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SRSNE Site Group

RCRA CAP 100% DESIGN REPORT (FINAL)

Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

October 2016

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ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
BBL	Blasland, Bouck & Lee, Inc.
CD	Consent Decree
CL&P	Connecticut Light & Power
COC	Chemical of Concern
CT DEEP	Connecticut Department of Energy and Environmental Protection
CY	cubic yard
DNAPL	dense non-aqueous phase liquid
GCL	geosynthetic clay liner
gpm	gallons per minute
HCTS	Hydraulic Containment and Treatment System
HDPE	High-Density Polyethylene
ISTR	In Situ Thermal Remediation
LLDPE	Linear Low Density Polyethylene
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NAPL	Non-aqueous Phase Liquid
NTCRA	Non-Time-Critical Removal Actions
PCB	polychlorinated biphenyls
PMC	Pollutant Mobility Criteria
PVC	polyvinyl chloride
RAWP	Remedial Action Work Plan
RCRA	Resource, Conservation and Recovery Act
RDEC	Residential Direct Exposure Criteria
RDWP	Remedial Design Work Plan
RD/RA	Remedial Design/Remedial Action
ROD	Record of Decision
RSRs	Remediation Standard Regulations
SIP	Soil Investigation Plan

SOW	Statement of Work
SPLP	Synthetic Precipitation Leaching Procedure
SRSNE	Solvents Recovery Service of New England, Inc.
TEQ	Toxic Equivalence Quotient
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

1 INTRODUCTION

1.1 Purpose and Scope

This document has been prepared on behalf of the SRSNE Site Group, an unincorporated association of Settling Defendants to a Consent Decree (CD) and Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut (Site). The CD was lodged on October 30, 2008 with the United States District Court for the District of Connecticut in connection with Civil Actions No. 3:08cv1509 (SRU) and No. 3:08cv1504 (WWE). The CD was entered by the Court on March 26, 2009.

The *Record of Decision* (ROD) (United States Environmental Protection Agency [USEPA] 2005) and SOW identify various components of the remedial action for the Site. Pertinent to this document, a key component of the remedial action – in-situ thermal remediation (ISTR) to address a zone of overburden non-aqueous phase liquid (NAPL) within and adjacent to the former Operations area – was implemented between 2013 and 2015. Having completed that work (***de maximis, inc.*** 2015), this document primarily addresses the design of three subsequent ROD-specified components of the remedial action: excavation and consolidation of impacted soils on the Cianci property, construction of a Resource Conservation and Recovery Act (RCRA) Subtitle C cap ("RCRA cap") in the former Operations Area of the Site, and restoration of habitat areas affected by remediation (to the extent possible). It also addresses other related activities to be implemented in conjunction with this phase of remedy implementation, including modifications to the Non-Time-Critical Response Action (NTCRA) 1 sheet pile wall, addressing impacted soils outside the planned RCRA cap limits (i.e., in addition to the targeted Cianci property areas), and construction of a rails-to-trails pathway extending from Lazy Lane to Curtiss Street.

Sections V.D and E of the SOW call for conceptual (30%), pre-final (95%), and final (100%) design submittals associated with the Remedial Design process. This approach was modified in the *Remedial Design Work Plan* (RDWP) (Arcadis 2010c) such that the initial design submittal would target a 65% design level to minimize the number of deliverables and streamline the design process. A document targeting the 65% conceptual design level was submitted on March 31, 2016 for review and comment by the USEPA and Connecticut Department of Energy and Environmental Protection (CT DEEP). Based on comments received from both agencies, as well as discussions during a meeting on April 19, 2016 and other design evaluations performed on behalf of the SRSNE Site Group, a draft 100% Design Document was submitted on July 26, 2016. Based on comments received from both agencies, as well as additional input provided via email and conference calls, responses to those comments were submitted on September 28, 2016. USEPA subsequently issued an approval letter on September 28, 2016. Copies of the agency comments with responses provided by the SRSNE Site Group, as well as a copy of the USEPA's approval letter, are provided in Attachment 1 hereto. Having been revised to address the agency comments and requirements of the approval letter, this document represents the final 100% design level.

