shall use manifests for transporting hazardous wastes as required by 40 CFR 263. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series.

K. The Contractor shall prepare hazardous waste manifests for each shipment of hazardous waste shipped off site. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable state or local law or regulation. Manifests and waste profiles shall be submitted to the Engineer for review and approval within twenty (20) days of the date that the disposal of the waste identified on the manifest was completed. The Contractor shall prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable state or local law or regulation for each shipment of hazardous waste. Notifications shall be submitted with the manifest to the Engineer for review and approval.

L. The Contractor shall prepare a bill of lading for each shipment of hazardous material that is not accompanied by a hazardous waste manifest. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C and any applicable state or local law or regulation and shall be submitted to the Engineer for review and approval. For laboratory samples, the Contractor shall prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261, Section 4(d) and (e) and any applicable state or local law or regulation. Bills of lading requiring shipper's certifications shall be signed by the Contractor.

M. The Contractor shall not deliver waste to any facility other than the disposal facility(ies) pre-approved by the Engineer and listed on the shipping manifest.

N. If necessary, wastes shall be treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. Selected treatment facilities for treatment of wastes or contaminated soil shall be responsible for the ultimate disposal of the treated wastes or soil. Under no condition shall the treated wastes or soil be returned to the site to be used as fill material.

O. In the event that an identified and approved facility ceases to accept the stated materials or the facility ceases operations, the Contractor shall be responsible for locating additional alternate permitted facility(ies) for approval. The Contractor shall be responsible for making the necessary arrangements to utilize the alternate facility(ies). The alternate facility(ies) must be approved in writing by the Owner in the same manner, time and with the same requirements as for any original facility. A RCRA Subtitle C permitted facility shall meet the requirements of 40 CFR 264 or a facility operating under interim status which meet the requirements of 40 CFR 265 and must be accepted by the Engineer. An off-site treatment, storage and disposal facility with significant RCRA violations or compliance problems (such as a facility known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used.

3.04 NON-HAZARDOUS WASTE MANAGEMENT

A. Non-hazardous waste from the Site shall be disposed of off-site in Owner-approved disposal facilities or beneficial reuse sites, including, but not limited to, municipal solid waste landfill, industrial waste landfills, or construction and demolition debris landfills. The disposal facility and haul route shall be proposed by the Contractor.

B. The Contractor shall characterize all materials for disposal purposes in accordance with the accepting facility requirements. Available analytical data will be provided upon request.

C. Wastes that have not been confirmed as hazardous or non-hazardous but have a reasonable expectancy of being hazardous will be managed in accordance with the hazardous waste management procedures until such time as they are proved to be non-hazardous through the appropriate waste characteristic analyses or a contained-in policy determination.

D. Non-hazardous waste shall not be reused as backfill in the excavation areas.

E. Rubbish and clean construction debris, metal, wood, office trash, etc. or other non-contaminated materials may be disposed of at approved local landfill or salvage company.

3.05 INVESTIGATION DERIVED WASTE (IDW) MANAGEMENT

A. The Contractor shall minimize, to the extent practical, the volume of IDW that will be generated.

B. Prior to transportation and disposal, IDW generated shall be containerized in open-head 55-gallon drums or dedicated roll-off boxes. Drums containing decontamination waste or IDW shall be permanently marked with a "paint stick" (side and top). An IDW label shall be placed on the drums and roll-off boxes. The label will state the contents of the drum, date(s) the waste was generated, and drum number.

C. An Investigation-Derived Waste Drum Log Form shall be prepared and maintained for each individual drum/roll-off box as an integral part of IDW management. In addition, a master IDW Inventory Log shall be maintained to document the generation, handling and disposal of all wastes generated as part of project.

D. The Contractor shall characterize the drummed waste and dispose the drums off-site within 90 days after the waste is generated.

E. The Contractor shall place drummed wastes in a lined temporary staging area with berms, aisle space, stacking height, periodic logged inspections, stormwater management, and security in accordance with applicable RCRA regulations for drum management.

3.06 CONSTRUCTION WATER

A. Construction water shall include groundwater, well development water, wastewater, rinsates, dewatering effluents, decontamination fluids, and other aqueous liquid that has come in contact with contaminated materials or equipment.

B. Unless a contained-in determination is obtained from NYSDEC, all construction water shall be assumed to be hazardous. The Contractor shall manage contact water in accordance with its decontamination water and wastewater management plan.

C. Fractional tanks shall be maintained according to applicable regulations including, regulations for a temporary unit as specified in 40 CFR 264.553.

D. Hazardous construction water from the Site shall be treated and/or disposed off-site in a facility licensed in the State of New York.

3.07 HAULING

A. Prior to shipment of any wastes off-site, the Contractor's TDC shall provide written certification to the Engineer that wastes have been properly packaged, labeled and marked in accordance with Department of Transportation and USEPA requirements.

B. The Contractor shall coordinate vehicle inspection and recording of quantities leaving the Site with the Engineer. These quantities shall be verified with recorded quantities at the disposal facility(ies). If any deviation between the two quantity records occurs, the matter is to be reported immediately to the Engineer.

C. The Contractor shall ensure that all trucks entering work areas and hauling materials off-site are decontaminated in the designated truck wash area.

D. The Contractor shall be held responsible for any and all actions necessary to remedy situations involving material spilled in transit or mud and dust tracked off-site.

E. The Contractor shall be responsible for inspecting the access routes for road conditions, overhead clearance, and weight restrictions. The Contractor shall also comply with weight restrictions by specifying a maximum weight in accordance with any limitations. The Contractor shall provide certified weigh records for each load from an off-site scale house or propose a system to weigh loaded trucks before they exit the Site. The proposed weigh system shall be approved by the Engineer.

F. The Contractor shall protect trucks against contamination by properly covering and lining them with compatible material or by decontaminating them prior to any use other than hauling contaminated materials. The Contractor is responsible for inspection of transportation vehicles prior to leaving the Site, to verify no material adheres to the wheels, undercarriage, tailgates, covers or other areas of transport vehicles.

G. All vehicles that come in contact with contaminated soil or water shall leave the site through the temporary truck wash.

H. To the maximum extent possible, the Contractor shall avoid use of local streets and residential areas to transport any excavated contaminated material and/or waste off-site. The Contractor shall schedule all movement of equipment, debris and materials in order to minimize disturbance to the local neighborhood or site operations.

I. The Contractor shall only use the transporter(s) identified in the approved plans for the performance of work. Any use of substitute or additional transporters must have previous written approval from the Engineer.

J. The Contractor shall not combine materials from other projects with material from the Site.

K. The Contractor shall coordinate the schedule for vehicle arrival and material deliveries at the construction Site to meet the approved project schedule. The schedule shall be compatible with the availability of equipment and personnel for material handling operations.

L. The shipping vehicles shall be in good operating condition and shall have current inspection certificates. Vehicles may be inspected by the Engineer at the Site prior to loading to verify that the vehicles have no fluid leaks, no unusually noisy mufflers or tailpipes, tires that are in good condition, operational brakes, horn, steering, operating controls, and safety devices. Vehicles shall be free of excess dirt, debris, oil, grease, and excessive rust. Vehicle beds used for hauling shall be free from drain holes, cracks, or other conditions that might permit waste to leak from the vehicle beds.

M. The drivers shall be fully trained and licensed, and have no prior major traffic violations. Major traffic violations are violations or incidents in which the driver was cited for being reckless, careless, or driving while intoxicated. The Engineer may reject any driver(s) deemed unqualified or unsafe to perform the work.

N. The Contractor shall schedule all movement of equipment, soil, and materials in order to minimize disturbance to the local neighborhood. The trucks shall be scheduled and routed in such a manner as to prevent excess traffic from waiting on-site during the excavation and loading activities. No prolonged idling of trucks shall be allowed while waiting. The loaded trucks shall be routed to the off-site disposal facility.

3.08 TRUCK WASH AND DECONTAMINATION

A. All equipment or vehicles that enters work areas or comes in contact with contaminated soil or water shall be decontaminated prior to leaving the site. No equipment including, but not limited to, excavators, backhoes and trucks, shall be allowed to leave work areas without being fully decontaminated.

B. Trucks shall enter the designated truck wash area to be defined by the Contractor and approved by the Engineer. The wash area shall be free of standing water prior to trucks entering the wash area. Upon entering, trucks shall be pressure washed to remove contaminated materials from the exterior and underside of the truck.

C. Decontamination water and accumulated soils shall be evacuated from the truck wash area prior to the pressure washed truck leaving the decontamination area.

D. Decontamination water and accumulated soils shall be managed in accordance with the requirements of this Specification.

END OF SECTION

OFF-SITE POLICY COMPLIANCE CERTIFICATION MEMO

Project/Contract #: ____
Waste Stream: ____
Primary TSDF, EPA ID # and Location: _________________________________
Secondary TSDF, EPA ID # and Location: _______________________________
Alter. TSDF, EPA ID # and Location: __________________________________

EPA Region	Primary Contact
I	(617) 918-1405
II	(732) 321-4341
III	(215) 814-3159
IV	(404) 562-9277
V	(312) 353-8207
VI	(214) 665-2282
VII	(913) 551-7164
VIII	(303) 312-6419
IX	(415) 972-3304
X	(206) 553-1061 (206) 553-2859

EPA representative contacted: ____
EPA representative phone number: ____
Date contacted: ____

Comment: ____

The above EPA representative was contacted on ___________. As of that date the above sites were considered acceptable in accordance with the Off-Site Policy in 40 CFR 300.440.

Name: ___________________________ Affirmation:_______________________________

Signature: _____________________________ Date:________________________________
Phone number: _____________________________

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, permits and incidentals required to perform all clearing and grubbing activities.

B. This work shall consist of clearing, grubbing, removal, and satisfactory disposal of all of trees, snags, logs, brush, stumps, and shrubs from the designated areas, except those items designated to remain.

1.02 SUBMITTALS

(Reserved)

1.03 REFERENCES

(Reserved)

1.04 DEFINITIONS

(Reserved)

PART 2 – PRODUCTS

(Reserved)

PART 3 – EXECUTION

3.01 PROTECTION

A. Protection of trees and vegetation, existing facilities, and utilities shall be performed in accordance with **Section 02 01 00** (Maintenance and Protection of Existing Conditions) of these Specifications.

B. Trees and other vegetation designated to remain undisturbed shall be protected from damage throughout the duration of the construction period. Any damages resulting from the Contractor’s operations shall be repaired by the Contractor.

C. Earthwork, stockpiling of materials, vehicular parking, and excessive foot or vehicular traffic shall not be allowed within the drip line of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species, similar condition, and like size unless otherwise approved by the Engineer.

D. Removal of vegetation in any area not necessary to perform the work is strictly prohibited.

3.02 MECHANICAL CLEARING AND GRUBBING

A. The Contractor shall clear and grub out all brush, hedges, weeds, heavy vegetation, and other vegetation material or growth, present on any and all areas within the project limits of disturbance, as indicated on the Engineering Drawings. Only those portions of the site necessary and required for access to and execution of the Work shall be cleared. The Contractor shall also remove rubbish, debris and other objectionable materials as part of the clearing activities.

B. No clearing, grubbing, or stripping of surficial soils or removal of surface finishes shall commence until the Contractor has staked out the proposed work, except for the work that may be required to complete the stakeout survey.

C. The Contractor shall maintain all areas within the project limits of disturbance in a neat, serviceable, and satisfactory condition until the project is accepted.

D. This work shall include the preservation from injury of all trees and other vegetation that are not within designated areas of clearing and grubbing, unless designated by the Engineer.

3.03 MATERIALS MANAGEMENT

A. All cleared and grubbed vegetative materials removed as a result of the clearing and grubbing activities shall be disposed of by the Contractor at an approved licensed sanitary landfill or composting site by a method approved by the Engineer.

B. The Contractor shall not burn or bury clearing and grubbing waste on-site.

C. Trees and limbs outside the construction area shall not be removed without the prior written approval of the Engineer.

D. Damage to trees and shrubs that are outside the project area shall be corrected at the Contractor's expense.

E. The Contractor shall comply with all local, State, and Federal rules and regulations and be responsible for payment of any and all fees that may result from the off-site disposal of materials.

F. Waste disposal manifests for any vegetative debris disposed offsite shall be submitted to the Engineer.

END OF SECTION

SECTION 31 23 16

EXCAVATION, TRENCHING, AND MATERIAL MANAGEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to perform excavation and/or trenching required for installation of the permeable reactive barrier and the reactive treatment zone and handling of materials in accordance with the Engineering Drawings and as specified herein.

B. Construction water shall be managed in accordance with applicable permit requirements and shall not be discharged directly to sanitary sewers, stormwater sewers, surface water, or wetlands.

C. All work by the Contractor shall be performed in accordance with the permits procured by the Owner and all applicable local, State, and Federal rules and regulations. Work shall not be permitted outside of the work area boundaries shown on the Engineering Drawings.

D. The Contractor shall be responsible for the design of temporary excavation support by a Professional Engineer, currently licensed in the State of New York.

E. The Contractor shall be responsible for the design of an excavation dewatering system by a Professional Engineer, currently licensed in the State of New York.

F. Temporary soil erosion and sediment control measures in accordance with **Section 01 57 13** (Soil Erosion and Sediment Control) of these Specifications and as shown in the Engineering Drawings shall be in place prior to initiating any excavation or stockpiling of materials.

1.02 SUBMITTALS

A. The Contractor shall obtain all required Federal, State and local permits to perform the scope of work specified herein, which have not been procured by the Owner.

B. The Contractor shall outline the proposed equipment and methods in the Contractor's Soil Excavation Plan. No work at the Site, with the exception of site inspection, surveys and the installation of the temporary soil erosion and sediment control measures, shall be performed until this plan is approved. At a minimum, the plan shall include:

a. Method of excavation and equipment to be used.

b. Temporary Excavation Support System Plan, as applicable.

c. Excavation Dewatering Plan.

d. Storage methods and locations for removed materials.

e. Borrow sources and haul routes.

f. Decontamination procedures.

g. Spill contingency plan.

C. The Contractor shall prepare and submit to the Engineer a Waste Materials Management Plan. No work at the Site, with the exception of site inspection, surveys and the installation of the temporary soil erosion and sediment control measures, shall be performed until this plan is approved. At a minimum, the plan shall include:

a. Proposed segregation and testing program for debris and other waste materials.

b. Details on the manner in which hazardous wastes will be managed.

c. Proposed on-site (i.e., within designated limits of project area) traffic routing to proposed stockpile areas.

d. Procedure for maintenance of traffic, including snow removal and contingencies for disabled vehicles, as necessary.

e. Description of inventory control of trucks, truck cleaning, queuing areas, and any similar features. Queuing on public streets, highways, or other public areas shall not be permitted.

f. Measures for erosion and run-on/runoff controls for materials stockpiles in accordance with the Soil Erosion and Sediment Control Plan included in the Engineering Drawings.

g. Measures for control and monitoring of VOCs, dust and particulates during removal activities.

D. Surveys shall be performed prior to and immediately after excavation to document as-built conditions. Surveys shall be performed in accordance with **Section 02 21 00** (Surveying) of these Specifications.

1.03 REFERENCES

American Society for Testing and Materials (ASTM)

ASTM D 5434 - 97	Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock

Occupational Safety and Health Administration (OSHA)

29 CFR 1910.120	Hazardous waste operations and emergency response
29 CFR 1926	Subpart P, Excavations

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

2.01 SPILL RESPONSE MATERIALS

A. The Contractor shall provide appropriate spill response materials including, but not limited to, containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

B. Spill response shall be performed in accordance with the requirements of the Contractor's Health and Safety Plan for the site.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to initiating the work, the Contractor shall inspect the Site, examine existing conditions and make all necessary preparations for the safe and proper execution of work. The Contractor shall be responsible for reviewing existing drawings and utilizing a locator service to field delineate the location(s) of each utility. The Contractor shall coordinate the utility mark-out and field verify the locations of all utilities, which include but may not be limited to gas piping, storm sewer piping, sanitary sewer piping, overhead and underground electrical lines/equipment/structures. If active utilities are present at locations that will interfere with the implementation of the work, the Contractor shall contact the Engineer and the appropriate utility company for recommendations and direction.

B. The Contractor shall engage a surveyor licensed in the State of New York to perform all surveying work defined in **Section 02 21 00** (Surveying) of these Specifications.

C. Temporary soil erosion and sediment control measures, in accordance with the Soil Erosion and Sediment Control Plan included in the Engineering Drawings and as required in **Section 01 57 13** (Soil Erosion and Sediment Control) of these Specifications, shall be in place and operational prior to initiating any excavation or stockpiling of materials.

D. All earthwork shall be conducted to minimize volatile organic compound emissions and fugitive dust beyond the Work area.

E. The Contractor shall mitigate and control all volatile organic compound emissions and fugitive dust beyond the Work area in accordance with **Section 01 35 29** (Health and Safety) of these Specifications.

F. The Contractor shall prepare as-built surveys of all completed excavations and backfill as required under these Specifications.

3.02 EXCAVATION AND TRENCHING

A. Designated areas shall be excavated to the limits and depths specified in the Engineering Drawings and shall not extend more than 0.5 feet beyond the depth and extent shown unless otherwise directed by the Engineer.

B. Excavation activities shall be conducted using excavation equipment (e.g., excavator, backhoe, etc.) and methods as determined by the Contractor and outlined in the Contractor's Soil Excavation Plan.

C. The Contractor shall excavate slopes to a safe angle of repose and/or utilize temporary excavation support system to support the side slopes of the excavation. The Contractor shall install temporary shoring to minimize the amount of excavation slope back.

   a. All sloping and shoring shall comply with the requirements of OSHA 1926, Subpart P.

   b. The Contractor shall engage a Professional Engineer licensed in the State of New York to prepare details of shoring, bracing, and other construction required for protection of the excavations. These drawings shall be submitted to the Engineer for general review, which shall not relieve the Contractor of responsibility for the adequacy of the design.

   c. The Contractor shall provide and install the temporary excavation support structures.

   d. The temporary excavation system shall prevent caving, erosion, or gulling of sides and ends of excavations.

   e. When no longer necessary, the Contractor shall remove all temporary excavation support structures, forms and all debris of every nature, taking care, upon the removal of temporary supports, not to cause movement of adjacent ground or structures or create the danger of a slide.

D. The Contractor shall perform excavation in such a manner which prevents unbalanced hydrostatic forces which could cause instability of excavation sides.

   a. The Contractor shall engage a Professional Engineer licensed in the State of New York to design an excavation dewatering system. This design, including the plan for management of dewatering water in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Material) of these Specifications and applicable permit conditions, shall be submitted to the Engineer for general review, which shall not relieve the Contractor of responsibility for the adequacy of the design.

   b. The Contractor shall procure all necessary permits and approvals for the installation and operation of the dewatering system, including but not limited to well and discharge permits.

   c. The Contractor shall provide, install, and operate the excavation dewatering system, including any treatment system(s) required prior to discharge.

   d. The dewatering system shall allow the continued excavation of materials to the target depth while maintaining the stability of the excavation.

e. When no longer necessary, the Contractor shall remove the excavation dewatering system and all appurtenances.

E. Excavations shall be performed in a manner that will limit dust or VOC generation, spills and potential mixing of various material streams. The Contractor shall be responsible for controlling dust resulting from the excavation activities in accordance with **Section 01 35 29** (Health and Safety) of these Specifications.

F. The Contractor shall maintain sides and slopes of excavation in safe condition until backfilling or other work is complete.

G. Where trenches are excavated, the bottom of all trenches shall be excavated clean so that a hard bottom is provided. The trench bottom shall be relatively smooth and free of rock. At a minimum, the trench bottom shall be cleaned at the start of each work day and prior to placement of backfill. If backfill placement operations have ceased for longer than 24 hours, the face of the backfill slope shall be cleaned prior to the placement of additional backfill.

H. The Engineer shall inspect all trench excavations prior to backfilling. The trench bottom shall be probed for any deposits or sloughed materials. Any loose or soft material, debris or cuttings shall be removed from the bottom of the trench with the excavation tools or other suitable means such as air lift pumps. The Contractor shall ensure that cleaning equipment will not remove material from the sidewalls of the trench.

I. After the trench bottom has been cleaned, the Contractor shall collect a sample of the trench bottom with a drive tube sampler. After visually examining the samples, the Engineer will either approve the trench at the points checked or require additional cleaning to remove any deposits or sloughed materials. If additional cleaning is required, additional samples shall also be collected and inspected by the Engineer.

J. The Contractor shall properly demarcate, guard and protect excavations to prevent them from becoming dangerous to persons or property.

K. The Contractor shall provide sufficient on-site vehicle/equipment access and egress to/from the excavation areas to facilitate the excavation of materials to the specified horizontal limits.

3.03 EXCAVATED MATERIAL MANAGEMENT

A. The Contractor shall segregate materials generated during excavation for disposal purposes in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications. The Contractor shall utilize material segregation and handling methods that will limit the amount of hazardous waste material being disposed off-site.

B. The Contractor shall notify the Engineer at least 48 hours prior to the start of excavation.

C. Excavated materials shall either be directly loaded into trucks for off-site disposal or be stored on-site in designated storage areas in accordance with the

Contractor's approved Waste Materials Management Plan and as approved by the Engineer.

D. If stockpiling, the Contractor may temporarily place excavated materials on two sheets of 6-mil polyethylene plastic overlain by at least 3 inches of stone and securely covered with 6-mil polyethylene with sand bags or similar means at the end of each working day and when not in active use.

   a. Stockpiles shall be located away from construction activity, occupied buildings, water drainage pathways, and areas prone to flooding, as directed by the Engineer.

   b. Stockpiles shall be shaped and graded, as applicable, to facilitate surface water drainage.

   c. The Contractor shall take measures necessary to prevent generation of dust and water leaching from stockpiles. The Contractor shall provide silt fence or hay bales at the perimeter of each stockpile in accordance with the approved Soil Erosion and Sediment Control Plan.

E. The Contractor may also use roll-off containers for temporary storage of excavated materials. At the end of each working day and when not in active use:

   a. Roll-off containers shall be located away from construction activity, occupied buildings, water drainage pathways, and areas prone to flooding, as directed by Engineer.

   b. Roll-off containers shall be lined and water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored materials.

F. The Contractor shall maintain all stockpiles and containers throughout the duration of the project until all materials have been removed and disposed of to the satisfaction of the Engineer.

   a. The Contractor shall determine stockpile and container waste classification through analytical testing in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Material) of these Specifications.

   b. The Contractor shall label all stockpiles and containers as to their waste classification and source identification. Warning signs shall be placed in the storage areas in accordance with general practices and regulations.

   c. The Contractor shall inspect all stockpiles and containers on a daily basis during construction and record inspection observations in a daily logbook for submittal to the Engineer on a weekly basis.

G. Following material characterization, materials shall be disposed off-site in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Material) of these Specifications.

H. The Contractor shall maintain project documentation with accurate records of material tracking. At a minimum, documentation shall include: daily field reports, estimates of volumes of materials in each stockpile and container, bills of lading, and minutes of meetings related to excavated material management.

A complete copy of this documentation shall be submitted to the Engineer on a weekly basis and at the completion of the Work.

3.04 WATER MANAGEMENT

A. In accordance with **Section 01 57 13** (Soil Erosion and Sediment Control) of these Specifications, the Contractor shall prevent and divert surface runoff from areas uphill of the excavation area using suitable means.

B. The Contractor shall, at all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations or other work areas and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the execution of the work. The method proposed by the Contractor for removal of water from excavations shall be subject to the review of the Engineer.

C. The Contractor shall procure all necessary permits and approvals for the management and disposal of water collected from work areas.

D. Water pumped or drained from excavations or excavated material stockpile areas shall be managed in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications and shall be disposed of in accordance with applicable permit requirements in a suitable manner without injury to adjacent property, the work under construction, or the environment. No water shall be discharged directly to sanitary, storm sewers, surface water bodies or wetlands.

E. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor.

END OF SECTION

SECTION 31 23 23

BACKFILLING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to install stone cover material as shown in the Engineering Drawings and specified herein.

B. All earthen materials used for stone cap construction shall be suitable for use as cover material, as indicated in this Specification. In addition, all imported materials shall be analyzed by an off-site laboratory and certified to be clean fill in accordance with DER-10/Technical Guidance for Site Investigation and Remediation (DER-10).

1.02 SUBMITTALS

A. As part of the Construction Work Plan, the Contractor shall prepare a management plan for transportation, staging, handling, and placement of imported materials and obtain approval from the Engineer prior to the importation of any material to the Site. The plan shall describe transportation routes, site ingress and egress, staging areas, on-site traffic control, stockpiling areas (if any), and production rates. The Contractor shall not use equipment or place materials except in a manner consistent with restricted area requirements as shown on the Engineering Drawings.

B. For each imported material source, the Contractor shall submit to the Engineer samples of proposed materials weighing approximately 50 pounds. The Engineer may select to accompany the Contractor to visit all material sources.

C. The Contractor shall complete and submit the Import Soil/Fill Form to NYSDEC prior to importing any material source.

D. The Contractor shall submit to the Engineer copies of licenses, certifications or other qualifications of the soil testing laboratory performing the field and/or laboratory testing.

E. Prior to delivery, the Contractor shall submit to the Engineer copies of certified laboratory test results and certificates of compliance attesting that imported materials meet the specified requirements for each imported material source. The Contractor shall not use imported materials without prior written authorization from the Engineer. With respect to the certification of imported materials, the following shall apply:

a. All imported materials shall be subjected, at a minimum, to the USEPA Target Contaminant List/Target Analyte List (TCL/TAL) analyses to ensure that materials are free from chemical contamination as defined in NYCRR Part 375-6.7(d). Testing shall be conducted at the frequencies defined in the CP-51/Soil Cleanup Guidance (latest revision) and per DER-10 subdivision 5.4(e).

b. A third-party certification shall be submitted for each imported material source certifying that "the materials originate from a virgin source and that, based on a review of historical site documentation, interviews of personnel with historical knowledge of the site and an inspection of the site and proposed borrow areas, the materials do not originate from an area of known historical discharges or evidence of contamination."

c. All imported materials except coarse aggregate, shall be subjected, at a minimum, to a soil classification (ASTM C 136, ASTM D 1140, ASTM D 2487 and/or ASTM D 4318), natural moisture content (ASTM D 2216) and modified proctor test (ASTM D 1557).

d. All coarse aggregate shall be subjected, at a minimum, to a soil classification (ASTM C 136, ASTM D 1140, ASTM D 2487 and/or ASTM D 4318).

e. A minimum of one sample shall be subjected to chemical and geotechnical analyses per 500 cubic yards of imported material and no less than one test per borrow area. The Engineer may direct additional tests should soil materials change during the course of work.

F. The Contractor shall submit copies of quality control field test results to the Engineer by the day following the "field tests" work day of the testing. Copies of quality control laboratory test results must be submitted to the Engineer prior to placement of overlying layers of material.

G. Elevation surveys shall be performed by the Contractor immediately after placement and grading to document as-built conditions. Surveys shall be performed in accordance with **Section 02 21 00** (Surveying) of these Specifications.

H. A summary report shall be submitted to the Engineer following construction. The report shall contain a list of the sampling locations referenced by site coordinates and elevations, and a presentation of the data collected.

1.03 REFERENCES

A. ASTM International (ASTM):

a. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

b. ASTM D 1140 – Standard Test Methods for Determining the Amount of Material Finer than the No. 200 (75 μm) Sieve in Soils by Washing

c. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Modified Effort

d. ASTM D 2216 – Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

e. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes

f. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. New York State Department of Environmental Conservation (NYSDEC):

a. 6 NYCRR Part 375 – Environmental Remediation Programs

b. DER-10/Technical Guidance for Site Investigation and Remediation (May 2010)

c. CP-51/Soil Cleanup Guidance (October 2010)

d. *New York State Standards and Specifications for Erosion and Sediment Control* (July 2016)

1.04 DEFINITIONS

(Reserved)

PART 2 - PRODUCTS

2.01 GENERAL

A. Sources of imported materials shall be approved by the Engineer before the material is delivered to the Site.

B. Imported materials shall be subjected to the required geotechnical and analytical testing prior to delivery to the site, or suitable existing materials as determined by the Engineer.

C. Imported materials shall consist of clean, uncontaminated soil free of clay organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material which may be compressible or which cannot be compacted properly. The material shall not contain stones, broken concrete or similar objects.

D. Imported materials shall meet the clean fill requirements of DER-10.

E. The Contractor shall be responsible for supplying materials meeting the specified gradations. Materials which do not meet gradation or quality requirements of this section will be rejected. No payment shall be made for rejected material.

F. Any material delivered to the Site which does not meet the specifications or which has become mixed with unacceptable amounts of subsoil during any operation at the source or during, placing or spreading, shall be rejected and replaced with acceptable material.

2.02 STONE COVER MATERIAL

A. Stone cover material shall be used for construction of the stone cap shown in the Engineering Drawings.

B. Stone cover material shall meet the clean fill requirements of DER-10.

C. Stone cover material shall conform to the following requirements:

a. Stone cover material shall consist of durable, sound, hard, angular rock and be resistant to weathering and to water action; free from overburden, spoil, shale, and organic material; and shall be washed and well-graded.

b. Less than 10% of the stone cover material shall pass through a No. 80 sieve.

c. The moisture content of the stone cover material shall not exceed 10 percent.

2.03 DEMARCATION LAYER

A. The demarcation layer shall consist of Tenax® Snow Guard Fence with a 1.75 inch by 1.75 inch opening or an Engineer-approved equivalent.

2.04 BACKFILL MATERIAL

(Reserved)

2.05 TOPSOIL

(Reserved)

PART 3 - EXECUTION

3.01 GENERAL

A. All required soil erosion control measures and facilities (i.e., silt fence, diversions, etc.) shall be in place prior to any site disturbance activities in accordance with the requirements of **Section 01 57 13** (Soil Erosion and Sediment Control) of these Specifications.

B. The Contractor shall conduct the cover material placement and grading in the locations specified in the Engineering Drawings and in accordance with the *New York State Standards and Specifications for Erosion and Sediment Control* (latest edition).

C. The Contractor shall conform to the requirements of **Section 31 23 16** (Excavation, Trenching, and Material Management) when managing water flow into work areas using proper and satisfactory means and devices.

D. All imported material types shall be managed in accordance with the approved imported materials management plan to be included in the Contractor's Construction Work Plan. Mixing of different material types is prohibited.

E. Loss of materials during loading, off-loading, and/or transport is prohibited.

The Contractor shall not be paid for material deposited outside the limits of the work area, as shown in the Engineering Drawings, unless otherwise directed by the Engineer.

3.02 SUBGRADE PREPARATION

A. Cover materials shall not be placed on surfaces that are frozen or contain frost. In the event that the subgrade is frozen, it shall be scarified, thawed and recompacted or removed, to the approval of the Engineer before the cover material is placed. Any soft spots resulting from frost shall be removed or recompacted to the satisfaction of the Engineer before new fill material is placed.

B. Unsatisfactory material in surfaces to be capped shall be removed and replaced with satisfactory materials as directed by the Engineer.

C. The demarcation layer shall be placed over the existing subgrade as shown in the Engineering Drawings.

D. The demarcation layer shall only be installed if the subgrade is dry.

E. At the time of installation, the demarcation layer shall be rejected if it has defects, rips, flaws, deterioration, or other damage incurred during manufacturing, transportation, or storage.

F. The demarcation layer shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.

G. The temporary use of sand bags or similar weights to help hold the demarcation layer in place shall be allowed. The temporary weights shall be removed as the subsequent stone cover layer is placed.

3.03 COVER MATERIAL PLACEMENT AND GRADING

A. The Contractor shall place cover material over the demarcation layer to the grades, contours, elevations, and dimensions indicated in the Engineering Drawings. Placement of materials shall not create swales or areas where ponding of water will occur.

B. Cover material shall be thoroughly mixed and spread evenly by mechanical equipment or other means above the approved subgrade and demarcation layer in lifts not exceeding six (6) inches and shall be built up in horizontal layers as nearly even as practicable.

C. Cover material shall not be placed outside of the areas shown on the Engineering Drawings. Any materials placed outside of these areas shall be removed by the Contractor at no cost to the Owner.

D. Grading tolerances shall be plus or minus 0.1 feet for all regraded surfaces unless otherwise indicated on the Engineering Drawings.

E. In the event of slides, sloughing or erosion in any part of the work, the Contractor shall remove the disturbed material from the damaged area and shall rebuild such portion as directed by the Engineer.

F. Upon completion of the placement and grading operations, the finished grade shall be smooth, free of ruts, terraces and holes and conform to elevations shown in the Engineering Drawings.

G. A survey shall be conducted upon completion of the cover material placement to document as-built conditions. Surveying shall be performed in accordance with the requirements of **Section 02 21 00** (Surveying) of these Specifications.

3.04 COMPACTION

(Reserved)

3.05 TOP SOIL PLACEMENT

(Reserved)

END OF SECTION

SECTION 31 41 16

STEEL SHEET PILING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to install sheet piling in the locations shown in the Engineering Drawings and as specified herein.

B. All work by the Contractor shall be performed in accordance with the permits procured by the Owner and all applicable local, State, and Federal rules and regulations.

C. Temporary soil erosion and sediment control measures in accordance with **Section 01 57 13** (Soil Erosion and Sediment Control) of these Specifications and as shown in the Engineering Drawings shall be in place prior to initiating installation of the sheet piling.

1.02 SUBMITTALS

A. The Contractor shall submit to the Engineer detail drawings for sheet piling, including fabricated sections, showing complete piling dimensions and details, driving sequence and location of installed piling. The Contractor shall submit drawing details of top protection, special reinforcing tips, tip protection, lagging, splices, fabricated additions to plain piles, cut-off method, corrosion protection, and dimensions of templates and other temporary guide structures for installing piling.

B. The Contractor shall provide details of the method for handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

C. The Contractor shall submit certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots prior to installing materials. Material test reports shall meet the requirements of ASTM A6/A6M.

   a. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site.

   b. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations.

   c. Testing of sheet piling shall meet the requirements of ASTM A6/A6M.

D. The Contractor shall submit the procedure for testing sheet piling interlocked joint strength in tension, prior to testing the sheet piling. The interlocked joint strength in tension test shall conform to the sheet piling manufacturer's standard test, and shall include at least two (2) 3-inch long coupons taken randomly from different as-produced pilings. The Contractor shall also submit a certified report showing results based on the approved testing procedures.

E. The Contractor shall submit to the Engineer the following for the proposed coal tar epoxy coating:

a. Schedule of products and paint systems to be used, including at a minimum the product manufacturer's name, product name, method of application, and minimum dry film thickness per coat of coating to be applied for each proposed product.

b. Additional product information including the manufacturer's product data sheet, technical and performance information, manufacturer's instructions and recommendations for surface preparation and application, and safety data sheet (SDS) for each product to be used.

c. A description of the surface preparation method and degree of cleanness to be achieved prior to applying coal tar epoxy coating.

d. A sample of each paint and finished coating product proposed to be used applied to an 8.5-inch by 11-inch piece of sheet metal.

e. Certification by coating manufacturer that each proposed coating product is suitable for the proposed use.

f. Certification that proposed product applicator has previously applied the proposed coating system, has the ability and equipment to prepare surface and apply the coating in accordance with the manufacturer's instructions and recommendations, and meets the qualifications specified in Paragraph 1.05B below.

F. The Contractor shall submit to the Engineer the following for the proposed pile interlock sealant:

a. Schedule of products to be used and additional product information including at a minimum the product manufacturer's name, the manufacturer's product data sheet, technical and performance information, manufacturer's instructions and recommendations on surface preparation and application, and SDS for each product to be used.

b. A description of the surface preparation method and degree of cleanness to be achieved prior to applying piling interlock sealant.

c. A sample of each sealant and finished interlock sealing to be used applied to an 8.5-inch by 11-inch segment of interlock for two paired pilings.

d. Certification by the sealant manufacturer that proposed sealant is suitable for the proposed use as a water barrier at piling interlocks.

e. Certification that proposed sealant applicator has previously applied the interlock sealant, has the ability and equipment to prepare surface and apply the sealant in accordance with the manufacturer's instructions and recommendations, and is an authorized installer by the sealant manufacturer per Paragraph 1.05C of this Specification Section.

G. The Contractor shall submit certification that surface preparation and protective coatings and interlock sealing have been applied in conformance with these Specifications.

H. Prior to the commencement of piling installation, the Contractor shall submit complete descriptions of sheet piling driving equipment including hammers, jetting equipment, extractors, protection caps and other installation appurtenances. Descriptive information shall include, at a minimum, manufacturer's name, model numbers, capacity, rated energy, hammer details, cushion material, helmet, and templates.

I. During installation of sheet piling, the Contractor shall maintain a pile driving record for each sheet pile driven. This record will be submitted to the Engineer at the completion of piling driving operations. At a minimum, the Contractor shall indicate on the installation record: installation dates and times, type and size of hammer, rate of operation, total driving time, dimensions of driving helmet and cap used, blows required per foot for each foot of penetration, final driving resistance in blows for final 6 inches, pile locations, tip elevations, ground elevations, cut-off elevations, and any reheading or cutting of piles. The Contractor shall also record any unusual pile driving problems during driving.

J. Within thirty (30) days of the completion of piling driving operations, the Contractor shall submit to the Engineer records of the completed sheet piling driving operations, including a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling. Survey data shall be provided in accordance with **Section 02 21 00** (Surveying) of these Specifications.

1.03 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

A. American Welding Society (AWS):

a. AWS D1.1/D1.1M – Structural Welding Code – Steel (latest version)

B. ASTM International (ASTM):

a. ASTM A6/A6M – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling (latest version)

b. ASTM A328/A328M – Standard Specification for Steel Sheet Piling (latest version)

c. ASTM A572/A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel (latest version)

d. ASTM A857/A857M – Standard Specification for Steel Sheet Piling, Cold-Formed, Light Gage (latest version)

C. Code of Federal Regulations (CFR):

a. 1926.800 – Underground Construction

D. The Society for Protective Coatings (SSPC)

a. SP 1 - Solvent Cleaning

b. SP 2 – Hand Tool Cleaning

c. SP 3 - Power Tool Cleaning

d. SP 5 - White Metal Blast Cleaning

e. SP 6 - Commercial Blast Cleaning

f. SP 7 – Brush-Off Blast Cleaning

g. SP 10 - Near-White Blast Cleaning

h. SP 11 – Power Tool Cleaning to Base Metal

1.04 DEFINITIONS

(Reserved)

1.05 QUALIFICATIONS

A. The Contractor shall have a minimum of five (5) years of experience installing steel sheet piles.

B. Coating work shall be performed by an SSPC-certified Contractor having a minimum of Category QP 1 certification for work without hazardous paint removal, and Category QP 2 certification for work involving hazardous paint removal.

C. Interlock sealing shall be performed by an installer authorized by the sealant manufacturer.

1.06 WARRANTY

A. The manufacturer shall warrant all equipment, materials, and products specified in this Section against defective materials and workmanship with the manufacturer's standard warranty, but for no less than one (1) year from the date of substantial completion.

B. The Contractor shall warrant the Work against defects for one (1) year from the date of substantial completion.

PART 2 PRODUCTS

2.01 STEEL SHEET PILING

A. Steel sheet piling shall be hot-rolled PZC-13 piles as manufactured by LB Foster Company or Engineer-approved equivalent. All sheet piles shall conform to ASTM A572, Grade 50. Cold formed sheet piling shall not be used.

B. Sheet piling shall be full-length sections of the dimensions shown in the Engineering Drawings.

C. Sheet piling shall have standard pulling holes.

2.02 COAL TAR EPOXY COATING

A. The sheet piles shall be coated with Carboline Bitumastic® 300 M, a high build coal tar epoxy manufactured by Carboline Company, or Engineer-approved equivalent. The coating shall be applied in accordance with the coating manufacturer's recommendations.

B. The Contractor shall provide coating materials that conform to local and State requirements. The Contractor shall notify the Engineer of any coating specified herein that fails to conform to local and State requirements.

   a. Lead Content: The Contractor shall only use coatings that are totally lead free.

   b. Chromate Content: The Contractor shall not use coatings containing zinc-chromate or strontium chromate.

   c. Asbestos Content: The Contractor shall not use materials containing asbestos.

   d. Mercury Content: The Contractor shall not use materials containing mercury or mercury compounds.

   e. The specified maximum VOC content shall apply to the unthinned product.

2.03 INTERLOCKS

A. Interlock connections shall be the ball and socket type.

B. The interlocks of sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed.

2.04 INTERLOCK SEALANT

A. The sheet pile interlocks shall be sealed with WADIT®, a non-toxic hot cast sealant distributed by PilePro®, or Engineer-approved equivalent. The sealing shall be applied in accordance with the sealant manufacturer's recommendations.

2.05 APPURTENANT METAL MATERIALS

A. Steel plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials shall conform to manufacturer's standards and to the requirements specified in the respective sheet piling standards.

2.06 PILE DRIVING EQUIPMENT

A. The Contractor shall provide sheet pile driving equipment conforming to the following requirements.

a. Driving Hammers: Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or vibratory type. The driving energy of the hammers shall be as recommended by the manufacturer for the piling weights and subsurface materials to be encountered. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

b. Jetting Equipment: Jetting will not be permitted without the Engineer's approval. If jetting is approved, it may be used at no additional cost to the Owner. Jetting equipment shall have not less than two removable or fixed jets of the water or combination air-water type. Water jets shall be designed so that the discharge volume and pressure are sufficient to freely erode the material under and adjacent to the piling.

2.07 DELIVERY, STORAGE, AND HANDLING

A. All materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports.

B. The Contractor shall store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. At a minimum, the Contractor shall support sheet piling on level blocks or racks spaced not more than 10 feet apart and not more than two (2) feet from the ends.

C. Storage of sheet piling should also facilitate required inspection activities and prevent damage to coatings and corrosion prior to installation.

D. The Contractor shall strictly follow the coating and sealant manufacturers' recommendations and instructions for storing and handling all coating and sealant products and materials.

a. The coating shall be delivered in sealed containers with legible and intact labels with all required information.

b. Containers shall be stored as specified by the accompanying SDS for each product.

c. The Contractor shall provide a separate staging area and suitable containers for storage of coating and sealing products and related coating and sealing equipment.

d. The Contractor shall store all coating and sealing products indoors at an ambient temperature less than 86˚F and avoiding direct UV radiation.

e. All products shall be used within the manufacturer's recommended shelf life.

f. The Contractor shall dispose of used or leftover containers, thinners, rags, brushes, and rollers in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications and applicable federal, state, and local laws and regulations.

PART 3 EXECUTION

3.01 EARTHWORK

A. Earthwork required as part of sheet pile installation activities shall be performed in accordance with **Section 31 23 16** (Excavation, Trenching, and Material Management) and **Section 31 23 23** (Backfill and Compaction) of these Specifications.

B. Pre-excavation and pre-augering will be permitted.

3.02 COAL TAR EPOXY COATING OF SHEET PILE

A. Surface Preparation:

a. All surfaces to receive protective coatings shall be cleaned prior to application of coatings. The Contractor shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and/or on factory finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.

b. The Contractor shall prepare only those areas which will receive the first coat of the coating system on the same day as the first coating will be applied.

c. The Contractor shall prepare surfaces for each coating system in accordance with the SSPC surface preparation specifications listed in Paragraph 1.03D of this Specification Section. If grease or oils are present on the piling surface, SSPC SP 1 must precede any other surface preparation method specified.

d. The Contractor shall remove all surface irregularities such as weld spatter, burrs, or sharp edges, prior to surface preparation. All sharp edges shall be rounded or chamfered, and all burrs, surface defects, and weld splatter shall be ground smooth prior to blast cleaning.

e. The abrasive blasting surface shall be prepared in accordance with the coating manufacturer's recommendations for the intended service.

f. The type and size of abrasive shall be selected to produce a surface profile that meets the system sheet requirements for the particular coating and service conditions. Abrasives shall be clean, hard, sharp cutting crushed slag. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

g. The Contractor shall comply with all applicable federal, state, and local air pollution control regulations for blast cleaning.

h. For air blast cleaning, compressed air shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of contaminants.

i. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another method prior to painting.

j. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

k. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

l. Cleaned surfaces shall be inspected by the Engineer prior to application of the first coat.

m. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

B. Coating Application:

a. The Contractor shall apply coatings in accordance with the coating manufacturer's instructions and recommendations. Materials shall be thoroughly stirred, strained, and kept at uniform consistency during application. Coatings manufactured by different manufacturers is prohibited.

b. The Contractor shall use properly designed brushes, rollers, and spray equipment for all coating applications.

c. The Contractor shall apply the coating system in accordance with the coating manufacturer’s instructions and recommendations and apply a minimum of two coats. The time between application of the first coat and the second coat shall be in strict accordance with the coating manufacturer’s specifications.

d. The first coat shall be applied to yield a dry film thickness of 8 to 10 mils. The second coat shall be applied so that the total dry film thickness of the two coats shall be a minimum of 16 mils.

e. Each coat shall be inspected by the Engineer prior to application of the next succeeding coat.

f. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

C. Environmental Conditions:

a. Atmospheric temperature must be 50 degrees Fahrenheit or higher during coating application, unless otherwise approved in writing by the coating manufacturer. The Contractor shall not apply coatings when inclement weather or freezing temperatures may occur during the curing time interval.

b. For exterior applications, wind velocities shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's specified limits.

c. Relative humidity must be less than 90% and the temperature of the surface to be painted must be at least 60 degrees during coating application, unless otherwise approved in writing by the coating manufacturer.

d. The Contractor shall provide adequate ventilation in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value specified on the manufacturer's SDS for the specific coating(s) being applied.

e. Recoat Time: In the event a coating has exceeded its recoat time limit, prepare the previously applied coating in accordance with the manufacturer's recommendations.

D. Protection:

a. The Contractor shall cover or otherwise protect surfaces not to be painted. Protective materials shall only be removed when appropriate.

b. The Contractor shall provide covers or shields to prevent surface preparation media and coatings from entering orifices in electrical or mechanical equipment. Where ventilation systems must be kept in operation at time of surface preparation, take precautions to shield intakes and exhausts to prevent the materials from entering system or being dispersed.

c. The Contractor shall provide signs to indicate fresh paint areas.

d. The Contractor shall provide daily cleanup of both storage and working areas and remove all paint refuse, trash, rags, and thinners. Leftover containers, thinners, rags, brushes, and rollers that cannot be reused shall be disposed in accordance with applicable federal, state, and local laws and regulations and **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications.

E. Inspection:

a. The Contractor shall provide and use a wet-film gauge to check each coating application approximately every 15 minutes in order to immediately correct film thickness under or over that specified in this Specification Section.

b. After each application, the Engineer will inspect the piling surface and measure film thickness once per approximately every 25 square foot area of finished piling. If film thickness is greater than or less than the thickness specified above, the rate of sub-measurement will be increased as required to determine the extent of the deficient area.

c. The Contractor shall remove and repair coatings that do not meet the thickness requirements specified above in accordance with these Specifications and to the satisfaction of the Engineer.

F. Cleaning and Repairs:

a. The Contractor shall remove any spilled, dripped, or splattered paint from piling surfaces.

b. The Contractor shall touch-up, repair and restore any prepared surfaces or damaged coats or finishes to the satisfaction of the Engineer.

3.03 SHEET PILE INTERLOCK SEALING

A. The sealant shall be installed at the mill or at the site by an authorized installer in accordance with the sealant manufacturer's recommendations.