1.2 Summary of Pre-Design Investigations

Various pre-design investigations have been performed to support the remedial design. This includes an expanded/updated topographic survey, a vapor control system evaluation, and a habitat evaluation to support the final restoration design. It also includes delineation of the five Cianci property excavation areas based on the delineation approach described in the Soil Investigation Plan (SIP; Attachment I to the RDWP). Finally, it includes a sampling program to delineate the nature and extent of dioxin[1] beyond the planned cap limits such that dioxin-impacted soils can be appropriately managed in conjunction with this work. The scope and findings of these activities are further discussed below.

1.2.1 Topographic Survey

A topographic survey was conducted during November and December 2015 by Pereira Engineering, LLC. The purposes of the survey were to provide topography and site features along the railroad right-of-way stretching from Lazy Lane to Curtiss Street, locate and determine the elevation of a newly installed rails-to-trails wood footbridge over the Quinnipiac River, and provide updated topography where soil/debris piles were expanded during the ISTR demobilization process. The results of this survey were incorporated into the CADD base map for the Site and serve as the basis for the Design Drawings (Appendix A).

1.2.2 Vapor Control System Evaluation

Section V.C.1.j of the SOW requires an "evaluation to determine whether (or not) a vapor control system is needed below the cap." As stated on Page 94 of the Record of Decision (ROD), "Based on current data, EPA does not believe that a vapor control system will be a necessary component of the multi-layer cap. However, further analysis of this issue will be performed during pre-design." Accordingly, the proposed approach for implementing this evaluation was described in the "Vapor Control System Evaluation" document, which was included as Attachment J to the RDWP (Arcadis 2010d). The stated purpose of the vapor control system evaluation is to assess the potential for vapor emission or accumulation beneath the cap components that could lead to concerns associated with cap stability or vapor accumulation to the extent that a vapor collection, control, and/or venting system would be warranted as part of the cap design.

As stated in the Vapor Control System Evaluation document, the specific conditions that exist within the former Operations Area following ISTR implementation represent a key factor affecting need for a vapor control system as part of the cap. In accordance with the SOW and the *In Situ Thermal Remediation Remedial Action Work Plan and Project Operations Plan* (TerraTherm 2014), the thermal remediation zone was subject to confirmation soil sampling to verify that the ISTR component achieved its Performance Standard of removing NAPL from the overburden soils. The scope and results of the confirmation sampling were summarized in the "In-Situ Thermal Remediation Construction Completion Report (***de maximis, inc.*** 2015). As further discussed in that document, Interim NAPL Cleanup Levels were achieved in all of the approximately 150 soil samples representing the final treated soil volume.

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[1] As used herein, "dioxin" refers to polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

Because the Interim NAPL Cleanup Levels represented soil concentrations below which NAPL could not be present, achievement of these goals demonstrates that NAPL was removed from the overburden soils. As also stated therein, the ISTR process achieved 99.73% removal of the VOC mass, exceeding the USEPA's expectations of 95 to 99% removal stated in the ROD.

The fact that the ROD indicated that USEPA did not believe that a vapor control system would be necessary (pending further evaluation during pre-design), combined with the fact that the ISTR process achieved Interim NAPL Cleanup Levels and removed a larger percentage of VOC mass than had been expected, suggests that a vapor control system is not a necessary component of the RCRA cap. The following considerations further support this conclusion:

- ISTR operations were carried out for a minimum of two additional weeks after collecting soil samples documenting achievement of the Interim NAPL Cleanup Levels. Accordingly, post-ISTR soil concentrations are likely even lower than indicated by the final confirmation soil samples data.
- Perimeter air monitoring for VOCs was performed during the pre-ISTR site preparation and ISTR implementation phases of the work. Action levels protective of nearby receptors were not exceeded[2] during either of these phases of work. In particular, the pre-ISTR site preparation activities were performed at a time prior to the removal of overburden NAPL and prior to the vapor collection system that operated during ISTR. As a result, the potential for ambient air impacts under those conditions would have been greater than could be expected under post-ISTR, and post-cap conditions. The fact that perimeter action levels were not exceeded under those conditions makes it extremely unlikely that they could be exceeded after ISTR and cap construction.
- In a municipal landfill, there is a potential for generation of pressurized gas buildup when solid organic waste is converted to methane gas via biologically-mediated processes in the absence of oxygen. Solid organic waste is not present in the cap area. Further, having removed residual NAPL, there is no expectation of pressure accumulation beneath the cap such that venting would be required.
- The potential for gas buildup beneath the cap due to anaerobic degradation of dissolved-phase VOCs was evaluated conservatively assuming that all of the carbon in remaining dissolved-phase VOCs would be simultaneously converted to methane (CH4) gas during instantaneous degradation. Groundwater VOC results for ISTR wells sampled during the post-thermal treatment period were used to estimate potential methane concentrations in groundwater. Estimated methane concentrations ranged from 0.17 to 19.3 mg/L for the ISTR wells, with an average estimated methane concentration of 6.8 mg/L. These results are consistent with measured methane concentrations in groundwater at NTCRA 1 Area monitoring wells sampled during the post-thermal treatment monitoring period where methane concentrations ranged from <0.0003 to 21 mg/L. The solubility of methane at standard temperature and pressure is approximately 28 mg/L. Methane in groundwater at concentrations below the solubility limit will tend to stay in solution and not result in release of gas to the subsurface. Based on these results, there does not appear to be a significant potential for buildup of gas beneath the cap due to anaerobic degradation of VOCs, even under the highly conservative