B. The interlocks shall be clean, dry, and free of grease at the time of sealant application. The "rolling skin" clinging to new steel sections, which partially consists of grease and oil, shall be removed by means of a rotating brush.

C. The Contractor shall clean the interlocks using compressed air, a steel wire brush, and/or high-pressure water jet as appropriate.

D. The sealant shall be heated uniformly in an indirect oilfired thermostatic controlled cooker within the temperature range recommended by the sealant manufacturer. During the heating phase the casting compound shall be stirred at regular intervals. Overcooked sealant shall not be used and shall be disposed of in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications and applicable federal, state, and local regulations.

E. The sealant shall not be melted more than twice.

F. The ambient temperature shall be higher than the minimum temperature recommended by the manufacturer at the time of application; if the ambient temperature is lower than the minimum recommended temperature, sealant can be modified in accordance with the Manufacture's recommendations.

G. The ends of the interlocks shall be sealed by means of a mastic to prevent the hot liquid product from flowing out of the interlocks.

H. During the cold season, steel sections shall be always first be slightly preheated with a torch in order to avoid a cold shock prior to application of sealant.

3.04 SHEET PILE PLACEMENT

A. Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings.

B. Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous wall throughout the length or run of piling wall.

C. Pilings shall be carefully located as shown in the Engineering Drawings. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line.

D. The pile shall be placed so the face will not be more than six (6) inches from vertical alignment at any point. Top of pile at elevation of cut-off shall be within 1/2 inch horizontally and two (2) inches vertically of the location indicated.

E. Manipulation of piles to force them into position will not be permitted.

F. The Contractor shall check all piles for heave and re-drive all heaved piles to the required tip elevation.

G. The Contractor shall provide temporary wales, templates, master pilings or guide structures to ensure that the pilings are placed and driven to the correct alignment.

   a. The Contractor shall use a system of structural framing sufficiently rigid to resist lateral and driving forces and to adequately support the sheet piling until design tip elevation is achieved.

   b. The Contractor shall use two templates, at least, when placing each piling. Templates shall not move when supporting sheet piling.

H. The Contractor shall provide outer template straps or other restraints as necessary to prevent the sheets from warping or wandering from the alignment. The template shall be marked for the location of the leading edge of each alternate sheet pile. If in view, the Contractor shall also mark the second level to assure that the piles are vertical and in position. If two guide marks cannot be seen, other means shall be used to keep the sheet pile vertical along its leading edge.

3.05 SHEET PILE DRIVING

A. The Contractor shall drive pilings with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

B. The Contractor shall maintain driving hammers in proper alignment during driving operations by use of leads or guides attached to the hammer. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock-melt or damages.

C. The Contractor shall discontinue the use of vibratory hammers and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute.

D. The Contractor shall employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. The Contractor shall use cast steel shoe to prevent damage to the tip of the sheet piling. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense.

E. Before commencing the driving of the final five (5) feet, the Contractor shall firmly seat the pile in place by the application of a number of reduced energy hammer blows.

F. The Contractor shall take adequate precautions to ensure that pilings are driven plumb. Where possible, the Contractor shall drive Z-pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet.

G. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall, the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1/8 inch per foot of length.

H. Pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. The Contractor shall incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than four (4) feet below that of any adjacent sheet pile.

I. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile shall not be more than two (2) feet below any adjacent sheet pile.

J. If the piling next to the one being driven tends to follow below final elevation, it may be pinned to the next adjacent piling.

K. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical, the Contractor shall make changes in the design alignment of the piling structure to ensure the adequacy and stability of the structure.

L. Pre-augering or spudding of piles may be used.

3.06 VIBRATION MONITORING

A. The Contractor shall place one seismograph near each subsurface utility line identified as a result of the Contractor's subsurface utility survey (refer to Specification Sections 01 35 29 – Health and Safety and 02 01 00 - Maintenance and Protection of Existing Conditions) to monitor vibration during pile driving. The seismograph shall be placed where the utility is the closest to pile driving location.

B. The Contractor shall perform pile driving such that vibrations in adjacent utilities are minimized and the peak particle velocity (PPV) measured at the seismographs placed on the utilities is less than 2 inches per second.

C. The Contractor shall immediately stop pile driving operations if the PPV reaches or exceeds 2 inches per second or damage to existing utilities is observed. The Contractor shall modify means and methods for pile driving operations to reduce vibration and meet PPV threshold. Any damage to existing utility lines shall be promptly repaired by the Contractor as directed by the Engineer at no additional cost to the Owner.

D. The Contractor shall provide a copy of the vibration monitoring data to the Engineer within 5 days after the completion of pile driving.

3.07 BEARING ELEVATION

A. The sheet piles shall be driven to the bearing elevation indicated in the Engineering Drawings or practical refusal as approved by the Engineer. A practical refusal is achieved if all of the following criteria are met:

a. Five blows are recorded to produce a total penetration length of ¼ inch or less.

b. The refusal occurs within 3 inches from the top of the rock as indicated in the Engineering Drawings.

The hammer shall be operated at the manufacturer's recommended stroke and speed when the blow counts are recorded.

3.08 CUTTING-OFF AND SPLICING

A. Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation.

B. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed at no additional cost to the Owner.

C. If directed by the Engineer, the Contractor shall splice pilings as required to drive them to depths greater than shown in the Engineering Drawings and extend them up to the required top elevation.

D. Pilings adjoining spliced pilings shall be full length unless otherwise approved by the Engineer. Splicing of pilings shall be as indicated:

a. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber.

b. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks.

c.Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings.

E. The tops of pilings excessively battered during driving shall be trimmed when directed, at no cost to the Owner. Piling cut-offs shall become the property of the Contractor and shall be removed from the site.

F. Holes shall be cut in pilings for bolts, rods, drains or utilities in a neat and workmanlike manner, as shown in the Engineering Drawings and/or as directed by the Engineer. The Contractor shall use a straight edge in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods, utilities and other items to be inserted through the wall and shall be booted as shown in the Engineering Drawings. The Contractor is prohibited from using explosives for cutting.

3.09 INSPECTION OF DRIVEN PILING

A. The Contractor shall perform continuous inspection during pile driving.

B. The Contractor shall inspect all piles for compliance with tolerance requirements. Any unusual problems which may occur shall be brought immediately to the attention of the Engineer.

C. The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.10 PULLING AND REDRIVING

A. The Contractor shall submit to the Engineer the proposed method of pulling sheet piling prior to pulling any piling.

B. The Contractor shall pull selected pilings after driving to determine the condition of the underground portions of pilings. Any piling so pulled and found to be damaged, to the extent that its usefulness in the structure is impaired, shall be removed and replaced at the Contractor's expense.

C. Pilings pulled and found to be in satisfactory condition shall be re-driven as directed by the Engineer.

D. The method of pulling piling shall be approved by the Engineer. Extractors shall be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Engineer determines that adjacent permanent construction has been damaged during pulling, the Contractor will be required to repair this construction at no cost to the Owner.

E. The Contractor shall pull pilings one sheet at a time.

F. Pilings fused together shall be separated prior to pulling, unless the Contractor demonstrates, to the satisfaction of the Engineer, that the pilings cannot be separated. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

END OF SECTION

SECTION 31 56 00

ZERO-VALENT IRON PERMEABLE REACTIVE BARRIER

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to construct a zero-valent iron (ZVI) permeable reactive barrier (PRB) and a ZVI treatment zone at the locations shown in the Engineering Drawings and conforming to the lines, grades, thicknesses, and typical cross sections shown on the Engineering Drawings and as specified herein.

B. The PRB and ZVI treatment zone shall be installed by a contractor with at least five (5) years of prior experience in successful PRB projects of similar or larger size and with utilizing ZVI as the treatment material.

C. All construction shall be performed in conformance with **Section 31 23 16** (Excavation, Trenching, and Material Management) of these Specifications.

D. All work by the Contractor shall be performed in accordance with the permits procured by the Owner and all applicable local, State, and Federal rules and regulations.

E. Temporary soil erosion and sediment control measures in accordance with Section **01 57 13** (Soil Erosion and Sediment Control) of these Specifications and as shown in the Engineering Drawings shall be in place prior to initiating construction of the PRB and ZVI treatment zone.

1.02 SUBMITTALS

A. At least 10 days before mobilization, the Contractor shall submit for the Engineer's use:

a. A minimum of 10 lbs of the proposed ZVI.

b. A minimum of 10 lbs of the proposed sand.

B. The Contractor shall submit an Implementation Plan for general review and approval to the Engineer a minimum of two weeks prior to the start of construction. The Implementation Plan shall at a minimum include:

a. The qualifications of the Specialist who will supervise the construction and quality control of the PRB and ZVI treatment zone, documenting at least five (5) years of experience and/or five (5) projects in successful construction of PRBs, with at least two (2) successful PRB projects of similar size or larger during the past ten (10) years.

b. The name, key contact, and qualifications of the off-site quality control laboratory. The laboratory shall have previous experience with the PRB and

ZVI materials, experienced laboratory technicians, and the required quality control testing equipment.

c. A work plan for construction of the PRB and ZVI treatment zone, including details on the proposed means and methods, equipment specifications, and schedules.

d. Plans showing equipment set-up and site use layout including storage areas, and work platform dimensions, as applicable.

e. Procedures for transportation and delivery of the proposed backfill materials.

f. Procedures for dosing, mixing and ensuring the homogeneity of the proposed ZVI backfill materials.

g. Procedures for trench excavation and backfilling.

h. Procedures for excavation shoring and/or dewatering, if necessary (refer to **Section 31 23 16** – Excavation, Trenching, and Material Management of these Specifications).

i. Procedures for excavated material management.

j. Procedures for clean-up.

C. At least two weeks prior to initiating construction, the Contractor shall submit the following for approval by the Engineer:

a. Material properties, composition (including gradation and carbon content), sources, and manufacturer's certificates of quality for the proposed ZVI to be used in the ZVI backfill;

b. Laboratory results for the tests listed in Table 1 below to be performed on the proposed ZVI.

c. Material properties, sources, and source's certificates of quality for the proposed sand to be used in the ZVI backfill (refer to Paragraph 2.03 of this Specification and **Section 31 23 23** – Backfilling of these Specifications);

d. Laboratory results for the tests listed in Table 1 below to be performed on the proposed sand.

e. Laboratory results for the tests listed in Table 1 below to be performed on the proposed ZVI backfill.

Table 1 – Premobilization Testing Requirements on PRB Materials

Matrix	No. Samples	Test	Method
ZVI	3	Sieve analysis	ASTM C136
		Chemical Composition	Note 1.
		Carbon content	Note 1.
Sand	3	Sieve analysis	ASTM C136
ZVI Backfill	3	Sieve analysis	ASTM C136
		Hydraulic conductivity	ASTM D2434 (Note 2)
		Carbon content	ASTM D2974
		Percent Iron	Note 3.

Notes
1. The chemical composition and carbon content to be provided by the ZVI manufacturer.
2. ZVI Backfill sample for hydraulic conductivity testing shall be prepared by rodding or compacting the material into the test mold/device in a manner that replicates full-scale placement.
3. Percent Iron testing shall be conducted via magnetic testing.

D. The Contractor shall submit a Quality Control Plan detailing personnel, responsibilities, inspections, and organization for ensuring the quality of construction required by these specifications. The plan shall define, at a minimum:

a. sample collection methods and frequencies;

b. testing methods and frequencies;

c. minimum or maximum acceptable values in conformance with these specifications; and

d. draft quality control forms to be used during implementation.

E. The Contractor shall submit the Manufacturer's Certificate of Compliance for each lot of ZVI delivered to the site.

F. During progress of the work, the Contractor shall submit the following reports:

a. Daily reports documenting the following by noon of the day following the date of the report:

i. Field test results and records of sounds taken during construction including the depth of the trench and backfill slope obtained each morning and evening. The soundings shall be used to generate an as-built profile of the trench, as constructed.

ii. A record of ZVI backfill material quantities, properties, and mix adjustments made during construction.

iii. Location of sample and number of samples collected for laboratory testing shall be noted.

iv. A record of quality control samples, tests and test results.

b. Laboratory test results shall be submitted within two (2) days of receipt of the report from the laboratory. Final reports shall be submitted within two (2) weeks of the completion of work.

G. The Contractor shall submit a scaled drawing providing a log of the subsurface materials excavated from each trench, and a profile of the completed PRB and ZVI treatment zone.

H. Within thirty (30) days of completing all field activities, the Contractor shall submit a final report detailing mix proportions, testing data, daily logs, and all quality control records as specified herein. The report shall include as-built surveys and drawings, including profiles, showing the actual elevations, depths and alignment of the completed PRB and ZVI treatment zone.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

a. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

b. ASTM D 2434 – Standard Test Method for Permeability of Granular Soils (Constant Head)

c. ASTM D 2974 – Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

d. ASTM D 4972 – Standard Test Method for pH of Soils

B. Code of Federal Regulations (CFR)

a. CFR 1926.800 – Underground Construction

1.04 DEFINITIONS

A. Ground Water Level is the piezometric level of the ground water as determined from piezometers and wells.

B. Reactive material is a homogeneous mixture of material produced by mixing sand with ZVI, which is placed into an excavated trench to complete the treatment zone.

C. Reactive media refers to dry granular ZVI material.

D. Specialist is an individual who has had proven and successful experience in PRB construction and is knowledgeable of: (1) the proper methods employed to prepare ZVI backfill materials, (2) PRB construction equipment, (3) trench excavation and backfill operations, and (4) PRB quality control testing.

E. Working Surface or Working Platform is the top of the surface from which the PRB and ZVI treatment zone shall be constructed.

F. Zero-Valent Iron (ZVI) backfill is a homogeneous mixture produced by mixing ZVI and sand, which is placed into the excavated trench to complete the PRB and ZVI treatment zone.

1.05 Quality Assurance

A. The Owner and/or the Engineer may perform quality assurance testing on representative samples obtained by the Contractor of the ZVI backfill.

B. The quality assurance testing will in no way relieve the Contractor of the responsibility of performing tests necessary to meet the Construction Quality Control (CQC) requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. The Contractor shall protect all products and materials from moisture, dirt, dust or other contaminants, spillage and deterioration during transit and storage.

B. For each shipment of materials, the Contractor shall provide written certification of compliance from the manufacturer verifying that the materials meet the requirements of this Specification and supplier’s certified weight.

C. Any materials not meeting this Specification shall be promptly removed from the Site, and replaced with materials conforming to these requirements at the Contractor's expense.

D. Materials shall originate from a single source capable of producing and delivering uniformly acceptable product that meets the requirements of this Specification.

2.02 ZVI

A. The ZVI shall be CC-1190 as manufactured by Connelly-GPM, Inc., or an Engineer-approved equivalent.

B. Iron shall be more than 95% iron/iron oxide (Fe0) by weight and have at least 2% total carbon, with a minimal oxide coating, and no hazardous levels of trace metal impurities.

C. Iron shall not have residual cutting oils or grease.

D. The ZVI shall have a gradation conforming to the following:

Table 2 – ZVI Gradation Requirements

Screen Size (U.S. Standard)	Percent Passing
8	100%
16	98.5-100%
30	45-80%
50	15-40%
100	0-20%
200	0-10%

2.03 SAND

A. The sand shall be subjected to the required geotechnical and analytical testing for imported material prior to delivery to the site in accordance with **Section 31 23 23** – Backfilling of these Specifications.

B. The sand shall be a washed silica sand conforming to the following gradation:

Table 3 – Sand Gradation Requirements

Screen Size (U.S. Standard)	Percent Passing
16	100%
30	45-80%
50	15-40%
100	0-20%
200	0-1%

2.04 ZVI BACKFILL

A. The ZVI backfill for the PRB shall consist of a minimum of 35% ZVI and up to 65% sand by volume.

B. The ZVI backfill for the ZVI treatment zone shall consist of a minimum of 20% ZVI and up to 80% sand by volume.

C. The saturated hydraulic conductivity of the ZVI backfill for both the PRB and ZVI treatment zone shall not exceed 1×10^{-3} cm/sec.

PART 3 EXECUTION

3.01 GENERAL

A. The PRB and ZVI treatment zone shall be constructed from the working surface.

B. The PRB and ZVI treatment zone shall be constructed to the elevations, lines, grades, and cross-sections shown and in accordance with these specifications and the Engineering Drawings, unless otherwise directed by the Engineer.

a. The PRB and ZVI treatment zone shall have essentially vertical walls (i.e., within two percent (2%) of vertical) and shall extend to the bottom elevation shown in the Engineering Drawings.

b. The alignment of the PRB and ZVI treatment zone shall follow the alignment shown in the Engineering Drawings within 1 foot of the centreline.

c. The Engineer may modify the dimensions and alignment of these features as determined necessary in the field.

C. An as-built profile of each trench bottom and ZVI backfill slopes, including descriptions of materials encountered in the trench bottom, shall be continuously maintained. This profile shall indicate the extent of excavation and the ZVI backfill profile at the end of each work day.

D. While these Technical Specifications consider PRB construction using supported or unsupported excavations, the Contractor may propose alternative methods, such as, but not limited to, hydraulic/biopolymer (biodegradable slurry) or continuous trenching. Details on these alternate methods shall be submitted to the Engineer for approval.

E. The Contractor’s PRB installation equipment shall have the capability to excavate at least 3 feet deeper than the maximum depth shown on the plans and the excavating tool shall have a width equal to or greater than the specified minimum width of the PRB.

F. Over-excavation will be allowed for overlaps of the PRB; however, the Contractor shall minimize the extent of over-excavation beyond the centerline of the trench to the extent practicable.

G. Construction will not be permitted when the air temperature is below 20ºF or when severe weather conditions may compromise the quality of the work.

3.02 ZVI BACKFILL PREPARATION

A. The Contractor shall prepare the ZVI backfill in a controlled manner using mixing equipment capable of thoroughly mixing the ZVI and sand into a homogeneous blend having the required gradation and properties. The mixing equipment shall have the means for precision weight measurement and metering to ensure the minimum ZVI dosage is applied and that a homogeneous ZVI backfill mixture is created.

B. The Contractor shall mix the ZVI backfill in batches of less than 20 CY that meet or exceed the minimum iron content by weight.

C. The ZVI backfill shall be mixed in a location approved by the Engineer.

D. Backfill material containing frozen lumps shall not be used to mix ZVI backfill.

E. Prior to placement, the percent iron content will be field verified.

F. A Mix Log conforming to the requirements of this Specification shall be completed by the Contractor for every batch of ZVI backfill.

3.03 PRB TRENCHING

A. Trenching for the PRB and ZVI treatment zone shall be performed in accordance with **Section 31 23 16** (Excavation, Trenching, and Material Management) of these Specifications.

B. If warranted, temporary shoring and dewatering of the excavation shall conform to the requirements of **Section 31 23 16** (Excavation, Trenching, and Material Management) of these Specifications.

C. The Contractor shall provide a vertical continuous three (3) foot minimum width trench to the required depth along the centerline of the alignment.

D. Excavation shall allow inspection and measurement immediately after completion and prior to backfilling.

E. At a minimum, the trench bottom shall be cleaned at the start of each work day and prior to placement of ZVI backfill. If ZVI backfill placement operations have ceased for longer than 24 hours, the face of the ZVI backfill slope shall be cleaned prior to the placement of additional ZVI backfill.

F. The trench bottom shall be probed for any deposits or sloughed materials prior to cleaning. Any loose material, debris or cuttings shall be removed from the bottom of the trench with the excavation tools or other suitable means such as air lift pumps. The Contractor shall ensure that cleaning equipment will not remove material from the sidewalls of the trench.

G. After the trench bottom has been cleaned, the Contractor shall collect a sample of the trench bottom with a drive tube sampler. After visually examining the samples, the Engineer will either approve the trench at the points checked or require additional cleaning to remove any deposits or sloughed materials. If additional cleaning is required, then additional samples shall be collected and inspected.

H. The trench shall be sounded immediately before placing the ZVI backfill in accordance with Paragraph 3.06 of this Specification.

I. If the trench excavation overlaps into previously completed ZVI PRB, the excavation shall extend a minimum of three (3) feet into the previously placed ZVI backfill at all depths.

J. Any removed section of completed ZVI PRB shall be refilled with ZVI backfill at no additional expense to the Owner.

K. Material excavated from the trench shall be managed and disposed off-site in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications.

3.04 ZVI BACKFILL PLACEMENT

A. Initial ZVI backfill placement shall be by one of the following methods:

   a. Placement by lowering ZVI backfill material to the bottom of the trench with crane and clamshell bucket;

   b. Placement or injecting from the bottom of the trench up using a tremie pipe.

   c. Constructing a lead-in trench 1H:1V or flatter at a point outside of the limits of work to allow a ZVI backfill face to form prior to reaching the full depth of the required slurry trench.

B. Free dropping of ZVI backfill shall not be permitted.

C. No payments will be made for the portions of trenches which lie outside of the limits of work.

D. ZVI backfill shall be placed in a manner that minimizes or prevents, to the extent practicable, backfill material bridging. The Contractor shall place the ZVI backfill in lifts that do not exceed two feet in thickness and shall periodically verify the thickness of material place in each lift.

E. Placement operations shall proceed in such a manner that the slope of the initially placed ZVI backfill is maintained. The ZVI backfill shall be placed so that it will slide down the forward face of the ZVI backfill slope. The ZVI backfill shall be placed in the excavated trench so that a constant slope is maintained. Placement shall be continuous from the beginning of the trench in the direction of the excavation to the end of the trench.

F. During ZVI backfill placement, the Constructor shall install a monitoring well within the PRB and ZVI treatment zone. This well shall be constructed as detailed in the Engineering Drawings and shall not include a filter pack.

3.05 CONSTRUCTION QUALITY CONTROL

A. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material.

B. Soundings shall be taken every 5 feet along the trench centerline prior to backfill placement using a weighted tape, cable or other device. Soundings shall be recorded to the nearest 0.5 foot. Soundings shall record the following:

a. The bottom elevation of the trench, which shall conform to the requirements of the Engineering Drawings.

b. The bottom elevation of the excavation immediately prior to placing the ZVI backfill and converted to an as-built drawing. Soundings and this drawing shall be reviewed daily and compared to prior soundings to verify the bottom elevation and the potential for sidewall collapse and/or accumulation of sediments.

c. The ZVI backfill slope and profile and trench bottom shall be sounded and converted to an as-built drawing. Soundings and this drawing shall be reviewed daily and compared to prior soundings to prior soundings the potential for trench collapse, excessive settlement or sloughing.

d. The thickness of the ZVI backfill lift.

C. The Contractor shall maintain and update an as-built profile drawing of the trench bottom and backfill slope, indicating the extent of excavation and backfill at the end of each working day.

D. The Contractor shall measure, record and report to the Engineer the weight of sand and ZVI mixed to create every batch. These measurements shall be made as part of the ZVI backfill mixing process using precision weight measurement and metering equipment.

E. The Contractor shall conduct the tests listed in Table 4 on the ZVI backfill.

Table 4 – ZVI Backfill Quality Control Testing Requirements

Matrix	Frequency	Test	Method
ZVI Backfill	Every batch	Sieve analysis	ASTM C136
		Hydraulic conductivity	ASTM D2434 (Note 1)
		Percent Iron	Note 2.

Notes 1. ZVI Backfill sample for hydraulic conductivity testing shall be prepared by rodding or compacting the material into the test mold/device in a manner that replicates full-scale placement.
Note 2. Percent Iron testing shall be conducted via magnetic testing.

F. The Contractor shall determine the percent iron in the ZVI backfill using the magnetic test. The initial gross weight of the previously dried ZVI backfilll sample will be measured, following exposure to a ferrous magnet the net weight of non-magnetized particles will be measured. Percent iron will be calculated as the net weight of non-magnetized particles divided by the total bulk weight subtracted from 1.

G. The Contractor shall prepare and submit to the Engineer a Mix Log for evert batch of ZVI backfill produced. The Mix Log shall include the following information: project name; equipment used for mixing; personnel operating equipment; weight of iron fraction in mix; weight of sand fraction in mix; treatment mix batch identifier; name of representative sample associated with treatment mix batch; date and time the sample was collected; date and time the sample was field tested for percent iron; the percent iron test result and an indication of whether the mixture passed or failed; the name of the individual conducting the percent iron testing; and logger's name.

H. The Contractor shall perform hydraulic pulse interference tests prior to and after PRB construction to verify that the hydraulic conductivity of the surrounding formation has not been reduced.

I. The Contractor shall perform geophysical imaging tests or inclined profiling using a driven electrical conductivity probe along the entire length of the PRB and ZVI treatment zone to verify their width and depth.

J. Results of all tests performed shall be recorded on the approved forms and signed by the Engineer.

K. Copies of all quality control documents shall be submitted with the Contractor's daily reports, including identification of where samples for laboratory testing were collected from.

END OF SECTION

SECTION 32 12 16

MILLING AND PAVING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to mill and repave the designated areas shown in the Engineering Drawings to conform to the lines, grades, thicknesses, and typical cross sections shown on the Engineering Drawings and as specified herein.

B. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to reconstruct the pavement over excavated areas in the designated areas shown in the Engineering Drawings to conform to the lines, grades, thicknesses, and typical cross sections shown on the Engineering Drawings and as specified herein.

C. Milled or excavated asphalt materials shall be transported to a licensed asphalt recycling facility.

D. All materials used for paving shall follow qualifications as specified in the Engineering Drawings and this section.

1.02 SUBMITTALS

A. Prior to mobilization, the Contractor shall submit a detailed plan of operation to the Engineer for approval that includes the following:

a. Number, type, and model of equipment.

b. Method of locating and maintaining joint locations if sawing and sealing.

c. Manufacturer’s recommendations for heating and applying joint sealant.

d. Manufacturer’s recommended laydown temperature for modified binders.

e. Paving sequence. Ensure that the HMA surface course is constructed for the full width of the traveled way as a single paving operation.

f. Schedule, hours of operation, and production rates.

g. Plant locations.

h. Method of maintaining HMA temperature during transportation.

i. Method of constructing and compacting joints as specified in Section 402-3.09 of the New York State Department of Transportation (NYSDOT) Standard Specifications.

j. Quality control plan outlining the use of the thin lift nuclear density gauge, quality control cores, and the control of the compaction process, and including:

i. Qualifications of the Field Quality Control Technician that will perform all

Quality Control sampling, testing and inspection. The Field Quality Control Technician shall be certified as a HMA Paving Inspector as certified by the Northeast Transport Training and Certification Program (NETTCP).

ii. Identification of the Quality Control testing laboratory, which shall be qualified through the NETTCP Laboratory Certification Program (LCP) or accredited through the AASHTO Accreditation Program (AAP).

B. The Contractor shall submit to the Engineer samples of aggregates and asphalt binder, together with the manufacturer's Certification of Compliance for the asphalt binder.

C. The Contractor shall submit to the Engineer a mix design including a job mix formula (JMF) for each mixture. The mix design shall include a statement naming the source of each component and a report showing that the results conform to the criteria specified in Section 401-2 of the NYSDOT Standard Specifications. The Contractor shall not use materials without prior written authorization from the Engineer.

D. The Contractor shall submit qualification data for the asphalt and joint-sealant manufacturers to the Engineer.

E. The Contractor shall submit measurements of the existing pavement profile in areas where pavement is removed from designated areas shown in the Engineering Drawings to allow construction of the Permeable Reactive Barrier.

F. The Contractor shall submit copies of quality control test results to the Engineer as soon as available.

G. Surveys shall be performed immediately after milling and paving to document as-built conditions. Surveys shall be performed in accordance with **Section 02 21 00** (Surveying) of these Specifications.

H. The Contractor shall submit to the Engineer copies of all fully executed manifests for all milled materials disposed off-site.

1.03 REFERENCES

<u>American Association of State Highway and Transportation Officials (AASHTO)</u>

AASHTO M 140 (2016)	Standard Specification for Emulsified Asphalt
AASHTO M 208 (2016)	Standard Specification for Cationic Emulsified Asphalt
AASHTO M 320 (2017)	Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 90 (2016)	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 176 (2013)	Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T 209 (2012)	Standard Method of Test for Theoretical Maximum

	Specific Gravity (Gmm) and Density of Hot-Mix Asphalt (HMA)
AASHTO T 245 (2015)	Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
AASHTO T 304 (2017)	Standard Method of Test for Uncompacted Void Content of Fine Aggregate

American Society for Testing and Materials (ASTM)

ASTM C 136/C 136M	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1188	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
ASTM D 2041/D 2041M	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2726/D 2726M	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
ASTM D 2950/D2950M	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3549/D3549M	Standard Test Method for Thickness of Height of Compacted Bituminous Paving Mixture Specimens
ASTM D 4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

Asphalt Institute

AI MS-22	Construction of Hot Mix Asphalt Pavements

New York State Department of Transportation (NYSDOT) Standard Specifications

Section 400	Hot Mix Asphalt
Section 401	Plant Production
Section 402	Hot Mix Asphalt (HMA) Pavements
Section 407	Tack Coat
Section 490	Cold Milling
Section 702	Bituminous Materials
Section 703	Aggregates

NYSDOT Materials Bureau

MM 5.16 (2012)	Hot Mix Asphalt (HMA) Mixture Design and Mixture Verification Procedures

1.04 DEFINITIONS

(Reserved)

PART 2 - PRODUCTS

2.01 COLD-MILLIING EQUIPMENT

A. The cold-milling machine shall be self-propelled, capable of milling the pavement to a specified depth and smoothness and of establishing grade control; with means of controlling transverse slope and dust produced during the pavement milling operation.

B. The machine shall have the ability to remove the millings or cuttings from the pavement and load them into a truck.

C. The milling machine shall not cause damage to any part of the pavement structure that is not to be removed.

2.02 TACK COAT

A. Tack coat used for paving shall be in compliance with Sections 407 and 702 of the NYSDOT Standard Specifications.

B. Tack coat shall consist of emulsified asphalts of the rapid-setting (RS), medium-setting (MS), and slow-setting (SS) types conforming to AASHTO M 140 or cationic emulsified asphalts of the rapid-setting (CRS), medium-setting (CMS), and slow-setting (CSS) types conforming to AASHTO M 208.

2.03 HOT MIX ASPHALT

A. HMA mixture shall be in compliance with the NYSDOT Standard Specifications and NYSDOT's Materials Method 5.16 – Hot Mix Asphalt (HMA) Mixture Design and Mixture Verification Procedures.

B. Composition of the mixture for HMA surface course is coarse aggregate, fine aggregate, and asphalt binder, and may also include mineral filler and Reclaimed Asphalt Pavement (RAP).

C. HMA shall contain less than 20 percent Reclaimed Asphalt Pavement (RAP) by weight of the total mixture.

D. HMA shall not contain Crushed Recycled Container Glass (CRCG).

2.04 AGGREGATES

A. Fine aggregate shall consist of materials conforming to the requirements of Section 703-01 of the NYSDOT Standard Specifications.

B. Coarse aggregate shall consist of crushed stone or crushed gravel conforming to Section 703-02 of the NYSDOT Standard Specifications.

C. Mineral filler shall be free from lumps and foreign materials, and shall conform to Section 703-08 of the NYSDOT Standard Specifications.

D. The combined aggregate gradation shall conform to the Design Control Points included in Table 1 of NYSDOT's Materials Method 5.16.

E. The combined coarse aggregate, when tested according to ASTM D 4791, shall be less than 10 percent flat and elongated pieces retained on the 9.5 mm sieve and larger. The aggregate shall be measured using the ratio of 5:1, comparing the length (longest dimension) to the thickness (smallest dimension) of the aggregate particles.

F. The combined fine aggregate in the mixture shall conform to the following requirements:

Test	**Test Method**	**Percent**
Uncompacted Void Content of Fine Aggregate	AASHTO T 304, Method C	40 (min)
Sand Equivalent	AASHTO T 176	45 (min)
Flat-and-Elongated Particles	ASTM D 4791	10 (max)

2.05 ASPHALT BINDER

A. Asphalt binder for HMA shall conform to standards specified in Section 702 of the NYSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 GENERAL

A. The HMA course shall be prepared, installed, and compacted in accordance with Section 402 of the NYSDOT Standard Specifications.

B. The HMA shall not be placed upon a wet or excessively damp surface or when the following conditions are not met:

a. Tack Coat: Minimum surface temperature of 40 degrees Fahrenheit.

b. Asphalt Surface Course: Minimum surface temperature of 50 degrees Fahrenheit at time of placement.

C. The Contractor may resume operations when the precipitation has stopped and the surface is free of water.

D. The Contractor shall field-verify existing grades and elevations prior to beginning paving activities in accordance with **Section 02 21 00** (Surveying) of these Specifications. The Contractor may not proceed with paving activities until approval of the compacted subgrade by the Engineer has been provided.

3.02 EXISTING PAVEMENT REMOVAL

A. The Contractor shall saw cut the perimeter of the pavement area to be excavated to allow for construction of the PRB and excavate the existing pavement section to a sound base.

B. Cuts shall be rectangular and extend 12 inches into adjacent sound pavement. The cut face shall be vertical.

C. The Contractor shall define the profile of the existing pavement to define the thickness of the asphalt surface, base course and subbase course during the excavation of pavement surfaces (refer to **Section 31 23 16** – Excavation, Trenching and Material Relocation).

D. Excavated materials shall be managed in accordance with **Section 31 23 16** (Excavation, Trenching, and Material Management).

3.03 GENERAL MILLING REQUIREMENTS

A. Milling of the existing asphalt surface shall be performed in accordance with Section 490 of the NYSDOT Standard Specifications.

B. Excessive dirt, clay, or other foreign material shall be cleaned and removed from the pavement surface immediately prior to cold milling the pavement. The Contractor shall provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface.

C. Milling shall not be performed when there is accumulation of snow or ice on the pavement surface.

D. The Contractor shall provide the necessary traffic controls during milling operations.

3.04 MILLING OPERATION

A. The Contractor shall mill the existing pavement surface to the specified depth, profile, and cross slope shown in the Engineering Drawings.

B. The milling shall proceed with care and in depth increments to ensure that only bituminous pavement is removed and base course is not disturbed. The

Contractor shall leave in place a ¼-inch thick layer of bituminous pavement over the undisturbed base course.

C. If HMA below the specified milling level becomes dislodged or delaminated, the Contractor shall remove and replace.

D. The Contractor shall make sufficient passes so that the designated area is milled to the grades and cross sections indicated in the Engineering Drawings.

E. Automatic grade controls shall be applied to control the line and grade of the milling machine. The Contractor shall employ either a stringline or ski reference system.

F. The Contractor shall replace teeth in the milling drum that become dislodged, broken, or unevenly worn.

G. The milled area shall be free from gouges, continuous grooves, ridges, and delaminated areas, and shall have a uniform texture consisting of discontinuous longitudinal striations. The striations shall not deviate more than one (1) inch in 200 feet from a line parallel to the center of the traveled way and do not exceed 3/8 inch in depth.

H. In areas inaccessible to the milling machine, the Contractor shall remove HMA with other equipment.

I. The Contractor shall repair or replace items damaged during milling such as manholes, valve boxes, utility lines, and pavement that is torn, cracked, gouged, broken, or undercut.

J. The milled material shall be removed from the pavement and loaded into trucks. Removed material shall have a minimum of 95 percent by weight passing a two (2) inch sieve when tested in accordance with ASTM C136, unless otherwise required by the licensed recycling facility.

K. The milled area shall be cleaned using a mechanical sweeper before opening to traffic and before subsequent construction or resurfacing.

L. If the milled area is opened to traffic prior to resurfacing, the Contractor will ensure that water can drain from the surface and does not become trapped. The edge must be slopped to provide a smooth transition from the milled surface to the remaining surface.

M. The milling operation, including removal of the milled material, shall be performed in a manner that prevents dust and other particulate matter from escaping into the air.

3.05 MILLING QUALITY ASSURANCE

A. The Contractor shall furnish and maintain at the site one 12 foot straightedge for testing the finished surface. Straightedges shall be in good condition, have handles and be constructed of aluminum or other lightweight metal, with blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy.

B. The Contractor shall check at least every 25 feet to ensure that the depth of milling is within 1/4 inch of the indicated grade line or elevation. Finished surfaces shall not deviate from the testing edge of a straightedge more than 1/4 inch in the transverse or longitudinal direction.

C. After completion of the final milling, the Contractor shall test the finished milled surface with the straightedge. The Contractor shall correct surface irregularities that depart from the testing edge by more than 1/4 inch. Skin patching for correcting low areas will not be permitted. The Contractor shall remove and replace the deficient low area by removing sufficient material to allow at least 1 inch of asphalt concrete to be placed.

3.06 MILLING MATERIALS MANAGEMENT

A. Asphalt millings removed from asphalt cap area shall be recycled at a licensed facility and managed in accordance with **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications.

3.07 PAVEMENT SECTION RECONSTRUCTION

A. The Contractor shall place fine aggregate material over the prepared subgrade in two (2) inch compacted lifts to match the total thickness of fine aggregate layer of the adjoining undisturbed pavement section.

B. The coarse aggregate material shall be placed in two (2) inch compacted lifts to match the total thickness of coarse aggregate layer of the adjoining undisturbed pavement section.

   a. The Contractor may add small quantities of fine aggregate material and/or water to the coarse aggregate material as needed to assist with compaction.

   b. Coarse aggregate layer shall be compacted to achieve a dry density of 110 pounds per cubic feet.

   c. Areas with excess water shall be reworked and aerated to reduce the moisture content before recompacting.

C. The surface shall be prepared and HMA placed in accordance with these specifications.

3.08 SURFACE PREPARATION

A. The underlying surface shall be cleaned of dust and debris immediately before placing the tack coat or HMA. The Contractor shall broom sweep areas prior to placement of tack coat or HMA.

B. Subbase shall be proof-rolled using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. The Contractor shall not dislodge or disturb aggregate embedded in compacted surface of base course.

D. The tack coat shall be applied in accordance with the Engineering Drawings, this section, and Section 407 of the NYSDOT Standard Specifications.

a. Immediately before beginning paving operations, the Contractor shall ensure that the surface is dry.

b. Tack coat or prime coat shall not be applied if the underlying surface is not dry or if weather conditions are not optimal (i.e., precipitation or temperatures below 40 degrees Fahrenheit).

c. The Contractor shall uniformly apply tack coat to existing pavement (including vertical surfaces abutting or projecting into new HMA paving) at a rate of 0.05 to 0.06 gallons/square yard and a temperature of 60 degrees Fahrenheit.

d. The Contractor shall apply tack coat only to areas to be paved in the same day.

e. Tack coat shall not be applied on curbs, gutters, manholes, and other similar structures. Exposed surfaces of these structures shall be cleaned and a uniform coating of polymerized joint adhesive shall be applied to contact surfaces before paving.

f. In areas inaccessible to distributor spray bars, the Contractor shall use hand spraying equipment for tack and prime coat.

g. Traffic shall not be allowed on tack coated or prime coated surfaces.

h. The Contractor shall correct uncoated or lightly coated areas, blot areas showing an excess of tack coat with sand or other similar material, remove blotting material before paving, and ensure that the material is not streaked or ribboned.

i. The tack coat shall be allowed to cure undisturbed to a condition that is tacky to the touch before HMA paving.

j. The Contractor shall avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. The Contractor shall remove spillages and clean affected surfaces.

3.09 TRANSPORTATION

A. The HMA shall be delivered using HMA trucks in sufficient quantities and at such intervals to allow continuous placement of the material.

B. The hauler shall submit to the Engineer a legible, signed and certified weigh ticket that includes the following information for each truck load:

a. Name and location of the HMA plant.

b. Project title.

c. Load time and date.

d. Truck number.

e. Mix designation.

f. Plant lot number.

g. Tare, gross, and net weight.

3.10 HMA PLACEMENT

A. HMA shall be placed over the prepared base in two (2) inch compacted layers to match the total thickness of the profile of the existing asphalt layer.

B. Before placing HMA, the Contractor shall ensure that the tack coat or prime coat has been placed as required and that the temperature of the screed on the HMA paver is heated to at least the laydown temperature of the HMA.

C. The Contractor shall ensure that the certified Field Quality Control Technician is present during paving operations.

D. HMA shall be applied in accordance with Section 402 of the NYSDOT Standard Specifications.

E. The Contractor shall place and compact the HMA at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated.

F. The Contractor shall construct paving courses in lifts of at least 4 times the nominal maximum aggregate size of the HMA being constructed.

G. When placing HMA, the Contractor shall ensure that the base temperature is at least 50 degrees Fahrenheit.

H. The Contractor shall regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The Contractor shall spread the HMA at a minimum temperature of 250 degrees Fahrenheit.

I. The Contractor shall place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required. After first strip has been placed and rolled, the Contractor shall place succeeding strips and extend rolling to overlap with previous strips.

J. Contractor shall promptly repair or correct surface irregularities in paving course behind the paver. The Contractor shall remove excess material forming high spots using hand tools and shall fill depressions using HMA to prevent segregation of the mix.

K. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the Contractor shall spread, rake and lute HMA with hand tools. For these areas, the Contractor shall dump, spread, and screed the HMA to obtain the required compacted thickness.

3.11 JOINTS

A. The formation of joints shall be performed ensuring a continuous bond between adjoining pavement sections. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness, density and grade.

B. Joints shall meet the following requirements:

a. Longitudinal joints, in successive courses, shall be offset a minimum of six (6) inches. The Contractor shall perform paving with the spring-loaded end plates of the paver in the "down" position.

b. Transverse joints, in successive courses, shall be offset a minimum of 24 inches.

c. Transverse joints shall be constructed as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements." The Contractor shall construct transverse joints to provide a smooth riding surface. When using a bulkhead to form the joint, the Contractor shall ensure that the bulkhead forms a straight line and vertical face. If a bulkhead is not used to form the joint, the Contractor shall make the joint by sawing the compacted HMA for a sufficient distance behind the end of the placement to ensure full thickness and a smooth surface at the joint. The Contractor shall remove the full lift thickness of HMA ahead of the sawed joint. In either case, the Contractor shall paint the joint face with polymerized joint adhesive before the fresh material is placed against it. Unless prohibited by field conditions, the Contractor shall cross roll to obtain thorough compaction of these joints.

C. Joints shall be compacted as soon as HMA will bear roller weight without excessive displacement.

D. Asphalt at joints shall be compacted to a density within two (2) percent of specified course density.

E. If a single paver does not spread the HMA the entire width of the roadway, paving shall be performed in echelon. The Contractor shall extend the screed and end gate of the trailing paver one (1) inch over the uncompacted HMA placed by the lead paver. Ensure that the uncompacted HMA elevation from the trailing paver is equal to that from the lead paver at the joint. The Contractor may construct either a butt joint or a wedge joint, but the joint shall not be raked.

F. If echelon paving is not possible, the Contractor shall construct the pavement using cold longitudinal joints.

a. When constructing the first lane, the Contractor shall compact so the line and grade of the edges of the HMA are not displaced.

b. The Contractor shall construct longitudinal joints parallel to the centerlines within a tolerance of ±3 (three) inches per 100 linear feet. If this tolerance is not met, the Contractor shall trim or mill the edge of the HMA mat as necessary.

c. Before paving the abutting lane, the Contractor shall ensure longitudinal joints are free from dust and debris.

d. For surface course only, the Contractor shall slowly and uniformly apply a 1/8-inch thick coating polymerized joint adhesive over the entire joint face of the longitudinal cold joint.

e. The Contractor shall maintain a uniform width and depth of overlapped material at all times. The Contractor shall position the paver so that the HMA overlaps the edge of the lane previously placed by one (1) to two (2) inches and shall leave the material sufficiently high to allow for compaction.

f. The Contractor shall lute back overlapped material, pushing the material off of the cold HMA and onto the hot HMA mat directly over the joint. The Contractor shall remove excess material instead of broadcasting it across the new lift.

g. When compacted, the Contractor shall ensure that the new mat at the joint is even or slightly higher (maximum 1/8 inch) than the previously placed adjoining mat. If the newly compacted mat results in a depression at the joint of 1/8 inch or more lower than the previously placed adjacent HMA lift, the Contractor shall suspend all paving operations until corrective action is taken to prevent reoccurrence.

3.12 COMPACTION

A. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The Contractor shall complete compacting before mix temperature cools to 240 degrees Fahrenheit.

B. The Contractor shall begin compacting at the sides and progress gradually to the center.

C. The Contractor shall operate rollers at a slow, uniform speed not exceeding 2-1/2 miles per hour. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be immediately corrected.

D. If necessary to prevent adhesion of the HMA to the rollers, keep the wheels moistened with water mixed with very small quantities of detergent.

E. Rolling operation shall be continued until the surface is of uniform texture, true to grade and cross section, marks are eliminated, the air voids conform to the specified requirements and the required field density is obtained.

F. Along forms, curbs, headers, walls, and other places not accessible to the rollers, the Contractor shall compact the HMA using a vibratory drum compactor.

G. The Contractor shall complete breakdown or initial rolling immediately after rolling joints and outside edge. The Contractor shall examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. The Contractor shall correct laydown and rolling operations to comply with requirements.

H. The Contractor shall begin intermediate rolling immediately after breakdown rolling while HMA is still hot enough to achieve specified density. The Contractor shall continue rolling until HMA course has been uniformly compacted to the target density

I. When paving in echelon, the Contractor shall keep the rollers for the first lane approximately six (6) inches from the unconfined edge adjacent to the second paving operation. After HMA from the second paver is placed against the uncompacted edge of the mat from the first paver, the Contractor shall compact the HMA on both sides of the joint.

J. The Contractor shall prevent lateral or vertical displacement of the unconfined edge during the compaction operation. The Contractor shall ensure that the edge of the drums of the rollers extends over the free edge of the mat by at least six (6) inches.

K. When compacting the butt or wedge joint and while paving the adjacent lane, the Contractor shall place the roller on the newly placed HMA and overlap the joint by approximately six (6) inches.

L. The Contractor shall take one core sample for every 1,000 square yards or less of installed pavement, with no fewer than three (3) cores taken.

M. The Contractor shall provide results of both the nuclear density and core testing to the Engineer. The core testing shall include the bulk specific gravity, the maximum specific gravity according to AASHTO T 209, and the percent air voids.

N. The Contractor shall finish roll paved surfaces to remove roller marks while HMA is still warm.

O. While surface is being compacted and finished, the pavement edges shall be trimmed to proper alignment. The Contractor shall compact edges thoroughly.

P. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area at the Contractor's expense. Skin patching will not be allowed.

Q. After final rolling, the Contractor shall not permit vehicular traffic on pavement until it has cooled and hardened. The Contractor shall erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.13 OPENING TO TRAFFIC

A. The Contractor shall only allow traffic or construction equipment, including paving equipment, on HMA courses after the surface temperatures is less than 140 degrees Fahrenheit.

3.14 MATERIAL ACCEPTANCE

A. Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor and approved by the Engineer.

B. Cores shall be drilled at least 12 hours after paving at random locations determined by the Engineer.

   a. The Contractor shall use drilling equipment with a water-cooled, diamond-tipped, masonry drill bit that produces a six (6)-inch nominal diameter cores for the full depth of the pavement.

   b. The core shall be removed from the pavement without damaging it.

   c. The cores and corresponding forms shall be placed in a ventilated container capable of being locked and sealed. The container shall provide protection and prevent damage during transit. Damaged cores will not be accepted.

   d. After removing the core, the Contractor shall remove all water from the hole, apply an even coating of tack coat to sides of the hole, and place HMA in maximum lifts of 4 inches in the hole and compact each lift.

   e. The Contractor shall ensure that the final surface is 1/4 inch above the surrounding pavement surface.

C. The full-depth cores shall be tested for surface course air voids, in-place density, surface course thickness, and total thickness at a frequency of one sample per 10,000 SF of pavement.

D. Testing shall demonstrate conformance with the following minimum requirements:

   a. The surface course thickness, determined pursuant to ASTM D 3549, shall be two (2)-inch plus ¼-inch, no minus.

   b. Finished surface course shall not deviate from the testing edge of a straightedge more than 1/8 inch in the transverse or longitudinal direction. Finished surfaces at a juncture with other pavements shall coincide with the finished surfaces of the abutting pavements. The deviations from the plan grade line and elevation will not be permitted in areas of pavements where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures involved.

   c. Crowned surfaces, tested using a crowned template centered and at right angle to the crown, shall have a maximum allowable variance from template of ¼-inch.

   d. The in-place density, determined from the average of compacted core samples according to ASTM D 1188 or ASTM D 2726, shall have:

      i. an average density of 96% of the reference laboratory density according to AASHTO T 245, but no less than 94% nor greater than 100%; and

      ii. an average density of 92 percent of the reference maximum theoretical density according to ASTM D2041, but no less than 90% nor greater than 96%.

E. Random mixture samples shall be collected for determining laboratory air voids and theoretical maximum density.

F. The final wearing surface of pavement shall conform to the elevations and cross sections shown in the Engineering Drawings and shall vary not more than 0.05 foot from the established plan grade. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements.

G. Surface smoothness of the pavement shall be evaluated in the presence of the Engineer. Detailed notes of the results of the testing shall be submitted to the Engineer within one day after the testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Engineer.

H. The Contractor shall furnish and maintain at the site one 12 foot straightedge for testing the finished surface. Straightedges shall be in good condition, have handles and be constructed of aluminum or other lightweight metal, with blades of box or box-girder cross section with flat bottom reinforced to ensure rigidity and accuracy.

I. The reference maximum theoretical density shall be determined by averaging the results from four samples of HMA delivered daily to the Site, prepared according to ASTM D2041 and compacted in accordance with job mix specifications.

J. In the event that the minimum requirements are not met, the Contractor shall remove and replace the HMA subject to the same requirements as the initial work.

END OF SECTION

SECTION 33 11 53

GROUNDWATER MONITORING WELLS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to install monitoring wells as shown on the Engineering Drawings.

B. All monitoring well installation, repair, abandonment, and reconstruction, shall be performed by a New York licensed driller.

1.02 SUBMITTALS

A. The Contractor shall obtain and submit to the Engineer any permits required for well installation.

B. The Contractor shall submit a statement of qualifications and contact information for the New York licensed driller to the Engineer before performing any well installation, repair, or abandonment work.

C. The Contractor shall submit to the Engineer a minimum of 10 lbs of the proposed cement at least 10 days prior to use.

D. The Contractor shall submit to the Engineer a minimum of 10 lbs of the proposed grout at least 10 days prior to use.

E. Upon completion of each installed well, the Contractor shall submit to the Engineer a Well Completion Report to include at a minimum the following:

a. The total depth of the completed well;

b. The depth of location of any lost drilling fluid, drilling materials or tools;

c. The grout intervals;

d. The complete description (including length, diameter, joint intervals, etc.) of well casings.

1.03 REFERENCES

A. ASTM International (ASTM):

a. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

b. ASTM A312/A312M – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

c. ASTM C150/C150M – Standard Specification for Portland Cement

d. ASTM C476 – Standard Specification for Grout for Masonry

e. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

B. New York State Department of Environmental Conservation (NYSDEC):

a. 6 NYCRR Part 375 – Environmental Remediation Programs

b. DER-10/Technical Guidance for Site Investigation and Remediation (May 2010)

c. CP-43: Groundwater Monitoring Well Decommissioning Policy (November 2009)

1.04 DEFINITIONS

(Reserved)

PART 2 PRODUCTS

2.01 GENERAL

A. The Contractor shall protect all products and materials from moisture, dirt, dust or other contaminants, spillage and deterioration during transit and storage.

B. For each shipment of materials, the Contractor shall provide written certification of compliance from the manufacturer verifying that the materials meet the requirements of this Specification.

C. Any materials not meeting the requirements of this Specification shall be promptly removed from the Site, and replaced with materials conforming to these requirements at the Contractor’s expense.

D. Damaged materials shall be replaced as directed by the Engineer at no additional cost to the Owner.

E. The Contractor shall be responsible for the security of all materials and equipment. The Engineer will not be responsible for any of the Contractor's materials or equipment vandalized, stolen, or otherwise rendered unsuitable for use on this project.

2.02 MONITORING WELLS

A. Monitoring wells shall be constructed of Schedule 40 PVC meeting ASTM D1785.

B. Should the well depth exceed 50 feet, the well shall be constructed with stainless steel casing meeting ASTM Standard A312/A312M-04b, having at least ANSI Schedule 5 for welded joints and ANSI Schedule 40 for threaded joints.

C. The well shall have a minimum of 10 feet of 0.020 inch slotted screen unless otherwise directed by the Engineer.

D. Cement shall conform to the specifications of ASTM C150, Type II cement.

E. Grout shall conform to the specifications of ASTM C476.

2.03 WATER

A. Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the cement and grout shall be used to produce the cement and grout.

B. The source of water shall be subject to the approval of the Engineer.

C. The Contractor shall be responsible for ensuring that the cement and grout resulting from the water always meets the standards of this Specification.

D. The water shall comply with the standards specified by the cement and grout manufacturers.

E. The Contractor shall condition water as needed to produce the cement and grout.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall maintain all existing monitoring wells, and protect them from damage from equipment and vehicular traffic.

B. The Contractor shall immediately report to the Engineer and retain a New York licensed driller to repair any monitoring wells damaged by the Contractor.

C. The Contractor shall retain a New York licensed driller to extend or otherwise modify existing monitoring wells at the Site as directed by the Engineer.

D. The Contractor shall retain a New York licensed driller to re-install monitoring wells requiring replacement due to Contractor negligence in accordance with these Specifications.

E. The Contractor shall retain a New York licensed driller to close wells scheduled for abandonment in accordance with NYSDEC's CP-43: Groundwater Monitoring Well Decommissioning Policy.

F. Excess drilling spoils and wastewater shall be promptly containerized and managed in accordance with all applicable local, State, and Federal regulations and **Section 02 81 00** (Transportation and Disposal of Waste Materials) of these Specifications.

G. Wells will be accepted by the Engineer when the well is developed to the point that it is producing water which is free of drilling fluid, additives and sediment as further defined in Paragraph 3.04 of this Specification.

3.02 WELL ABANDONMENT

A. Wells designated to be abandoned and/or reinstalled in the Engineering Drawings shall be decommissioned in accordance with NYSDEC's CP-43: Groundwater Monitoring Well Decommissioning Policy.

B. The New York licensed well driller shall obtain all applicable well records prior to sealing the well in order to verify the depth and diameter of the well.

C. All water used in monitoring well abandonment shall be in accordance with Paragraph 2.03 of this Specification.

3.03 WELL INSTALLATION

A. Monitoring wells shall be installed in accordance with industry standards, per DER-10/Technical Guidance for Site Investigation and Remediation, by a New York licensed well driller of the proper class.

B. The preferred technique for drilling shall be using Hollow Stem Auger (HSA). In the event the overburden soils cannot be penetrated using HSA, then the use of an alternative method approved by the Engineer shall be employed.

C. An initial borehole shall be located and advanced to the depths shown in the Engineering Drawings and as directed by the Engineer.

D. Once the borehole has attained the required depth, a monitoring well shall be installed in the borehole.

E. The well screen and casing shall be placed to the bottom of the borehole, taking care to center the well in the borehole.

F. The filter pack shall be carefully added to the borehole, from the bottom of the borehole to a depth a minimum of 2 feet above the top of the screened portion of the well. Care shall be taken during placement to avoid bridging. The HSAs shall be slowly withdrawn from the borehole as the filter pack is placed, taking care to maintain at least 6-inches of filter pack in the bottom of the augers.

G. Grout shall be used to seal the annular space above the filter pack to approximately one foot below the ground surface. The HSAs shall be withdrawn as the grout is placed. No cuttings from the borehole may be added to the grout. Grout shall terminate at the base of the manhole or vault for flush-mount well installations.

H. The annulus outside the casing pipe shall be grouted by tremie methods. The Contractor shall insure that the inside of the well casing remains free of grout.

I. In the event the borehole wall collapses during installation of the monitoring well, the Contractor shall take all measures necessary to correct this situation to the satisfaction of the Engineer and at no additional cost to the Owner.

J. A survey to document as-built conditions shall be performed immediately following well construction in accordance with **Section 02 21 00** (Surveying) of these Specifications.

3.04 WELL DEVELOPMENT

A. Following completion of monitoring well construction, each monitoring well shall be developed to create a good hydraulic connection between the well screen and the adjacent formation.

B. The monitoring wells shall be developed using a centrifugal pump or a submersible pump. Fine-grained material around the well screen shall be drawn into the well and removed by agitating the well water with a surge block or by pumping water from the well at alternating discharge rates. Accumulated sediments shall be removed from the wells by pumping. Should the pumping and surging method prove ineffective or not feasible due to the depth to water in the monitoring well, an alternative development method approved by the Engineer shall be used.

C. Periodic measurements of pH, specific conductance, temperature, and turbidity shall be performed by the Contractor during development. The goal of the well development process shall be to obtain less than 50 NTU, and less than 10% variance on the other parameters between successive well volumes.

3.05 WASTE MANAGEMENT

A. All waste generated from the construction, abandonment and development of monitoring wells shall be managed as hazardous waste in accordance with Section 02 81 00 (Transportation and Disposal of Waste Material) of these Specifications.

END OF SECTION

ATTACHMENT D
GROUNDWATER MODELING - PROPOSED ZVI PERMEABLE REACTIVE BARRIER DESIGN

ENVIRON
Engineers of North Carolina

GROUNDWATER MODELING
PROPOSED ZVI PERMEABLE REACTIVE BARRIER DESIGN

PROJECT NAME:	Steel Treaters, Inc., Troy, NY		
PROJECT NUMBER:	02-39035A		
CALCULATIONS BY:	Jinjun Wang, PhD, PE	Date:	October 18, 2017
REVIEWED BY:	Jon Johnson, PhD	Date:	October 20, 2017
APPROVED BY:	Jose Sananes, PE	Date:	October 20, 2017

1. PROBLEM STATEMENT

As shown in **Figure 1**, two treatment areas are proposed for the site: (a) a granular zero valent iron (ZVI) permeable reactive barrier (PRB) and hydraulic routing system between the northern side of the former building and Campbell Avenue (referred herein as the PRB); and (b) a ZVI treatment zone in the vicinity of the former pit (referred herein as the southern treatment zone). Since the purpose of these two subsurface structures is to address groundwater contamination at the site, a numerical groundwater flow model was constructed to support their design. This memorandum presents the results of this groundwater modeling.

2. OBJECTIVES

The specific objectives of the groundwater flow modeling include:

- Defining the configuration or alignment of the proposed PRB and southern treatment zone such that it ensures capture of the groundwater plume; and
- Defining the hydraulic properties of the treatment media such that implementation of the PRB or southern treatment zone will not result in groundwater mounding upgradient of the proposed ZVI treatment areas.

3. APPROACH

First a one-layer steady-state MODFLOW model was constructed and calibrated to historical groundwater elevations measured at the Site. Then, the calibrated model was used to simulate the groundwater flow with various designs of the PRB and the southern treatment zone to achieve the final remediation design.

4. AVAILABLE DATA AND DOCUMENTS

- Site Investigation Report by InteGreyted International, LLC. ("InteGreyted") and dated June 4th, 2004.
- Supplementary Site Investigation Report by Delta Environmental Consultants, Inc. ("Delta") and dated April 28th, 2005.
- Technical Memorandum, Structural Geology Evaluation – Steel Treaters, Troy NY by Barton & Loguidice, P.C. ("B&L") and dated September 17th, 2010.
- Technical Memorandum, Bedrock Well Installation Activities – Steel Treaters, Troy NY by B&L and dated 2011.
- Pre-Remedial Investigation Report by B&L and dated October 2011.

- Remedial Investigation Report by B&L and dated November, 2013.
- Pre-Design Investigation Report by ENVIRON Engineers of North Carolina, PC ("EENC") and dated July 2016.
- Pre-Design Investigation Report and Remedial Action Workplan by EENC and dated November 2016.
- The Ground-Water Resources of Rensselaer County, New York by the U.S. Geological Survey and dated 1950.
- Water Resources of the Albany-Schenectady-Troy Area by the U.S. Geological Survey and dated 1964.
- Glacial Geology of the Troy, N.Y. Quadrangle by LaFleur and dated 1965

5. GEOLOGIC AND HYDROGEOLOGIC SETTING

5.1 Site Geology

According to the Pre-Remedial Investigation Report (B&L, 2011), the Site lies in the western part of Rensselaer County, in the Hudson-Champlain section of the Ridge and Valley physiographic province. To the west of the site and separated by a well-defined escarpment, is a lowland area (roughly 200 feet lower than the site) that consists of the broad plain of the Hudson River Valley. The Site is underlain by sedimentary bedrock of the Schodack and Nassau formations, and the Normanskill Shale. These formations comprise a broad belt of closely related rocks that extend the full length of the western part of Rensselaer County. These formations consist of closely folded green to black shale, with similar lithologic and hydrologic properties. In general, these formations can yield small but reliable quantities of water (4 to 5 gallons per minute) from drilled wells for domestic use (Cushman, 1950; Halberg, et al, 1964).

The Pre-Remedial Investigation Report (B&L, 2011) also indicates that surficial deposits within the general vicinity of the Site are the result of a single late Wisconsin age glacial advance and the subsequent formation of Lake Albany during the glacial retreat. The western quarter of the Troy quadrangle (which encompasses the site) is underlain by lacustrine clay and silt beds attributed to Lake Albany. In the vicinity of the Site, surficial geologic mapping indicates the deposits of "Lake Albany clays" (clays and silts), overlain in some areas by more than 4 feet of sand, as well as bedrock outcropping. Also in the vicinity of the Site are recent alluvial deposits associated with the Wynantskill (LaFleur, 1965).

As detailed in the Pre-Remedial Investigation Report (B&L, 2011), exposed bedrock is present upslope, bordering the site to the east and south. The bedrock surface map indicates a surface sloping from south and southwest to the north and northeast, generally mimicking site topography. During the site investigation and the remedial investigation, a number of soil borings and monitoring wells were installed. Logs of these borings and monitoring wells are provided in the Site Investigation Report (InteGreyted, 2004), Supplementary Site Investigation Report (Delta Environmental Consultants, Inc., 2005), Pre-Remedial Investigation Report (B&L, 2011), Remedial Investigation Report (B&L, 2013), and Pre-Design Investigation Report and Remedial Action Workplan (EENC, 2016). According to the boring logs, the depth to bedrock ranges from 6 to 29 feet at the Site sloping downward from west to east. Logs indicate a wide range in unconsolidated layer thicknesses across the site. There is a 2 to 11 feet thick gray silt layer with trace sand across most of the site just above bedrock. This gray silt layer is overlain by a layer of brown silt which is largely unsaturated. The thickness of the brown silt layer varies between 2.5 and 12 feet. Above the brown silt layer, the uppermost layer across the site, consists of brown silty sand with thickness between 4 and 10 feet and is typically unsaturated. The groundwater table is usually located within the gray silt layer above bedrock, however at times it is present in the overlying brown silt layer and/or the brown silty sand layer due to the seasonal variation of water table.

5.2 Surface Water

The nearest surface water body is the Wynantskill, which is located less than 500 feet to the north of the site. Based on topography, the Wynantskill is the major drainage feature for the site and surrounding area. The Wynantskill flows westward to Burdens Pond, which is roughly one half mile from the site. Overflow from Burdens Pond flows westward, through a ravine, into the Hudson River.

5.3 Groundwater

Based on groundwater contour maps prepared by InteGreyted (2004), Delta (2005), B&L (2011, 2013), and EENC (2016), overburden groundwater has consistently flowed in a generally northern direction toward the Wynantskill. Based on ground water contour maps prepared by B&L (2013), groundwater in the shallow bedrock zone appears to mimic the overburden groundwater and flow to the north. According to hydraulic data from nested shallow and deep bedrock wells, the vertical gradient in the bedrock zone appears to be generally upward.

6. GROUNDWATER FLOW MODELING

6.1 One-Layer Model Construction

Considering the fact that the overburden groundwater primarily occurs within the gray silt layer underneath the Site, a one-layer steady state groundwater model was constructed using MODFLOW to simulate average groundwater flow conditions in the overburden aquifer at the Site to help design the PRB and the southern treatment zone.

The MODFLOW model was developed with the following structures:

- The lateral extent of the MODFLOW model was defined based on historical groundwater data (refer to **Figure 1**).
- A uniform model grid of 2 foot by 2 foot was applied throughout the model region, resulting in a grid of 200 rows and 100 columns.
- The top elevation of the model was defined from the surveyed ground surface elevations at the Site, which range from 266.25 feet to 275.20 feet within the model region.
- The bottom of the model was defined as the top of the bedrock. The bedrock surface was defined based on boring logs advanced to the top of or into bedrock at the Site. Bedrock surface elevations within the model region range between 243.03 feet and 266.92 feet.
- As discussed in **Section 5.3**, overburden groundwater at the Site has consistently flowed in a generally northern direction, thus, the model boundaries were created accordingly. As shown in **Figure 1**, given the mapped groundwater flow direction, the model boundaries were specified as constant head boundaries to the north and the south, and no-flow boundaries to the east and west. While sixteen (16) rounds of groundwater elevation data were collected from the Site wells between February 2005 and May 2013, only two rounds included all the monitoring wells – the June 2010 and May 2013 groundwater sampling events. Therefore, to define average groundwater elevation at the upgradient and downgradient constant head boundaries, water levels from these two sampling events were averaged and a groundwater elevation contour map was created to approximate the head distribution throughout the model region (refer to **Table 1**).

Head values of 273.5 feet and 252.0 feet were assigned to the south and north constant head boundaries, respectively, based on the groundwater contours at these boundaries. The no-flow boundaries were then created perpendicular to the observed contour lines, except for the northern portion of the west no-flow boundary, which represents the portion of bedrock above the water table.

Table 1. Groundwater Elevations from Historical Sampling Events

Well ID	Easting (ft)	Northing (ft)	Groundwater Elevation (ft)		Average Groundwater Elevation (ft)
			6/30/2010	5/23/2013	
MW-1	713240	1412205	267.83	273.67	270.75
MW-2	713245	1412265	266.29	270.83	268.56
MW-3	713238	1412375	259.46	259.63	259.55
MW-4	713159	1412345	262.13	263.49	262.81
MW-5	713200	1412173	268.33	273.54	270.94
MW-6	713154	1412208	267.35	272.64	270.00
MW-7	713222	1412241	266.93	271.68	269.31
MW-8	713170	1412259	266.46	272.52	269.49
MW-9	713252	1412302	265.42	269.82	267.62
MW-10	713213	1412332	263.70	266.61	265.16
MW-11	713162	1412430	255.19	255.38	255.29
MW-12	713216	1412378	258.44	258.78	258.61
MW-14	713221	1412455	252.82	253.09	252.96
MW-16	713216	1412228	267.96	271.80	269.88

The following was assumed in the development of the groundwater flow model:

- As stated in the Technical Memorandum, Bedrock Well Installation Activities – Steel Treaters, Troy NY (B&L, 2011), the top of the bedrock was "typically not noticeably weathered," and "the bedrock flow system is not a meaningful contaminant migration pathway." In addition, as discussed in **Section 5.3**, the hydraulic data from nested shallow and deep bedrock wells, indicate an upward vertical gradient in the bedrock zone. Thus, for the purpose of simulating groundwater flow within the unconfined aquifer, it was assumed that the bedrock is impervious to groundwater flow.
- Since most of the Site and model domain is covered or paved, zero recharge rate was applied to the model region.
- Aquifer tests and geotechnical laboratory hydraulic conductivity tests on undisturbed samples have been previously performed at the Site. As presented in **Table 2**, the hydraulic conductivities measured ranged from 0.06 to 1.26 ft/day, with a geometric mean of 0.18 ft/day. Therefore, the initial horizontal hydraulic conductivity was defined as 0.18 ft/day uniformly throughout the model domain, with a horizontal to vertical hydraulic conductivity ratio of 10 to 1.

Table 2. Summary of Historical Aquifer Test Results

Aquifer Test	Well	K (cm/s)	K (ft/day)
2005 Supplementary Investigation Slug Test	MW-1	6.12E-05	0.17
	MW-2	5.46E-05	0.15
	MW-8	9.90E-05	0.28
	MW-9	4.69E-05	0.13
2016 Pre-Design Investigation Aquifer Test	Drawdown Test	4.45E-04	1.26
	Recovery Test	5.75E-05	0.16
2016 Pre-Design Investigation EW-1 Geotechnical	Test 1	1.97E-05	0.06
	Test 2	3.82E-05	0.11
	Geometric Mean	6.45E-05	0.18

6.2 Model Calibration

The MODFLOW model was calibrated using (a) historical groundwater elevation data; and (b) hydraulic conductivities derived from slug tests performed as part of the 2005 Supplemental Investigation. The model calibration was performed using an automated model calibration procedure named PEST (Doherty, 2010). As part of the PEST calibration, a technique known as pilot point calibration was used to calibrate the hydraulic conductivity (K) distribution (Doherty et al., 2010), where each "pilot point" is a calibration parameter associated with a unique K value at a specific location in the model grid. The set of pilot points is then interpolated to create a smooth but heterogeneous K distribution covering the entire model domain. The degree of heterogeneity and the values of K are determined by the automated fit to the calibration targets. This is in contrast to traditional hydraulic conductivity calibration, which involves dividing the whole domain into predefined geometric blocks, referred to as zones, with constant hydraulic conductivity in each.

As shown in **Figure 2**, the pilot points were first placed at locations where the 2005 Supplemental Investigation slug tests were conducted. The K values derived from these slug tests were assigned to these pilot point locations as initial K values, and these K values remained fixed during the model calibration. At other locations, additional pilot points were placed throughout the model domain and distributed as evenly as possible. An initial K value of 0.18 ft/day (corresponding to the geometric mean of the data presented in **Table 2**) was assigned to these additional pilot point locations. During the model calibration, K values at these pilot point locations were adjusted until calibrated and then krigged to form the K distribution within the model region. The K value at the additional pilot point locations were assigned upper and lower bounds based on the historical laboratory test and aquifer test results (refer to **Table 2**). Considering the fact that these K values range from 0.06 to 0.28 ft/day, except for a single test with an elevated K from the 2016 pre-design investigation aquifer test (1.26 ft/day). An upper bound of 0.5 ft/day and a lower bound of 0.05 ft/day were assigned to all additional pilot points so that the K values associated with these pilot points could be calibrated over a realistic range of values close to the observed values but not biased high.

To assess the quality of model calibration, calibration targets, or points in space and time where one of the model dependent variables has been measured, were used. In this case, the average groundwater elevation data at known monitoring wells (presented in **Table 1**), were used as the calibration targets. At each target location, an error term called "residual" is computed as the difference between the field measurement and the model-computed value. The range of residuals helps determine whether the quality of the calibration is adequate.

Table 3 presents the calibration statistics, which indicate how well a model's simulation results match the field measured head values, for the calibration target data set. According to the table, the difference between the simulated and observed water levels in the monitoring wells is 0.72 foot on average, indicating a well calibrated groundwater flow model. **Figure 3** depicts the horizontal hydraulic conductivities within active model cells. As shown in the figure, the hydraulic conductivity is relatively high in the vicinity of the Campbell Ave and along the southern portion of the site building, while there is a low hydraulic conductivity zone located between Campbell Ave and the site building. **Figure 4** presents a scatter plot comparing simulated head values against field measured water level data. This figure indicates that the scatter around the 1:1 line is relatively balanced, with approximately equal distribution of errors above and below the line, again indicating a well calibrated flow model.

Table 3. Model Calibration Statistics

Number of Targets	14
Range in Observed Values	17.98
Minimum Residual	-0.53
Maximum Residual	2.51
Sum of Squared Residuals	7.50
RMS Error	0.73
Residual Mean	0.19
Absolute Residual Mean	0.34
Standard Deviation	0.71
Scaled Residual Mean	0.01
Scaled Absolute Residual Mean	0.02
Scaled Standard Deviation	0.04
Scaled RMS Error	0.04

6.3 PRB Simulation

Once the groundwater flow model was calibrated, it was used to optimize the alignment of the proposed PRB such that it ensured the maximum practicable capture of the on-site groundwater plume. Specifically, isoconcentration maps of the major site contaminants (TCE, cis-1,2-DCE, 1,1-DCE, TCA, and 1,1-DCA) were used to initially position the proposed PRB. The model was then used to optimize the configuration of the proposed PRB, which includes a pervious ZVI treatment barrier and impermeable hydraulic barriers on either side of the PRB. The impermeable hydraulic barriers of the proposed PRB serve to route groundwater towards the permeable section containing the reactive media. As shown in **Figure 5**, the impermeable segments of the barrier were simulated as no flow cells. For this analysis, the hydraulic conductivity values in the proposed PRB were adjusted such that (a) minimal groundwater mounding occurred upgradient of the PRB; (b) it limited offsite plume migration; (c) it prevented groundwater plume flow around the PRB; and (d) the greatest contaminant mass would be captured and eventually treated by the reactive media of the PRB.

Following various groundwater simulations under various combinations of PRB configuration and hydraulic conductivity, it was concluded that (a) the reactive media should have a horizontal hydraulic conductivity of at least 5 ft/day (1.76 x 10^{-3} cm/s) and (b) the optimal configuration of the PRB is that presented in **Figure 5**.

6.4 Southern Treatment Zone Simulation

The proposed southern treatment zone targets mass reduction near the source area, where the highest concentrations of chlorinated ethenes and ethanes have historically been detected. This treatment area was defined in a similar manner as described in **Section 6.3**, except that the area with the highest concentrations of chlorinated ethenes and ethanes (i.e., near the source zone) was used to initially position the proposed treatment zone (refer to **Figure 5**). As with the PRB, the calibrated groundwater flow model was used to optimize the configuration of the proposed treatment zone. Specifically, the hydraulic conductivity values in the proposed treatment zone were adjusted such that (a) minimal groundwater mounding occurred upgradient of the treatment zone; and (b) groundwater did not bypass the treatment zone; and (c) the greatest contaminant mass would be captured and eventually treated by the reactive media in the treatment zone.

Following various groundwater simulations using various hydraulic conductivity values, it was concluded that (a) the reactive media should have a horizontal hydraulic conductivity of at least 5 ft/day (1.76 x 10^{-3} cm/s) and (b) the optimal configuration of the PRB is that presented in **Figure 5**.

7. SUMMARY AND CONCLUSIONS

A one-layer steady-state groundwater flow model was constructed and calibrated to average historical groundwater elevations measured at the Site. This model was used to simulate groundwater flow conditions for various PRBs and treatment zone configurations to optimize their alignment and define the hydraulic properties of the treatment media such that: (a) minimal groundwater mounding occurred upgradient of the PRB; (b) it limited offsite plume migration (in the case of the PRM only); (c) it prevented groundwater plume flow around the PRB or treatment zone; and (d) the greatest contaminant mass would be captured and eventually treated by the reactive media of the PRB.

Following various groundwater simulations under various alignments and hydraulic conductivities, it was concluded that (a) the reactive media in both PRB and the treatment zone should have a horizontal hydraulic conductivity of at least 5 ft/day (1.76^{-} x 10^{3} cm/s); and (b) the optimal configuration of the PRB and southern treatment zone is that presented in **Figure 5**.

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ENVIRON
Engineers of North Carolina

FIGURES

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RAMBOLL ENVIRON

DRAFTED BY: JW | DATE: 9/1/2017

GROUNDWATER MODEL REGION AND BOUNDARIES
FORMER STEEL TREATERS, INC. FACILITY
520 CAMPBELL AVENUE
TROY, NEW YORK

FIGURE 1

02-39035A

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RAMBOLL ENVIRON	GROUNDWATER MODEL CALIBRATION TARGETS AND PILOT POINTS FORMER STEEL TREATERS, INC. FACILITY 520 CAMPBELL AVENUE TROY, NEW YORK	FIGURE 2
DRAFTED BY: JW / DATE: 9/1/2017		02-39035A

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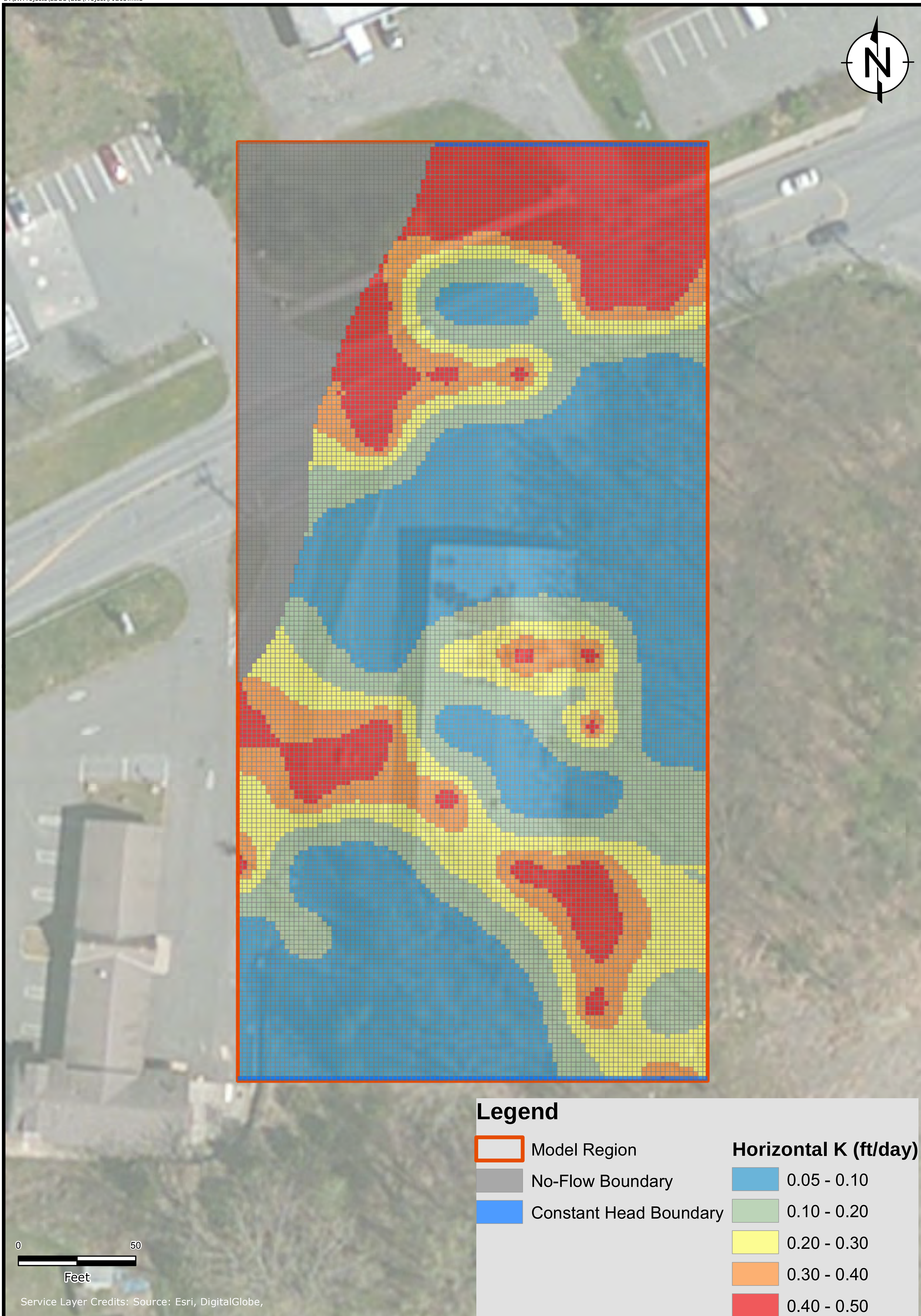

RAMBOLL ENVIRON	CALIBRATED HYDRAULIC CONDUCTIVITIES FORMER STEEL TREATERS, INC. FACILITY 520 CAMPBELL AVENUE TROY, NEW YORK	FIGURE 3
DRAFTED BY: JW · DATE: 9/1/2017		02-39035A

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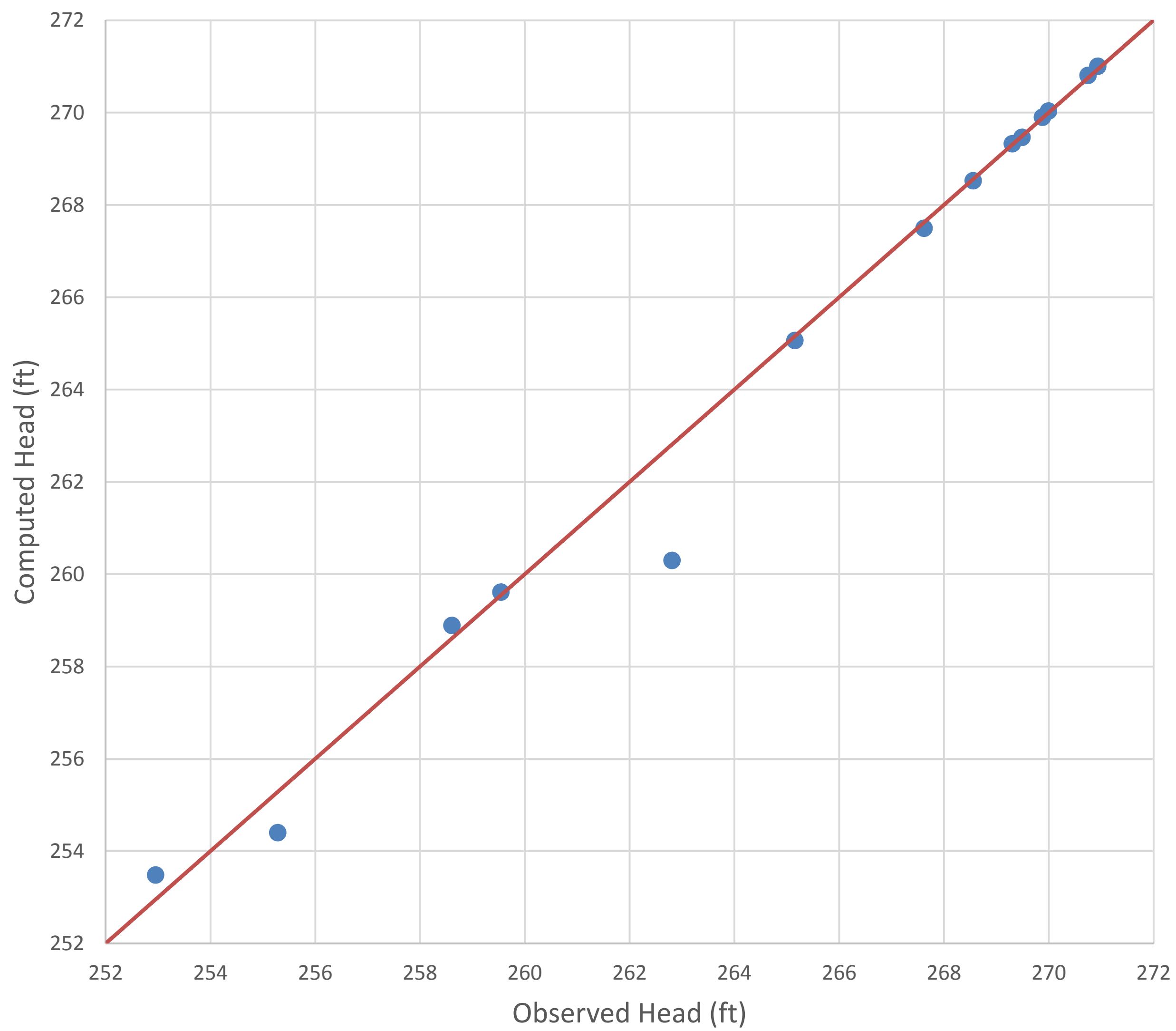

RAMBOLL ENVIRON

DRAFTED BY: JW | DATE: 9/1/2017

SCATTER PLOT COMPARING SIMULATED VS. OBSERVED WATER LEVELS
FORMER STEEL TREATERS, INC. FACILITY
520 CAMPBELL AVENUE
TROY, NEW YORK

FIGURE
4

02-39035A

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RAMBOLL ENVIRON	SIMULATED GROUNDWATER FLOW WITH PROPOSED REMEDIAL ACTIONS FORMER STEEL TREATERS, INC. FACILITY 520 CAMPBELL AVENUE TROY, NEW YORK	FIGURE 5
DRAFTED BY: JW DATE:		02-39035A

ATTACHMENT E
DESIGN CALCULATIONS - PROPOSED ZVI PERMEABLE REACTIVE BARRIER

ENVIRON
Engineers of North Carolina

DESIGN CALCULATIONS
PROPOSED ZVI PERMEABLE REACTIVE BARRIER DESIGN

PROJECT NAME:	Steel Treaters, Inc., Troy, NY		
PROJECT NUMBER:	02-39035A		
CALCULATIONS BY:	Jinjun Wang, PhD, PE	Date:	September 29, 2017
REVIEWED BY:	Jon Johnson, PhD	Date:	October 10, 2017
	Scott Warner	Date:	October 14, 2017
APPROVED BY:	Jose Sananes, PE	Date:	October 20, 2017

1. PROBLEM STATEMENT

Historical sampling conducted at the site has identified the following analytes above the applicable New York Ambient Water Quality Standards for Class GA Water (AWQS-GA): tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), 1,1-dichloroethylene (1,1-DCE), vinyl chloride (VC), 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethane (1,1,2-TCA), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), methylene chloride, and total xylenes.

As shown in **Drawing 1**, two treatment areas are proposed for the site: (a) a granular zero valent iron (ZVI) permeable reactive barrier (PRB) and hydraulic routing system between the northern side of the former building and Campbell Avenue (PRB); and (b) a ZVI treatment zone in the vicinity of the former pit (southern treatment zone). This memorandum documents the calculation of treatment system components, including ZVI contents for the two proposed treatment areas.

2. OBJECTIVES

The specific design objectives include:

- Determining the required ZVI content in each of two proposed ZVI treatment areas; and
- Specifying the composition of the ZVI backfill (i.e., ZVI and sand) materials for the proposed ZVI treatment areas.

3. AVAILABLE DATA AND DOCUMENTS

- Proposed remedial system layout prepared by Ramboll Environ (**Drawing 1**)
- Permeable Reactive Barrier: Technology Update, dated 2011 and prepared by ITRC (Interstate Technology & Regulatory Council).
- Report of Findings, Bench-Scale Evaluation of Zero-Valent Iron for Destruction of COCs, dated March 16, 2017 and prepared by Prima Environmental Inc.
- An Assessment of Zero Valence Iron Permeable Reactive Barrier Projects in California, dated April 22, 2008 and prepared by John Muegge
- ZVI specifications provided by Connelly-GPM, Inc. and Compass Remediation Chemicals (included as Attachment A)

4. APPROACH

The composition of the ZVI backfill materials in each of the two proposed ZVI treatment areas was defined by calculating the treatment system width required to reduce the concentration of chlorinated VOCs in groundwater- to meet the applicable AWQS-GA. The ZVI composition for each treatment system was then selected to assure that groundwater velocity and contaminant resident time within the ZVI treatment system allow sufficient contaminant reduction to occur.

5. ANALYSIS AND ASSUMPTIONS

5.1 CVOCs Decay Rates in ZVI

As recommended in the Permeable Reactive Barrier: Technology Update (ITRC, 2011), a bench-scale treatability test was conducted by PRIMA Environmental, Inc. (2017) using groundwater collected from the Site to evaluate the ability of ZVI to reductively dechlorinate the COCs. According to the study:

> *"ZVI destroyed TCE, 1,1,1-TCA and cis-DCE, as expected, but had little effect on 1,1-DCA. The half-life for TCE removal increased over time, ranging from < 13 minutes when the iron was fresh (about 8 pore volumes put through) to 43 minutes after 37 pore volumes, 51 minutes after 69 pore volumes, and 462 minutes after 80 pore volumes. Loss of total and dissolved iron along the length of the ZVI bed suggests that the loss of reactivity may be due to precipitation of iron minerals.*
>
> *1,1,1-TCA degradation was rapid with the rate increasing with the age of the column. The half-life for 1,1,1-TCA removal was 24 minutes when the iron was fresh, but less than 3.6 minutes after 69 pore volumes were put thought. 1,1,1-TCA was partially transformed to 1,1-DCA, but 1,1-DCA did not account for all of the 1,1,1-TCA lost.*
>
> *cis-DCE decreased in tests with sufficiently long contact times (about 3 hrs or 3 days), but small increases were seen with shorter contact time (1.5 hours) because cis-DCE is a reactive intermediate of TCE transformation and TCE transformation was incomplete."*

The rate constants and half-lives from the treatability study are summarized in **Table 1** (PRIMA, 2017). As shown in **Table 1**, in two cases the half-life of TCE is significantly longer than the half-life of 1,1,1-TCA, in the other cases the half-life is roughly comparable. The average TCE half-life in the first three cases in Table 1 is 36 minutes, while that for TCA is 10.4 minutes, indicating that TCE takes about three times longer to reductively dechlorinate than TCA. These values are consistent with our experience from other historical studies.

Table 1. Rate Constants and Half-Lives from the Treatability Study

Analyte	Contact Time (min)	Total Pore Volumes Put Through	k_{obs} (min-1)	R^2 (-)	$t_{1/2}$ (min)
First Sample Event					
TCE	*180*	*8*	> 0.052*	1*	< 13*
1,1,1-TCA	*180*	*8*	0.029	1	24
Second Sample Event					
TCE	*89*	*37*	0.0162	0.9795	43
1,1,1-TCA	*89*	*37*	> 0.20*	1*	< 3.5*
Third Sample Event					
TCE	*89*	*69*	0.0135	0.9366	51
1,1,1-TCA	*89*	*69*	> 0.19*	1*	< 3.6*
Fourth Sample Event					
TCE	4200	80	0.0015	1	462
1,1,1-TCA	4200	80	0.0014*	1*	< 495*

** Estimated value. Analyte was not detected in any measured sample except influent. A concentration of 1/2 the reporting limit and a time equal to the contact time in the first port for which the analyte was not detected, was used to estimate kobs.*

The treatability study were not intended to and thus did not define half-lives for PCE, cis-1,2-DCE and VC, therefore, additional literature review was conducted to obtain representative half-lives for these compounds. The California Department of Toxic Substances Control Office of Pollution Prevention and Technology Development report titled "*An Assessment of Zero Valence Iron Permeable Reactive Barrier Projects in California*" ("Assessment Report"; Muegge, 2008) provides half-lives and estimated rate constants of CVOCs in ZVI, which are summarized in **Table 2**. Comparison of the average TCE half-life in ZVI from the treatability study for the first three cases[1] in Table 1 (i.e., 36 minutes or 0.6 hour) with that provided in in the Assessment Report (i.e., 0.6 hour) indicates that they are comparable. Therefore, the half-lives and associated rate constants for PCE, cis-1,2-DCE and VC provided in in the Assessment Report were considered valid for the design calculations.

Table 2. CVOCs Half-Lives in ZVI from the Assessment Report

Analyte	Half-Life in ZVI (hrs)	Estimated Rate Constant ($cm^3/(g\cdot day)$)
PCE	0.3	20.7
TCE	0.6	10.3
cis-1,2-DCE	3.1	2.0
VC	4.7	1.31

1 The TCE half-life reported from the fourth sample event in Table 1 is significantly larger than the first three, and is based on a much lower flow rate than the other data points. The reduced flow rate for the fourth sample event is not representative of expected groundwater flow conditions during wall operations (400-500 times slower than the expected groundwater flow rate). Therefore, the half-life for the fourth sample event was excluded from this evaluation.

5.2 Concentrations Used in the Design Calculation

As shown in **Drawing 1**, the proposed PRB is located approximately17 feet to the north (i.e., downgradient) of monitoring well MW-10, while the proposed southern treatment zone is located about 17 feet to the north (i.e., downgradient) of monitoring well MW-07. Thus, for design purposes, the expected contaminant concentrations for the proposed ZVI treatment areas were conservatively assumed to correspond to the maximum concentrations measured in MW-10 and MW-07 during the December 2015 and May 2016[2] sampling events (**Table 3**). These are considered conservative estimates because the additional migration distance to the ZVI treatment zone is anticipated to result in additional degradation and, therefore, a lower concentration entering the PRB.

Table 3. Concentration of Analytes Exceeding NY AWQS-GA

Analyte	AWQS-GA (µg/L)	Concentration in MW-07 (µg/L)	Concentration in MW-10 (µg/L)
PCE	5	37	1.5
TCE	5	6100	1700
cis-1,2-DCE	5	100	360
trans-1,2-DCE	5	ND	5.5
1,1-DCE	5	67	21
VC	2	ND	29
1,1,1-TCA	5	690	11
1,1,2-TCA	1	2.9	ND
1,1-DCA	5	280	24
1,2-DCA	0.6	6	0.82

As presented in **Table 3**, TCE, 1,1,1-TCA, and PCE have the same AWQS-GA (i.e., 5 µg/L), but the TCE concentration is more than two orders of magnitude higher than that of 1,1,1-TCA in MW-10, and PCE is below the AWQS-GA at MW-10. In addition, the TCE concentration at MW-07 is about one order of magnitude higher than TCA, and two orders of magnitude higher than PCE. Thus, for design purposes, TCE will be considered the target contaminant.

5.3 ZVI Barrier Design Calculations

Considering that TCE typically has a longer required degradation half-life (i.e., it degrades slower) than 1,1,1-TCA and that TCE concentrations are substantially greater that those of 1,1,1-TCA and PCE in both proposed treatment areas, TCE and its degradation byproducts (i.e., cis-1,2-DCE and VC) will control the design of the ZVI Barriers. That is, by the time the chlorinated ethenes starting with TCE are reductively dechlorinated to meet their corresponding AWQS-GA, the chlorinated ethanes will have been reductively dechlorinated to below their corresponding AWQS-GA [3]. Even though TCE also degrades through more efficient and faster chemical pathways, reductive dechlorination is an industry accepted and more conservative and thus safer design metric. Therefore, the ZVI barrier design will target reduction of the chlorinated ethenes starting with TCE.

2 MW-10 was dry during the May 2016 sampling event and was not sampled.

3 Except for 1,1-DCA, which is discussed later in this section.

The Assessment Report (Muegge, 2008) indicates that the required ZVI barrier thickness can be determined using the following equation (Equation 1):

$$\frac{M}{A} = F\frac{un}{k_1}Ln(\frac{P_0}{P}) \qquad \textbf{Equation 1}$$

where,

M = mass of iron in the barrier, g
A = frontal area of the barrier, cm^2
F = safety factor (4)
u = groundwater flowrate, cm/day
n = soil porosity (0.30)
k_1 = temperature compensated rate constant, $cm^3/(g \cdot day)$
P_0 = initial contaminant concentration, µg/L
P = final contaminant concentration, µg/L

The mass of iron in the barrier can be defined using the following relationship (Equation 2):

$$w = \frac{M}{A\rho_{iron}} \qquad \textbf{Equation 2}$$

where,

w = barrier width, cm
ρ_{iron} = bulk density of iron (2.2 g/cm^3)

Equation 1 can be solved to calculate the width of pure ZVI barrier (Equation 3):

$$w = \frac{0.54}{k_1}uLn(\frac{P_0}{P}) \qquad \textbf{Equation 3}$$

Note a safety factor of 4 is built into the calculation.

As presented in **Table 4**, this equation was used to define the minimum required width for the two ZVI barriers such that the chlorinated ethenes and ethanes can be reductively dechlorinated to meet the applicable AWQS-GA assuming the following:

- The decay pathway for chlorinated ethenes is TCE to cis-1,2-DCE, VC, and then ethene;
- Because the existing trans-1,2-DCE and 1,1-DCE concentrations are up to two orders of magnitude lower than the existing cis-1,2-DCE concentrations, only cis-1,2-DCE was considered in the calculations.
- The k_1 values for cis-1,2-DCE and VC used in the calculation were adopted from the Assessment Report (Muegge, 2008);
- The k_1 value for TCE used in the calculation was adopted from the average of the first three measurements in the Treatability Study.
- The groundwater velocity values representative of the treatment zone locations were calculated based on the groundwater model constructed for the site as recommended by ITRC (2011);
- The initial TCE concentration for the PRB design was assumed to correspond to that measured at MW-10 during the December 2015 sampling event. As a conservative measure the cis-1,2-DCE and VC concentrations were defined from a TCE concentration of 1,700 µg/L, assuming stepwise 100% decay and conversion to 1,2-DCE and then 100% decay and conversion to VC. These two

hypothetical concentrations are higher than the measured concentrations in MW-10 (i.e., 1,254 µg/L vs. 360 µg/L for cis-1,2-DCE; and 810 µg/L vs. 29 µg/L for VC), therefore, as a conservative measure, the hypothetical concentrations were used in the design calculation. The initial TCE concentration for the southern treatment zone calculation was assumed to correspond to that measured at MW-07 during the December 2015 sampling event. Similar to the PRB, the cis-1,2-DCE and VC concentrations were defined from a TCE concentration of 6,100 µg/L, assuming a 100% decay and conversion to daughter products. These two hypothetical concentrations are higher than the measured concentrations in MW-07 (i.e., 4,501 µg/L vs. 100 µg/L for cis-1,2-DCE; and 2,901 µg/L vs. non-detect for VC), therefore, as a conservative measure, the hypothetical concentrations were used in the design calculation.

Table 4. Calculation of Required ZVI Barrier Thickness for Chlorinated Ethenes

Treatment Area	Contaminant	Rate Constant k_1	Groundwater Flow Rate u	Initial Concentration P_0	AWQS-GA P	Calculated Wall Thickness w
		$cm^3/(g \cdot day)$	ft/day	ppb	ppb	ft
PRB	TCE	10.3	0.235	1700	5	0.07
	cis-1,2-DCE	2.0	0.235	1254	5	0.35
	VC	1.31	0.235	810	2	0.58
					Total	**1.00**
Southern Treatment Zone	TCE	10.3	0.109	6100	5	0.04
	cis-1,2-DCE	2.0	0.109	4501	5	0.20
	VC	1.31	0.109	2901	2	0.33
					Total	**0.57**

As presented in **Table 4**, the minimum total required thickness for the PRB (assuming a wall that is 100% ZVI) was conservatively calculated to be 1 foot, and 0.57 foot for the for the southern treatment zone. These are conservative estimates because: (a) they are based on measured concentrations in monitoring wells located upgradient from the proposed treatment areas; (b) the initial concentrations of cis-1,2-DCE and VC used in the calculations were conservatively developed from TCE concentrations; and (c) a safety factor of 4 is applied during the equations provided in the Assessment Report. Considering that both ZVI treatment zones will be installed within 3-foot trenches, the equivalent minimum ZVI content for the PRB and southern treatment zone is 35% and 20% by volume, respectively.

5.4 ZVI Carbon Content

The treatability test results suggest that ZVI barriers might not be able to dechlorinate 1,1-DCA effectively. Review of groundwater monitoring data from December 2015 and May 2016 sampling events revealed that: (1) at monitoring wells where 1,1-DCA was detected, the concentrations from the May 2016 event are lower than those from the December 2016 event, indicating possible occurrence of natural degradation; and (2) the 1,1-DCA concentration in monitoring well MW-10 from the December 2015 sampling event is 24 µg/L, less than 5 times the AWQS-GA (5 µg/L). Therefore, to ensure that the 1,1-DCA concentration will be remediated below the AWQS-GA, ZVI backfill with a higher organic content will be specified to promote the ongoing natural degradation processes.

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5.5 ZVI Material Specification

Groundwater flow simulations conducted for the site indicate that the ZVI treatment areas need to have a horizontal hydraulic conductivity of at least 5 ft/day (2 x 10^{-3} cm/sec) to achieve the appropriate residence time characteristics and thus remediation design goals. As summarized in **Table 5**, based on the ZVI specifications for three products from Connelly-GPM, Inc. (i.e., ETI CC-1004; CC-1190; and CC-1200) and one from Compass Remediation Chemicals (i.e., ZVI–8/50), Connelly-GPM's CC-1190 meets the minimum hydraulic conductivity requirements and provides the highest carbon content.

Table 5. ZVI Product Comparison

ZVI	Supplier	Hydraulic Conductivity (ft/day)	Carbon Content (%)
ETI CC-1004	Connelly-GPM, Inc.	200	2.85 - 3.23
CC-1190	Connelly-GPM, Inc.	6	2.5
CC-1200	Connelly-GPM, Inc.	3	2.5
ZVI–8/50	Compass Remediation Chemicals	200	1.5 - 2.5

According to the manufacturer, the CC-1190 ZVI would at least 95% iron/iron oxide (Fe0) by weight, have at least 2.5% total carbon, and have the following gradation:

Screen Size (U.S. Standard)	Percent Passing
8	100%
16	98.5-100%
30	45-80%
50	15-40%
100	0-20%
200	0-10%

To create the ZVI backfill for the three-foot wide treatment zone, the CC-1190 ZVI is to be mixed with washed sand (35% ZVI and 65% sand by volume for the PRB and 20% ZVI and 80% sand by volume for the southern treatment zone). To maintain the required hydraulic conductivity, the washed sand is to conform to the following gradation:

Screen Size (U.S. Standard)	Percent Passing
16	100%
30	45-80%
50	15-40%
100	5-20%
200	0-1%

6. SUMMARY AND CONCLUSIONS

Two in-situ treatment areas using ZVI as reactive treatment medium are proposed for the site to reduce CVOC concentrations in groundwater to below applicable AWQS-GA. The required ZVI content in each of the two proposed treatment zones was calculated in accordance with the Assessment Report (Muegge, 2008). Based on the analysis, the minimum width of a pure ZVI barrier required for the PRB and southern treatment zone is 1.0 foot and 0.57 foot, respectively. Considering that the ZVI treatment areas will be installed within 3-foot trenches, the equivalent minimum ZVI content for the PRB and southern treatment zone is 35% and 20% by volume, respectively. The balance is to consist of washed sand. To achieve the remediation design goals, the ZVI backfill is to have a horizontal hydraulic conductivity of at least 5 ft/day (2 x 10^{-3} cm/sec) and contain total carbon content of at least 2.5%. Based on ZVI manufacturer product sheets, the Connelly-GPM's CC-1190 is the selected ZVI.

7. REFERENCES

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PRIMA Environmental, Inc., 2017. Report of Findings, Bench-Scale Evaluation of Zero-Valent Iron for Destruction of COCs.

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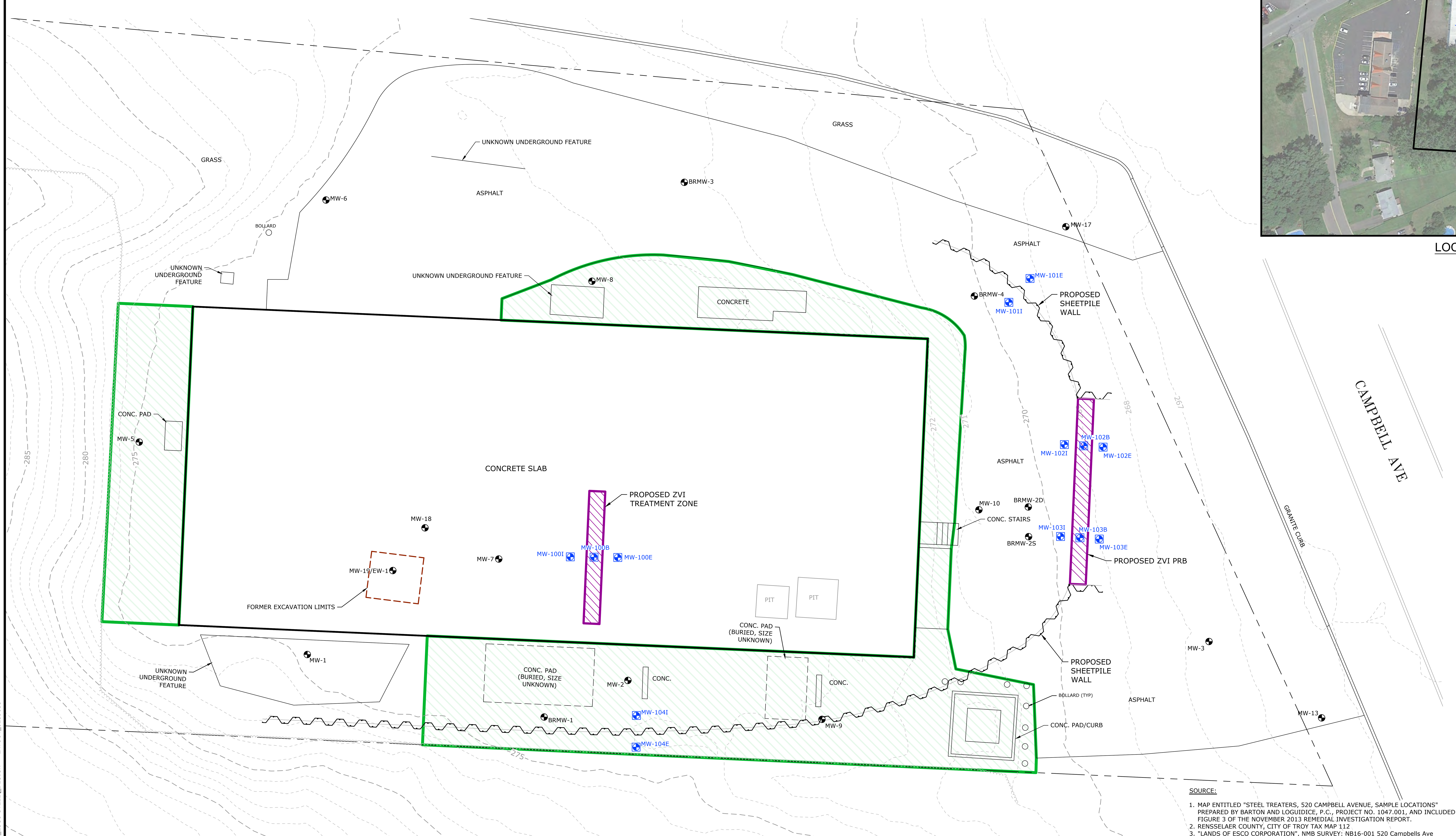
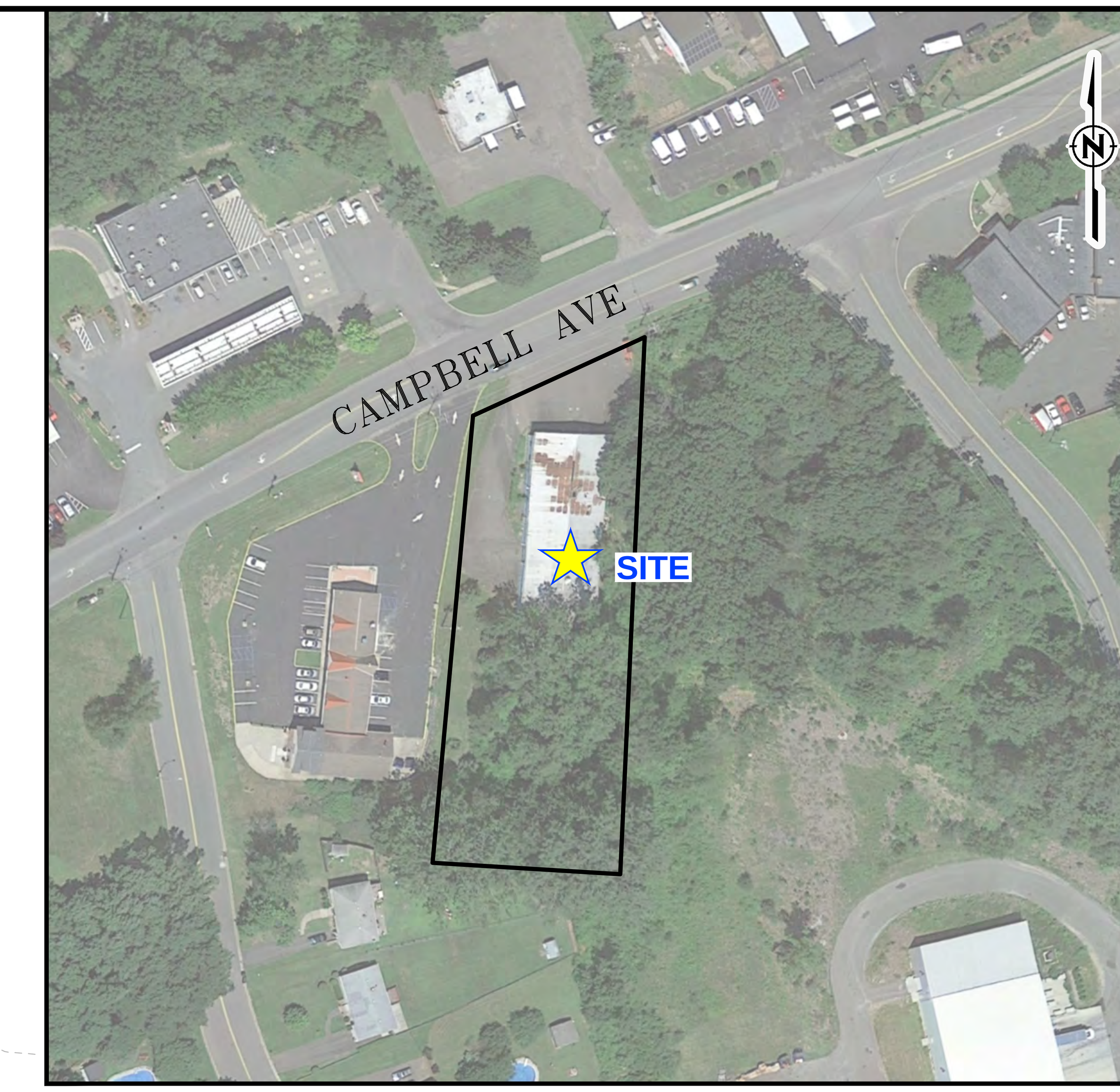
DRAWING





LOCATION MAP
1" = 100'

SOURCE:
Google Earth[TM] Pro. MAPPING SERVICE.
IMAGE DATE: 07/15/2015.

10 0 10 20
SCALE IN FEET

SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
2. RENSSELAER COUNTY, CITY OF TROY TAX MAP 112
3. "LANDS OF ESCO CORPORATION", NMB SURVEY: NB16-001 520 Campbells Ave 020416.dwg DATED FEB. 4, 2016.
4. ALL SAMPLE LOCATIONS SHOWN IN LIGHT GRAY ARE APPROXIMATE. LOCATIONS BASED ON "SITE MAP SHOWING SOIL AND GROUNDWATER SAMPLING LOCATIONS" PREPARED BY BARTON & LOGUIDICE, P.C. AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
5. "UNKNOWN UNDERGROUND FEATURE" REFERS TO SUBSURFACE METALLIC ANOMALIES IDENTIFIED DURING THE GEOPHYSICAL SURVEY COMPLETED BY NAEVA GEOPHYSICS ON NOVEMBER 24, 2015.
6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

REV.	DATE	DR.	CH.	REVISION

SITE LAYOUT AND PROPOSED PRB LOCATIONS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	DRAWING 1
DRAFTED BY: MSB	SCALE: AS SHOWN	
APPROVED BY: JS	PROJECT: 0239035A	

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ATTACHMENT F
DESIGN CALCULATIONS - PROPOSED SHEETPILE WALL

SHEET PILE DESIGN
PROPOSED ZVI PERMEABLE REACTIVE BARRIER DESIGN

PROJECT NAME:	Steel Treaters, Inc., Troy, NY		
PROJECT NUMBER:	02-39035A		
PREPARED BY:	Lin Zhao, PhD, PE	Date:	November 3, 2017
REVIEWED BY:	Jose Sananes, PE	Date:	November 3, 2017
APPROVED BY:	Jose Sananes, PE	Date:	November 3, 2017

1. PROBLEM STATEMENT

As shown in **Figure 1**, two treatment areas are proposed for the site: (a) a granular zero valent iron (ZVI) permeable reactive barrier (PRB) and hydraulic routing system between the northern side of the former building and Campbell Avenue (referred herein as the PRB); and (b) a ZVI treatment zone in the vicinity of the former pit (referred herein as the southern treatment zone).

As shown on the Design Drawings (Attachment B), an impermeable hydraulic barrier (i.e., sheet pile wall) will be installed on either side of the PRB with a total combined length of 210 linear feet. The sheet pile wall is intended to route groundwater towards the permeable section containing the reactive media and located between the two sheetpile wall spans. The sheet pile wall was designed to function as a watertight barrier for a design life of 100 years. As such, corrosion resistance and watertightness were two major factors that were considered in the design. Since this sheet pile will not support any excavations and has no structural purpose (i.e., earth pressures on either side of the sheet pile wall are the same), geotechnical and structural stability analyses were not required.

2. CORROSION EVALUATION OF SHEET PILE

The steel sheet pile wall could be subject to corrosion as a result of chemical reactions between steel and the surrounding environment, with the presence of moisture increasing the electrical conductivity of the environment in contact with the steel surface. The sheet pile wall was designed to have adequate durability to function as a water barrier. The selection of sheet pile was based on an evaluation of corrosion resistance. Probable life expectances were estimated for PZC13, PZC14, PZC18, and PZC19 (ASTM A572 Gr. 50 and 60) with no coating, coal tar epoxy coating, fusion bonded epoxy coating, and cathodic protection based on the expected loss to corrosion for contaminated formerly industrial site conditions.

Table 1 presents losses of thickness due to corrosion for steel sheet piles under different site conditions (ArcelorMittal, 2008). Table 1 indicates that annual loss of thickness is 0.03 mm for polluted natural soil and industrial grounds. Considering that site soils would be considered "polluted natural soil and industrial grounds," an annual loss of thickness would be applicable 0.03 mm. Applying a factor of safety of 1.5, an annual loss rate of 0.045 mm was used to compute probable life expectancy of the sheet pile wall.

As summarized in **Table 2**, probable life expectances for PZC13, PZC14, PZC18, and PZC19 indicate that a design life of at least 100 years can be expected for all sheet pile sections with or without corrosion protection. Based on the results of corrosion evaluation, ASTM A572 Gr. 50/60 PZC13 sheet piles (or engineer-approved equivalent) were recommended to be used in this project because it is lighter in weight than PZC14, PZC18, and PZC19, and may require smaller cranes for their installation.

Table 1. Loss of Thickness Due to Corrosion for Steel Sheet Piling (ArcelorMittal, 2008)

Soil, with or without groundwater:	DESIGN LIFE:				
	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils	0.00 mm	0.30 mm	0.60 mm	0.90 mm	1.20 mm
Polluted natural soils and industrial grounds	0.15 mm	0.75 mm	1.50 mm	2.25 mm	3.00 mm
Aggressive natural soils (swamp, marsh, peat...)	0.20 mm	1.00 mm	1.75 mm	2.50 mm	3.25 mm
Non-compacted and non-aggressive fills [B] (clay, schist, sand, silt...)	0.18 mm	0.70 mm	1.20 mm	1.70 mm	2.20 mm
Non-compacted and aggressive fills [B] (ashes, slag...)	0.50 mm	2.00 mm	3.25 mm	4.50 mm	5.75 mm

A. Values are provided for general guidance only. Local knowledge may lead to the use of other values for design. The values given for 5 and 25 years are based on measurements, whereas other values are extrapolated.

B. In compacted fills, these corrosion losses should be divided by two.

C. The highest corrosion rate is usually found at the splash zone of marine environments or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the submerged zone.

Table 2. Probable Life Expectancy of Sheet Piles

Pile	Web/Flange Thickness (in.)	Max Allowable Sacrificial Thickness[1] (in.)	Corrosion Loss of Thickness (mm/year)	Probable Life Expectancy (year) (ASTM A572 Gr. 50 and 60)			
				No Coating	Coal Tar Epoxy Coating of 16 mils[2]	Fusion Bonded Epoxy Coating[3]	Cathodic Protection[2]
PZC13	0.375	0.1875	0.045	106	126	131	126
PZC14	0.420	0.210	0.045	119	139	144	139
PZC18	0.375	0.1875	0.045	106	126	131	126
PZC19	0.420	0.21-	0.045	119	139	144	139

Notes: 1- The maximum allowable sacrificial thickness is half of the original thickness as recommended by LB Foster Piling (2017); 2- The typical life expectancy for coal tar epoxy coating and cathodic protection is 20 years (LB Foster Piling, 2017); 3- The typical life expectancy for fusion bonded epoxy coating is 25 years (LB Foster Piling, 2017).

3. COATING of SHEET PILE

While it was determined that corrosion protection was not necessary based on the corrosion analysis, for additional protection, coal tar epoxy coating, which provide similar protection as cathodic protection but is more economical and does not require periodic maintenance, is recommended. Carboline Bitumastic® 300 M (high build coal tar epoxy), manufactured by Carboline Company, or engineer-approved equivalent, is recommended to be used for coating of sheet piles to provide corrosion protection for the following reasons:

- The product is most widely used in the sheet pile for corrosion protection in the east coast.
- The product has excellent chemical, corrosion, and abrasion resistance.
- The product can be used for long-term corrosion protection of steel against water, wastewater, seawater, alkaline water and acidic water corrosion.
- The product has excellent impact resistance.
- The product meets US Corp of Engineers C-200 and C200a.
- The product meets American Water Works Association (AWWA) C-210 Standard: Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- The product can be brush or spray applied at the project site or at the sheet pile mill.
- According to the manufacturer, this product will not be negatively affected by the presence of chlorinated ethenes and ethanes at the concentrations detected in site soils and groundwater, and will not leach into groundwater.

4. SEALING OF SHEET PILE INTERLOCKS

To improve the water tightness of the steel sheet pile sections, which will have ball and socket interlocks, the joints should be sealed. Sealing of interlocks is intended to prevent seepage through interlocks and impermeabilze the sheet pile wall. WADIT®, a non-toxic hot cast sealant distributed by PilePro® (or Engineer-approved equivalent) is proposed to impermeabilize the interlocks for the following reasons:

- The product provides both water-stopping and corrosion protection.
- The product acts as a pile lubricant by reducing friction and preventing interlocks from “heating up”.
- Comprehensive test data on this product indicates that there is no water leakage through the pile interlock (TU Dortmund, 2008).
- This product is non-toxic, made from natural raw materials, and protects against hazardous substances.
- This product is highly durable and performs well in a variety of environments, including contaminated media.
- The product can be easily applied using a pipe.
- According to the manufacturer of WADIT®, the product will not be negatively affected by the presence of chlorinated ethenes and ethanes at the concentrations detected in site soils and groundwater.

5. SUMMARY OF SHEET PILE DESIGN

The sheet pile wall design focused on corrosion protection considering a 100-year design life. A conservatively assumed sheet pile wall thickness loss of 0.045 mm/year was assumed given its proposed installation in “polluted natural soils or industrial ground” as defined in the 2008 Piling Handbook

(ArcelorMittal, 2008). While all ASTM A572 Grade 50/60 steel sheetpile sections evaluated provided a service life of more than one hundred years without the need for coatings or cathodic protection, for additional protection the sheetpiles will be coated with Carboline Bitumastic® 300M, a high build coal tar epoxy manufactured by Carboline Company® (or Engineer-approved equivalent). The PZC13 steel sheetpile sections as manufactured by LB Foster Company (or Engineer-approved equivalent) were selected as they are the lighter sections and may require smaller cranes for their installation. The steel sheetpile sections will have ball and socket interlocks which will be sealed with WADIT®, a non-toxic hot cast sealant distributed by PilePro® (or Engineer-approved equivalent) to impermeabilize the interlocks.

6. REFERENCES

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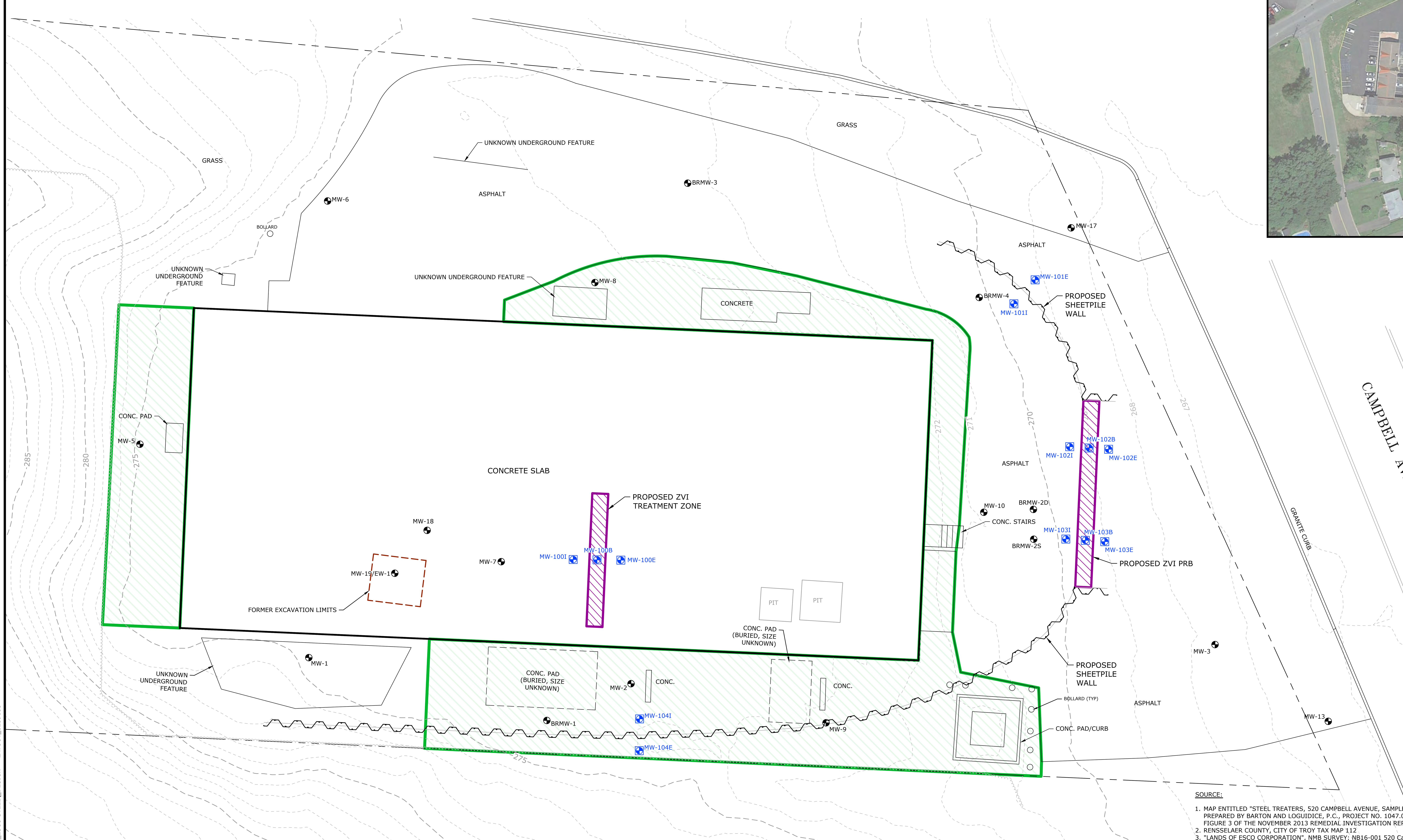
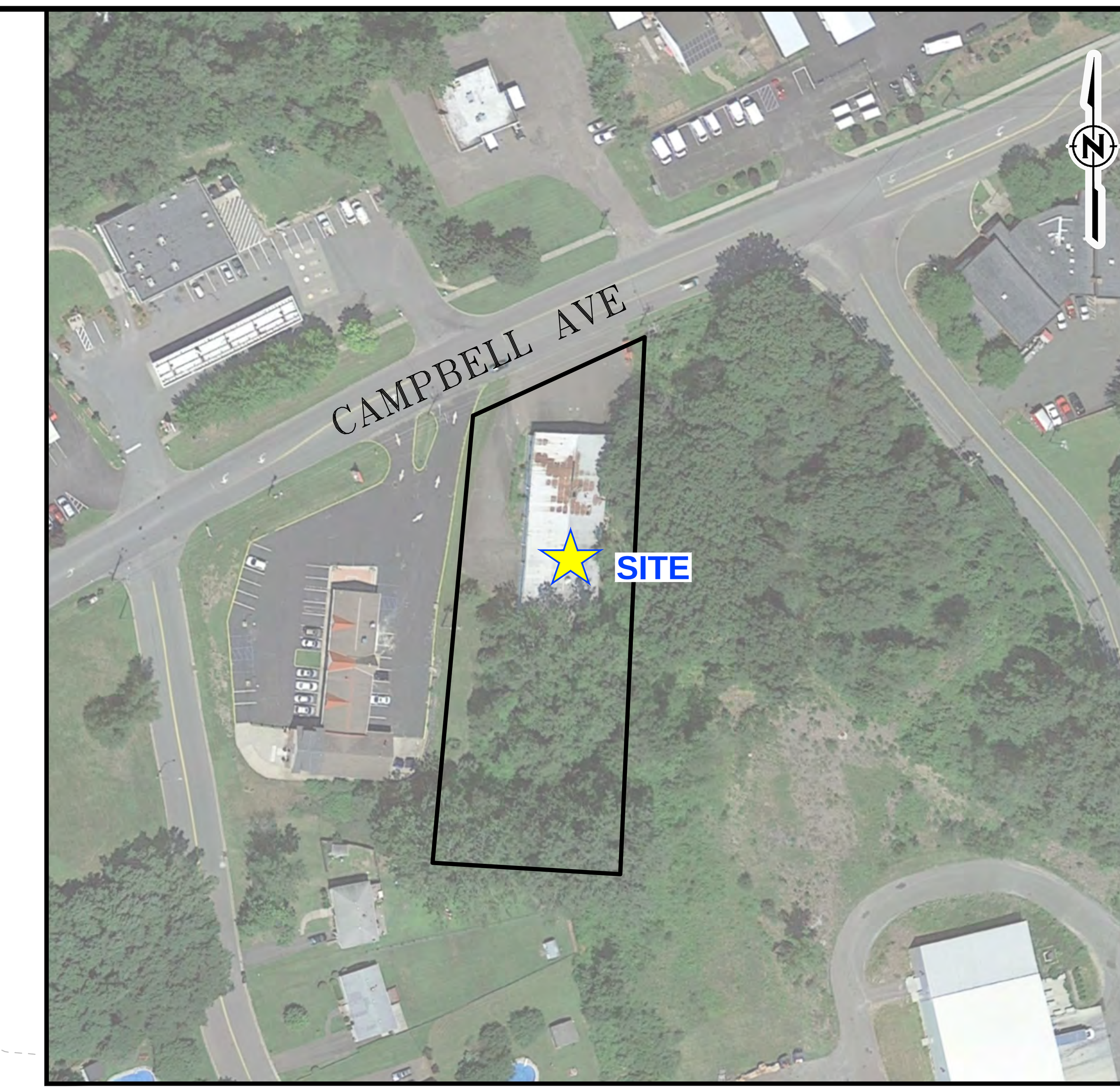
FIGURE 1





LOCATION MAP
1" = 100'

SOURCE:
Google Earth™ Pro. MAPPING SERVICE.
IMAGE DATE: 07/15/2015.

LEGEND
- PROPERTY BOUNDARY
- EXISTING GRADE CONTOUR
- APPROXIMATE TREE LINE
- MONITORING WELL LOCATION
- PROPOSED SHALLOW MONITORING WELL
- PROPOSED CAP LIMITS

10 0 10 20
SCALE IN FEET

SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
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6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

REV.	DATE	DR.	CH.	REVISION

SITE LAYOUT AND PROPOSED PRB LOCATIONS

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	DRAWING
DRAFTED BY: MSB	SCALE: AS SHOWN	1
APPROVED BY: JS	PROJECT: 0239035A	

MBLE! 11/6/17
\\ENV-PRI-FP01\CAD\0239035_ESCO STEEL_DESIGN < LAYOUT_0239035 >

ATTACHMENT G
HEALTH AND SAFETY PLAN

Prepared for:
Steel Treaters, Inc.
Troy, NY

Prepared By:
ENVIRON Engineers of North Carolina, PC
Princeton, NJ

Date:
September 2017

Site Number:
V00578-4

Project Number:
02-39035A

HEALTH AND SAFETY PLAN

FORMER STEEL TREATERS, INC. FACILITY
520 CAMPBELL AVENUE
TROY, NEW YORK
NEW YORK STATE VOLUNTARY CLEANUP PROGRAM

EMERGENCY CONTACT INFORMATION

Site Name: **Steel Treaters, Inc.**

Specific Location: **520 Campbell Ave, Troy, NY, 12180**

Table 1: Emergency Response Telephone Roster

Contact	Name	Office Phone #	Mobile Phone #
Local Fire Department	Troy Fire Department	911 (518) 270-4471	
Local Hospital	Samaritan Hospital	(518) 271-3300	
Local Police	City of Troy Police Department	911 (518) 270-4411	
EENC Principal	Drew Bonas	(609) 243-9874	(609) 240-5581
EENC Project Manager	Jose Sananes	(609) 243-9882	(732) 841-1218
EENC Designated Site Supervisor	Brian Robinson	(860) 503-1662	(203) 233-7907
Health and Safety Coordinator	Sharon Burkett	(609) 243-9832	(609) 306-8361
Client Contact	Travis Quarles	(503) 228-2141	
Contractor: ADT	Rich Donnely	(518) 326-1441	
Contractor: CT Male Associates	Michael Groff	(518) 786-7413	
Poison Control		800-222-1222	

POTENTIAL CHEMICALS OF CONCERN:

Volatile organic compounds – Ethanes (1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane), ethenes (cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, vinyl chloride), and 1,4-dioxane.

ROUTE DESCRIPTION AND MAP TO HOSPITAL

Hospital Information:

Hospital Name: Samaritan Hospital

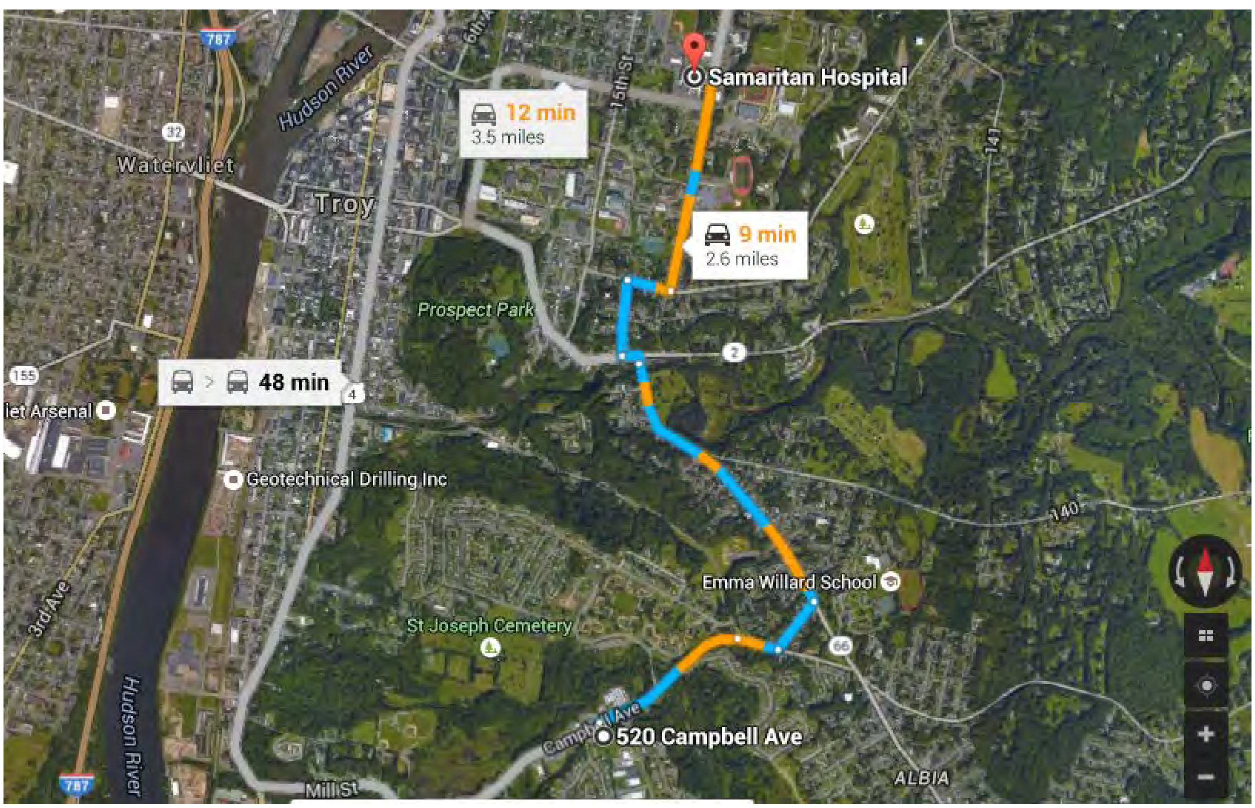
Hospital Address: *2215 Burdett Avenue, Troy, NY*

Hospital Phone Number: *(518) 271-3300*

Directions to Area Hospital:

Head east (turn right) on Campbell Ave toward Colleen Road

- Slight right onto Spring Ave
- Turn left onto Myrtle Ave
- Turn left onto Pawling Ave
- Turn left onto Congress St
- Turn right onto Brunswick Ave
- Turn right onto Tibbits Ave
- Turn left onto Burdett Ave
- End: 2215 Burdett Ave, Troy, NY (Destination will be on the left)



CONTENTS

TABLES

APPENDICES

HEALTH & SAFETY PLAN REVIEW AND APPROVAL

By signing below, it is acknowledge that this HASP identifies the activities that are anticipated to be performed in the field. In addition, this HASP identifies the personal protective and monitoring equipment that may be necessary to be on site and be available for use. It is also understood that the provisions of this HASP will be updated if there is a change of a task and/or the addition of tasks and will be approved by the individuals listed below or their designee.

Drew Bonas Principal-In-Charge	Signature	9/29/2017 Date
Jose Sananes Project Manager	Signature	9/29/2017 Date
Sharon Burkett Health & Safety Coordinator	Signature	9/29/2017 Date
Evan Anderson Certified Industrial Hygienist	Signature	9/6/2017 Date
Brian Robinson Designated Site Supervisor	Signature	9/29/2017 Date
Kim Groff Designated HASP Preparer	Signature	8/31/2017 Date

This form MUST be signed prior to starting the on-site work. In addition, a copy of this form should be returned to the office Health and Safety Coordinator prior to leaving for the field. After completion of the project, the original signed HASP must be retained in the project file.

Author's Initials: BTR/KMG Typist's Initials: File Name: 44716v2

1. INTRODUCTION

This HASP was prepared to inform all Environ Engineers of North Carolina (EENC) personnel of known or reasonably anticipated potential hazards and safety concerns at this Site. All personnel participating in field activities must be trained in the general and specific hazards unique to the job they are performing and, if applicable, meet recommended medical examination and/or training requirements. All EENC employees shall follow the guidelines, rules, and procedures contained in this site-specific HASP. EENC personnel shall contact the Project Manager (PM) if unexpected conditions are encountered at the site, including but not limited to new processes; changes in operation, products, services; additional or changes in the chemicals of concern; and/or unsafe conditions are encountered which were not previously addressed in this HASP.

Each contractor, subcontractor, and visitor shall be expected to review and understand the hazards, risks, and control methods (including emergency procedures) as outlined in this HASP, and sign off on the HASP. This can be accomplished either during the project planning stage or during the first safety briefing on site. However, contractors and subcontractors will be required to prepare their own HASP to address site safety and work hazards associated with their proposed site activities prior to mobilization to the site. In addition, each subcontractor will be required to provide EENC with their site-specific HASP, and communicate the types of hazards and control methods associated with their activities to EENC during the first safety briefing on site and as conditions change. Relevant Contractor information regarding the identification of hazards and appropriate control strategies for the hazards for their particular job tasks should also be presented and a site-specific HASP should be available for review by all parties. Each contractor or subcontractor must assume direct responsibility for its own employees' health and safety.

Copies of the HASPs will be kept on site for review and reference during all site activities. Upon completion of the project, the finalized and signed copy of the HASP will be placed in the project file.

1.1 Site Description

Steel Treaters, Inc. (STI) acquired the site, which consisted of vacant land, in 1965 from Charles E. Weber & Son. The site was previously developed with an approximately 8,400-square-foot building, which was located in the northern portion of the site. The single story building was damaged by a fire in 2005 and demolished in April 2017; all that remains currently is the building slab. The southern portion of the site is wooded and undeveloped.

Starting in 1966, STI utilized the facility to heat treat metal machine parts, which were received from various manufacturers. The majority of the work conducted at the site involved tempering and case hardening of metal parts, as well as annealing of metal parts. Air and vacuum furnaces were used at the facility, and some parts were cooled using quench oil. Anhydrous ammonia was also used onsite during the heat treatment process to generate atmosphere for the furnaces.

Past site activities were believed to have included the use of solvents, including 1,1,1 trichloroethane and trichloroethylene, which were stored in 55-gallon drums and used for vapor degreasing of metal parts. The solvents were reportedly reclaimed following use. STI reportedly believed that usage of these solvents ended in approximately 1991. STI's operations ceased following the 2005 fire and ESCO Portland (ESCO) acquired the site in 2012. The site is currently vacant.

1.2 Specific Work Activities

The field activities currently underway or planned for the immediate future include the following work activities or tasks:

- Task 1 – Groundwater Monitoring Well Installation and Sampling
- Task 2 – Mobilization for Construction
- Task 3 – Soil Erosion and Sediment Control
- Task 4 – Clearing and Grubbing
- Task 5 – PRB/ZVI Treatment Area Construction
- Task 6 – Transportation and Off-Site Disposal of Waste Materials
- Task 7 – Cover System Installation
- Task 8 – Demobilization

Each of these Tasks is further described as follows:

Task 1 - Groundwater Monitoring Well Installation and Sampling

EENC will oversee the installation of groundwater monitoring wells by the Contractor. Groundwater samples will be collected by EENC from the site monitoring wells following USEPA Region 1 low flow groundwater sampling procedures or passive diffusion bags (PDBs) to minimize the generation of excess groundwater that will require off-site management and groundwater sampling efforts.

Task 2 – Mobilization for Construction

This task will include the oversight of mobilizing all necessary equipment, supplies, materials, and personnel by the Contractor to the Site for completion of remedial action implementation.

Task 3 – Soil Erosion and Sediment Control

EENC will oversee the installation and maintenance of soil erosion and sediment control measures (e.g., hay bales, silt fence) by the Contractor.

Task 4 – Clearing and Grubbing

EENC will provide oversight of clearing and grubbing all areas to be excavated or capped and all support zone areas by the Contractor.

Task 5 – PRB/ZVI Treatment Zone Construction

This task will include oversight of the construction of a permeable reactive barrier (PRB) and zero valent iron (ZVI) treatment zone. This will include excavation and disposal of soil and placement of ZVI backfill materials.

Task 6 – Transportation and Off-Site Disposal of Waste Materials

This task includes oversight of the loading and off-site disposal by the Contractor using triaxle truck of materials including, but not limited to: excavated soil; waste generated by the Contractor; and trees and vegetation which have been cleared and grubbed and cannot be reused on-site.

Task 7 –Cover System Installation

EENC will provide oversight of milling and repaving of existing paved areas and installation of aggregate cover material in existing landscaped areas.

Task 8 – Demobilization

EENC will provide oversight for the Contractor's removal of all temporary equipment and facilities, excess supplies, excess materials, any remaining wastes, and personnel from the Site, including office supplies and equipment, small tools, storage trailers, and any other requirements or related miscellaneous items.

1.3 Site Safety Requirements

All work will be conducted during daylight hours. Work will cease in the event of adverse weather conditions including lightning, thunder, ice storm or blizzard conditions which render the work unsafe. While EENC will not perform subsurface work during the execution of this project, the Contractor (to be contracted by the Client) will. While EENC will not subcontract the Contractor, SPI 27 – Subsurface and Overhead Clearance has been attached and will be provided to the Contractor for its reference. The Contractor will follow its own Health and Safety Plan and adhere to its own policies for subsurface utility clearance as well as the requirements of the Technical Specifications.

2. IDENTIFICATION OF KEY HEALTH AND SAFETY PERSONNEL

An efficient on-site operation requires that all key personnel be identified and that their roles and responsibilities be clearly defined. Below is a discussion of the management structure for this project.

2.1 Principal in Charge / Project Manager

Responsibilities include overall coordination of site activities. The Principal in Charge (PIC) and the project manager (PM) have overall accountability and responsibility for the safety of operations and the health and safety of all personnel.

2.2 Health and Safety Coordinator and Director

The local Health and Safety Coordinator (HSC) and Corporate Health & Safety Director are resources for development of the site-specific HASP and will be consulted on all related health and safety issues that arise in the field, including any changes in the scope of work. The Health and Safety Director will make all final decisions regarding questions on the HASP.

2.3 Designated Site Supervisor

The site supervisor is responsible for field-related activities under the direction of the PM and for maintaining field operations in accordance with project requirements. This person is responsible for enforcing daily implementation of the HASP and resolving health and safety issues. In addition, this person will:

- Establish and ensure maintenance of site work zones.
- Monitor the work area and personal breathing zone and ensure compliance of workers relative to pre-established personal protection levels.
- Evaluate site conditions (i.e., weather, chemical, physical) and recommend any modifications to existing levels of protection.
- Ensure that daily safety briefings are conducted and documented in this HASP (see Section 9) or in the field logbook.
- Initiate emergency response procedures with immediate communication to the project manager.
- Exercise stop-work authority in the event of imminent danger to project personnel.
- Notify PM of any noncompliance and/or unsafe conditions.
- Conduct regular inspections to determine effectiveness of the HASP.

2.4 Project Personnel

Project personnel involved in field activities are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to fellow employees.
- Conducting only those tasks that they believe they can do safely.

- Reporting all occurrences and/or unsafe conditions to the supervisor and/or project manager.

Further, any person working on-site has the authority to **stop work** if any operation threatens the health and safety of on-site workers or the surrounding community. In the event that such a situation occurs, the Site Supervisor shall be notified immediately. EENC's Site Supervisor will update the EENC PIC/PM/MP and on all project-related health and safety issues as they arise.

Table 2: EENC Personnel Contact Information

Personnel Telephone Roster

Company / Title	Personnel	Office	Cell
EENC Principal in Charge	Drew Bonas	(609) 243-9874	(609) 240-5581
EENC Project Manager	Jose Sananes	(609) 243-9882	(732) 841-1218
EENC Corporate Health and Safety Director	Sharon Burkett	(609) 243-9832	(609) 306-8361
EENC Project Health and Safety Coordinator	Brian Robinson	(860) 503-1662	(203) 233-7907
EENC Designated Site Supervisor	Brian Robinson	(860) 503-1662	(203) 233-7907
Client Contact	Travis Quarles	(503) 228-2141	

Table 3: Contractor / Subcontractor Contact Information

Contractor / Subcontractor Telephone Roster

Company / Title	Personnel	Office	Cell
EENC will not have any subcontractors. The work will be performed by a Contractor to be contracted by the Client.			

3. HAZARD EVALUATION

The Project Hazard Analysis below identifies the hazards anticipated to be encountered by the project team based on the tasks presented in Section 1.2.

Table 4: Project Hazard Analysis

Chemical Hazards Present: ☐ None	☒ Flammable/combustible ☐ Compressed gas ☐ Explosive ☐ Organic peroxide ☐ Oxidizer ☐ Water reactive ☐ Unstable reactive ☐ Dust/Fumes/Particulates	☐ Corrosive ☐ Toxic ☐ Highly Toxic ☐ Irritant ☐ Sensitizer ☒ Carcinogen (potential) ☐ Mutagen ☐ Other:
Physical Hazards Present: ☐ None	☐ Heat ☒ Cold ☒ Walking/working surfaces ☒ Visible Dust ☒ Traffic/Vehicles ☒ Noise ☒ Other: vibration	☐ Ionizing radiation ☐ Non-ionizing radiation ☐ Electricity ☒ Severe Weather ☒ Poor lighting ☒ Overhead Hazards
Environmental / Mechanical Hazards Present: ☐ None	☒ Heavy machinery/ Drill Rigs ☒ Trenching/excavation ☐ Docks-marine operations ☐ Docks-loading ☒ Drilling ☐ Forklifts ☐ Operations on Water ☐ Elevated heights (includes fall protection) ☒ Overhead/Underground utilities ☐ Confined spaces ☒ Power tools	☒ Cranes/Hoists/Rigging ☐ Ladders ☐ Scaffolding ☐ Manlifts ☐ Gas cylinders ☐ Roadway work ☐ Railroad work ☐ Energized equipment (LO/TO) ☐ Pressurized equipment (LO/TO) ☒ Drums and containers ☐ Others:
Biological Hazards Present: ☐ None	☐ Animal/human fluids or blood ☐ Animal/human tissue(s) ☒ Poisonous/irritating plants ☐ Other:	☐ Contaminated needles ☐ Live bacterial cultures ☐ Insects/rodents/snakes ☐ Other:
Ergonomics Hazards Present: ☐ None	☒ Repetitive motion ☒ Awkward position ☒ Heavy Lifting ☒ Frequent Lifting	☐ Limited movement ☐ Forceful exertions ☒ Vibration ☐ Other:
Personal Safety / Security: ☐ None	☒ Personal safety ☐ Security issue ☐ Project site in isolated area ☒ Employees working alone ☐ Wild/Feral Animals	☐ Employees working early/late ☐ Potentially dangerous wildlife ☐ Guard or stray dogs in area ☐ No/limited cell phone service ☐ Other:

3.1 Specific Chemicals of Concern

The chemicals listed in the table below includes the identification of chemical contaminants known and/or suspected of being present on-site, the affected media, known concentrations (if applicable), the Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV), and the Action Level (i.e., 50% of the PEL/TLV). This information will be inserted into Table 5 below. In addition, Appendix A contains specific hazardous property information for commonly encountered chemicals although a Material Safety Data Sheet (MSDS) (or equivalent) will also be included in Appendix A.

Table 5: Chemicals of Concern

Chemical	Environmental Media [1]	Highest Measured Concentration	PEL / TLV [2]
1,1-dichloroethane	SO, GW	6.8 ppm (SO)	100 ppm
1,2-dichloroethane	SO, GW	0.022 ppm (SO)	1 ppm
1,1,1-trichloroethane	SO, GW	1.8 ppm (SO)	350 ppm (15 min ceiling)
cis-1,2-dichloroethene	SO, GW	10 ppm (SO)	200 ppm
tetrachloroethene	SO, GW	2.2 ppm (SO)	25 ppm
trichloroethene	SO, GW	120 ppm (SO)	25 ppm
vinyl chloride	SO, GW	1.5 ppm (SO)	1 ppm (skin)
1,4-dioxane	SO, GW	2.4 ppm (SO)	100 ppm

Notes:

[1] Codes for environmental media: **SL**=Sludge; **GW**=Ground Water; **SW**=Surface Water; **LW**=Liquid Waste; **SO**=Soil; **A**=Air; **OTH**= Other (Specify)

[2] PEL: Permissible Exposure Limit / TLV: Threshold Limit Value, use appropriate PEL which would be country or state specific or if one is not available may be from a recognized source.

mg / m^3: milligrams per cubic meter

mg / kg: milligrams per kilograms

ppm: Parts per million

%: Minimum percent allowed for personal entry into a space

4. HAZARD CONTROLS

A general summary of the hazards and an evaluation of those hazards are presented below. More detailed control procedures are provided in the Appendix B or in other section of this HASP as indicated in Table 6.

Table 6: Summary of Hazards

Task Number(s)	Hazards	Relative Hazard / Risk Rating*	Hazard Controls Appendix and / or HASP Section
1, 5, 6, 7	Chemical	NA☐ Low☒ Medium☐ High☐	B1
1, 2, 3, 4, 5, 6, 7, 8	Physical	NA☐ Low☐ Medium☒ High☐	B2
1, 2, 3, 4, 5, 6, 7, 8	Mechanical	NA☐ Low☐ Medium☒ High☐	B3
1, 2, 3, 4, 5, 6, 7, 8	Traffic/Equipment	NA☐ Low☐ Medium☒ High☐	B4
1, 2, 3, 4, 5, 6, 7, 8	Electrical Hazards	NA☐ Low☒ Medium☐ High☐	B5/B18
1, 2, 3, 4, 5, 6, 7, 8	Fire/Explosion	NA☐ Low☒ Medium☐ High☐	B6
1, 2, 3, 4, 5, 6, 7, 8	Noise (acoustical)	NA☐ Low☒ Medium☐ High☐	B7
	Ventilation / Oxygen Deficiency	NA☒ Low☐ Medium☐ High☐	B8
	Heat Stress	NA☒ Low☐ Medium☐ High☐	B9
1, 2, 3, 4, 5, 6, 7, 8	Cold Stress	NA☐ Low☐ Medium☒ High☐	B10
	Insects, Spiders, Snakes	NA☒ Low☐ Medium☐ High☐	B11
1, 2, 3, 4, 5, 6, 7, 8	Poisonous Plants	NA☐ Low☒ Medium☐ High☐	B12
1	Personal Safety	NA☐ Low☒ Medium☐ High☐	B13
1, 2, 3, 4, 5, 6, 7, 8	Working Alone	NA☐ Low☒ Medium☐ High☐	B14
1, 2, 3, 4, 5, 6, 7, 8	Severe Weather	NA☐ Low☒ Medium☐ High☐	B15
1, 4, 5, 7	Above and Underground Utilities	NA☐ Low☒ Medium☐ High☐	B16 & Sections 4.2 - 4.3
5	Trenching/Excavation	NA☐ Low☐ Medium☒ High☐	Use Comprehensive HASP
	Water Safety	NA☒ Low☐ Medium☐ High☐	Use Comprehensive HASP
1, 3, 4, 5, 6, 7, 8	Ergonomics / Material Handling	NA☐ Low☒ Medium☐ High☐	B17

Table 6: Summary of Hazards			
Task Number(s)	**Hazards**	**Relative Hazard / Risk Rating***	**Hazard Controls Appendix and/or HASP Section**
1	Power Tools	NA☐ Low☐ Medium☒ High☐	B18
1, 2, 3, 4, 5, 6, 7, 8	Vehicle Use	NA☐ Low☐ Medium☒ High☐	B19
	Seasonal Hunting	NA☒ Low☐ Medium☐ High☐	B20
	Demolition	NA☒ Low☐ Medium☐ High☐	Use Comprehensive HASP
	Unexploded Ordinances	NA☒ Low☐ Medium☐ High☐	Use Comprehensive HASP
	Closed/Abandoned Mines	NA☒ Low☐ Medium☐ High☐	Use Comprehensive HASP
	Confined Space	NA☒ Low☐ Medium☐ High☐	Section 9
1, 3, 4, 5, 6, 7, 8	Spills	NA☐ Low☒ Medium☐ High☐	Section 8
Note: A single hazard may be listed under several Tasks. In this case, use the highest Severity ranking of the tasks evaluated as the overall ranking.			

Table 7: * Hazard/Risk Matrix Decision Table				
The Hazard...	**Has No Severity**	**Has Minimal Severity**	**Has Moderate Severity**	**Has High Severity**
Is Not Present (i.e., 0% of your on-site time does not expose you to this Hazard)	NA	NA	NA	NA
Is Rarely Present (i.e., <25% of your on-site time exposes you to this Hazard)	NA	LOW	LOW	MED
Is Sometimes Present (i.e., 25% - <50% of your time exposes you to this Hazard)	NA	LOW	MED	HIGH
Is Frequently to Constantly Present (i.e., 50% to 100% of your time exposes you to this Hazard)	NA	MED	HIGH	HIGH

Table 7: * Hazard / Risk Matrix Decision Table
*Relative Risk Rating Scale takes into account the frequency of the hazard and the severity of injury the hazard can cause to employees without regard to PPE usage. In general, • Minimal Severity requires first aid; • Moderate Severity requires professional medical attention; and • High Severity requires immediate medical attention/life threatening.

4.1 General Subsurface Clearance Requirements

If the tasks presented in this HASP involve subsurface work, Table 8 and the specific procedures outlined in section 4.2 are applicable and must be followed. Table 8 summarizes the steps required to be completed, including justification of any exceptions. This table must be completed in its entirety prior to conducting subsurface work.

Table 8: Subsurface Clearance (SSC) Actions

Subsurface Clearance (SSC) Pre-Project Planning Checklist
Document the steps that must be followed and justify any exceptions.
This checklist MUST be completed in its entirety.

SSC Requirements	Yes	No	NA	Comments
1. Prequalification of Contractor for capability of ground disturbance work performed (See Section 4)	☒	☐	☐	The Contractor (to be contracted directly by the Client) will conduct the SSC per the project specifications included in the contract documents, the requirements of the Contractor's own HASP and the Contractor's own policies for subsurface utility clearance. While not applicable, the Contractor will be provided with a copy of SPI 27 (which is appended to this HASP) for its reference.
2. "Designated Person" for SSC work assigned (must be on-site)	☒	☐	☐	EENC will not perform subsurface work during the execution of this project; the Contractor (to be contracted by the Client) will. The Contractor will follow its own Health and Safety Plan and adhere to its own policies for subsurface utility clearance as well as the requirements of the Technical Specifications.
3. Historical Site Information Review	☒	☐	☐	Site layout map from previous investigations.
4. Development of site-specific plot plan	☒	☐	☐	A site survey is included in the project file and will be available on site. This information is included in the design drawings included in the contract documents.

Table 8: Subsurface Clearance (SSC) Actions

Subsurface Clearance (SSC) Pre-Project Planning Checklist
Document the steps that must be followed and justify any exceptions.
This checklist MUST be completed in its entirety.

SSC Requirements	Yes	No	NA	Comments
5. Ground penetrating location marked prior to locate(s) and alternate locations chosen	☒	☐	☐	Per the requirements of the project specifications included in the contract documents and Contractor HASP, the Contractor will perform a private subsurface utility survey. The EENC site supervisor will verify with contractor that Dig Safely NY was notified and will record the locate ticket number.
6. Service notifications provided to clear/locate **public** utilities	☒	☐	☐	Per the requirements of the project specifications included in the contract documents and Contractor HASP, the Contractor will be contacting Dig Safely NY prior to earthwork. The EENC site supervisor will verify with contractor that Dig Safely NY was notified and will record the locate ticket number. Sewer: City of Troy List One Call #: 811 List locate ticket #:
7. **Private** locate contracted for on-site utilities	☒	☐	☐	Contractor will be performing SSC prior to any groundbreaking per the project specifications included in the contract documents and the requirements of their HASP; EENC site supervisor will verify with contractor that SSC has been completed.
8. Designated Person present during private locating	☒	☐	☐	Designated person is the Contractor HSO. EENC site supervisor will verify with Contractor's Designated Person that SSC has been completed.
9. Underground utilities identified prior to commencement of intrusive activities as reasonably feasible	☒	☐	☐	Site walk will be conducted and plans and survey reviewed onsite with Contractor to ensure locations of utilities are understood prior to any earthwork by Contractor.
10. Site walkover conducted to assess utility locations, visual indicators and complete SSC Field Checklist	☒	☐	☐	Contractor and its Designated Person will conduct the site walkover in accordance with the requirements of their HASP. EENC site supervisor will verify with Contractor's Designated Person that SSC has been completed in advance of any groundbreaking and prior to staging equipment (e.g., for overhead hazards). The SSC Field Checklist included in Appendix C will be used as a guide.

Table 8: Subsurface Clearance (SSC) Actions

Subsurface Clearance (SSC) Pre-Project Planning Checklist Document the steps that must be followed and justify any exceptions. This checklist MUST be completed in its entirety.				
SSC Requirements	**Yes**	**No**	**NA**	**Comments**
11. Ground penetration locations(s)/area(s) and Critical Zones (i.e., the 5ft or 1.5m distance surrounding intrusive activities in every direction) cleared	☒	☐	☐	The Contractor will take appropriate precautions when excavating around or near utilities in accordance with the project specifications included in the contract documents and the requirements of their HASP.

4.2 Specific SSC Procedures

The hazards posed by the presence of underground and overhead services are significant. Where there is a requirement for ground penetrating activity, the work shall be thoroughly vetted prior to commencing subsurface work. No intrusive work is to be conducted until the hazards associated with the possible presence of underground and overhead services have been properly identified, and safe locations for intrusion marked and agreed upon. This applies to any intrusive site work (i.e., any work which will involve the disturbance or penetration of the ground or manmade surface by mechanical or manual means, INCLUDING: trial pit excavations, borehole excavations (shell and auger, rotary, hydraulic, percussive), gas spiking, manual excavations, hand digging, intrusion into vertical, indoor, or below ground surfaces, and/or any other on-site activity where disturbance of the ground surface is required). If conducting intrusive activities, the following tasks must be completed **and documented** prior to initiating ground disturbance activities (each is summarized below):

4.2.1 Historical Site Information Review

Obtain the most recent as-built drawings and/or site plans (including underground storage tank (UST), product and vent lines), as available. Consider requesting any other site plot plans, surveys, photographs, and information that might be instructive from the client or other sources. Site information reviewed shall be specified in Table 8 SSC Actions (below).

4.2.2 Plot Plan

Develop a plot plan the accurately reflects all available information and site conditions as accurately as possible, including the number of facilities/pipelines or utilities, locations and alignments. The plot plan shall be updated as SSC activities commence to properly capture site-conditions or visual indicators. Intrusive activities shall not proceed without an updated plot plan or drawing.

4.2.3 Pre-Marking Ground Disturbance Locations

Whenever feasible, ground disturbance locations and/or areas shall be pre-marked using white stakes, white paint or white flags (or black in cases where snow is on the ground) prior to the public and/or private utility mark-outs. Pre-marking provides the line locators with visual boundaries as guidance in clearing locations and placing marks.

4.2.4 Line Location Services

In areas where public and private resources are available, **EENC will contact both public and private utility locate services for any project that involves intrusive activities.** In order to give line operators sufficient time to respond to a request to locate, a minimum of 72 business hours is required prior to the planned start of work. In the event that the driller/excavator retains these services, EENC will conduct a follow-up to confirm utility locate information.

Meet directly with the private locator and provide them with location plans, if possible. If an on-site meeting with the private locator is not possible, you MUST contact the private locator so that they understand the scope of the proposed subsurface work and the extent of their activities.

4.2.5 Site Walkover-Visual Indicators

The Designated Person MUST conduct site walk-over and complete the SSC Field Checklist (Appendix C) for all projects that involve ground disturbance. The site walk-over and visual inspection is most effective when completed during locating activities, but, at a minimum, must be completed PRIOR to ground disturbance. The main intent of the SSC Field Checklist is to identify above ground indicators which may identify the potential existence of subsurface issue. It will also be used to confirm that common utilities have been accounted for, located and verified. Any potential underground utilities should be marked on a site plot plan and the site walkover should be documented utilizing EENC's Subsurface Clearance Field Checklist.

4.2.6 Utility Mark-out

All known pipelines and utilities, as noted on the plot plan, pipeline map or drawing, that pass within the search zone must be located, identified and marked to indicate location and alignment.

A qualified and competent line locator shall conduct line-locating practices utilizing available pipeline maps or plot plans for all areas within the search zone. Direct connection (clamping on) to all possible nearby underground services should be undertaken whenever possible to increase the success rate/reliability in locating. **The specific ground penetration location must be cleared to the edge of the critical zone** (5 feet or 1.5m area surrounding intrusive locations/areas in every direction) using a search and sweep method to verify maximum detection capabilities.

If anticipated services are not identified or located, drilling or ground disturbance will not occur until the service is visually identified.

Commonly used utility mark out colors and identifiers are listed below:

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit, and Lighting Cables

YELLOW - Gas, Oil, Petroleum, or Gaseous Materials

ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewer and Drain Lines

Upon completion of their work (whether you are on-site or not), the private locator MUST contact you to present their results. In addition to providing you with an overall summary of their work, **they must also inform you of any unique circumstance(s) which limited their ability in locating the potential presence of underground utilities (e.g., the existence of overhead electrical lines); if they encountered any abnormalities (e.g., concrete surfaces with reinforced rebar); and/or any other condition which may have diminished the validity of their results and efforts**.

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PIC.

4.2.7 Clearance of Ground Disturbance Locations & Critical Zones

After anticipated utilities have been located and marked, use the available information along with regulatory requirements and project objectives to select final ground disturbance locations.

Each specific ground penetration location must be cleared to the edge of the critical zone (5 feet or 1.5m area surrounding intrusive locations/areas in every direction) using a search and sweep method to verify maximum detection capabilities. Ensure that all detected services and those featured on location plans are outside of the critical zone of EACH location where intrusive work will occur, using a sweep and search method.

The critical zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by on-site conditions, human factors, and equipment. **No intrusive activities shall take place within a critical zone with which utilities or visual indicators intersect**. When known utilities intersect ground disturbance critical zones, boring and/or excavation location criteria should be reevaluated by the Designated Person and PM, and if possible, moved to a pre-cleared alternate location.

In the event that work is required to be conducted in a critical zone containing a marked utility or visual indicator, approval MUST be obtained from the PIC, PM and H&S Director prior to ground penetrating activities.

4.2.8 Overhead Lines

Ensure that any ground penetrating activities are located a minimum of 28 feet (9m) horizontally from any overhead electric cable supported wooden poles, or 50 feet (15m) horizontally in the case of those supported on metal poles/towers. Where this cannot be achieved, contact relevant electricity provider for guidance as well as the PIC/PM and Director H&S.

5. PERSONAL PROTECTIVE EQUIPMENT

This section of the Site Health and Safety Plan is a reference of selection for different levels of PPE. The protective equipment will be selected based on the contaminant type(s), concentration(s) in air (if any), standing liquid (if any), or other applicable matrix, and the known route(s) of entry into the human body.

Table 9: Task Specific PPE

Task Description	Level of Protection				
	A	B	C	Mod D	D
Groundwater Monitoring Well Installation and Sampling	☐	☐	☐	☒	☐
Mobilization for Construction	☐	☐	☐	☐	☒
Soil Erosion and Sediment Control	☐	☐	☐	☐	☒
Clearing and Grubbing	☐	☐	☐	☐	☒
PRB/ZVI Treatment Area Construction	☐	☐	☐	☐	☒
Transportation and Off-Site Disposal of Waste Materials	☐	☐	☐	☐	☒
Cover System Installation	☐	☐	☐	☐	☒
Demobilization	☐	☐	☐	☐	☒

Key:

Level D: Long sleeve shirt*; long pants*; hard hat; eye protection; hearing protection; and safety shoes.

Level D Modified: Level D protection plus protective coveralls, as required; and appropriate hand protection.

Level C: Level D (Modified) protection plus negative pressure respiratory protection with appropriate cartridges; chemical protective coveralls in lieu of general coveralls; use of inner and outer sets of hand protection.

Level B: Level C protection plus Pressure-demand supplied air respirator with escape bottle in lieu of negative pressure respirator; chemical resistant coveralls with hood; chemical resistant boots.

Level A: Level B protection plus fully encapsulating (gas tight) chemically resistant suit.

*Clothing made of natural fibers shall be worn when a shock or arc flash hazard exists.

Table 10: Personal Protective Equipment and Supplies

Equipment	Req	Rec	NA	Equipment	Req	Rec	NA
Steel-toe Boots	☒	☐	☐	SCBA	☐	☐	☒
Outer Disposable Boots	☐	☒	☐	Full-face Airline Resp.	☐	☐	☒
Long Sleeve Shirt and Pants	☒	☐	☐	Full Face Negative Pressure Resp.	☐	☐	☒
Flame Retardant Coveralls	☐	☐	☒	Half Face Negative Pressure Resp	☐	☐	☒

Table 10: Personal Protective Equipment and Supplies

Equipment	Req	Rec	NA	Equipment	Req	Rec	NA
Tyvek Suit	☐	☐	☒	Powered Air Purifying Resp	☐	☐	☒
Poly-coated Tyvek / Saranex Suit	☐	☐	☒	First Aid Kit	☒	☐	☐
Fully Encapsulated Chemical Suit	☐	☐	☒	Fire Extinguisher	☒	☐	☐
Hearing Protection (e.g., during sheet piling and well drilling)	☒	☐	☐	Mobile Phones	☒	☐	☐
Leather Gloves	☐	☒	☐	Walkie Talkies	☐	☐	☒
Outer Chemical Gloves (Type): Nitrile	☒	☐	☐	Water or Other Fluid Replenishment	☒	☐	☐
Inner Chemical Gloves (Type):	☐	☐	☒	Eye Wash	☒	☐	☐
Hard Hat	☒	☐	☐	Sunscreen	☐	☒	☐
Safety Glasses with Side Shields	☒	☐	☐	Insect Repellent	☐	☒	☐
Vented (Splash proof) Goggles	☐	☐	☒	Other: High Visibility Vest	☒	☐	☐

Key:

Req = Required;

Rec = Recommended;

NA = Not Applicable

6. AIR MONITORING/SAMPLING PROCEDURES

Conducting an applicable task may necessitate using one or more monitoring devices as listed in Table 11, particularly if gases, vapors, explosion hazards and/or oxygen deficient atmosphere can occur or are expected. If a monitoring device will be utilized, the corresponding device letter should be placed in the column labeled "Monitoring Instrument Required" in Table 12.

Table 11: Monitoring Devices Available

A	PID (10.6 eV)	**H**	Summa Canister
B	PID (11.7 eV)	**I**	Heat Stress Monitor
C	FID	**J**	Air Sampling:
D	OVA	**K**	Air Sampling:
E	CGI/LEL	**L**	Radiation Detector
F	Colorimetric Indicator Tubes	**M**	Gas Multimeter
G	Dust Monitoring	**N**	Other Device:

With respect to Table 12, also insert the task and the applicable Action Level in the appropriate box using 50% of the most restrictive (lowest) PEL or TLV as the Trigger. For example, if the most restrictive PEL for a particular VOC is 50 ppm, use 25 ppm as the "Trigger" value.

Table 12: Required Monitoring

Required Monitoring	**Constituent**	**Task(s)**	**Trigger (Action Level)**	**Monitoring Instrument Required**
If monitoring is necessary to identify that a risk is at or above tolerable limits and/or is used in controlling a risk on site, document the task and the maximum allowable exposure or trigger, and the monitoring instrument required to be used.	Oxygen		19.5% to 23.5%	
	Carbon Monoxide		25 ppm	
	H_2S		5 ppm	
	C_2S			
	CH_4		0.5% or 5000 ppm	
	VOCs: Total	1	0.5 ppm	B
	Semi-VOCs:			
	Metals			
	Dusts	5	150 ug/m^3 or 100 ug/m^3 above background	G (See CAMP for equipment specifications)
	Others:			
	Others:			

6.1 Action Level Guidance

In general, this HASP must address site-specific chemicals as noted in Table 12. However, there are chemicals commonly encountered in the workplace that may not be a chemical targeted for sampling but nonetheless will have adverse health effects. These chemicals are listed in Table 13 below.

Table 13: Action Levels for Commonly Encountered Compounds

Compound	**Action Level**
VOC (as Benzene)	0.5 ppm MAXIMUM
CH_4	0.5% MAXIMUM or 5000 ppm
CO_2	0.25% OR 2500 ppm MAXIMUM
CO	25 ppm MAXIMUM
H_2S	5 ppm MAXIMUM
O_2	19% MINIMUM – 23.5% MAXIMUM

6.1.1 Volatile Organic Compound

An action level for each chemical or group of chemicals should be based on 50% of the most restrictive (lowest) relevant PEL or TLV. If a sustained (i.e., 1-minute sampling period) total volatile organic compound (VOC) reading within proximity to the breathing zone as determined by a photo ionization detector (PID) is above the action level, site personnel shall attempt to mitigate the situation through the use of engineering controls (i.e., move upwind, increase air circulation) as indicated in Table 14. If the action level still cannot be met, personnel shall leave the area and contact the PM and HSC for further instructions.

Table 14: Volatile Organic Compound

Instrument	Calibration Gas Standard	Frequency / Duration of Air Monitoring	Action Level[1] (Breathing Zone)	Action
Photo ionization detector (PID) calibrated daily	100 ppm isobutylene	Every 5-10 minutes, take a 1-minute reading.	>0.5 ppm, sustained in proximity to breathing zone	Stand upwind or Introduce engineering controls (i.e., blower fans) (Level D) Evaluate controls (see below)
After Introduction of Engineering Controls				
PID calibrated daily	100 ppm isobutylene	Every 5-10 minutes, take a 1-minute reading.	< 0.5 ppm	Continue work (Level D)
			0.5-1 ppm, sustained in proximity to breathing zone	Don respirator (Level C); Contact HSC to evaluate; draeger tubes can be used to rule out the presence of vinyl chloride. If vinyl chloride is NOT present, action level can be raised to 12.5 ppm (1/2 TLV STEL limit for TCE)
			> 1 ppm, sustained in proximity to breathing zone	Discontinue work; if draeger tubes rule out presence of vinyl chloride, action level can be raised to 12.5 ppm

Note:
[1] Action Levels for "Known contaminants" should be based upon each contaminant's Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV).

6.1.2 Combustible Gas Indicator (CGI) / Oxygen Meter

Table 15: Combustible Gas Indicator (CGI) / Oxygen Meter

Meter Response	Action / Respiratory Protection
CGI response <10% LEL	Continue normal operations with regular, periodic monitoring
CGI response > 10% LEL	Discontinue operations; evacuate personnel and prohibit entry; allow to vent until readings are <10%.
Oxygen level <19.5% or >23.5%	Retreat from work area; consult with PM and HSC about upgrading to Level B respiratory protection, adding mechanical ventilation, and / or possible changes in work practices.

6.1.3 Odors

If strong odors are encountered or if personnel develop headaches, dizziness or other potential exposure symptoms, the personnel shall leave the work area to a well-ventilated area and contact the PM and HSC for further instructions.

6.1.4 Dusts

The permissible exposure levels for total and respirable dusts are 15 and 5 mg/m^3, respectively. In general, at these concentrations you will not be able to read the face of a wristwatch (with your arm extended) when the total dust concentration reaches 15 mg/m^3. Particles of dust in the respirable size range cannot be seen without the aid of a microscope but in aggregate, may be perceived as a haze. More importantly and with few exceptions, when dust is noticeable in the air, more respirable particles will exist than larger particles.

Typically, controlling dusty investigative activities through the use of a water sprayer will control potential exposures. However, in the event that dusty conditions exist that are not related to investigative/remedial activities (dry, uncovered soils with high winds), personnel shall leave the area and contact the PM and HSC for further instructions.

In accordance with provisions of the project Community Air Monitoring Plan (CAMP), continuous dust monitoring will be conducted upwind and downwind during all ground intrusive work areas. This monitoring will be conducted to determine the concentration of particulate matter (as PM10). These readings will be obtained with real-time monitoring equipment capable of generating data on a 15-minute average basis. Per NYSDOH, additional dust suppression measures will be implemented if the downwind PM10 reading is more than 100 µg/m3 above the upwind concentration. Visible dust conditions must also be prevented.

Should visibly dusty conditions persist despite the measures employed by the contractor, personnel will advise on-site personnel to cease work and institute additional dust control measures or alter its work practices. Until such dust conditions are remediated, no work will be conducted.

7. DECONTAMINATION

7.1 Sampling and Construction Equipment Decontamination

Decontamination involves the orderly controlled removal of contaminants. All undedicated sampling equipment and sampling meters (if applicable) will be cleaned prior to and between each use. All on-site equipment will be decontaminated and allowed to air dry before leaving the site. Decontamination maybe accomplished using an approved cleaner, water, and steam. Subcontractors will be responsible for decontamination of their own equipment used during field operations, as well as disposal of the decontamination fluids. Decontamination fluids and soil cuttings will be temporarily stored in on-site 55-gallon drum and spending offsite disposal.

7.2 Personnel Decontamination

All site personnel should minimize contact with contaminants. All disposable PPE will be disposed of in approved 55-gallon drums (including respirator cartridges). Non-disposal PPE must be decontaminated, particularly the safety boots. Any PPE that cannot be decontaminated should be disposed of along with waste generated from field operations. The drums will be sealed and labeled appropriately, stored at a single secure location on the site, and be disposed of appropriately off-site.

Personnel shall wash and remove PPE prior to leaving the site. At a minimum, gross removal of contaminants from the PPE, removal of the PPE, and washing of hands and face shall be required upon exiting the work area.

During emergencies, the need to quickly respond to an accident or injury must be weighed against the risk to the injured party from chemical exposure. It may be that the time lost or additional handling of an injured person during the decontamination process may cause greater harm to the individual than from the exposure that would be received by undressing that person without proper decontamination. The decision must be made by the HSC.

7.3 Investigation-Derived Material Disposal

1. Drill cuttings/well water: on-site in properly labeled drums.
2. Decontamination solutions: on-site in properly labeled drums.

8. EMERGENCY RESPONSE PLAN (ERP)

NOTE: Specific emergency contact information and applicable directions to the nearest medical facility are contained in Appendix B (i.e., the FIRST AND LAST PAGES of this HASP). In the event that an emergency situation occurs, SECURE the safety of yourself and those working under your direction and then contact appropriate site and EENC representatives that are referenced in Section 2.4 of this HASP.

8.1 Stop Work Authority

All EENC employees have the authority and obligation to stop any task or operation where concerns and/or questions regarding the control of HSE risk exist, are not clearly established, or are not understood. Management is responsible for creating a culture where Stop Work Authority is exercised freely and without fear of retribution or intimidation.

When an unsafe condition is identified, a Stop Work intervention will be initiated and treated as a "near miss". As such, an incident report will be completed in accordance with Standard Practice Instruction 19 entitled "Incident Reporting" so that the unsafe condition can be documented, reviewed, and corrective actions and preventative measures be implemented as applicable.

These actions will be coordinated by the Site Supervisor, with support from the PM/PIC/MP and the HSC, and all affected personnel will be notified of the Stop Work issue. No work will resume until all Stop Work issues and concerns have been adequately addressed. Most issues can be resolved in a timely manner at the job site, but occasionally additional investigation and corrective actions may be required. Work may resume when it is safe to do so.

8.2 General Emergency Guidelines

8.2.1 First Aid Procedures

Each field project should have a first aid kit available for use. The contents of which should be based the treatment of the following potential injuries: major wounds, minor wounds (cuts and abrasions), minor burns and eye injuries including protective gloves, breathing barrier, eyewash solutions, and bandages. Since each workplace is unique, additional first aid products should be selected to augment required contents based on the particular work environment.

If an employee is injured, general first aid will be administered. If safety concerns or hazardous conditions are still present, the individual shall be moved to avoid further injury or risk. In the event that an employee is injured in a contaminated area, general first aid will be administered and then the employee will be moved to the support zone for decontamination (if applicable), additional first aid, and preparation for transportation, giving due consideration to which risk will be greater; the spread of contamination or the health/safety of the individual.

8.2.2 Fire Procedures

In the event of a fire, the client contact and/or the local fire fighting authorities shall be immediately notified. If safe and feasible, a fire extinguisher may be used to attempt to extinguish the fire. Upon depletion of one fire extinguisher, all personnel shall evacuate the area and await local fire fighters.

8.2.3 Spill Procedures

If warranted, before any work is initiated at the site, applicable local, state, and/or Federal Emergency Response Authorities will be identified by the preparer of this HASP. In the event of a spill, the client contact shall be immediately notified. If possible and feasible, attempts should be made to contain the spill. If it is determined by consultation with the PM and Client contact that there is no apparent threat to the population or environment, arrangements should be made with a commercial cleanup company to mitigate the spill.

8.2.4 Uncovering an Underground Service (Intact)

In the event of any damage or dislocation of any underground facility/pipeline or utility in connection with ground disturbance activity, work activities shall cease in the area of the damaged facility. The Designated Person shall immediately call the applicable emergency phone number. Then, the affected utility and One Call service shall be notified, if applicable. The One Call service may be able to assist with contact numbers for notifying member companies in the event of any damage. NO ONE should attempt to repair, clamp or constrict the damaged utility.

ALWAYS ASSUME THAT ANY UNDERGROUND PIPE OR SUBSURFACE LINE IS LIVE!

- Stop Work; remove tools if safe to do so.
- Clear all persons from the scene.
- Call the emergency number.
- Contact the One Call/utility member for guidance, if applicable.
- Contact the PM and/or PIC so they can contact the Client, MP, Director of H&S and HSC.

8.2.5 Striking an Underground Electrical/Telecom Cable

- Stop work, remove tools ONLY if safe to do so (operator seats in excavators are normally electrically isolated ALTHOUGH OTHER PARTS MAY BE LIVE IF STILL IN CONTACT WITH A LIVE CABLE).
- Evacuate the immediate area.
- In the event of injuries provide first aid and summon medical assistance.
- Contact the site contact.
- Contact the PM/Director and HSC.
- Contact the electricity/telecom provider, as directed by site contact and/or PM.
- Do not allow anyone to enter the area of the excavation until the electricity provider has made the cable safe.

8.2.6 Striking a Pressurized Gas Pipeline

- Stop work, leave tools in-place but shut off any running equipment, including engines.
- Evacuate the immediate area.
- Ensure there are no sources of ignition in the area.
- Contact the site contact.
- Contact the PM/Director and HSC.
- Contact the pipeline owner, as directed by site contact and/or PM.
- Do not re-enter the immediate area until safe to do so.

8.2.7 Striking a Pressurized Water Main

- Stop work, remove tools if safe to do so, and if necessary and safe to do so, confine jetting water, if appropriate.
- Evacuate immediate area and inform site personnel.
- Ensure that water flowing away is not creating potential hazards (e.g., electrical shorting, flooding, contaminant migration etc) and where possible warn those likely to be affected.
- Contact the site contact.
- Contact the PM/Director and HSC.
- Contact the pipeline owner, as directed by site contact and/or PM.
- Do not re-enter the immediate area until safe to do so.

8.3 Incident Reporting

With respect to incidents, the following types of EHS incidents are to be reported:

- All employee injuries and illnesses that include first aid, doctor/hospital visits which may or may not involve restricted work and/or lost time;
- Environmental incidents and exposures, such as spills or other unplanned releases to the environment or nonconformance to operating procedures;
- All evacuations (false or real);
- Any Property damage;
- Near miss incidents which could have resulted in an injury, an accident, environmental impact or significant loss of facilities;
- Public/third party liability - Incidents that involve injury, illness or property damage due to the actions of any non-EENC employee arising out of, or in connection with the Firm's contracted scope of work, operations, products, or premises.

All of the incidents types outlined above MUST be communicated by the affected employee or an EENC employee witnessing the incident to either the local HSC, PM, or PIC immediately following the incident, either in person or via phone, e-mail, or text messaging. This contacted person will then ensure that the other core project members, plus the Director of

H&S, and the Managing Principal are informed either in person or via phone, e-mail, or text messaging, regardless of time of day. The PIC will notify the client of the incident as appropriate in a timely fashion. For incidents involving three or more employees which need in-patient hospitalization and/or the death of any employee, the applicable regulatory agency will be notified by the Director of Health and Safety.

In the event of an incident, an Incident Investigation Report form will be forwarded for completion by the affected employee and sent the core project members (i.e., the local HSC, PM, or PIC), the Director of H&S, and the Managing Principal for preliminary root cause analysis. The root cause analysis will not be deemed complete until input from the Director of H&S and the Managing Principal (and others as necessary) has been obtained. Similarly, the implementation of any corrective/preventive actions will NOT be implemented until input from the Director of H&S and the Managing Principal (and others as necessary) has been obtained.

9. CONFINED SPACE ENTRY

EENC's health and safety policy prohibits unauthorized entry into confined spaces. In the event that entry into a confined space is required, EENC employees (or its subcontractor's employees) will need additional training prior to entering the confined space. Without supplemental Confined Space training, entry into confined spaces is prohibited. In addition, entry authorization will only be given after EENC management has reviewed the nature of the confined space, the hazards present, and the measures needed to ensure safety. Under these circumstances, EENC will work with the host facility/client to determine training requirements, sampling requirements, written program requirements, and equipment needed to safely enter the confined space.

It is not anticipated that confined space entry will be required for this project and/or the jobs listed in this HASP. If confined space entry is required, this HASP will be modified accordingly to adhere to all applicable regulations.

10. HEALTH AND SAFETY PLAN FIELD TEAM SIGNATURES

Sign off sheet attesting that the HASP has been made available and reviewed by the individual prior to entry into the site.

I have read, understood, and agree with the health and safety protocols presented in the Health and Safety Plan (HASP) and the information discussed in the health and safety briefing. I also understand that noncompliance with the HASP may result in dismissal from the site.

Printed Name	Title	Company	Signature

Date: ____________________ **Time:** ____________

Location: ______________________________

Conducted By: ______________________________

Signed By: ______________________________

11. SAFETY MEETING CHECKLIST

The Site Supervisor should consider discussing the following topics with all field personnel conducting work as part of this HASP, as applicable.

Date and Time of Meeting: ____

Conducted By: ____

CHECK TOPIC(S) DISCUSSED:

HASP Content	**HASP Content**
☐ Chemicals of Concern	☐ Personnel On-Site (Introductions)
☐ Tasks to be Performed	☐ Responsibilities
☐ Location of Tasks	☐ Monitoring equipment
☐ Hazards/Risks of Tasks	☐ Other ______________________
☐ Site Limitations (e.g., cell phone use)	☐ Other ______________________
First Aid	**Industrial Sanitation and Hygiene**
☐ Facilities	☐ Drinking water
☐ Reporting and Records	☐ Restrooms/Porta toilets
☐ Treatment of ______________________	☐ Personal Cleanliness
Personal Protective Equipment	**Housekeeping**
☐ Glasses, Goggles, and Shields	☐ Waste Containers
☐ Hard Hats	☐ Waste Materials
☐ Respirators	☐ Other ______________________
☐ Gloves	
☐ Other ______________________	
Emergency Procedures	**Fire Prevention**
☐ Communications	☐ Extinguisher Locations
☐ Primary Rally Point:	☐ Designated Smoking Areas
☐ Secondary Rally Point:	☐ Hot Work
☐ Headcount	☐ Flammable Liquids Present
☐ Hospital Location/Route	☐ Explosives Present
☐ PPE/Decon	☐ Other ______________________
☐ Other ______________________	
Special Tools / Equipment	**Vehicles/Heavy Equipment**
☐ Chain saws / Chop saws	☐ Transportation of Employees
☐ Other ______________________	☐ Operation and Inspection
☐ Other ______________________	☐ Preventative Maintenance
	☐ Other ______________________

Discussion ____

____

____

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APPENDIX A
CHEMICAL INFORMATION AND MATERIAL SAFETY DATA SHEETS

HAZARDOUS PROPERTY INFORMATION

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
Volatile Organic Compounds (VOCs)									
☐	Acetic acid (64-19-7)	Miscible	1.05	103	11 mm	4.0% 19.9%	10 ppm	50 ppm	0.074 (d)
☐	Acetone (67-64-1)	Miscible	0.79	0	180 mm	2.5% 12.8%	250 ppm	2,500 ppm	62 (d) 130 (r)
☐	Acrolein (107-02-8)	40%	0.84	-15	210 mm	2.8% 31%	C 0.1 ppm Skin	2 ppm	1.8 (d)
☐	Acrylonitrile (107-13-1)	7%	0.81	30	83 mm	3% 17%	2 ppm Skin	85 ppm Ca	1.6 (d)
☐	Benzene (71-43-2)	0.07%	0.88	12	75 mm	1.2% 7.8%	1 ppm Skin	500 ppm Ca	61 (d) 97 (r)
☐	Bromodichloro-methane (75-27-4)	4500 mg/l	1.98	--	50 mm	Non-flam	None established	None determined	--
☐	Bromoform (75-25-2)	0.10%	2.89	--	5 mm	Non-flam	0.5 ppm Skin	850 ppm	1.3 [j]
☐	Bromomethane (74-83-9)	2%	1.73	--	1.9 atm	10% 16.0%	1 ppm Skin	250 ppm Ca	80 [j]
☐	Carbon Tetrachloride (56-23-5)	0.05%	1.59	--	91 mm	Non-flam	2 ppm Skin	200 ppm Ca	252 (d)
☐	Chlorobenzene (108-90-7)	0.05%	1.11	82	9 mm	1.3% 9.6%	10 ppm	1000 ppm	1.3 (d)
☐	2-Chloroethyl-vinyl Ether (110-75-8)	0.02%	1.05	61	27 mm	--	None established	None determined	--
☐	Chloroethane (75-00-3)	0.60%	0.92	-58	1000 mm	3.8% 15.4%	100 ppm Skin	3800 ppm	4.2 [j]
☐	Chloroform (67-66-3)	0.50%	1.48	--	160 mm	Non-flam	2 ppm	500 ppm Ca	192 (d)
☐	Chloromethane (74-87-3)	0.50%	0.92	--	5.0 ATM	8.1% 17.4%	50 ppm	2000 ppm Ca	10 [j]
☐	Dibromo-chloromethane (124-48-1)	2700 mg/l	2.5	--	76 mm	--	None established	None Determined	--
☐	Dibutyl phthalate (84-74-2)	0.001% (77°F)	1.05	315	0.00007 mm	0.5% --	5 mg/m^3	4,000 mg/m^3	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
☐	1,2-Dichlorobenzene (95-50-1)	0.01%	1.3	151	1 mm	2.2% 9.2%	25 ppm Skin	200 ppm	--
☒	1,1-Dichloroethane (75-34-3)	0.60%	1.18	2	182 mm	5.4% 11.40%	100 ppm	3,000 ppm	--
☐	1,1-Dichloroethylene (DCE) (75-35-4)	0.04%	1.21	-2	500 mm	6.5% 15.5%	1 ppm	None determined	190 [j]
☒	1,2-Dichloroethane (107-06-2)	0.90%	1.24	56	64 mm	6.2% 16%	1 ppm	50 ppm Ca	26 (d) 87 (r)
☒	1,2-Dichloroethylene (540-59-0)	0.40%	1.27	36-39	180-265 mm	5.6% 12.8%	200 ppm	1,000 ppm	17 - 170 [k]
☐	1,2-Dichloropropane (78-87-5)	0.30%	1.16	60	40 mm	3.4% 14.5%	75 ppm	400 ppm Ca	0.26 (d) 0.52 (r)
☐	1,3-Dichloropropene (542-75-6)	0.20%	1.21	77	28 mm	5.3% 14.5%	1 ppm Skin	None Determined Ca	1 [j]
☐	Bis-(2-Ethylhexyl)-phthalate (DEHP) (117-81-7)	0.00%	0.99	420	<0.01 mm	0.3% --	5 mg/m^3	5,000 mg/m^3 Ca	--
☐	Diethyl phthalate (84-66-2)	0.10%	1.12	322	0.002 mm	0.7% --	5 mg/m^3	None Determined	--
☐	Dinitrotoluene (DNT) (25321-14-6)	Insoluble	1.32	404	1 mm	-- --	0.15 mg/m^3 Skin	50 mg/m^3 Ca	--
☐	Endrin (72-20-8)	Insoluble	1.7	--	0.00001 mm Low	--	0.1 mg/m^3 Skin	2 mg/m^3	--
☐	Ethyl benzene (100-41-4)	0.01%	0.87	55	7 mm	0.8% 6.7%	100 ppm	800 ppm	2.3 [j]
☐	Hydrazine (302-01-2)	Miscible	1.01	99	10 mm	2.9% 98%	0.01 ppm Skin	50 ppm Ca	3.7 (d)
☐	Methyl ethyl ketone (MEK) (78-93-3)	28%	0.81	16	78 mm	1.4% 11.4%	200 ppm	3000 ppm	16 (d) 17 (r)
☐	Methyl tert-butyl ether (MTBE) (1634-04-4)	5.1 g/100ml	0.7	-18	245 mm	1.6% 8.4%	40 ppm	None determined	0.32 – 0.47mg/m^3 [l]
☐	Methylene chloride (75-09-2)	2%	1.33	--	350 mm	13% 23%	25 ppm	2,300 ppm Ca	160 (d) 230 (r)

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
☐	Phenol (108-95-2)	9% (77°F)	1.06	175	0.4 mm	1.8% 8.6%	5 ppm Skin	250 ppm	0.06 (d)
☐	1,1,2,2-Tetrachloroethane (79-34-5)	0.30%	1.59	--	5 mm	Non-flam	1 ppm Skin	100 ppm Ca	7.3 (d)
☒	Tetrachloroethylene (PCE) (127-18-4)	0.02%	1.62	--	14 mm	Non-flam	25 ppm	150 ppm Ca	47 (d) 71 (r)
☐	Toluene (108-88-3)	0.07% (74°F)	0.87	40	21 mm	1.1% 7.1%	50 ppm Skin	500 ppm	1.6 (d) 11 (r)
☒	1,1,1-Trichloroethane (71-55-6)	0.40%	1.34	--	100 mm	7.5% 12.5%	350 ppm	700 ppm	390 (d) 710 (r)
☐	1,1,2-Trichloro-ethane (79-00-5)	0.40%	1.44	--	19 mm	6% 15.5%	10 ppm Skin	100 ppm Ca	--
☐	1,2,4-Trichlorobenzene (120-82-1)	0.003%	1.45	222	1 mm	2.5% 6.6% (302 °F)	C 5 ppm	None Determined	3 [j]
☒	Trichloroethylene (TCE) (79-01-6)	0.1% (77°F)	1.46	--	58 mm	8% 10.5%	25 ppm	1,000 ppm Ca	82 (d) 110 (r)
☐	Trichlorofluoromethane (75-69-4)	0.1% (75°F)	1.47	--	690 mm	Non-flam	C 1,000 ppm	2000 ppm	--
☐	1,1,2-Trichloro-1,2,2-trifluoroethane (76-13-1)	0.02%	1.56	--	285 mm	-- --	1,000 ppm	2,000 ppm	--
☐	1,2,4-Trimethylbenzene (95-63-6)	0.006%	0.88	112	1 mm	0.9% 6.4%	25 ppm	None determined	2.4 (d)
☒	Vinyl Chloride (75-01-4)	0.1% (77°F)	0.91	--	3.3 atm	3.6% 33%	1 ppm Skin	None Determined Ca	--
☐	Xylene (o, p, m, mix) (1330-20-7)	Slightly soluble	0.86-0.88	81-90	7-9 mm	0.9% 7%	100 ppm	900 ppm	20 (d) 40 (r)
	Metals								
☐	Aluminum metal and oxide (as Al)	b	2.7	--	0 mm	e	10 mg/m^3 (respirable)	None determined	--
☐	Antimony (7440-36-0)	b	6.69	--	0 mm	e	0.5 mg/m^3	50 mg/m^3	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
☐	Arsenic (inorganic compounds, as As)	b	5.73	--	0 mm	e	0.010mg/m^3	5 mg/m^3 Ca	--
☐	Arsenic (organic compounds, as As)	Properties vary depending upon the specific organic arsenic compound.					0.2mg/m^3	None determined	--
☐	Barium chloride(as Ba) (10361-37-2)	38%	3.86	--	low	Non-flam	0.5 mg/m^3	50 mg/m^3	--
☐	Barium nitrate (as Ba) (10022-31-8)	9%	3.24	--	Low	e	0.5 mg/m^3	50 mg/m^3	--
☐	Beryllium and compounds (as Be)	b	1.85	--	0 mm	e	0.0002 mg/m^3	4 mg/m^3 Ca	--
☐	Cadmium dust (as Cd)	b	8.65	--	--	e	0.005 mg/m^3	9 mg/m^3 Ca	--
☐	Chromium (III) compounds (as Cr)	b	Properties vary depending upon the specific compound.				0.5 mg/m^3	25 mg/m^3	--
☐	Cobalt metal dust and fume (as Co) (7440-48-4)	Insoluble	8.92	--	0 mm	e	0.02 mg/m^3	20 mg/m^3	--
☐	Copper dust and mist (as Cu)	b	8.94	--	0 mm	e	1 mg/m^3	100 mg/m^3	--
☐	Lead	Insoluble	11.34	--	0 mm	e	0.05 mg/m^3	100 mg/m^3	--
☐	Manganese, Fume and compounds (as Mn) (7439-96-5)	Insoluble	7.2	--	0 mm	Comb-ustible	0.2 mg/m^3	500 mg/m^3	--
☐	Mercury compounds (as Hg) Except alkyl compound	b	13.6	--	0.0012 mm	e	0.025 mg/m^3 Skin	10 mg/m^3	--
☐	Molybdenum (7439-98-7)	Insoluble	10.28	--	0 mm	Comb-ustible	10 mg/m^3 3 mg/m^3 (resp.)	5,000 mg/m^3	--
☐	Nickel and other compounds (as Ni)	Insoluble	8.9	--	0 mm	e	1 mg/m^3	10 mg/m^3 Ca	--
☐	Selenium (7782-49-2)	Insoluble	4.28	--	0 mm	Comb-ustible	0.2 mg/m^3	1 mg/m^3	--
☐	Silver, metal dust, and soluble compounds (as Ag)	b	10.49	--	0 mm	e	0.01 mg/m^3	10 mg/m^3	--
☐	Thallium (soluble compouds, as Ti)	b	Properties vary depending upon the specific compound.				0.1 mg/m^3 Skin	15 mg/m^3	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
☐	Vanadium pentoxide dust and Fume (1314-62-1)	0.8%	3.36	--	0 mm	e	0.05 mg/m^3 (Respirable)	35 mg/m^3	--
☐	Zinc oxide (1314-13-2)	b	5.61	--	0 mm	e	5 mg/m^3	500 mg/m^3	--
	Miscellaneous								
☐	Ammonia (7664-41-7)	34%	--	--	8.5 atm	15% 28%	25 ppm	300 ppm	17 (d)
☐	Asbestos (1332-21-4)	Insoluble	--	--	0 mm	Non-flam	0.1 fibers/cc	None determined	--
☐	Chromic Acid and chromates (1333-82-0)	63%	2.7	--	Very low	Non-flam	0.005 mg/m^3	15 mg/m^3 Ca	--
☐	Cyanide (as CN)	--	--	--	--	Non-flam	5 mg/m^3 Skin	--	--
☐	DDT (50-29-3)	Insoluble	0.99	162-171	0.0000002 mm	--	1 mg/m^3 Skin	500 mg/m^3 Ca	--
☐	Diesel Fuel #2 (68476-34-6)	Insoluble	0.81-0.90	130	--	0.6-1.3 6-7.5	None established	None determined	--
☐	Fluorides, as F	--	--	--	--	--	2.5 mg/m^3	None determined	--
☐	Gasoline (8006-61-9)	Insoluble	0.72-0.76	-45	38-300 mm	1.4% 7.6%	300 ppm	Ca None determined	--
☐	Kerosene (8008-20-6)	Insoluble	0.81	100-162	5 (100°F)	0.7% 5.0%	200 mg/m^3g Skin	None determined	--
☐	Naphthalene (91-20-3)	0.03%	1.15	174	0.08 mm	0.9% 5.9%	10 ppm	250 ppm	0.038 (d)
☐	PCB (42% chlorine) (53469-21-9)	Insoluble	1.39	--	0.001 mm	Non-flam	1 mg/m^3 Skin	5 mg/m^3 Ca	--
☐	PCB (54% chlorine) (11097-69-1)	Insoluble	1.38	--	0.00006 mm	Non-flam	0.5 mg/m^3 Skin	5 mg/m^3 Ca	--
☐	Phosphorus (yellow) (7723-14-0)	0.0003%	1.82	--	0.03 mm	-- --	0.1 mg/m^3	5 mg/m^3	--
☐	Polycyclic Aromatic Hydrocarbons (PAH)	Properties vary depending upon the specific compound. Listed in NIOSH as Coal Tar Pitch Volatiles					0.2 mg/m^3	80 mg/m^3 Ca	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean [i] (ppm)
SITE-SPECIFIC SUBSTANCES (Add hazardous property information on any substances that are of concern at the site but are not listed above.)									
☒	1,4-Dioxane	soluble	1.030	52	27 mm	1.7% 25.2%	100 ppm	500 ppm	169.2

EXPLANATIONS AND FOOTNOTES:

[a] Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water, such as gasoline. However, most of these materials are water soluble at the part per million or part per billion level. Gasoline, for example, is insoluble in the gross sense, and will be found as a discrete layer on top of the ground water. But certain gasoline constituents, such as benzene, toluene, and xylene, will also be found in solution in the ground water at the part per million or part per billion levels.

[b] Solubility of metals depends on the compound in which they are present.

[c] Several chlorinated hydrocarbons exhibit no flash point in a conventional sense, but will burn in the presence of high energy ignition source or will form explosive mixtures at temperatures above 200 °F.

[d] Expressed as mm Hg under standard conditions.

[e] Explosive concentrations of airborne dust can occur in confined areas.

[f] Cal/OSHA Time-weighted Average (TWA) Permissible Exposure Limits (PELs) except where noted in g. The substances designated by "Skin" in the PEL column may be absorbed into the bloodstream through the skin, the mucous membranes and/or the eye, and contribute to the overall exposure. “C” notation indicates the number given is a ceiling value.

[g] TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists (ACGIH). Currently, there is no Cal/OSHA PEL.

[h] The substances with a “Ca” notation in the IDLH column are considered to be potential occupational carcinogens by NIOSH.

[i] Odor thresholds values extracted from “*ODOR THRESHOLDS for Chemicals with established Occupational Health Standards*”, American Industrial Hygiene Association, 1997.
(d) Odor detection threshold: Lowest concentration at which a stimulus is being detected.
(r) Odor recognition threshold: Lowest concentration at which a definite odor character is detected.

[j] Values extracted from the U.S. Environmental Protection Agency Technology Transfer Network, Air Toxics website. URL: www.epa.gov/ttn/atw/, 2006

[k] Value extracted from “*HESIS Guide to Solvent Safety*” California Department of Health Services, 2004. URL: http://www.dhs.ca.gov/ohb/HESIS/solv_cht.htm

[l] Value extracted from “*Chemical Summary For Methyl-Tert-Butyl Ether*”, U.S. Environmental Protection Agency, Office Of Pollution Prevention and Toxics, August 1994. URL: http://www.epa.gov/chemfact/s_mtbe.txt

APPENDIX B
CONTROL MECHANISMS

The following Control Methods should be implemented for the listed Hazards.

B1 Chemical Hazards – EENC personnel, contractors, subcontractors, and visitors shall wear appropriate personal protective equipment (PPE) while performing site activities. At a minimum, equipment shall include safety glasses, steel-toed boots, and hard hats (when overhead work being performed or when overhead hazards exist). EENC personnel shall familiarize themselves with the appropriate health and safety responses for exposure to known on-site chemicals prior to beginning work at the site. See Attachment A for chemical safety data. Consult with your local Health and Safety Coordinator (HSC) for any personal air monitoring requirements.

B2 Physical Hazards – EENC personnel shall minimize the risk of slips, trips, and falls by keeping the work area clear of excess equipment and cleaning up wet surfaces as soon as possible. In addition, the floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition. Employees should avoid walking through/on wet and/or cluttered surfaces and be conscious of the fact the wet surfaces could be slippery and could cause injury. Spilled materials should be cleaned up immediately.

Sufficient illumination should be provided in all areas at all times. Employees should notify the responsible person (e.g., Principal–in-Charge, Project Manager, and/or Health and Safety Coordinator) of conditions where there is an absence of sufficient natural and/or permanent artificial light.

All employees are responsible for maintaining the work area(s) and in a clean and orderly manner, and for notifying the responsible person (e.g., Principal–in-Charge, Project Manager and/or Health and Safety Coordinator) of conditions beyond their control.

B3 Mechanical Hazards –EENC personnel shall not attempt to operate equipment they are not familiar with and/or are not equipped not protection devices (e.g., guards). Personnel shall familiarize themselves with the equipment being utilized on site and shall at a minimum, know how to stop or turn off the equipment.

B4 Traffic/Heavy Equipment Safety – EENC personnel should, under no circumstances, operate or ride on heavy equipment which is being used by a subcontractor. Site personnel will maintain a safe distance of at least 20 feet (6.5 meters) or more, depending on circumstances and directives, from all heavy equipment in operation. If activities warrant closer proximities to operating equipment, personnel will don brightly colored vests and a second person will stand watch to keep him/her out of the path of equipment while performing the required activity. Eye contact with the equipment operator will be maintained.

B5 Electrical Hazards – Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, a qualified electrician must perform it.

Properly ground all electrical equipment. Avoid standing in water when operating electrical equipment. Ground fault outlets or adapters shall be used for any electrical equipment. Apparatus, tools, equipment, and machinery will not be repaired while in operation. Lockout/Tagout (LOTO) procedures will be implemented when necessary. If equipment must be connected by splicing wires, electrical work must be performed by a licensed and competent electrician.

B6 Fire and Explosion Hazards – The presence of petroleum and solvent contaminated material presents a potential fire hazard. Smoking and use of open flame will be prohibited in the Lab. The use of non-sparking tools and equipment will be implemented if conditions warrant. Where the potential of fire exists, EENC will provide portable fire extinguishers. Where applicable, all fire extinguishers shall be mounted no higher and no lower than 4 feet (1.22 m) from the floor and/or shall be readily accessible for use, where applicable. All fire extinguishers shall be maintained as follows:

- Fully charged and in operable condition;
- Clean and free of defects; and
- Readily accessible at all times

B7 Acoustical Hazards – Hearing protection will be worn by all personnel operating or working within the vicinity of equipment when noise is sufficient to interfere with general conversation at a normal speaking volume; when noise levels exceed 85dBA; and/or when manufacturers' requirements indicates that it's usage is mandatory. Personal hearing protectors, such as earplugs or earmuffs, may be used to reduce the amount of noise exposure while the above control measures are being evaluated or if such controls fail to reduce the exposure levels to below the PELs.

B8 Ventilation / Oxygen Deficiency Hazards – EENC personnel shall monitor the work area for oxygen deficiency hazards using monitoring devices that have been appropriately calibrated and are recommended for this specific use, as applicable. If direct air monitoring readings suggest an oxygen deficiency and/or the build-up of harmful substances, leave the area and contact your Project Manager. Implementation of corrective actions may include but not be limited to increasing work zone ventilation or evaluating alternatives (e.g., removing equipment that is generating combustion exhaust or venting the exhaust to the exterior of the building). However, work will not continue until the ventilation/oxygen deficiency hazard has been properly addressed, implemented, and verified.

B9 Heat Stress – Heat stress can be a significant hazard, especially for workers wearing protective clothing. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and in the prevention of heat stress incidents.

Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers. Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium, or unconsciousness. Heat stroke is a life threatening condition that must be treated by competent medical authority.

Heat Stress Prevention

Whenever possible or within the control of EENC, engineering controls should be utilized to protect workers from heat related hazards. For example, isolation from the heat source, ventilation such as open windows, fans or other methods of creating air flow, and heat shielding such as awnings or umbrellas. Appropriate work practices can also lessen the chances of heat related hazards. Some of these include:

- Water intake should be about equal to the amount of sweat produced (i.e., drinking 5-7 ounces of water every 15-20 minutes). Electrolyte fluids may also be necessary.
- Whenever possible, gradual exposure to heat is preferred to allow the body's internal temperature to actuate to the working conditions.
- Whenever possible, adjust the work schedule to reduce risk of heat stress. For example, postpone nonessential or heavier work to the cooler part of the day and perform work in the shade if portable.
- Rotate personnel to reduce the amount of time spent working in direct sun and heat.
- Increase the number and/or duration of rest breaks, and whenever possible, rest break areas should be in a cool area and as close to the work area as is feasible.

Wear appropriate PPE when necessary, such as thermally conditioned clothing, self-contained air conditioning in a backpack, and plastic jackets/vests with pockets that can be filled with dry ice or ice. However, based on the type of work being done, where work is being performed, or other required PPE, these options may be prohibited or make the use of this PPE impossible or impractical.

Allocation of Work in a Work / Rest Cycle	**Acclimatized**				**Action Limit (Unacclimatized)**			
	Light	**Moderate**	**Heavy**	**Very Heavy**	**Light**	**Moderate**	**Heavy**	**Very Heavy**
75-100%	31.0 (87.8F)	28.0 (82.4F)	--	--	28.0 (82.4F)	25.0 (77F)	--	--
50-75%	31.0 (87.8F)	29.0 (84.2F)	27.5 (81.5)	--	28.5 (83.3F)	26.0 (78.8F)	24.0 75.2F)	--
25-50%	32.0 (89.6F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	29.5 (85.1F)	27.0 (80.6F)	25.5 (77.9)	24.5 (76.1F)
0-25%	32.5 (90.5F)	31.5 (88.7F)	30.5 (86.9F)	30.0 (86F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	27.0 (80.6F)

B10 Cold Stress – The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness, and cold water. One or any combination of these factors can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects.

A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures. Major risk factors for cold-related stresses include:

- Wearing inadequate or wet clothing increases the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication that inhibits the body's response to the cold or impairs judgment.

- Having a cold or certain diseases, such as diabetes, heart, vascular, and thyroid problems, may make a person more susceptible to the winter elements.
- Being male increases a person's risk to cold-related stresses. Men experience far greater death rates due to cold exposure than women, perhaps due to inherent risk-taking activities, body-fat composition, or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, may speed up the effects of cold weather.
- Aging -- the elderly are more vulnerable to the effects of harsh winter weather.

TABLE 2. Cooling Power or Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

▢ Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

Cold Stress Prevention

Engineering controls should be utilized whenever possible to protect workers from cold related hazards. For example, on-site heat sources, heated shelters, work areas shielded from drafty or windy conditions, and the use of thermal insulating material on equipment handles.

Effects arising from cold exposure will be minimized by the following control measures:

- Personnel will be trained to recognize cold stress symptoms.
- Field activities will be curtailed or halted if the equivalent chill temperature is below 20 F.
- As much as possible, work that exposes personnel to the cold will be done during the warmest hours of the day.
- Inactivity in cold conditions will be kept to a minimum.
- Frequent short breaks in warm, dry shelters will be taken.
- Vehicles will be equipped with supplies in case the vehicle becomes inoperable (e.g., blanket, dry clothing, water, food, a shovel, etc.

The following PPE will be provided during work in cold environments

- Workers will be provided with insulated dry clothing when the equivalent chill temperature is less the 30 F.
- Feet, hands, the face, and the head should be protected (40% of the body's heat can be lost when the head is exposed).
- Foot and hand wear may also need to be waterproof.
- Clothing should be layered so that adjustments can be made to changing environmental temperatures and conditions. For example, an outer layer to break the wind, a middle layer that will absorb sweat and retain insulation when wet, and an inner layer that allows ventilation.

B11 Insects, Snakes and Spiders – Care will be taken by all site workers to avoid stinging or biting insects such as ticks, spiders, bees, wasps, hornets, and yellow jackets. Workers allergic to any particular insect sting or bite should seek medical attention if stung or bitten and may need to carry emergency medicine prescribed by their doctor.

Care should always be taken to avoid these insects and increased vigilance is necessary during high infestation seasons, when opening protective casings of monitoring wells, and when walking through areas of heavy vegetation or areas known to be infested.

To minimize the chance of bites/stings:

- Wear appropriate PPE such as light colored clothing so you can see insects, long pants tucked into boots, long sleeves when possible, a hat, and gloves if you are cutting brush or need to handle or move vegetation.
- Check your body and clothing for insects, shower after work and wash/dry clothes at as high temperature as possible.
- Don't swat at insects and don't eat in areas where there are insects.
- Avoid sweet smelling personal hygiene products and, unless contraindicated by the work being performed (e.g., sampling, data collection), wear EPA approved repellants such as those containing DEET.

Black Widow Spider

Brown Recluse Spider

Spider bites generally cause only localized reactions such as swelling, pain, and redness. However, bites from a Black Widow or Brown Recluse, or if you are allergic to spiders, can cause symptoms that are more serious.

First Aid for Spider Bites:

- Clean the bite area with soap and water and place a cold pack over the bite area to reduce swelling.
- Monitor for allergic reactions. If victim has more than minor pain, or if nausea, vomiting, difficulty breathing, or swallowing occurs, medical attention should be sought immediately.

Tick

Removing a Tick

Ticks are common, especially in the warmer weather months and may carry diseases such as Rocky Mountain Spotted Fever and Lyme disease.

First Aid for Tick Bites:

- Use a fine tipped tweezers, grasp tick firmly as close to skin as possible and pull the body away from skin. Avoid crushing the body and don't twist.
- If parts of the tick remain in the skin, don't be alarmed as the mouth will dislodge as skin sloughs off.
- Wash area with soap and water and apply antiseptic or antibiotic ointment to prevent infection.
- If unexplained symptoms develop such as severe headaches, fever, or rash within 10 days of the bite, seek medical attention.
- If possible, contain tick in an air tight container for identification purposes in the event of a serious reaction.

Chigger and Chigger Bites

Chiggers are tiny, s-legged wingless organisms that grow up to become a type of mite. They are found in tall grass and weeds and their bites cause severe itching.

First Aid for Chiggers:

- Reduce discomfort and prevent infection
- The affected area should be kept clean by washing with soap and water
- A topical hydrocortisone cream, antihistamine, or local anesthetic may be of value in reducing the itching
- The wounds should not be scratched, if possible
- If signs of infection occur, consult your physician

Wasp

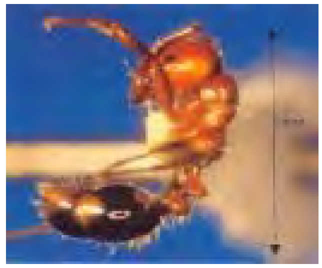
Bee

Bees and wasps belong to the phylum Arthropod family, and they are crucially important to the pollination of plants, specifically flowers, fruits, and vegetables. A sting from a bee or wasp will cause itching, irritation, redness and/or swelling at the sting site.

First Aid for Bee Stings:

- Remove the stinger as quickly as possible - venom continues to enter the skin from the stinger for 45 to 60 seconds following a sting – using a flat dull object, like a credit card. Slid the flat object in the opposite direction of the stinger to remove it from the skin
- Wash the wound using soap and water
- Apply ice for swelling and pain
- A topical hydrocortisone cream, antihistamine, or local anesthetic may be of value in reducing itching
- If the sting occurs on the neck or mouth, seek medical attention immediately, swelling in these areas may cause suffocation

A small percentage of people are allergic to stings and a sting can be fatal, caused by a disruption to breathing and circulatory systems called anaphylactic shock. If the sting is followed by severe symptoms, seek medical attention immediately. Allergic people should never be alone for outdoor activities since help may be needed for prompt emergency treatment. Allergic people should have an identification bracelet as well as carry something like an "EpiPen" for immediate treatment for anaphylactic shock.


Fire Ants

Fire ants are a variety of stinging ants with over 280 species worldwide. Typically, a colony produces large mounds in open areas, and feeds mostly on young plants, seeds, and insects. They nest in the soil, often near moist areas such as river banks and pond edges. Unlike other ants which bite and then spray acid on the wound, fire ants bite only to get a grip and then sting, injecting toxic alkaloid venom. This results in a painful stinging sensation, similar to what a fire burn feels like.

First Aid for fire Ant Bites:

- Move rapidly away from the nest
- Quickly remove or kill ants on skin and clothing to prevent further stings
- Wash the area gently with soap and water to rid the skin of any venom
- Place cool cloth or ice cloth on sites for 15 minutes, and to relieve pain, dab the area with calamine lotion, a topical (cortisone) or oral antihistamine (e.g. benadryl) to help with swelling
- Do not scratch the blister because this can lead to infection
- Allergic response is rare, but symptoms are difficulty breathing, light headedness, and weakness. Immediate medical attention is required

Snakes serve as an important role as predators in the ecosystem, and help maintain populations of rodents and other prey.

First Aid for Venomous Snake Bites:

- Wash and immobilize the injured area, keeping it lower than the heart if possible
- Seek medical attention immediately
- DO NOT apply ice, cut the wound, apply a tourniquet, or suck the bite
- Remain calm and try not to move the bitten body part
- Wash the bite with soap and water
- Remove jewelry or other items that may be affected by rapid swelling of affected body parts
- Try to identify the type of snake: note color, size, patterns, and markings
- The bite will be painful and have two distinct puncture wounds
- If venom is injected there will be burning and swelling

- ONLY FOR CORAL SNAKE BITES: apply a mild wrapping on the wound

Water Moccasin (aka Cotton Mouth)

Rattlesnake

Coral Snake

Copperhead

B12 Poisonous Plants – Plants poison on contact, through ingestion, or by absorption or inhalation. They cause painful skin irritations upon contact and can cause internal poisoning when eaten.

Poison Ivy

Poison Sumac

Giant Hogweed

Poison Oak

First Aid for Poisonous Plants:

- Wash exposed areas with cold running water as soon as you can
- When possible, wash your clothing
- Relieve itching by taking cool showers and applying topical anti-itch medications or hydrocortisone
- The rash is often arranged in streaks or lines where you brushed against the plant
- In a few days, the blisters become crusted and take 10 days or longer to heal
- If the reaction is severe or worsens, seek medical attention

B13 Personal Safety – If it is deemed that a work site is in an area where an employee's personal safety may be at risk from potential criminal acts, wild animals, etc. the risks will be evaluated and implementation of preventative measures will be taken to minimize the risk. Informational resources such as the client, local law enforcement officials, Park or Wildlife Service, and Animal Control could be utilized to assess the risk and to ensure the safest possible work environment. For example, local law enforcement can be made present or make frequent drive-bys while work is being done, outside security can be hired, and work can occur only during certain times of the day or work may not proceed at all. Some general guidelines are provided here, but each situation is different and actions must be taken based on the specifics of each.

In areas of risk, employees will communicate via cell phones or 2-way radios, and will check-in at predetermined times throughout each workday. If employees do not call in to the Project Manager or designated representative, the team will be contacted, and if unsuccessful, local law enforcement will be notified.

If you see wild animals while driving, stay in your vehicle. Never get out for a photo or a closer look. Keep windows up and don't try to keep the animal from crossing a road with your vehicle. If you see a wild animal while on foot, never approach the animal. If the animal has not seen you, go back the way you came. Do NOT turn your back and run which could evoke their natural predator instinct. Instead, keep facing the animal and back away at a steady pace. Let it know you are human by talking in a low voice and waving your hands slowly. If you are near a car or building, get inside. In addition, in areas of higher risk (i.e., contacted officials have indicated that wild animals are a nuisance), employees may want to consider carrying "pepper spray".

If, while on the project site, and despite any precautions set forth, if an employee feels that their personal safety is at risk, they shall cease work, leave the work area and immediately report their concerns so that appropriate steps can be taken.

B14 Working Alone and Working in Isolated Areas – Site and Operations employees will assess the risk of working alone as outlined in section 4 in this HASP. And whenever possible, employees will not work alone in isolated areas. If the isolated area involves hiking/walking into areas that are unmarked or if there is potential to become directionally disoriented (e.g., no trails, unmarked trails, forested or highly vegetated areas), employees will be trained on the use of a compass and trail/topography maps and if necessary, will take wilderness safety training. The employee will work with the Park/Wildlife service on what emergency planning if necessary (e.g., unexpected weather, animal attack, and search/rescue).

Communicating through cell phones or 2-Way Radios will be utilized whenever possible. Employees will check-in at predetermined times throughout each workday and as the risk rating increases, employees will check-in more frequently. If employees do not call in to the Project Manager or designated representative, the team will attempt to be contacted. If contacting the employee is unsuccessful, the appropriate authorities will be notified. In addition, and especially if communication is not possible during the day, the planned start and estimated finish times for the day will be communicated, and employees will check in at the beginning and end of the work day.

If employees will be moving from isolated area to isolated area, there will be established beginning and ending locations, planned start and estimated finish times, and planned routes that will be followed throughout the day. Employees will not deviate from this schedule without first contacting the appropriate personnel. It may also be necessary to notify the client, law enforcement, or Park/Wildlife officials of these schedules.

Local authorities should be contacted about any hunting season that may be in session, and if it is possible that hunters may be present in the area in which EENC personnel will be working. If so, employees will wear brightly colored hardhats/hats and reflective vests, will not work before dusk, and work will end 30 minutes before dusk.

If this is not possible to complete work during day light hours, employees will wear appropriate reflective apparel and have appropriate lighting, such as portable lighting, flashlights, or headlamps as appropriate for the activity being conducted. Personal security will be assessed and measures taken as discussed above if appropriate.

B15 Severe Weather – Severe weather conditions include high winds, electrical storms, and heavy rain. At a minimum, all work outdoors will cease during these events. When lightning is spotted, site personnel should use the following steps to avoid injury:

- Workers should note the flash-boom ratio (i.e., count the seconds after the lightning was seen until the thunder was heard).
- By counting the seconds between seeing lightning and hearing thunder and dividing by 5, you can estimate your distance from the storm (in miles or kilometers). If the storm is 6 miles (9.6 kilometers) away or less (30 seconds between when lightning was seen and thunder was heard) workers must stop work and take shelter.

- If the storm is more than 6 miles (9.6 kilometers) away (greater than 30 seconds between lightning and thunder), the site supervisor should monitor the storm and be prepared to cease work if the storm approaches an unsafe distance. Since storms can travel at varying speeds and the amount of time at takes to cease and secure operations will also vary, so prudent judgment should be exercised when storms are in the vicinity and/or developing (e.g., darkening skies, increasing wind speeds, etc.).
- Workers should not stay in exposed areas (outdoors on the ground, on a roof, in an aerial lift, on a steel truss, on an ungrounded steel structure, in a golf cart, un-sided building, etc.) after lightning has been witnessed. All personnel must move to a safe location.
- Workers should wait 30 minutes from the last sight of lightning or sound of thunder before returning to work.
- Those required to travel from one building to another during the 30 minute wait time should do so only by enclosed vehicle.
- Once the 30 minute wait time period has elapsed and no additional lightning or thunder has been seen or heard, individuals may resume normal work.

B16 Aboveground and Underground Utilities – Various forms of underground and aboveground utility lines or pipes (carrying water, wastewater, gas, and or electricity) may be encountered during work activities. Every effort shall be made to locate and mark underground utilities prior to the start of intrusive work. At a minimum, EENC will conduct a historical site review to develop a plot plan with the most up to date utility information, contact the appropriate One Call service (where available), contract a Private utility locating service (where available), and clear the critical zone around any intrusive location to 5 feet (1.3 m) in every direction. Please reference section 4 of the site-specific HASP and SPI 27 Subsurface Clearance for more information.

Work involving machinery with high extensions (backhoes, etc.) will remain at least 10 feet (3.3 meters) from overhead power lines. As line voltage increases, your safe working distance will also increase. If overhead lines are present, call the utility company and find out what voltage is on the lines so the safe working distance can be calculated, or stay at least 28 feet (9m) from cables supported on wooden poles, and 50 feet (15m) from cables supported on metal poles.

Should any operations cause equipment to come into contact with utility lines, the appropriate authority will be notified immediately and an Incident Report will be completed. Work will be suspended until the appropriate actions for the particular situation can be taken.

B17 Material Handling/Ergonomics – Proper lifting techniques such as keeping the back straight and legs bent, shall be utilized when lifting equipment. If the equipment cannot be lifted in this manner, it is too heavy to lift alone. Call other personnel, or use a mechanical device for lifting.

B18 Power Tools – Power tools can be hazardous when improperly used since these types of tools use an energy source: Electric, liquid fuel, hydraulic, pneumatic, and powder-actuated. The following precautions will be taken by employees to prevent injury:

- Power tools will always be operated within their design limitations.
- Eye protection, gloves and safety footwear are recommended during operation.

- Store tools in an appropriate dry location when not in use.
- Work only in well illuminated locations.
- Tools will not be carried by the cord or hose.
- Cords or hoses will not be yanked to disconnect it from the receptacle.
- Cords and hoses will be kept away from heat, oils, and sharp edges or any other source that could result in damage.
- Tools will be disconnected when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
- Observers will be kept at a safe distance at all times from the work area.
- Tools will be maintained in a clean manner, and properly maintained in accordance with the manufacturers guidelines.
- Ensure that proper shoes are worn and that the work area is kept clean to maintain proper footing and good balance.
- Ensure that proper apparel is worn. Loose clothing, ties, or jewelry can become caught in moving parts.
- Tools that are damaged will be removed from service immediately and tagged "Do Not Use".

B19 Vehicle Use – Work areas and site conditions must be considered when designating and selecting a vehicle for use. The vehicle shall be maintained in safe working order as required by the manufacturer. This would include a routine preventive maintenance schedule for servicing and checking of safety-related equipment. Special consideration should be taken when weather conditions reduce the safety and visibility while driving. Appropriate measures should be taken while driving during inclement weather including snow, icy, and/or wet conditions; high winds; hail, heavy rains; debris or other impairments to safe driving caused by natural weather.

B20 Seasonal Hunting Hazards – During recreational hunting seasons, field personnel will wear appropriate clothing, such as fluorescent orange Hi-Vis vests, so as to be visible to hunters and not blend in with the landscape. Field personnel should also use whistles, air horns and/or other means to make their presence known to hunters and wildlife alike. The schedule of the hunting season, if applicable, will be included as an addendum to this HASP in order to inform personnel of the type of game (e.g., deer, pheasant, duck, etc.) that is being hunted and the type of weapon being used (e.g., bow & arrow, shot gun, single shot rifle, etc.). Be aware that even if "No Trespassing" and/or "No Hunting Allowed" signs are posted, trespassers and/or hunting may still be on site. At no point should field personnel or contractors confront trespassers.

APPENDIX C
SUBSURFACE CLEARANCE FIELD CHECKLIST AND SPI 27

SUBSURFACE CLEARANCE (SSC) FIELD CHECK LIST

(Use this form to document & identify field elements of SSC. Retain the completed form with the project file)

Site Name/Project No.: ______________________ Designated Person: ______________________

Walkover Date: ______________________ PIC/PM: ______________________

Intrusive Locations Surveyed: ______________________

(EENC MANAGED SUBSURFACE CLEARANCE ACTIVITIES)	Yes	No	N/A	Comments
1. The potential for unexploded ordnance (UXO) has been assessed and a UXO survey performed, if applicable.	☐	☐	☐	
2. Public utility markings are present for all utility companies notified. List the companies with public utilities present on-site and cross check with expected utilities and on-site indicators:	☐	☐	☐	
Natural gas/oil/petroleum lines and associated tanks:	☐	☐	☐	
Electric:	☐	☐	☐	
Potable water pipes, hydrants:	☐	☐	☐	
Sewers (storm/process water/sanitary) and/or Manways/Grates/Culverts:	☐	☐	☐	
Public lighting (street and traffic):	☐	☐	☐	
Telephone and Data Lines:	☐	☐	☐	
Other underground utilities:	☐	☐	☐	
3. Private utilities marked and scope discussed with/provided to locator	☐	☐	☐	Subcontractor Name: Contact #:
Alternate intrusive locations chosen in case of refusal or presence of utilities/indicators in Critical Zone	☐	☐	☐	
Describe nonconformity or unexpected conditions found by locator	☐	☐	☐	
4. Site Walkover performed to confirm utility markouts and assess the presence of Visual Indicators. If visual indicators are present, note location in comments/Plot Plan:	☐	☐	☐	
Indication of underground storage tank/piping and dispense islands	☐	☐	☐	
Non-native soils, surface depressions, new/dead vegetation	☐	☐	☐	
Saw cuts, patched surfaces, warning tape or other surficial indicators of below ground work	☐	☐	☐	
Pumps, pump galleries, piping manifolds and/or racks, process equipment, compressors, etc.	☐	☐	☐	
On or below-grade transformers	☐	☐	☐	
Fuel oil lines, tanks, fill ports, observation wells, vent stacks, hydraulic lift systems	☐	☐	☐	
Adjacent/supplemental buildings with no apparent utility feeds (electricity, water, gas)	☐	☐	☐	
Other:	☐	☐	☐	
5. Plot Plan updated to reflect most accurate site SSC information. Describe any on-site additions/changes	☐	☐	☐	
6. Ground Disturbance location(s) and Critical Zones (5ft/1.5m distance in every horizontal direction surrounding disturbance locations) cleared of utilities and visual indicators	☐	☐	☐	Contact PIC/PM and H&S Director if utilities pass through the Critical Zone of a planned ground disturbance location
A mark has been placed on each intrusive location and radial marks extending to the edge of the Critical Zone	☐	☐	☐	
Intrusive locations and Critical Zones cleared of utilities using sweep and search method or other applicable SSC investigative methods.	☐	☐	☐	
Once evaluated and cleared of utilities, intrusive locations cannot be moved and a Critical Zone must be maintained around the locations	☐	☐	☐	
Alternative intrusive locations used due to obstructions within Critical Zone. Describe abandoned and alternative locations	☐	☐	☐	
7. Pre-start H&S meeting conducted and SSC risk/hazards discussed	☐	☐	☐	
Locate results and intrusive locations/Critical Zones understood by all parties involved	☐	☐	☐	

Form completed by ______________________ ______________________ ______________________

Name Date Signature

Prepared By:
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333 W. Wacker Drive, Suite 2700
Chicago, Illinois

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December 2013

Revision Date
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Version Number
2011 Version 7

STANDARD PRACTICE INSTRUCTION 27

SUBSURFACE AND OVERHEAD CLEARANCE

RAMBOLL ENVIRON

STANDARD PRACTICE INSTRUCTION 27

IMPLEMENTATION DATE: December 2013

REVISION DATE: December 2015

SUBJECT: Subsurface Clearance

BASIS: The hazards posed by the presence of underground and overhead services are significant. When the hazards are correctly identified prior to subsurface work, the risks associated with such hazards can be minimized. As such, no intrusive work is to be conducted by Ramboll Environ US Corporation (Ramboll Environ) personnel or Ramboll Environ subcontractors until the hazards associated with the possible presence of underground and overhead services in and around the work area are identified and safe locations marked and agreed upon by site personnel and project team, as applicable. This Standard Practice Instruction (SPI) applies to intrusive site work including without limitation: test pit or trench excavations; borehole excavations using hand auger, shell and auger, rotary, hydraulic and percussive methods; gas spiking; manual excavations; hand digging; borings into vertical, indoor, or belowground surfaces greater than 6 inches (15 cm;) and/or, any other on-site activity where penetration of a surface is required.

GENERAL: The approach outlined in this SPI is designed to ensure the health, safety and welfare of Ramboll Environ staff, contractors and others potentially affected by Ramboll Environ's work. The aim of this SPI is to manage risk to the lowest practicable level, ensuring compliance with the relevant applicable legislation and Ramboll Environ Policy.

RESPONSIBILITY: This SPI will be implemented when conducting intrusive work and where overhead lines are present, and will be supplemented (or superseded, if necessary) only if additional requirements (e.g., local, regional or country specific regulation, client requirements) do not prevent adequate evaluation of utilities. The Director of Health and Safety ("Director of H&S") is solely responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Director is the sole person authorized to amend these instructions. Nonetheless, all Ramboll Environ employees are authorized to stop work and have the duty to halt any operation where there is danger of serious personal injury, property damage, and/or harm to the environment.

EXECUTIVE SUMMARY

The intent of this executive summary is to identify the general tasks that must be performed to reduce the likelihood of encountering subsurface structures during intrusive activities. It is not a substitute for following the requirements identified in the remainder of this document.

It is recognized that country specific procedures may slightly vary (e.g., commercial line location services may not be available in all geographical locations where Ramboll Environ conducts operations). Nonetheless, The minimum SSC requirements that are to be followed are outlined below.

Administration:

☐ Utilize a properly executed subcontract and Proof of Insurance, or its equivalent (See Section 4)

Field Work:

☐ Conduct a historical site information review (See Section 6.2)

☐ Develop a HASP/RA and complete the Pre-Project Planning Checklist (See Sections 6.3)

☐ Develop a Plot Plan that reflect Site utility conditions (See Section 6.4)

☐ Premark intrusive location(s)/area(s) (See Section 6.5)

☐ Contact a public locate (One Call Agency), where available (See Section 6.6)

☐ Contract a private locate, where available (See Section 6.6)

☐ Perform a site walkover-visual inspection (See Section 6.7)

☐ Ensure utilities are adequately marked (See Section 6.8)

☐ Ensure critical zones are identified and cleared (See Section 6.9)

☐ Ensure minimum distances are maintained from overhead lines (See Section 6.10)

☐ Complete the SSC Field Checklist (See Section 8.2 and Attachment B, Table 2)

☐ Conduct and document the daily project/safety meeting (See Section 8.3)

☐ Retain project-related documentation in project file (See Section 10)

CONTENTS

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

CAT	Cable Avoidance Tool
GD	Ground Disturbance
HASP	Health and Safety Plan
H&S	Health and Safety
HSC	Health and Safety Coordinator (Ramboll Environ)
IA	Intrusive Activities
JSA	Job Safety Analysis
MP	Managing Principal (Ramboll Environ)
PD	Project Director (Ramboll Environ)
PIC	Principal-in-Charge (Ramboll Environ)
PM	Project Manager (Ramboll Environ)
PPE	Personal Protective Equipment
RA	Risk Assessment
Ramboll Environ	Ramboll Environ US Corporation, formerly ENVIRON International Corporation (ENVIRON)
SSC	Subsurface Clearance
SPI	Standard Practice Instruction

DEFINITIONS

Critical Zone: The area bounded by a 5 foot (1.5 meter) radius extending horizontally from the intrusion point where subsurface objects may exist that if encountered could result in injuries, damaged equipment or property, or disruption of utility services.

See Figure 1 below for an example of a single intrusive location and the 5 foot (1.5 meter) critical zone around it that must be cleared.

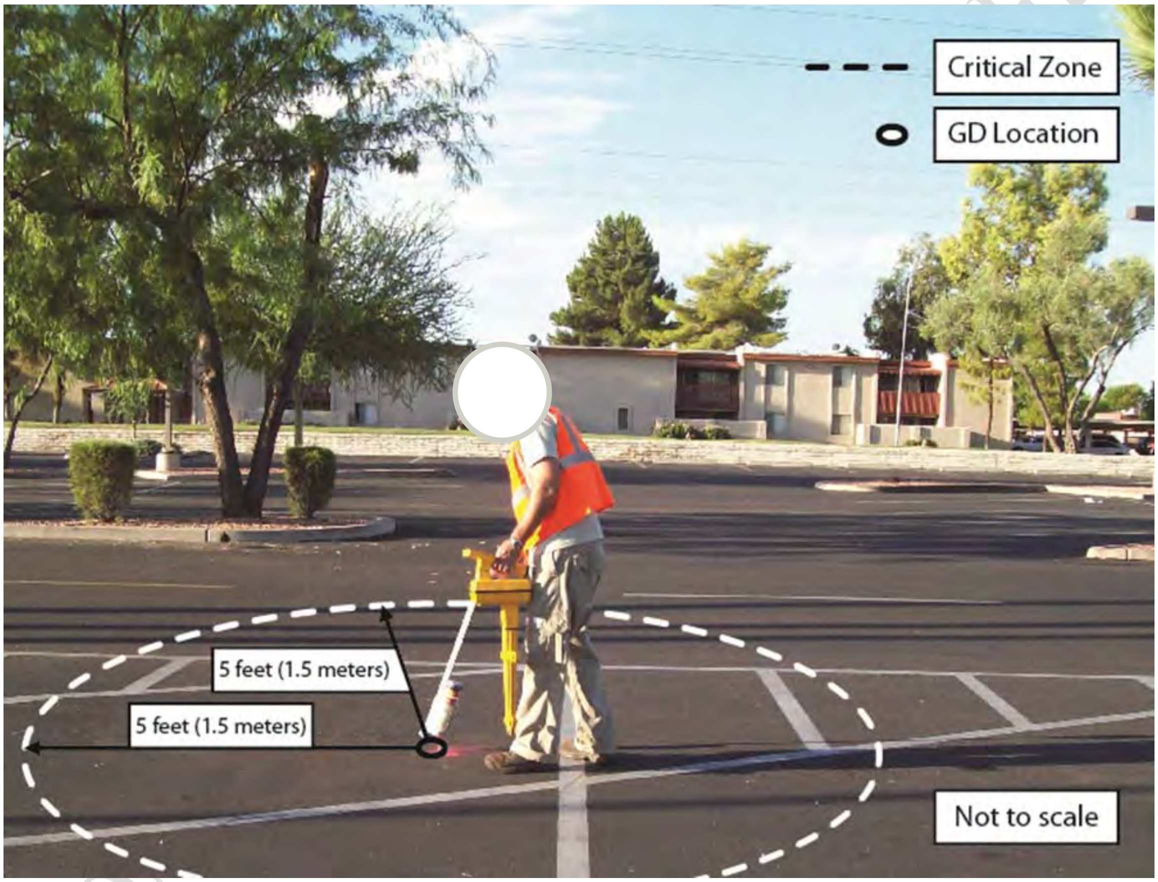


Figure 1:

The white dashed circle represents the critical zone of 5 feet (1.5 meters) radius from the Intrusion Point.

Designated Person: An employee assigned by the PM or PIC/PD that has sufficient professional or technical training, knowledge, experience and authority to implement the requirements in this SPI.

Dig/Drill Zone: The area of ground or surface to be disturbed during drilling or excavating.

Excavation: Any man-made cut, cavity, trench or depression in the earth's or other surface, formed or caused by earth or material removal.

Director of H&S: When used in this document, this term refers to the Global and European Directors of Health & Safety and/or their designated person.

High Risk Area: Exploration/excavation locations that require a higher level of precaution due to the increased level of danger and/or potential complexity of underground systems/services. Examples include: the edge of any tank/basin, pump islands, and/or pump galleries; areas containing electrical transformers, compressors, production wells, loading racks or other process equipment associated with underground utilities and/or structures, and; areas with the potential for unexploded ordinances.

Ground Disturbance Point: The point on the ground surface where intrusive work will be performed. This may be a single point such as when using a hand augur or a large area where an excavator will remove the surface.

Intrusion Point: The point where intrusive work will be performed; this can include ground surfaces as well as building/structural surfaces.

Intrusive Activities (IA): Any indentation, interruption, intrusion, excavation, construction or other work activity that disturbs the surface of a building/structure material or the earth.

Line Location Organization: Commonly referred to as a "One Call," an organization that coordinates utility locating services with member utility companies. Line Location Organizations may not be located in all geographical regions and/or countries. Refer to your regional / country specific organizations for availability.

One Call: A commonly used term for a service that coordinates utility locating services (e.g., "One Call" system in North America, "Before You Dig" in Australia and UK). These organizations do not perform the locating service themselves but rather contact the affected local utility companies, which will then mark where their utility lines are buried, but only on public property. A summary of contact information for several One Call organizations is provided in Attachment C.

Plot Plan: A map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

Search Zone: The parcel of land or definitive area where intrusive activities may be performed and which can be subject to locating of utilities.

Subsurface Clearance (SSC): Use of specialized equipment to locate subsurface structures and objects and mark them on a map and/or the surface in order to avoid them during intrusive work activities.

Sweep and Search: An electronic sweep of the critical zone or any other critical area using grid patterns and a locator capable of detecting buried objects. Note that some location equipment can only detect metallic objects; locators that can detect both metallic and non-metallic objects are required.

Ticket: A service or request made to a One Call organization. Ticket life must be valid for the term of the project.

Tolerance Zone: The tolerance zone is the width of an underground utility plus a specified tolerance distance on both sides of that utility; this zone varies based on utility company requirements and/or local, city, county, State, and/or country specific regulations. Under NO circumstances are powered-digging equipment to be used within this zone.

Unobstructed Intrusive Locations: A series of locations in close physical proximity and unobstructed by an edifice(s) so that Designated Person can accurately infer the connectedness of the underground utilities in that area. For example, if ground disturbance points surround a large building on site and public utilities are also present, it would be prudent to perform SSC Checks for each unobstructed group of points.

1. OVERVIEW

Ramboll Environ will review and evaluate this SPI on a triennial basis or when changes or incidents occur that prompt revision of this document. Effective implementation of this program requires support from all levels of Ramboll Environ management within Ramboll Environ and communication of its requirements to affected personnel.

2. SCOPE

The purpose of this Subsurface Clearance (SSC) SPI is to reduce the likelihood of subcontractors or Ramboll Environ employees encountering subsurface or overhead structures and utilities during intrusive activities being performed on Ramboll Environ projects. The SSC requirements outlined in this SPI are met by:

- Implementing the procedures presented in this SPI
- Developing and implementing a site-specific Health and Safety Plan (HASP) / Risk Assessment (RA)
- Completing the Intrusive Work Pre-Project and Field Checklist
- Training employees
- Complying with applicable regulatory requirements; and
- Following guidance provided by a utility company and/or One Call organization, as applicable.

It is recognized that country-specific procedures may slightly vary (e.g., commercial line location services may not be available). In these instances, the minimum SSC requirements to be followed are presented in Section 7.0 of this SPI, “Manual Verification”.

Intrusive Activities (IA) include but are not necessarily limited to:

- Mechanical excavation (back hoes, drilling augers, probes, etc.);
- Manual ground penetration (other than surficial sampling and hand clearing when preapproved in critical zones);
- Intrusion in manmade surfaces (such as Sheetrock, asphalt, cement, flooring); and
- Mechanical scraping activity (e.g., road grading).

3. RISK ASSESSMENT

Conducting an effective risk assessment prior to commencing any job is an integral part of occupational health and safety management which identifies the potential hazards, assesses the risk and includes implementing control mechanisms. In general, the steps to be completed as part of a risk assessment are as follows:

1. Conduct a thorough review of the tasks that need to be performed to complete each job;

2. Identify the hazards that may result in undesired events potentially causing injury, damage or environmental impacts;
3. Assess the level of risk based on these hazards that may arise when conducting the identified tasks; and
4. With a complete understanding of the proposed tasks, hazards and risks, implement the appropriate control mechanisms to mitigate the identified hazards.

Although a thorough risk assessment will need to be conducted for the entire proposed scope of work, at a minimum and in general, project personnel will need to include underground and/or overhead hazards as part of the overall risk assessment, as applicable. Some hazards to consider are as follows:

- **Chemical Hazards**: These may include the chemicals of concern on the site which personnel may come into contact with during work activities (e.g., drilling on a landfill, excavation of contaminated soils) and/or chemicals which are brought onto the site for use, if applicable;
- **Site Hazards**: The Site location and surrounding areas may have irritating plants/insects/animals, uneven walking/working surfaces, bodies of water, railroads, etc.;
- **Jobs/Tasks**: Specific jobs/tasks related to working around utilities (e.g., uncovering, striking and/or damaging an underground / overhead utility, heavy machinery/drill rigs, etc.); and
- **Safety Hazards**: Security issues, lone working, seasonal hunting, inclement weather, etc., as applicable.

The greatest risk when working around underground and/or overhead utilities is striking and/or damaging the utility. The risk varies with the type of line service for example, electricity versus water or telecommunication cables, etc.

Using the general hazards that are outlined above, the level of risk and the potential control mechanisms can now be assessed and implemented, respectively, which would complete an effective risk assessment. More importantly, the contents of this SPI should be used and considered as part of the risk assessment in order to understand and identify the specific task/job/project hazards, risks and control mechanisms associated with the type of work activities that is desired to be completed. In addition, other SPIs and/or country specific regulatory requirements (if more stringent than the applicable SPI) should also be considered as part of the overall risk assessment, as applicable.

4. ROLES AND RESPONSIBILITIES

- **Ramboll Environ H&S Director and Designated Representatives:**
  - Approving exceptions to this SPI and intrusive work in High Risk areas in advance, as required by this or HASP policy.

- **Ramboll Environ Principal in Charge (PIC) / Project Director (PD):**
  - Define contractual and legal responsibilities associated with intrusive activities before site work begins.
  - Ensuring and verifying that intrusive project work activities are consistent with this SPI and any associated practices.
  - Approving exceptions to this SPI or in the site Health and Safety Plan (HASP) / Risk Assessment (RA) in advance and with H&S approval.
  - Assigning responsibilities to trained and experienced Ramboll Environ personnel (i.e., Designated Persons) in a manner consistent with goals and objectives of this SPI.
- **Ramboll Environ Project Manager:**
  - Implement the requirements of this SPI on each project that involves intrusive work activities
  - Approve the site-specific HASP for each project
  - Approve the SSC Field Checklist
  - Retain project-related documentation in project file
- **Ramboll Environ Personnel:**
  - Attend training in Ramboll Environs' SSC procedures by completing the SSC on-line module and must comply with this practice and site-specific procedures, as applicable.
  - If assigned the role of Designated Person, be responsible for implementing the requirements of this SPI as assigned by the PM or PIC/PD
  - Halt work activities that post a serious and imminent danger to persons, property or the environment.
- **SSC Contractor:**
  - Observe, with Ramboll Environ, the intrusive point and critical zone of each intrusive work area.
  - Perform work in accordance with regulatory and contractual requirements.

5. MINIMUM REQUIREMENTS FOR SUBCONTRACTOR ENGAGEMENT

Subcontractors who provide locating services to Ramboll Environ are required to meet the requirements in this SPI through use of their own standards, practices and procedures that meet or exceed those described in this SPI.

Each project that utilizes a locating subcontractor must have a fully executed subcontract agreement in place prior to initiating any field activities. The agreement must:

- Utilize the template subcontract agreement form, or equivalent;
- Be signed by the applicable Ramboll Environ representative;

- Define the project scope, budget, and general terms and conditions (T&C), at a minimum;
- Be correctly and completely executed by both parties;
- Be retained either in hard copy or electronically; and
- Accompanied by a proof of insurance. For projects completed in North America, the certificate of insurance must be provided, and at a minimum:
  - Comply with our subcontract agreement
  - Name Ramboll Environ as additionally insured, and the client, as applicable;
  - Be valid and in effect for the entire project; and
  - Include the proper types and limits for the work being conducted (e.g., locator vs. driller).

Utility locating services without a fully executed subcontract agreement (or the equivalent) and proof of insurance are prohibited from working on Ramboll Environ projects. Any deviation from this requirement must be pre-approved in writing by the PIC/PD and/or the Director of H&S and described in the HASP/RA.

Locating contractors should be able to or provide evidence of appropriate training and experience in:

- Operating the required equipment for locating underground utilities and interpreting and processing raw data to define the type, location and size of subsurface utility lines, where applicable;
- Maintaining and calibrating locating equipment;
- Serving as a liaison with local asset owners to gain their knowledge/experience of the area; and
- Where applicable, coordinating a public utility mark-out by contacting the designated "One-Call" agency for the area.

6. PRE-JOB PLANNING

The following tasks should be completed and documented prior to initiating intrusive activities (each of which is fully described in the sections referenced below):

- Historical site information review (Section 6.2)
- Development of site-specific HASP/RA (Section 6.3)
- Preparation of a Plot Plan (Section 6.4)
- Pre-marking of intrusive locations (Section 6.5)
- Line location services (Section 6.6)
- Site walkover-visual inspection (Section 6.7)
- Utility mark out (Section 6.8)

- Clearance of critical zones (Section 6.9)
- Overhead lines (Section 6.10)

6.1 General Requirements

The PM or Designated Person must ensure that where applicable:

- The appropriate Line Location Organization (e.g., One Call, Dial Before You Dig, etc.) and private utility locators are notified a minimum of 72 business hours in advance of planned intrusive activities, or as applicable by the local, state, region or country requirements/regulations;
- Utilities are appropriately marked, and
- The proposed intrusive locations have been cleared to the critical zone.

Where Line Location Organizations and private utility locators are not available in a project area, the PIC/PD is to be notified and guidelines presented in Section 7.0 must be applied.

6.2 Historical Site Information Review

The PM or designated representative will ensure that available historical site records are reviewed and interviews of knowledgeable site personnel are conducted and cross referenced to determine the potential existence and location of underground facilities/pipelines and utilities in the vicinity of the work areas. When sources are reviewed and/or interviewed, this information will be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes).

The following are examples of information associated with identifying subsurface structures:

6.2.1 Maps and Plans

Plot plans, facility maps or lease drawings, as available, can be one source that can be reviewed and cross referenced with other sources of information to verify accuracy and develop a Plot Plan showing existing utilities and intrusive activities planned at the site as accurately as possible. The Plot Plan can be created onsite by hand in the field log, on an existing site plan, or in electronic format as long as the measurements and/or scale are accurate. Sources of information relevant to underground utility location may include:

- Maps and figures showing under and aboveground equipment, piping, utilities and/or any surface or subsurface hazards;
- Historic site information (maps, photos, files);
- Site as-builts drawings;
- Easement maps and historical Plot Plans;
- Previous site investigations;
- Fire insurance plans;
- Tank dip charts; and

- Elevations and coordinate maps.

It is important to note that as-builts and historic maps may not accurately reflect existing conditions including proposed utilities that were never built or more recent modifications. Therefore, do not negate the requirement for a public and private utility locate, where available.

6.2.2 Interviews

When available or is reasonable to do so, the names of personnel that are consulted for information about utilities and subsurface structures in the purposed work area will need to be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes). Potential sources can include but not be limited to the following:

- Client / facility / operator personnel that may be familiar with area operations and/or may have knowledge of facilities/pipelines and/or abandoned and/or recently installed lines not otherwise documented.
- Landowner and/or tenants may also have knowledge of buried utilities and other site information.

6.3 HASP / RA

A site-specific HASP and/or RA must be developed prior to initiating field activities. Concerning SSC, the HASP/RA must:

- Complete the pre-project planning checklist (refer to Attachment A, Table 1) which outlines the SSC tasks to be completed prior to intrusive activities. Proposed dates and activities should be as accurate as possible for planned field activities. When information is not available at the time the HASP is drafted and approved, the Designated Person must ensure the pre-project planning checklist is updated and completed prior to intrusive activities. In addition to planning SSC steps for the project, this checklist should also be used to provide justification for each exemption to the required clearance processes;
- When on Site, and prior to intrusive activities, complete the SSC Field Checklist (refer to Attachment B, Table 2) for <u>each location</u> where intrusive activities are anticipated to occur or for each group of unobstructed intrusive locations. Conservative, professional judgment is to be used in determining whether subsequent intrusion points are unobstructed and if one SSC Field Checklist can be used to clear all locations. As a reminder, the SSC Field Checklist is to be completed prior to intrusive activities being performed and be used as a tool for double checking that all actions that need to be completed;
- Include a Plot Plan indicating the location of known underground and overhead facilities and utilities within the search zone available for reference at the work site;
- In the event intrusive work is required within a high risk area, include approval from PIC/PD and the Director of H&S.
- Include a list of emergency response resources with telephone numbers; and

- Include a list of client, regulatory, Ramboll Environ, utility, and subcontractor emergency contact information and procedures.

If proposed field activities differ from the scope of work, Plot Plan and/or the Pre-Project Planning Checklist, the Designated Person will ensure that the project-specific HASP and Pre-Project Planning Checklist are updated to reflect these changes and communicate those changes to project personnel. Deviations from specified requirements must be documented and approved prior to the commencement of intrusive activities.

6.4 Plot Plan

Intrusive activities are not to proceed without a Plot Plan clearly indicating the facilities/pipelines or utilities, locations and their alignments in the project area. A Plot Plan is a map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

If the information needed to create a Plot Plan is not available and/or known in the pre-planning stage, at a minimum, the logbook or field notes will include a map to reflect the Site, the proposed intrusive locations, and the critical zone surrounding them. While in the field, existing information can then be added to reflect available information (e.g., above ground visual indicators like a transformer or a gas meter), and site conditions as accurately as possible. If the Plot Plan is a separate, stand-alone document (i.e., not part of the field logbook), this information should also be clearly identified and referenced in the field logbook / notes.

6.5 Pre-Marking of Intrusive Locations

If practical, intrusive points and critical zones should be pre-marked with easily visible, identifiable markings such as brightly colored stakes, white paint or white flags (or black in cases where snow is on the ground) prior to the public and/or private utility mark-outs. Pre-marking provides the utility line locators with visual boundaries as guidance in clearing locations and placing marks.

During subsurface pre-project planning consider additional locations for clearance in the event that refusal is met at specific boring locations. A twenty-five percent (25%) buffer is recommended (i.e., one alternate boring location for every four (4) borings planned). Alternate borings also be located and cleared using the requirements outlined in this SPI.

6.6 Line Location Services

In areas where public <u>and</u> private resources are available, Ramboll Environ or a designated subcontractor will contact both public and private utility locate services for projects that involve intrusive activities.

In order to give utility line operators sufficient time to respond to a request to locate, a minimum of 3 business days should be provided prior to the planned start of work, or as required by local, state, region or country regulations.

In rare instances, confidentiality agreements may restrict notification of public utilities. In these cases, and when allowed by local regulations, this exception and justification must be noted in the HASP/RA and approved by the PM, PIC/PD and Director of H&S. In the event that a subcontractor performs the location, Ramboll Environ will confirm with the subcontractor the utility locate information (including, but not limited to, the One Call (Attachment C) and /or private locate service contacted, confirmed public utilities on the site, positive responses from utility companies).

6.6.1 Public Utility Locate

Public utility locators may only mark lines on public property, easements or rights-of-way. This means private lines running from the main line may not be marked. To ensure that these lines are also located and marked, a Private Locating Company must be retained (see Section 6.6.2 below) entitled "Private Utility Locate".

Nonetheless, it is important to provide an accurate location to the One Call service. Address, City, Township, County and other location designations can change and should be confirmed prior to submitting the clearance location to the One Call service. Universal search tools, such as Google, mapping tools, and the most up-to-date area maps, can be used to aid in verifying information where uncertainty exists.

When a One Call service order is made, otherwise known as a "ticket", the One Call organization contacts each utility company that is a "member" of their service. Then, each member utility then sends out a One Call Utility Locator to mark their services in the area specified. The person who makes the call must confirm which utility companies are and are NOT included in their service and record this information in the Pre-Project Planning Checklist (Attachment A, Table 1).

It is important to provide as accurate a location for locating as possible to the One Call service. In some instances, a location may be annexed or moved from a township/county/location it had previously listed as an address, which can create confusion regarding the locate ticket request sent to the facility company. City, Township, County and other location designations should be confirmed prior to submitting the clearance location to the One Call service to ensure public locators clear the appropriate location(s). Universal search tools, such as Google, mapping tools, and the most up-to-date area maps, can be used to aid in verifying information where uncertainty exists.

It should be noted that in some areas, not all of the utility companies have agreements with the One Call service. This means that not all utility companies are part of the One Call process. For example, a city water or sewer department may not participate whereby their utilities would not be included nor marked by the One Call service. Hence, the Designated Person who places the One Call public locate request should follow-up with the One Call service to identify which utility companies are being dispatched to the location and record this information in the Pre-Project Planning Checklist (Attachment A, Table 1).

Crosscheck the list of member utilities in the proposed area with the following list of common utilities to ensure potential facilities have been identified on the site. This comparison can be documented on the SSC Field Checklist (Attachment B, Table 2) and/or field logbook:

- Telephone
- Cable television/communications
- Natural gas
- Electricity
- Water
- Sewer/stormwater
- Optical fiber

Before intrusive activities begin, utilities must be marked or an "all clear" received, unless an exemption has been pre-approved. An "all clear" can consist of a mark at the site (such as "no electric" painted on the ground) or direct contact from the utility via fax, email or a phone call indicating the lack of facilities in the project area. If contact is not made by the agencies identified by the public utility locate process, it should **NOT** be assumed that such utilities are not present. Instead, the One Call service should be re-contacted to determine the status.

One Call services often provide a "positive" call back. This may mean that:

- Each member company notified the ticket originator that they do not have any facilities in the proposed dig area, or that they have marked the approximate locations (usually within a 48 hour period).
- The One Call service may have only posted a comment (e.g., they need an extension).

Therefore the nature of the positive call back must be confirmed. Communications regarding utilities for a specific project should be kept with the HASP/RA in the project file and/or written in the field logbook.

If contact is not made by the agencies identified by the public utility locate process, it should **NOT** be assumed that such utilities are not present. Instead, the public utility locate agency should be re-contacted to determine the status. If you arrive at the site and the public utilities have not been marked and /or "all clear" communications have not been received, **INTRUSIVE WORK IS TO BE HALTED** and a follow-up call made to the One Call service. Allow adequate time for the utility companies to respond to the re-mark request. Consider checking the work area for facilities/pipelines or utility markers or meters in order to verify the correct company has been contacted to clear utilities or supply additional information.

Most public "One Call" utility mark-outs have a limited time period for which they remain valid. It is critical that this time period be taken into account to prevent the expiration of clearance prior to the completion of intrusive field activities. Confirm the ticket life is valid for the extent of the project. The applicable ticket life varies from locale to locale. An extension can be requested when there are no changes to the jobsite address or extent of work.

Generally, most standard public utility locators will only mark the main line for the utility company to which they are contracted and only mark up to the property line. Water and sewer companies locate main water lines in easements and rights-of-way and lines to a water meter, but may not locate the water facilities from a meter to a home or sewer lateral. Electric companies **usually** locate their lines to homes and businesses, but not those running to swimming pools pumps, irrigation systems or other buildings on the property. **This means private lines running from the main line may not be marked.** To locate and mark these lines, a Private Locating Company (see section 6.6.2 below) must be retained.

6.6.2 Private Utility Locate

When intrusive work occurs on or near private property, a private locator must be retained to locate utilities, as available. Many private locators will only locate from the marked utilities located by the public utility locate service by placing a trace signal on those lines and identifying where the lines are buried. While this is an accurate method for locating those specific lines, it is possible to miss utilities that are not identified by the public utility locate service.

A more comprehensive underground inspection will be conducted by the private locator, with special attention paid to any visual indicators or utilities, high risk areas and **the specific intrusive location(s), and critical zone(s)** using a search and sweep method, as project conditions warrant.

Some of the most common private facilities include:

- Fiber optic telecommunication cables
- Aboveground and underground tanks and delivery systems
- Industrial steam and condensate pipes
- Satellite television cables
- Stadium and security lights
- Lighted commercial signs
- Process water and fire protection systems
- Low voltage electrical wiring
- Electric fence / animal containment systems

Upon completion of their work, the private locator should contact the Designated Person to present their results. In addition to providing an overall summary of their work, the private locator should also identify any unique circumstance(s) that limited their ability in locating the potential presence of underground utilities (e.g., the existence of overhead electrical lines); if they encountered any abnormalities (e.g., concrete surfaces with reinforced rebar); and/or any other condition which may have diminished the validity of their results and efforts (e.g., concrete reinforced with rebar).

Further, designated Ramboll Environ personnel technically trained and competent in using Cable Avoidance Tools (CATs) are required to clear Intrusive locations and/or areas prior to intrusive activities. This is both in areas where private and public locators are and are not available.

6.7 Site Walk-Visual Inspection

The Designated Person must complete the SSC Field Checklist (Attachment B, Table 2) during a site walk-visual inspection to identify above ground indicators which may identify the potential existence of subsurface issues and to confirm that common and/or expected utilities have been accounted for, located and verified prior to commencing intrusive activities. The site walkover and visual inspection is most effective when done during the private locate, because the extent of locating efforts can be verified and questions regarding visual indicators answered. Where possible, a site representative with knowledge of subsurface utilities/structures should also participate in the site walk/visual inspection.

Visible indicators are evidence of underground utilities within the proposed work area and search zone, examples of which are contained in Attachment D, "Anatomy of Utilities". These may include:

- Facilities/pipelines
- Power lines
- Natural gas pipelines
- Gas meters
- Aboveground and underground tanks
- Electric service risers
- Utility cables
- Nearby lines and structures
- Patches in concrete or asphalt
- New clearings
- Spoil piles
- Road construction
- Previously disturbed soils
- Service pits
- Buildings with no visible evidence of service
- New vegetation, color changes or growth
- Edge of any tank basin, pump island, pump gallery, manifold, electrical transformer, compressor, production well, explosive magazines, loading rack, or other process equipment with associated underground lines.

If any visual indicators are discovered during the site walk that are not reflected on the Plot Plan, the field book and the Plot Plan must be accurately marked to reflect these observations. Intrusive work will not commence until identified issues with the indicators have been resolved.

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PIC/PD.

6.8 Utility Mark-out

Known pipelines and utilities that pass within the search zone will be located, identified and marked to indicate location and alignment and be documented.

If possible, the Designated Person should meet with the private locator to provide him or her with:

- Intrusive plans pre-marked with intrusive locations and critical zones as well as an appropriate number of alternate locations
- A Plot Plan and/or the results of the visual inspection
- Plans depicting proposed exploration / excavation locations.

If an onsite meeting with the private locator is not possible, conduct a phone call with the private locator to ensure they understand the scope of the proposed subsurface work and the extent of activities.

A qualified and competent line locator (as outlined in Section 4) should:

- Conduct private line-locating practices utilizing appropriate equipment (Attachment E provides a brief description of the types and attributes of commonly used locator tools) and Plot Plans for all areas within the search zone.
- Directly connect (clamp on) to possible nearby underground services to increase the success rate/reliability in locating.
- Energize electrical sources within the vicinity (e.g., light poles, signs, pumps, etc.) at the time of locating. This increases the chance of identifying potential underground electrical services.

If anticipated services have not been identified or located, drilling or intrusive work will not occur until the service is visually identified or confirmed to be absent. Examples include: when a visual indicator of a line is present (such as a sewer grate) and no line is traced from it, or if a utility line is indicated on a historical site drawing, but no investigation has occurred in the field to confirm or deny its presence. Potential intrusive locations with suspected subsurface utilities/structures present must be avoided and a new location at least five feet (1.5 meters) away must be cleared.

Using the information obtained during the visual inspection, public One Call mark-out and the private utility mark-out, the proposed exploration/excavation locations will be confirmed in the field. The markings of locations should be made in accordance with the generally accepted color code for facilities identification for the region. Attachment F provides examples of commonly used utility mark out colors and identifiers, which may differ by area, region or country. Check local regulations prior to intrusive activities to ensure that markings are clearly understood by the field staff.

Further, where Ramboll Environ personnel are trained and competent in their use, Cable Avoidance Tools (CATs) will be used to clear intrusive locations and/or areas to the critical zone prior to intrusive activities.

6.8.1 Line Location Methods

A variety of remote sensing technologies can be used for detecting underground facilities depending on structural composition of the buried materials, soil composition, and surface access. There is no one procedure or tool that can provide accurate location information for all types of facilities in all types of situations. Attachment E entitled "Underground Locating Equipment" provides a brief description of the types and attributes of commonly used locator tools.

In addition to equipment choice, there are situational variables that affect detection accuracy. For example, the more conductive the soil, the more shallow the conductor can appear. Sandy, loose soil with a high mineral content can give sensitive readings; pipe locations under these conditions may be deeper than the locator equipment readings indicate. Moisture content or water table levels can also affect depth readings. Locating indoors provides additional difficulties, including but not limited to interference from reinforced concrete, canopies, and metallic structures.

For equipment that determines location by sensing an electronic signal introduced into the underground system, the strength of the equipment depends on where the signal was introduced into the system, proximity of structural uprights connected to the underground system, and nearby surface obstructions that dissipate the signal. Selection of radio signal frequency can also affect signal clarity. **Equipment readings cannot be taken as absolute values.** They depend on situational effects associated with locator equipment calibration, field conditions, and the operator's familiarity with the particular operating characteristics.

Plastic and concrete pipe and fiber optic cable are difficult to detect with common locator tools because they do not contain metal. A metal tracer wire or detectable warning tape may be buried with or attached to the pipe/facility when they are first installed to aid in locating these structures at a future date. Varieties of tracer wire and detectable tape are designed to be sturdy enough to be plowed into the trench during backfill operations.

6.9 Clearance of Disturbance Locations within Critical Zones

After anticipated utilities have been located and marked, use the available information along with regulatory requirements and project objectives to select final intrusive locations **that have been cleared to the edge of the critical zone**. Ensure that detected services and those featured on location plans are outside of the critical zone.

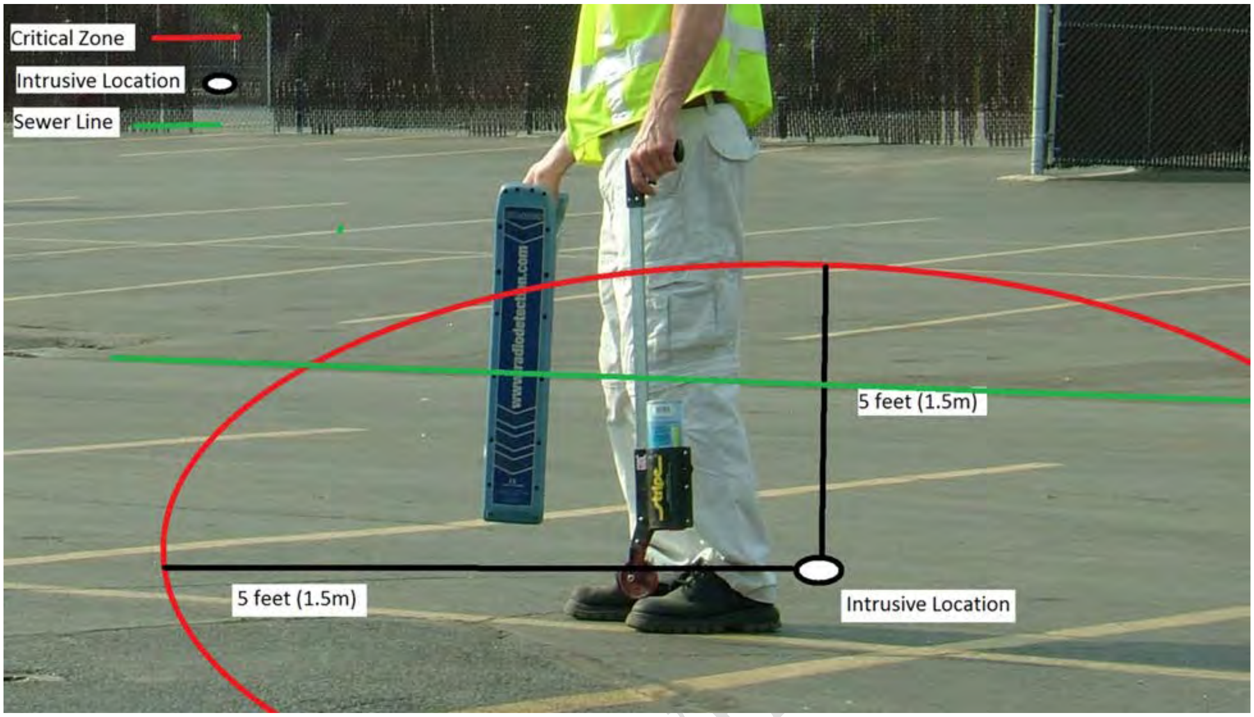


Figure 2:

A private locator clears the critical zone for a boring location. In this figure, the visual indicator of the sewer line is outside the critical zone, but the line has been laterally traced to the edge of the critical zone, therefore a new boring location should be chosen.

The critical zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by onsite conditions, human factors, and equipment. When known utilities intersect critical zones, the PM must be notified and ideally, the intrusive location would be moved to a pre-cleared alternate location. Intrusive activities will not take place within a critical zone where utilities or visual indicators intersect without the prior approval of the H&S Director.

In the event that work must be conducted in a critical zone containing a marked utility or visual indicator, approval must be obtained from the PIC/PD and Director of H&S prior to conducting intrusive activities. The approval and approved methodology for intrusive work closer than 5 feet (1.5 meters) from utilities will be made on a case-by-case basis once adequate information has been provided and reviewed by the Director of H&S, and PIC/PD. The decision will be made based on:

- Location criteria (the reason a boring/sample is needed in that location);
- Distance from the utility;
- Drilling method;
- Confidence in location methods;
- Geophysical conditions at the site;

- Pipe construction and contents;
- Regulated tolerance distance at the location; and
- Other influencing factors.

At a minimum, any mechanical intrusive activities that occur within 5 feet (1.5 meters) of a utility or indicator AND have been authorized by the PIC/PD, and Director of H&S, will be hand cleared or vacuum excavated to a depth of 6 feet (1.8 meters). **Hand digging or auguring, manual excavation or soft-dig techniques may not be used in lieu of the SSC requirements presented in this SPI.** Any deviation from these requirements stated must be approved in advance by the PIC/PD and Director of H&S.

6.10 Overhead Lines

Overhead power lines that may pose a hazard during movement of equipment must be clearly documented and minimum clearance distances will be maintained. Regulated minimum distances vary by voltage, area, region, and country. When voltage(s) of nearby power lines have been determined and confirmed by the utility company, Ramboll Environ personnel will maintain the minimum distance required by applicable regulations or requirements.

When the specific voltage and minimum clearance distances are **unknown**, the following clearance distances will be maintained:

- Intrusive activities performed by raised mechanical equipment must be located a minimum clearance distance of:
  - 28 feet (8.5m) horizontally from any overhead electric cable supported on wooden poles; or
  - 50 feet (15.25m) horizontally from any overhead electric cable supported on metal poles/towers.

If clearance distances cannot be achieved, the relevant electricity provider must be contacted for guidance; the PIC/PD and Director H&S will be notified as well.

To apply the clearance distances described above:

1. Estimate the ground position parallel to the power line overhead based on visual observations. Do NOT come in physical contact with the line or use vertical tools to estimate positioning.
2. From that ground position, measure the lateral distance from the line as required above
3. Ensure intrusive locations are further than the required distance from overhead lines. Repeat steps 1 and 2 at different locations, as necessary to address larger intrusive areas.
4. Take strong winds that may cause the lines to move or droop, into consideration and give the drill mast a 3-foot (0.9m) buffer zone.

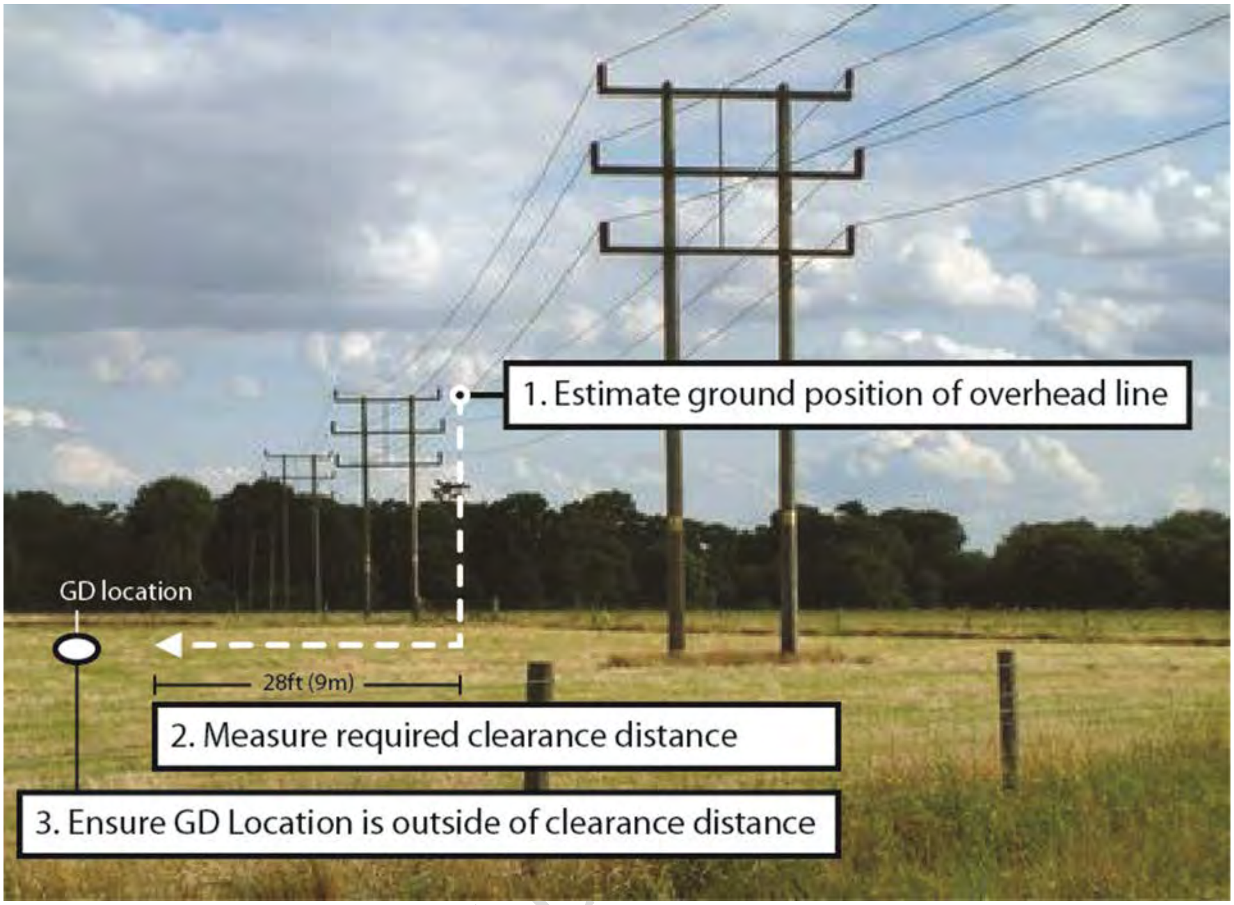


Figure 3:

To measure the ground distance from an overhead utility line, estimate the ground position of the line, measure the lateral distance from that point, and ensure the boring location is outside the clearance area.

A spotter must be used when mechanical equipment is being raised or lowered, to ensure safe distances are maintained. Keep in mind that the angle changes as the mast moves and travels into its vertical position.

7. MANUAL VERIFICATION

In areas where public and private utility locators are **not** available or cannot access the site, in general, the work practices conducted prior to intrusive activities are exactly the same as when private locates are available, with the exception that Ramboll Environ employees have the responsibility of clearing the critical zone surrounding each intrusive location. More specifically, the requirements to be followed for areas where public and private utility locators are **not** available or cannot access the site, verify that:

- A local One Call organization and private utility locators are not available for the area;

- Due diligence regarding historical site information has been performed and a site-specific Plot Plan has been developed;
- A visual inspection has been performed;
- The proposed intrusive locations are cleared to a minimum of 5 feet (1.5 meter) extending in the horizontal direction where intrusive work is planned, and;.
- Hand digging, hand auguring, or soft-dig methods (i.e., vacuum excavation) will be employed to a depth of 6 feet (1.8 meter) below ground surface (bgs).

7.1 Historical Site Information Review

The PM or designated representative will ensure that available historical site records are reviewed and interviews of knowledgeable site personnel are conducted and cross referenced to determine the potential existence and location of underground facilities/pipelines and utilities in the vicinity of the work areas. When sources are reviewed and/or interviewed, this information will be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes).

The following are examples of information associated with identifying subsurface structures:

7.1.1 Maps and Plans

Plot plans, facility maps or lease drawings, as available, can be one source that can be reviewed and cross referenced with other sources of information to verify accuracy and develop a Plot Plan showing existing utilities and intrusive activities planned at the site as accurately as possible. The Plot Plan can be created onsite by hand in the field log, on an existing site plan, or in electronic format as long as the measurements and/or scale are accurate. Sources of information relevant to underground utility location may include:

- Maps and figures showing under and aboveground equipment, piping, utilities and/or any surface or subsurface hazards;
- Historic site information (maps, photos, files);
- Site as-builts drawings;
- Easement maps and historical Plot Plans;
- Previous site investigations;
- Fire insurance plans;
- Tank dip charts; and
- Elevations and coordinate maps.

It is important to note that as-builts and historic maps may not accurately reflect existing conditions including proposed utilities that were never built or more recent modifications. Therefore, do not negate the requirement for a public and private utility locate, where available.

7.1.2 Interviews

When available or is reasonable to do so, the names of personnel that are consulted for information about utilities and subsurface structures in the purposed work area will need to be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes). Potential sources can include but not be limited to the following:

- Client / facility / operator personnel that may be familiar with area operations and/or may have knowledge of facilities/pipelines and/or abandoned and/or recently installed lines not otherwise documented.
- Landowner and/or tenants may also have knowledge of buried utilities and other site information.

7.2 HASP / RA

A site-specific HASP and/or RA must be developed prior to initiating field activities. Concerning SSC, the HASP/RA must:

- Complete the pre-project planning checklist (refer to Attachment A, Table 1) which outlines the SSC tasks to be completed prior to intrusive activities. Proposed dates and activities should be as accurate as possible for planned field activities. When information is not available at the time the HASP is drafted and approved, the Designated Person must ensure the pre-project planning checklist is updated and completed prior to intrusive activities. In addition to planning SSC steps for the project, this checklist should also be used to provide justification for each exemption to the required clearance processes;
- When on Site, and prior to intrusive activities, complete the SSC Field Checklist (refer to Attachment B, Table 2) for <u>each location</u> where intrusive activities are anticipated to occur or for each group of unobstructed intrusive locations. Conservative, professional judgment is to be used in determining whether subsequent intrusion points are unobstructed and if one SSC Field Checklist can be used to clear all locations. As a reminder, the SSC Field Checklist is to be completed prior to intrusive activities being performed and be used as a tool for double checking that all actions that need to be completed;
- Include a Plot Plan indicating the location of known underground and overhead facilities and utilities within the search zone available for reference at the work site;
- In the event intrusive work is required within a high risk area, include approval from PIC/PD and the Director of H&S.
- Include a list of emergency response resources with telephone numbers; and
- Include a list of client, regulatory, Ramboll Environ, utility, and subcontractor emergency contact information and procedures.

If proposed field activities differ from the scope of work, Plot Plan and/or the Pre-Project Planning Checklist, the Designated Person will ensure that the project-specific HASP and Pre-Project Planning Checklist are updated to reflect these changes and communicate those changes to project personnel. Deviations from specified requirements must be documented and approved prior to the commencement of intrusive activities.

7.1 7.3 Plot Plan

Intrusive activities are not to proceed without a Plot Plan clearly indicating the facilities/pipelines or utilities, locations and their alignments in the project area. A Plot Plan is a map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

If the information needed to create a Plot Plan is not available and/or known in the pre-planning stage, at a minimum, the logbook or field notes will include a map to reflect the Site, the proposed intrusive locations, and the critical zone surrounding them. While in the field, existing information can then be added to reflect available information (e.g., above ground visual indicators like a transformer or a gas meter), and site conditions as accurately as possible. If the Plot Plan is a separate, stand-alone document (i.e., not part of the field logbook), this information should also be clearly identified and referenced in the field logbook / notes.

7.4 Site Walkover-Visual Inspection

The Designated Person must complete the SSC Field Checklist (Attachment B, Table 2) during a site walk-visual inspection to identify above ground indicators which may identify the potential existence of subsurface issues and to confirm that common and/or expected utilities have been accounted for, located and verified prior to commencing intrusive activities. The site walkover and visual inspection is most effective when done during the private locate, because the extent of locating efforts can be verified and questions regarding visual indicators answered. Where possible, a site representative with knowledge of subsurface utilities/structures should also participate in the site walk/visual inspection.

Visible indicators are evidence of underground utilities within the proposed work area and search zone, examples of which are contained in Attachment D, “Anatomy of Utilities”. These may include:

- Facilities/pipelines
- Power lines
- Natural gas pipelines
- Gas meters
- Aboveground and underground tanks
- Electric service risers
- Utility cables
- Nearby lines and structures
- Patches in concrete or asphalt

- New clearings
- Spoil piles
- Road construction
- Previously disturbed soils
- Service pits
- Buildings with no visible evidence of service
- New vegetation, color changes or growth
- Edge of any tank basin, pump island, pump gallery, manifold, electrical transformer, compressor, production well, explosive magazines, loading rack, or other process equipment with associated underground lines.

If any visual indicators are discovered during the site walk that are not reflected on the Plot Plan, the field book and the Plot Plan must be accurately marked to reflect these observations. Intrusive work will not commence until identified issues with the indicators have been resolved.

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PIC/PD.

7.5 Utility Mark-out

Known pipelines and utilities that pass within the search zone will be located, identified and marked to indicate location and alignment and be documented using, but not limited to:

- Intrusive plans pre-marked with intrusive locations and critical zones as well as an appropriate number of alternate locations
- A Plot Plan and/or the results of the visual inspection
- Plans depicting proposed exploration / excavation locations.

If anticipated services are not identified or located, intrusive work is not to occur until the service is visually identified or confirmed to be absent. Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PIC/PD. Examples include: when a visual indicator of a line is present (such as a sewer grate) and no line is traced from it, or if a utility line is indicated on a historical site drawing, but no investigation has occurred in the field to confirm or deny its presence. Potential exploration locations with suspected subsurface utilities/structures present are to be avoided and a new location at least five feet (1.5 meters) away will be similarly cleared.

Further, where Ramboll Environ personnel have been trained and are competent in the use of Cable Avoidance Tools (CATs), in general, the information discussed above should be reviewed and the following first steps taken to locate utilities:

- Conduct line-locating practices utilizing appropriate equipment and Plot Plans for all areas within the search zone.
- Directly connect (clamp on) to possible nearby underground services to increase the success rate/reliability in locating.
- Energize electrical sources within the vicinity (e.g., light poles, signs, pumps, etc.) at the time of locating. This increases the chance of identifying potential underground electrical services.

7.6 Clearance of Disturbance Locations within Critical Zones

After anticipated utilities have been located and marked, use the available information along with regulatory requirements and project objectives to select final intrusive locations **that have been cleared to the edge of the critical zone**. Ensure that detected services and those featured on location plans are outside of the critical zone.

The critical zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by onsite conditions, human factors, and equipment. When known utilities intersect critical zones, the PM must be notified and ideally, the intrusive location would be moved to a pre-cleared alternate location. Intrusive activities will not take place within a critical zone where utilities or visual indicators intersect without the prior approval of the H&S Director.

In the event that work must be conducted in a critical zone containing a marked utility or visual indicator, approval must be obtained from the PIC/PD and Director of H&S prior to intrusive activities. The approval and approved methodology for intrusive work closer than 5 feet (1.5 meters) from utilities will be made on a case-by-case basis once adequate information has been provided and reviewed by the Director of H&S, and PIC/PD. The decision will be made based on:

- Location criteria (the reason a boring/sample is needed in that location);
- Distance from the utility;
- Drilling method;
- Confidence in location methods;
- Geophysical conditions at the site;
- Pipe construction and contents;
- Regulated tolerance distance at the location; and
- Other influencing factors.

At a minimum, any mechanical intrusive activities that occur within 5 feet (1.5 meters) of a utility or indicator AND have been authorized by the PIC/PD, and Director of H&S, will be hand cleared or vacuum excavated to a depth of 6 feet (1.8 meters). **Hand digging or auguring, manual excavation or soft-dig techniques may not be used in lieu of the SSC requirements presented in this SPI.** Any deviation from these requirements stated must be approved in advance by the PIC/PD and Director of H&S.

8. ON-SITE ACTIVITIES

8.1 General

The following requirements will be completed before beginning work:

- Confirm the written approvals and agreements discussed in Section 5 of this SPI, have been obtained;
- Confirm underground and overhead utilities have been located in the general search area, critical zone/proposed intrusive location(s);
- Electrical sources on-site must be de-energized during intrusive activities, where possible;
- Emergency shutoffs should be located and noted on plot plan;
- NEVER allow mechanical equipment to be moved when elements are in the extended position, such as a drill rig with the mast in the raised or partially raised, or a dump truck with a raised bed; and
- Notify landowners and/or tenant, where necessary and practicable.

8.2 SSC Field Checklist

In general, the Checklist serves as an intrusive activity permit. Intrusive activities will only begin once the Checklist has been reviewed, completed and accepted by the Designated Person on-site. Prior to commencing intrusive activities, the Designated Person on-site will review the information contained in Attachment A, Table 1 and complete the Subsurface Clearance (SSC) Field Checklist (Attachment B, Table 2) .

The Subsurface Field Checklist must be completed for each location (e.g., each drilling location) where intrusive activities will occur or each group of unobstructed locations. The completed form must be retained with the HASP in the project file, and acknowledgement that the SSC Field Checklist has been completed will be documented in the field logbook. Alternatively, it is acceptable to note that each item on the Checklist has been reviewed in the field logbook, in lieu of completing the separate form.

8.3 Daily Safety Meeting

A daily safety meeting will be conducted and documented in the HASP / RA or the field log book including the topics discussed and a signed attendance list with the printed name of the attendee, their signature, and company affiliation .

The following topics, at a minimum, will be included in the meeting:

- Review of the HASP/RA including the Hazard Analysis and Control Summary (i.e., potential hazards and safe work practices), Emergency Response Plan, applicable permitting requirements, etc.
- Review of the SSC Checklist.

- Proposed intrusive locations/areas will be adequately marked and the critical zone cleared. Locations that have been marked on the ground and have been cleared by the private locator are considered **FIXED**. Intrusive operations MAY NOT be conducted at any position within the critical zone, other than that point or area at the center specifically cleared to 5 feet (1.5 meters) unless approval has been granted by the PIC/PD and the Director of H&S.
- Agree that project field staff have the right and responsibility to 'Stop Work' as outlined in Section 7.5.
- Donning proper personal protective equipment (PPE) as outlined in the respective HASP / RA, as required.
- Accidents, injuries, provision of first aid, near misses and unsafe acts or conditions are to be reported in accordance with SPI 19. "Incident Reporting".

8.4 Stop Work Authority

Ramboll Environ personnel have the responsibility and authority to stop work or decline to perform an assigned task without fear of reprisal should they believe such work presents an unacceptable or unmitigated hazard. The Stop Work Authority may include, but is not limited to, discussions with co-workers, supervisors, or safety representatives to resolve work related issues or concerns, address potential unsafe conditions, clarify work instructions, and/or propose additional controls.

Under NO circumstances are work activities to be performed if:

- There is an uncertainty with the results of the public and/or private locate;
- Additional information is provided after the public/private locates have been performed that contradicts/conflicts with existing information;
- Work is required within the critical zone surrounding proposed intrusive location that has not been agreed upon by the PIC/PD and Director of H&S; and/or
- Identified unsafe conditions or safety concerns have not been resolved.

In these instances, the PIC/PD, PM and/or Director of H&S **MUST** be contacted for further input and guidance **PRIOR** to proceeding with work activities.

9. INCIDENT MANAGEMENT

Uncovering, damaging, or dislocating of an underground utility and/or contact with overhead utility lines are considered a reportable incident to Ramboll Environ and will follow the requirements set forth in SPI 19 Incident Reporting.

Nonetheless, in the event of uncovering an underground or overhead utility intact and undamaged:

- Cease work activities in the area of the facility/pipeline or utility.
- Clear all personnel from the area.

- Immediately call the applicable emergency phone number(s).
- Notify the affected utility and One Call services, if applicable. The One Call service may be able to assist with contact numbers for notifying member companies in the event of any damage.
- DO NOT attempt to repair, clamp or constrict the damaged utility.
- Notify the PM, PIC/PD, HSC and the Director of H&S. The PM or PIC/PD will contact the Client/Property Owner/Tenant and MP.
- ALWAYS ASSUME THAT ANY UNDERGROUND PIPE OR SUBSURFACE LINE IS LIVE!
- Take photographs from a distance that is safe to do so. Take statements from witnesses at the scene.
- Mark the underground structure(s) on the Plot Plan and move to an alternate cleared location, if available, once the Directors of H&S or their designated representatives have given approval for work to continue.

9.1 Damaging an Underground Electrical / Telecom Cable

- Stop work.
- Evacuate all personnel from the immediate area to a safe distance as site conditions warrant, giving consideration to employees which may not be able to safely evacuate (e.g., the excavator that hit the line may now be energized and the operator may not be able to safely exit the vehicle).
- Call the emergency number (e.g., fire, police, site-specific emergency service).
- Provide first aid and summon medical assistance, as needed.
- Contact the One Call/utility member for guidance, if applicable.
- Notify the PM, PIC/PD, HSC and the Director of H&S. The PM or PIC/PD will contact the Client/Property Owner/Tenant and MP.
- Do not allow anyone to enter the area until the electricity/utility provider has made the cable safe.

9.2 Damaging a Pressurized Gas Pipeline

- Stop work.
- Leave tools in-place but shut off any running/energized equipment, and/or potential sources of ignition in the area
- Evacuate the immediate area to a safe distance as site conditions warrant.
- Call the emergency number.
- Contact the pipeline owner and/or One Call, if applicable.
- Notify the PM, PIC/PD, HSC and the Director of H&S. The PM or PIC/PD will contact the Client/Property Owner/Tenant and MP.
- Do not re-enter the immediate area.

9.3 Damaging a Pressurized Water Main

- Stop work, remove tools and confine jetting water if safe and necessary to do so.
- Evacuate immediate area.
- Call the emergency number.
- Contact the water utility and/or One Call, if applicable.
- Ensure that water is not creating additional potential hazards (e.g., electrical shorting, flooding, contaminant migration etc.) and where possible warn those likely to be affected.
- Notify the PM, PIC/PD, HSC and the Director of H&S. The PM or PIC/PD will contact the Client/Property Owner/Tenant and MP. Do not re-enter the immediate area.

9.4 Mandatory Follow-up Procedures

If a site employee is injured on-site and immediate medical treatment beyond first aid is needed, the designated site supervisor is instructed to call 911 (or other designated emergency phone number) and then report the incident via Ramboll Environ's Incident Reporting System (SPI 19).

If the post-incident investigations and root cause analysis result in amendments to the HASP, they will be approved and implemented by the Project HSC or the Director of H&S. All site personnel will be informed of the revisions to the HASP and the resolution of any outstanding safety concerns prior to returning to their Site functions.

The necessary steps to ensure that operations can safely resume include:

- Receiving an "all-clear" from the impacted utility.
- Ensuring that all emergency equipment (fire extinguisher, communication system, first aid kits and first aid station) is in functional order;
- Clearing all incident-caused debris from the Site, if safe to do so;
- Inspecting area and equipment that may have been impacted by the incident; and
- Approval by the Directors of H&S or their designated representative.

10. RECORDKEEPING

The following records will be maintained in the onsite project files and transferred to the main project file when the project is complete:

- A complete Pre-Project Planning Checklist (Attachment A, Table 1) summarizing SSC methods and providing justification for any exemptions to the required clearance process.
- Field Log Book including:

- A detailed summary of the site visual inspection conducted prior to the initiation of intrusive field activities including the names/titles of site representatives interviewed, the areas reviewed for intrusive activities, and the potential presence of subsurface utilities/structures as reported by the site representatives.
- Potential underground utilities or subsurface structures identified during the public and/or private utility mark-out.
- Applicable information regarding the public "One Call" mark-out, ticket number, existing utilities, etc..

- Subsurface Clearance Field Checklist included in the site-specific Health and Safety Plan (Attachment B, Table 2) for each drilling location where intrusive activities might occur.
- Plot Plan, including any updates, reflecting the location(s) of known underground and overhead facilities and utilities with the search zone.

11. REFERENCES

American Public Works Association. April 1999. Uniform Color Code (http://www.apwa.net/).

American Society for Testing and Materials. September 1999. Standard Guide for Selecting Surface Geophysical Methods (D 6429-99).

NJUG Guidelines on the Positioning and Colour Coding of Underground Utilities' Apparatus. Volume 1. October 2013.

SPI 19 Incident Reporting

12. REVISION SUMMARY

Version	Author	Description of Change	Date
6.0	KMH, CD	Update to existing language/organization; updated definition/acronyms; updated pictures; added Risk Assessment section; updated tables.	11/2013

ATTACHMENT A
PRE-PROJECT PLANNING CHECKLIST

Table 1: Pre-Project Planning Checklist

Pre-Project Planning Checklist for Intrusive Work
Document the steps that must be followed and justify any exceptions.
This checklist MUST be completed in its entirety.

SSC Requirements	Yes	No	NA	Comments
Prequalification of Contractor for capability of locating work (See Section 4)	☐	☐	☐	Name of subcontractor(s)
Historical Site Information Review	☐	☐	☐	Specify what information was reviewed (e.g., maps, figures, photos, as-built drawings)
Interviews Conducted	☐	☐	☐	List personnel interviews conducted
Development of site-specific Plot Plan	☐	☐	☐	Denote where a copy can be found (i.e., Attachment D to project HASP, Specific project file name, will be developed on-site, etc.
Intrusive location(s) will be marked prior to locate(s) and alternate locations chosen	☐	☐	☐	Describe reason for exception if not performed or not applicable
Service notifications provided to clear/locate **public** utilities	☐	☐	☐	List companies notified for public locate (for example): ☐ Electric: Ameren ☐ Telephone: AT&T ☐ Cable: Comcast ☐ Gas: Marathon ☐ Sewer: City of Chicago Who contacted One Call: Driller, Ramboll Environ One Call #: 811, 800-892-0123 Locate ticket #: XCR1234
Private locate contracted for on-site utilities	☐	☐	☐	Name of subcontractor(s)
Designated Person or duly authorized representative will be present during private locating	☐	☐	☐	Name of Designated Person: Describe reason for exception if not performed or not applicable
Pre-Project Checklist for Intrusive Work completed by:				

ATTACHMENT B
SSC FIELD CHECKLIST

RAMBOLL ENVIRON

SUBSURFACE CLEARANCE (SSC) FIELD CHECK LIST

(Use this form to document & identify field elements of SSC. Retain the completed form with the project file)

Site Name/Project No.: ____________________ Designated Person: ____________________

Walkover Date: ____________________ PIC/PM: ____________________

Intrusive Locations Surveyed: ____________________

(Ramboll Environ MANAGED SUBSURFACE CLEARANCE ACTIVITIES)	Yes	No	N/A	Comments
1. The potential for unexploded ordnance (UXO) has been assessed and a UXO survey performed, if applicable.	☐	☐	☐	
2. Public utility markings are present for all utility companies notified. List the companies with public utilities present on-site and cross check with expected utilities and on-site indicators:	☐	☐	☐	
Natural gas/oil/petroleum lines and associated tanks:	☐	☐	☐	
Electric:	☐	☐	☐	
Potable water pipes, hydrants:	☐	☐	☐	
Sewers (storm/process water/sanitary) and/or Manways/Grates/Culverts:	☐	☐	☐	
Public lighting (street and traffic):	☐	☐	☐	
Telephone and Data Lines:	☐	☐	☐	
Other underground utilities:	☐	☐	☐	
3. Private utilities marked and scope discussed with/provided to locator	☐	☐	☐	Subcontractor Name: Contact #:
Alternate intrusive locations chosen in case of refusal or presence of utilities/indicators in Critical Zone	☐	☐	☐	
Describe nonconformity or unexpected conditions found by locator	☐	☐	☐	
4. Site Walkover performed to confirm utility markouts and assess the presence of Visual Indicators. If visual indicators are present, note location in comments/Plot Plan:	☐	☐	☐	
Indication of underground storage tank/piping and dispense islands	☐	☐	☐	
Non-native soils, surface depressions, new/dead vegetation	☐	☐	☐	
Saw cuts, patched surfaces, warning tape or other surficial indicators of below ground work	☐	☐	☐	
Pumps, pump galleries, piping manifolds and/or racks, process equipment, compressors, etc.	☐	☐	☐	
On or below-grade transformers	☐	☐	☐	
Fuel oil lines, tanks, fill ports, observation wells, vent stacks, hydraulic lift systems	☐	☐	☐	
Adjacent/supplemental buildings with no apparent utility feeds (electricity, water, gas)	☐	☐	☐	
Other:	☐	☐	☐	
5. Plot Plan updated to reflect most accurate site SSC information. Describe any on-site additions/changes	☐	☐	☐	
6. Ground Disturbance location(s) and Critical Zones (5ft/1.5m distance in every horizontal direction surrounding disturbance locations) cleared of utilities and visual indicators	☐	☐	☐	Contact PIC/PM and H&S Director if utilities pass through the Critical Zone of a planned ground disturbance location
A mark has been placed on each intrusive location and radial marks extending to the edge of the Critical Zone	☐	☐	☐	
Intrusive locations and Critical Zones cleared of utilities using sweep and search method or other applicable SSC investigative methods.	☐	☐	☐	
Once evaluated and cleared of utilities, intrusive locations cannot be moved and a Critical Zone must be maintained around the locations	☐	☐	☐	
Alternative intrusive locations used due to obstructions within Critical Zone. Describe abandoned and alternative locations	☐	☐	☐	
7. Pre-start H&S meeting conducted and SSC risk/hazards discussed	☐	☐	☐	
Locate results and intrusive locations/Critical Zones understood by all parties involved	☐	☐	☐	

Form completed by ____________________ ____________________ ____________________

Name Date Signature

ATTACHMENT C
ONE CALL AGENCY CONTACTS

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
811 Dig Safe (MA, ME, NH, RI, VT)	811
Alabama Alabama 811 www.al811.com	811 or 1-800-292-8525
Alaska Alaska Digline, Inc. www.akonecal.com	811 or 1-800-748-3121
Arizona Arizona Blue Stake www.azbluestake.com	811 or 1-800-782-5348
Arkansas Arkansas One Call	811 or 1-800-482-8998
California (North) Underground Service Alert of North www.usanorth.org	811 or 1-800-227-2600
California (South) Underground Service Alert Dig Alert www.digalert.org	811 or 1-800-227-2600
Colorado Colorado 811 www.co811.org	811 or 1-800-922-1987
Connecticut Call Before You Dig www.cbyd.com	811 or 1-800-922-4455
Delaware Miss Utility of Delmarva www.missutilitydelmarva.com	811 or 1-800-282-8555
District of Columbia District One Call www.missutility.net	811 or 811 or1-202-265-7177
Florida Sunshine Sate One Call www.callsunshine.com	811 or 1-800-432-4770
Georgia Georgia 811 www.georgia811.com	811 or 1-800-282-7411
Hawaii Hawaii One Call www.callbeforeyoudig.org	811 or 1-866-423-7287

One-Call Agency Contacts

Agency	Phone Number
United States	
Idaho Pass Word Dig Line, Inc. www.digline.com	811 or 1-800-342-1585
Idaho (Bonner/Boundry) Pass Word www.passwordinc.com	811 or 1-800-626-4950
Idaho (Kootenai County) Pass Word www.passwordinc.com	811 or 1-800-428-4950
Idaho (Shoeshone-Benewah) Pass Word www.passwordinc.com	811 or 1-800-398-3285
Illinois (Outside of Chicago) Julie www.illinois1call.com	811 or 1-800-892-0123
Illinois (Chicago) Digger – Chicago Utility Alert Network egov.cityofchicago.org	811 or 1-312-744-7000
Indiana Indiana 811 www.indiana811.com	811 or 1-800-382-5544
Iowa Iowa One Call www.iowaoncecall.com	811 or 1-800-292-8989
Kansas Kansas One Call www.kansasonecall.com	811 or 1-800-344-7233
Kentucky Kentucky 811 www.kentucky811.org	811 or 1-800-752-6007
Louisiana LA One Call www.laonecall.com	1-800-272-3020
Maine Dig Safe www.digsafe.com	811 or 1-888-344-7233
Maryland (West of Chesapeake Bay) Miss Utility of Maryland www.missutility.net	811 or 1-800-257-7777

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
Maryland (East of Chesapeake Bay) Miss Utility of Delmarva www.missutilitydelmarva.com	811 or 1-800-282-8555
Massachusetts Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
Michigan Miss Dig www.missdig.org	811 1-800-482-7171
Mississippi Mississippi 811 www.ms811.org	811 or 1-800-227-6477
Missouri Missouri One Call System www.mo1call.org	811 or 1-800-344-7483
Montana Montana 811 www.montana811.com	811 or 1-800-424-5555
Montana (Flathead and Lincoln Counties) Montana Once Call Center www.udig.org	811 or 1-800-551-8344
Nebraska Diggers Hotline of Nebraska www.ne-diggers.com	811 or 1-800-331-5666
Nevada USA North www.usanorth.org	811 or 1-800-227-2600
New Hampshire Dig Safe System, Inc. www.digsafe.com	811 or 1-800344-7233
New Jersey New Jersey One Call www.nj1-call.org	811 or 1-800-272-1000
New Mexico New Mexico One Call, Inc. www.nmonecall.org	811 or 1-800-321-2537
New York (North of 5 Boroughs) Dig Safely New York www.digsafelynewyork.com	811 or 1-800-962-7962

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
New York (5 Boroughs and Long Island) New York 811, Inc. www.newyork-811.com	811 or 1-800-272-4480
North Carolina North Carolina 811 www.nc811.org	811 or 1-800-632-4949
North Dakota North Dakota One Call www.ndonecall.com	811 or 1-800-795-0555
Ohio Ohio Utilities Protection Service www.oups.org	811 or 1-800-362-2764
Oklahoma Call Okie www.callokie.com	811 or 1-800-522-6543
Oregon Oregon Utility Notification Center www.digsafelyoregon.com	811 or 1-800-332-2344
Pennsylvania Pennsylvania One Call System, Inc, www.paonecall.org	811 or 1-800-242-1776
Rhode Island Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
South Carolina South Carolina 811 www.sc811.org	811 or 1-888-721-7877
South Dakota South Dakota One Call www.sdonecall.com	811 or 1-800-781-7474
Tennessee Tennessee 811 www.tennessee811.com	811 or 1-800-351-1111
Texas Texas811 www.texas811.org	811
Utah Blue Stakes of Utah www.bluestakes.org	811 or 1-800-662-4111

One-Call Agency Contacts

Agency	Phone Number
United States	
Vermont Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
Virginia Virginia 811 www.va811.com	811 or 1-800-552-7001
Washington Utility Notification Center www.callbeforeyoudig.org	811 or 1-800-424-5555
West Virginia Miss Utility of West Virginia www.muwv.org	811 or 1-800-245-4848
Wisconsin Diggers Hotline www.diggershotline.com	811 1-800-242-8511
Wyoming One-Call of Wyoming www.onecallof wyomng.com	811 or 1-800-849-2476
Australia	
Dial Before You Dig (Australia)	1100
Canada	
Alberta Alberta One Call www.alberta1call.com	1-800-242-3447
British Columbia BC One Call www.bconecall.bc.ca	1-800-474-6886
Manitoba Call Before You Dig www.callb4udig.mb.ca Does not complete locate requests, but provides a list of utility companies	Various
Ontario Ontario One Call www.on1call.com	1-800-400-2255
Quebec Info Excavation www.info-ex.com	1-800-663-9228
Saskatchewan Sask 1st Cal www.sask1stcall.com	1-866-828-4888

One-Call Agency Contacts	
Agency	**Phone Number**
United Kingdom	
National One-Call (United Kingdom)	0844 800 9957

APPENDIX D
FIRST AID GUIDANCE

Prepared for:
Ramboll Environ US Corporation
Chicago, Illinois

Date
July 2011

SUPPLEMENTAL FIRST AID GUIDANCE
JULY 2011

RAMBOLL ENVIRON

CONTENTS

1. INSECT BITES AND STINGS

Care will be taken by all site workers to avoid stinging or biting insects such as ticks, spiders, bees, wasps, hornets, and yellow jackets. Workers allergic to any particular insect sting or bite should seek medical attention if stung or bitten and may need to carry emergency medicine prescribed by their doctor.

Care should always be taken to avoid these insects and increased vigilance is necessary during high infestation seasons, when opening protective casings of monitoring wells, and when walking through areas of heavy vegetation or areas known to be infested.

To minimize the chance of bites/stings:

- Wear appropriate PPE such as light colored clothing so you can see insects, long pants tucked into boots, long sleeves when possible, a hat, and gloves if you are cutting brush or need to handle or move vegetation.
- Check your body and clothing for insects, shower after work and wash/dry clothes at as high a temperature as possible.
- Don't swat at insects and don't eat in areas where there are insects.
- Avoid sweet smelling personal hygiene products and, unless contraindicated by the work being performed (e.g., sampling, data collection), wear EPA approved repellants such as those containing DEET.

1.1 Spider Bites

Spider bites generally cause only localized reactions such as swelling, pain, and redness. However, bites from a Black Widow or Brown Recluse, or if you are allergic to spiders, can cause symptoms that are more serious.

Black Widow Spider

Brown Recluse Spider

1.1.1 First Aid for Spider and Scorpion Bites and Stings

- Clean the bite area with soap and water and place a cold pack over the bite area to reduce swelling.

- Monitor for allergic reactions. If the victim has more than minor pain or if nausea, vomiting, difficulty breathing, or swallowing occurs: medical attention should be sought immediately. CALL 911.

1.2 Ticks

Ticks are common, especially in the warmer weather months and may carry diseases such as Rocky Mountain Spotted Fever and Lyme disease.

Tick

Removing a Tick

1.2.1 First Aid for Tick Bites

- Use a fine tipped tweezers, grasp tick firmly as close to skin as possible and pull the body away from skin. Avoid crushing the body and don't twist.
- If parts of the tick remain in the skin, don't be alarmed as the mouth will dislodge as skin sloughs off.
- Wash area with soap and water and apply antiseptic or antibiotic ointment to prevent infection.
- If unexplained symptoms develop such as severe headaches, fever, or rash within 10 days of the bite, seek medical attention.
- If possible, contain tick in an air tight container for identification purposes, in the event that a serious illness results

1.3 Chiggers

Chiggers are tiny, s-legged wingless organisms that grow up to become a type of mite. They are found in tall grass and weeds and their bites cause severe itching.

Chigger and Chigger Bites

1.3.1 First Aid for Chiggers

- Reduce discomfort and prevent infection
- The affected area should be kept clean by washing with soap and water
- A topical hydrocortisone cream, antihistamine, or local anesthetic may be of value in reducing the itching
- The wounds should not be scratched, if possible
- If signs of infection occur, consult your physician

1.4 Bees and Wasps

Bees and wasps belong to the phylum Arthropod family, and they are crucially important to the pollination of plants, specifically flowers, fruits, and vegetables. A sting from a bee or wasp will cause itching, irritation, redness and/or swelling at the sting site.

Wasp

Bee

A small percentage of people are allergic to stings and a sting can be fatal, caused by a disruption to breathing and circulatory systems called anaphylactic shock. If the sting is followed by severe symptoms, seek medical attention immediately. Allergic people should never be alone for outdoor activities since help may be needed for prompt emergency treatment. Allergic people should have an identification bracelet as well as carry something like an "EpiPen" for immediate treatment for anaphylactic shock.

1.4.1 First Aid for Bee Stings

- Remove the stinger as quickly as possible - venom continues to enter the skin from the stinger for 45 to 60 seconds following a sting – using a flat dull object, like a credit card. Slid the flat object in the opposite direction of the stinger to remove it from the skin.
- Wash the wound using soap and water
- Apply ice for swelling and pain
- A topical hydrocortisone cream, antihistamine, or local anesthetic may be of value in reducing the itching
- If the sting occurs on the neck or mouth, seek medical attention immediately, swelling in these areas may cause suffocation

1.5 Fire Ants

Fire ants are a variety of stinging ants with over 280 species worldwide. Typically, a colony produces large mounds in open areas, and feeds mostly on young plants, seeds, and insects.

They nest in the soil, often near moist areas such as river banks and pond edges. Unlike other ants which bite and then spray acid on the wound, fire ants bite only to get a grip and then sting, injecting toxic alkaloid venom. This results in a painful stinging sensation, similar to what a fire burn feels like.



Fire Ants

1.5.1 First Aid for Fire Ant Bites

- Move rapidly away from the nest
- Quickly remove or kill ants on skin and clothing to prevent further stings
- Wash the area gently with soap and water to rid the skin of any venom.
- Place cool cloth or ice cloth on sites for 15 minutes, and to relieve pain, dab the area with calamine lotion, a topical (cortisone) or oral antihistamine (e.g., Benadryl) to help with swelling
- Do not scratch the blister because this can lead to infection
- Allergic response is rare, but symptoms are difficulty breathing, light headedness, and weakness. Immediate medical attention is required.

2. SNAKES

Snakes serve as an important role as predators in the ecosystem, and help maintain populations of rodents and other prey.

2.1 First Aid for Venomous Snake Bites:

- Wash and immobilize the injured area, keeping it lower than the heart if possible
- Seek medical attention immediately
- DO NOT apply ice, cut the wound, or apply a tourniquet
- Do not cut or suck the bite
- Remain calm and try not to move the bitten body part
- Remove jewelry or other items that may be affected by rapid swelling of affected body parts
- Try to identify the type of snake: note color, size, patterns, and markings
- The bite will be painful and have two distinct puncture wounds
- If venom is injected there will be burning and swelling
- ONLY FOR CORAL SNAKE BITES: apply a mild wrapping on the bite wound

Water Moccasin (aka Cotton Mouth)

Rattlesnake

Coral Snake

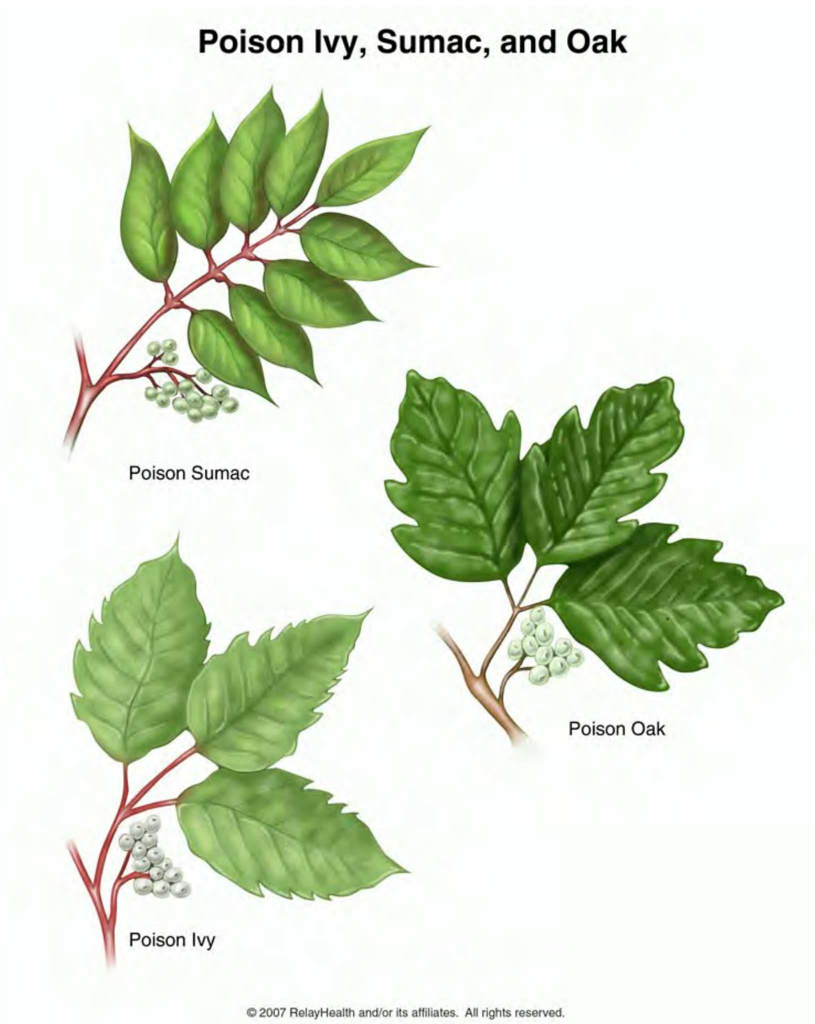
Copperhead

3. POISONOUS PLANTS

Poisonous Plants – Plants poison on contact, through ingestion, or by absorption or inhalation. They cause painful skin irritations upon contact and can cause internal poisoning when eaten.

3.1 First Aid for Poisonous Plants

- Wash exposed areas with cold running water as soon as you can
- When possible, wash your clothing
- Relieve itching by taking cool showers and applying topical anti-itch medications or hydrocortisone
- The rash is often arranged in streaks or lines where you brushed against the plant
- In a few days, the blisters become crusted and take 10 days or longer to heal
- If the reaction is severe or worsens, seek medical attention




Poison Ivy



Poison Sumac


Poison Oak

Giant Hogweed

4. HEAT STRESS

Heat stress can be a significant hazard, especially for workers wearing protective clothing.

Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and in the prevention of heat stress incidents.

Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers. Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium, or unconsciousness. Heat stroke is a life threatening condition that must be treated by competent medical authority.

ACGIH screening criteria for heat stress exposure in degrees Celsius for an 8 hour work day 5 days per week with conventional breaks will be used in determining safe exposure for acclimatized and unacclimatized employees.

Allocation of Work in a Work/Rest Cycle	Acclimatized				Action Limit (Unacclimatized)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	31.0 (87.8F)	28.0 (82.4F)	--	--	28.0 (82.4F)	25.0 (77F)	--	--
50-75%	31.0 (87.8F)	29.0 (84.2F)	27.5 (81.5)	--	28.5 (83.3F)	26.0 (78.8F)	24.0 75.2F)	--
25-50%	32.0 (89.6F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	29.5 (85.1F)	27.0 (80.6F)	25.5 (77.9)	24.5 (76.1F)
0-25%	32.5 (90.5F)	31.5 (88.7F)	30.5 (86.9F)	30.0 (86F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	27.0 (80.6F)

4.1 Heat Stress Prevention

Whenever possible or within the control of Ramboll Environ, engineering controls should be utilized to protect workers from heat related hazards (e.g., heat shielding such as using awnings or umbrellas). Appropriate work practices can also lessen the chances of heat related hazards. Some of these include:

- Water and/or electrolyte fluids should be about equal to the amount of sweat produced (i.e., drinking 5-7 ounces (150 -200 mL) of water every 15-20 minutes). Ideally, fluids should be at room temperature to allow for quicker absorption. Consider keeping water at room temperature and electrolyte fluids chilled. Do NOT chill both.

- Whenever possible, gradual exposure to heat is preferred to allow the body's internal temperature to actuate to the working conditions.
- Whenever possible, adjust the work schedule to reduce risk of heat stress. For example, postpone nonessential or heavier work to the cooler part of the day and perform work in the shade if portable.
- Rotate personnel to reduce the amount of time spent working in direct sun and heat.
- Increase the number and/or duration of rest breaks, and whenever possible, rest break areas should be in a cool area and as close to the work area as is feasible.

Wear appropriate PPE when necessary, such as thermally conditioned clothing, self-contained air conditioning in a backpack, and plastic jackets/vests with pockets that can be filled with dry ice or ice. However, based on the type of work being done, where work is being performed, or other required PPE, these options may be prohibited or make the use of this PPE impossible or impractical.

4.2 Heat Related Illnesses

4.2.1 Heat Stress

This is the mildest heat-related illness, but prompt action may prevent it from turning into a more severe heat-related illness. Symptoms include irritability, lethargy, significant sweating, headache, or nausea. The following guidance can be used in the identification and treatment of heat related illness.

4.2.2 Heat Stress First Aid

- Take victim to a protected (e.g., shaded, cool) area, remove any excess protective clothing, and provide cool fluids.
- If an air-conditioned spot is available, this is an ideal break location.
- Once the victim shows improvement he/she may resume working, however the work pace and practices (e.g., does fluid intake need to be increased) should be moderated to prevent recurrence of the symptoms.

4.2.3 Heat Exhaustion

Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Symptoms include pale, clammy skin, and profuse sweating, vomiting, and the bowels may move involuntarily. The pulse is weak and fast, breathing is shallow. Fainting can occur.

4.2.4 Heat Exhaustion First Aid

Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling – you do not want the victim to shiver).

- Call a physician or emergency service, or transport the victim to medical care.
- Remove all protective outerwear.
- If the victim is conscious, it may be helpful to give him/her sips of water.

4.2.5 Heat Stroke

Heat stroke is a severe medical condition requiring first aid and emergency treatment by a medical professional as death can occur without appropriate care. Heat Stroke represents the collapse of the body's cooling mechanisms. As a result, body temperatures often rise to between 105° – 110° F (40.5° – 43.3° C). As the victim progresses toward heat stroke symptoms include hot and usually dry, red and spotted skin, headache, dizziness, nausea, mental confusion, delirium, possible convulsions and loss of consciousness.

4.2.6 Heat Stroke First Aid

- Immediately remove the victim from the work area to a shady or cool area with good air circulation (avoid drafts or sudden chilling – you do not want the victim to shiver).
- Summon emergency medical help to provide on-site treatment and transportation to a medical facility.
- Remove all protective outerwear and loosen personal clothing.
- Apply cool wet towels, ice bags, etc. to the head, armpits, and thighs. Sponge off the bare skin with cool water or even place the victim in a tub of cool water.

4.2.7 Skin Hazards

Sunburn and prickly heat are both symptoms of skin irritation/damage produced through exposure to sunlight and operating in hot work environments.

- Protect exposed skin with an appropriate sunscreen. A sunscreen with a sun protection factor (SPF) of 15 or greater is required for work in the sun with reapplication at breaks and lunch.
- Heat rash, also known as prickly heat, can be prevented by the application of a hydrophobic, water repellent barrier cream such as Kerodex 71.

5. COLD STRESS

The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness, and cold water. One or any combination of these factors can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects.

A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures. Major risk factors for cold-related stresses include:

- Wearing inadequate or wet clothing increases the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication that inhibits the body's response to the cold or impairs judgment.
- Having a cold or certain diseases, such as diabetes, heart, vascular, and thyroid problems, may make a person more susceptible to the winter elements.
- Being male increases a person's risk to cold-related stresses. Men experience far greater death rates due to cold exposure than women, perhaps due to inherent risk-taking activities, body-fat composition, or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, may speed up the effects of cold weather.
- Aging -- the elderly are more vulnerable to the effects of harsh winter weather.

TABLE 2. Cooling Power or Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

5.1 Cold Stress Prevention

Engineering controls should be utilized whenever possible to protect workers from cold related hazards. For example, on-site heat sources, heated shelters, work areas shielded from drafty or windy conditions, and the use of thermal insulating material on equipment handles. Effects arising from cold exposure will be minimized by the following control measures:

- Personnel will be trained to recognize cold stress symptoms.
- Field activities will be curtailed or halted if the equivalent chill temperature is below 20 F (7C).
- As much as possible, work that exposes personnel to the cold will be done during the warmest hours of the day.
- Inactivity in cold conditions will be kept to a minimum.
- Frequent short breaks in warm, dry shelters will be taken.
- Vehicles will be equipped with supplies in case the vehicle becomes inoperable (e.g., blanket, dry clothing, water, food, a shovel, etc.

TABLE 3. Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
–26° to –28°	–15° to –19°	(Norm. Breaks)	1	(Norm. Breaks)		75 min	2	55 min	3	40 min	4
–29° to –31°	–20° to –24°	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4	30 min	5
–32° to –34°	–25° to –29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
–35° to –37°	–30° to –34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
–38° to –39°	–35° to –39°	40 min	4	30 min	5	Non-emergency work should cease					
–40° to –42°	–40° to –44°	30 min	5	Non-emergency work should cease							
–43° & below	–45° & below	Non-emergency work should cease									

Notes for Table 3

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at –35°C (–30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
   5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

*Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

5.2 Cold-Related Illness

5.2.1 Hypothermia

Hypothermia occurs when the body temperature falls to a level where normal muscular and cerebral functions are impaired. Although it usually occurs in freezing air and water temperatures, it can occur in any climate if a person's internal body temperature falls below normal. Symptoms should not be ignored, and a supervisor should be notified as soon as hypothermia is suspected.

Initially, symptoms may include shivering, an inability to do complex motor functions, sluggishness and mild confusion as the body temperature drops to around 95 F. As the body temperature falls, speech may become slurred, and behavior may be irrational, simple motor functions may be difficult to do and a state of "dazed consciousness" may exist. In severe state (below 90 F or 32 C), heart rate, blood flow, and breathing will slow. Unconsciousness and full heart failure can occur.

5.2.2 Hypothermia First Aid

5.2.2.1 On Land

- Call for emergency, and then help move the victim (unless other injuries prohibit their being moved) to a warm, dry area and replace wet clothing with warm, dry clothing or a blanket. Move the person carefully because movement can increase the irritability of the heart.
- If the person is conscious and lucid, warm liquids can be provided, but never alcohol or caffeinated drinks. If possible, have them to move their arms and legs to create muscle heat.
- If the person is unconscious or unable to assist, place warm bottles/packs in the person's arm pits, groin, neck and head areas.
- Do not rub the person's body or place them in warm water.

5.2.2.2 In Water

- Call for emergency help and get the victim out of the water. Move them carefully because movement can increase the irritability of the heart.
- If it is you in the water, do not swim unless a floating object or person can be reached quickly as swimming uses the body's heat and reduces survival time by about 50%.
- If you are in the water, conserve body heat by folding arms across the chest, keeping thighs together, bending knees and crossing ankles, if another person is in the water with you, huddle together.
- If you are in the water, do not remove clothing-button, buckle, zip, and tighten collars, cuffs, shoes, and hoods as the water trapped next to the body provides a layer of insulation that may slow the loss of heat.

5.2.3 Frostbite

Frostbite occurs when the skin literally freezes, and deep frostbite can affect deeper tissues such as tendons and muscles. Frostbite usually occurs when temperatures drop below 30 °F (1°C), but wind chill effects can cause frostbite at above-freezing temperatures. The ears, fingers, toes, cheeks, and nose are the most commonly affected body parts. Initially, symptoms include an uncomfortable sensation of coldness. Tingling, stinging or an aching feeling of the exposed area is followed by numbness. Frostbitten areas appear white and cold to the touch and with deeper frostbite, the area becomes numb, painless, and hard, and can turn black.

5.2.4 Frostbite First Aid

- Seek medical attention as soon as possible and treat any existing hypothermia first.
- Warm liquid can be provided, but not alcohol or caffeinated drinks such as tea and coffee.
- Do not rub the affected areas, but cover them with dry, sterile gauze or soft, clean bandages.
- Do not try rewarming the affected area if you have not been specifically trained to do so and/or if there is a chance the affected area will get cold again

6. SMALL CHEMICAL SPILLS

Chemical hazards present in environmental samples or in the environment being sampled are NOT the only "chemicals of concern". Toxic chemicals may also be brought onto a site as part of the sampling event in the form of sample preservatives. In general, sample preservation is required for most water samples. Two practices exist for adding a preservative: 1) addition of the preservative to the samples in the field; and 2) addition of the preservative to the sampling containers prior to sending the samplers into the field. In either case, EXTREME caution MUST be exercised when adding a preservative to a sample vial or using vials which already contain a preservative since these preservatives will vary in concentration and type. Some examples of the type of preservatives which may be encountered include sodium thiosulfate to remove chlorine; hydrochloric acid or ammonium chloride to stabilize pH and reduce biological activity; or sodium bisulfate.

6.1 Chemical First Aid (Body)

In the event that you suspect that you have been exposed to a chemical, whether or not you were wearing PPE, you should:

- Remove yourself or the victim from the accident area.
- Remove any contaminated clothing.
- Wash the injured area to dilute or remove the substance, using large volumes of water.
- Wash for at least 20 minutes, taking care not to allow runoff to contact unaffected parts of your body.
- Gently brush away any solid materials, again avoiding unaffected body surfaces.
- Especially wash away any chemical in your eye. Sometimes the best way to get large amounts of water to your eye is to step into the shower.

6.2 Chemical First Aid (Eye)

For all chemical injuries to the eye, the first thing you should do is immediately irrigate the eye copiously. Ideally, specific eye irrigating solutions should be used for this, but if none are available regular tap water will do just fine.

- Begin washing your eye before taking any other action and continue for at least 10 minutes. The longer a chemical is in your eye, the more damage will occur. Diluting the substance and washing away any particles that may have been in the chemical are extremely important.
- Ideally, in a work setting, you would be placed in an emergency eyewash or shower station and your eye washed with sterile isotonic saline solution. If sterile saline is not available, use cold tap water.
- All acid or alkali eye burns require immediate treatment and evaluation by a doctor. You should be taken immediately to the closest emergency department. If you suspect a serious injury may have occurred or are otherwise not able to make the trip to the emergency room quickly, then you should call an ambulance to shorten transport time.

Take the Materials Safety Data Sheet (MSDS) on the chemical you were exposed to with you to the hospital. Further Reading:

- Chemical Eye Burns
- Corneal Flash Burns
- Wilderness: Eye Injuries Treatment
- Chemical Burns Treatment
- Corneal Flash Burns Treatment
- Chemical Eye Burn Treatment
- Burns to the Eye-Emergencies
- See All Eye Burns Topics
- Top Picks
- See Pinkeye and Learn to Treat It
- Symptoms of Styes in the Eyes
- Choosing an Eye Doctor
- Men's Super Foods Including Eye Health Boosters
- Learning to Live With Blindness
- Correcting Double Vision After Brain Injury

Any time you experience pain, tearing, redness, irritation, or vision loss, go to a hospital's emergency department for immediate evaluation, even if you believe the chemical is only a mild irritant.

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APPENDIX E
EMERGENCY INFORMATION

EMERGENCY CONTACT INFORMATION

Site Name: **Steel Treaters, Inc.**

Specific Location: 520 Campbell Ave, Troy, NY, 12180

Table 1: Emergency Response Telephone Roster

Contact	Name	Office Phone #	Mobile Phone #
Local Fire Department	Troy Fire Department	911 (518) 270-4471	
Local Hospital	Samaritan Hospital	(518) 271-3300	
Local Police	City of Troy Police Department	911 (518) 270-4411	
EENC Principal	Drew Bonas	(609) 243-9874	(609) 240-5581
EENC Project Manager	Jose Sananes	(609) 243-9882	(732) 841-1218
EENC Designated Site Supervisor	Brian Robinson	(860) 503-1662	(203) 233-7907
Health and Safety Coordinator	Sharon Burkett	(609) 243-9832	(609) 306-8361
Client Contact	Travis Quarles	(503) 228-2141	
Contractor: ADT	Rich Donnely	(518) 326-1441	
Contractor: CT Male Associates	Michael Groff	(518) 786-7413	
Poison Control		800-222-1222	

POTENTIAL CHEMICALS OF CONCERN:

Volatile organic compounds – Ethanes (1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane), ethenes (cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, vinyl chloride), and 1,4-dioxane.

ROUTE DESCRIPTION AND MAP TO HOSPITAL

Hospital Information:

Hospital Name: Samaritan Hospital

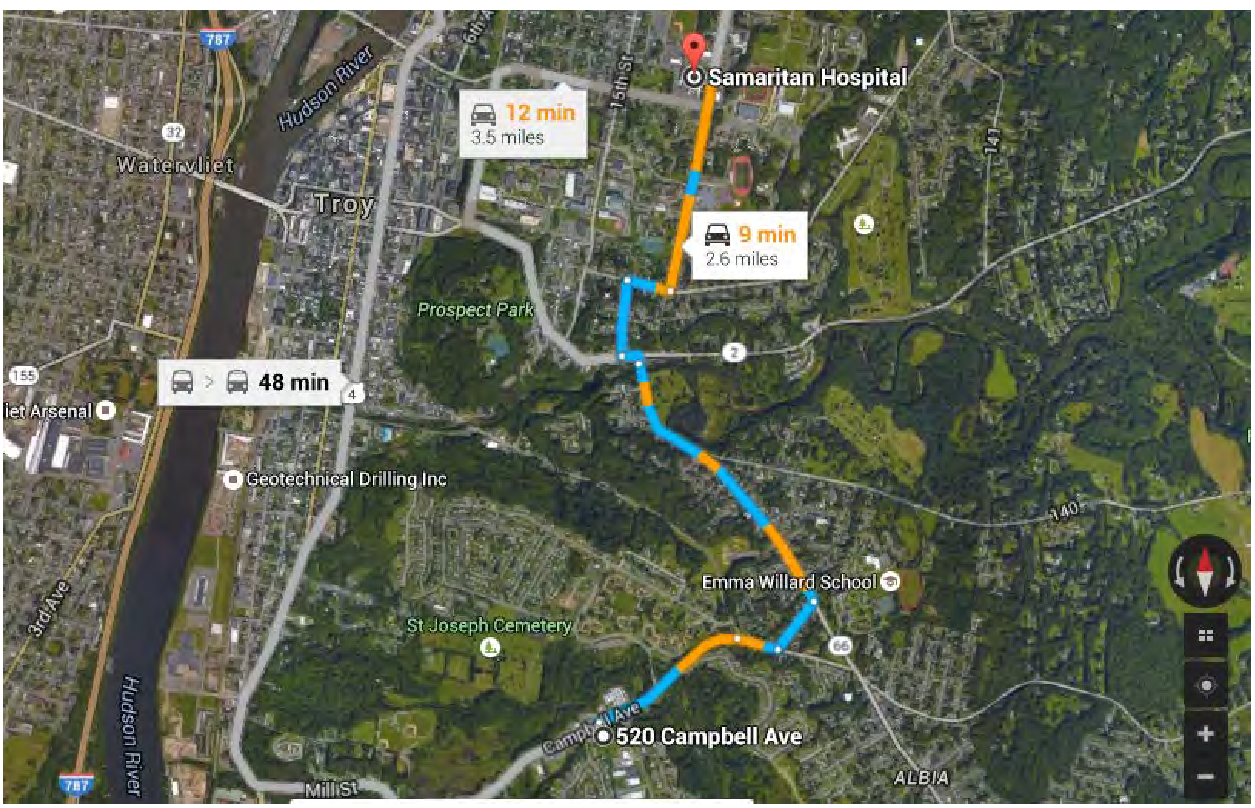
Hospital Address: *2215 Burdett Avenue, Troy, NY*

Hospital Phone Number: *(518) 271-3300*

Directions to Area Hospital:

Head east (turn right) on Campbell Ave toward Colleen Road

- Slight right onto Spring Ave
- Turn left onto Myrtle Ave
- Turn left onto Pawling Ave
- Turn left onto Congress St
- Turn right onto Brunswick Ave
- Turn right onto Tibbits Ave
- Turn left onto Burdett Ave
- End: 2215 Burdett Ave, Troy, NY (Destination will be on the left)



ATTACHMENT H
COMMUNITY AIR MONITORING PLAN

Prepared for:
Steel Treaters, Inc.
Troy, NY

Prepared By:
ENVIRON Engineers of North Carolina, PC
Princeton, NJ

Date
October 2017

Project Number
02-39035A

COMMUNITY AIR MONITORING PLAN

FORMER STEEL TREATERS, INC FACILITY

520 CAMPBELL AVENUE

TROY, NEW YORK

NEW YORK STATE VOLUNTARY CLEANUP PROGRAM

CONTENTS

1. INTRODUCTION

This Community Air Monitoring Plan (CAMP) was prepared to identify the real-time monitoring for volatile organic compounds (VOCs) and particulates that are required at the downwind perimeter of the site to provide a measure of protection for the downwind community from potential airborne contaminant releases as a direct result of remedial work activities. This CAMP was prepared based on the guidance provided in DER-10 / Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010), including the generic CAMP presented in Appendix 1A. The monitoring requirements listed below will be in effect during all ground intrusive activities.

Copies of the CAMP will be kept on site for review and reference during all site activities.

1.1 Site Description

Steel Treaters, Inc. (STI) acquired the site, which consisted of vacant land, in 1965 from Charles E. Weber & Son. The site was previously developed with an approximately 8,400-square-foot building, which was located in the northern portion of the site. The single story building was damaged by a fire in 2005 and, as required by the City of Troy Bureau of Code Enforcement, was demolished in April 2017; all that remains currently is the building slab. The southern portion of the site is wooded and undeveloped.

Starting in 1966, STI utilized the facility to heat treat metal machine parts, which were received from various manufacturers. The majority of the work conducted at the site involved tempering and case hardening of metal parts, as well as annealing of metal parts. Air and vacuum furnaces were used at the facility, and some parts were cooled using quench oil. Anhydrous ammonia was also used onsite during the heat treatment process to generate atmosphere for the furnaces.

Past site activities were believed to have included the use of solvents, including 1,1,1-trichloroethane and trichloroethylene, which were stored in 55-gallon drums and used for vapor degreasing of metal parts. The solvents were reportedly reclaimed following use. STI reported that usage of these solvents ended in approximately 1991. STI's operations ceased following the 2005 fire and ESCO Portland (ESCO) acquired the site in 2012. The site is currently vacant.

1.2 Remedial Activities

The planned remedial activities include ground intrusive activities in the approximate areas shown on **Figure 1**. The intrusive activities are reasonably expected to be more than 20 feet from any downwind receptors, as only parking areas, roads, or similar areas are within 20 feet of the site boundary (i.e., areas where individuals are not expected to spend extended periods of time). The work area is approximately 160 feet from the closest residential property boundary and approximately 95 feet from the closest commercial structure.

2. MONITORING REQUIREMENTS

2.1 VOC Monitoring

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shut down.

All 15-minute readings will be recorded and be available for State (New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH)) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded. Any exceedances of the above limits, including the duration and response actions will be included in a CAMP report to be submitted to NYSDEC. Any exceedances of the above limits, including the duration and response actions will be included in a CAMP report to be submitted to NYSDEC.

2.2 Particulate Monitoring

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations during the handling of waste or contaminated soil, or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Particulate monitoring is not necessary during the handling of uncontaminated materials (e.g., clean fill).

The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. The minimum performance standards are as specified in Appendix 1B of DER-10. In addition, fugitive dust migration will be visually assessed during all work activities.

If the downwind PM-10 particulate level is in excess of 150 ug/m^3 or is 100 micrograms per cubic meter (ug/m^3) greater than background (upwind perimeter) for a 15-minute period, or if airborne dust is observed leaving the work area, then the upwind background level will be confirmed immediately and dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 100 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 ug/m^3 or greater than 100 ug/m^3 above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to 150 ug/m^3 or less, within 100 ug/m^3 of the upwind level, and in preventing visible dust migration.

Should the action level of 150 ug/m^3 continue to be exceeded, work will stop and NYSDEC will be notified. The notification will include a description of the control measures implemented to prevent further exceedances.

All readings will be recorded and be available for State (NYSDEC and NYSDOH) and County Health personnel to review.

3. QUALITY ASSURANCE/QUALITY CONTROL

In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC).

To ensure the quality of the air monitoring data, operators will follow operating instructions provided by the manufacturer and/or equipment provider. The instrument will be calibrated and the performance (span) will be checked daily. Calibration and span checks will be recorded in the field notes and all measurements will be recorded and saved in electronic form with backup copies.

FIGURE 1

SOURCE:

1. MAP ENTITLED "STEEL TREATERS, 520 CAMPBELL AVENUE, SAMPLE LOCATIONS" PREPARED BY BARTON AND LOGUIDICE, P.C., PROJECT NO. 1047.001, AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
2. RENSSELAER COUNTY, CITY OF TROY TAX MAP 112
3. "LANDS OF ESCO CORPORATION", NMB SURVEY: NB16-001 520 Campbells Ave 020416.dwg DATED FEB. 4, 2016.
4. ALL SAMPLE LOCATIONS SHOWN IN LIGHT GRAY ARE APPROXIMATE. LOCATIONS BASED ON "SITE MAP SHOWING SOIL AND GROUNDWATER SAMPLING LOCATIONS" PREPARED BY BARTON & LOGUIDICE, P.C. AND INCLUDED AS FIGURE 3 OF THE NOVEMBER 2013 REMEDIAL INVESTIGATION REPORT.
5. "UNKNOWN UNDERGROUND FEATURE" REFERS TO SUBSURFACE METALLIC ANOMALIES IDENTIFIED DURING THE GEOPHYSICAL SURVEY COMPLETED BY NAEVA GEOPHYSICS ON NOVEMBER 24, 2015.
6. EXISTING CONTOURS: 1-METER DEM, NYS ORTHO ONLINE, WWW.ORTHOS.DHSES.NY.GOV, 2016.

REV.	DATE	DR.	CH.	REVISION

SOIL EROSION AND SEDIMENT CONTROL PLAN

ESCO STEEL
520 CAMPBELL AVENUE
CITY OF TROY, NEW YORK

ENVIRON
ENVIRON Engineers of North Carolina, PC
CERTIFICATE NUMBER: 0012568

PREPARED BY: JS/TA	DATE: 11/06/2017	FIGURE 1
DRAFTED BY: MSB	SCALE: AS SHOWN	
APPROVED BY: JS	PROJECT: 0239035A	

DBLANCHARD 11/6/17
F:\0239035_ESCO STEEL_DESIGN < SESC_0239035 >