[2] For reasons that could not be attributed to other sources, such as equipment calibration or operation of vehicles.

assumption that all of the VOC mass is simultaneously converted to methane via anaerobic degradation.

- There are no buildings or receptors immediately adjacent to the cap area. Even in the unexpected event of VOC migration via soil gas and surface expression near the perimeter, the VOCs would not be diverted into occupied buildings or areas where receptors are routinely present.

Based on these data and considerations, a vapor control system is not included in the RCRA cap design.

1.2.3 Habitat Restoration Evaluation

An initial habitat characterization of the Site was performed in 2009 (Arcadis 2010a), prior to initiating disturbances associated with remedial activities. The objective of the initial habitat characterization effort was to identify the dominant vegetative communities supporting the natural habitats of the Site and surrounding areas to enable the restoration design for these habitats if and when they are disturbed by remedial activities. The results of that effort were summarized in the *Habitat Characterization Report* (Arcadis 2010a). A subsequent site reconnaissance was performed in the fall of 2015 to observe the extent of disturbances resulting from the prior remedial activities on natural habitats and identify the areas where habitat restoration design is needed to re-establish pre-remedial conditions (where feasible). A summary of key findings from the 2015 habitat reconnaissance is provided in Appendix B. The disturbances resulting from remedial activities were defined and observed to occur in previously characterized habitats such that the 2009 habitat characterization remains an appropriate baseline for designing the restoration component of the current remedial design. The restoration of the identified natural habits is discussed in Section 8 of this report.

1.2.4 Delineation of Cianci Property Soil Removal Areas

The remedial approach for the Site includes removal of soils from five discrete areas on the Cianci Property to address sample locations where one or more constituents exceeded the cleanup levels for soil and wetland soil indicated in Table L-2 of the ROD. To better delineate the horizontal and vertical excavation limits for these five areas, pre-design sampling was proposed in the Soil Investigation Plan (Attachment I of the RDWP). This sampling was initiated in May of 2010, although the initial sampling did not result in complete delineation of the areas. Once site preparation and ISTR implementation activities were completed, the delineation sampling resumed and was completed in August of 2015. The details and results of the Cianci Property delineation sampling are described in the SIP Delineation Memo (Arcadis 2016), which is provided as Appendix C hereto.

The basis for resulting horizontal and vertical delineations for each of the five discrete Cianci Property is described in Appendix C. These delineations serve as the design basis for the initial target removal limits and volumes that are reflected in this report and the associated design drawings. Note that the SIP delineations were only for non-dioxin constituents; delineation of dioxin-affected areas are discussed in the following subsection. Note also that these areas may be subject to bottom and sidewall confirmation sampling as discussed in the Post-Excavation Confirmatory Sampling Plan (Attachment G to the RDWP) and further discussed in Section 5.6 of this document.

Based on the delineations reflected in Appendix C, initial removal areas, depths, and volumes for the five Cianci property excavation areas are summarized as follows:

Excavation Area	Surface Area (ft^2)	Removal Depth(s) (ft)	Volume Cubic Yard (CY)
EA-1	1,264	2	94
EA-2	818	1	30
EA-3	900	1	33
EA-4	1,695	2 and 4	178
EA-5	10,280	2	761
Totals:	**14,957**	**--**	**1,096**

Note also that, as further discussed in Section 5.6, additional "pre-delineation" sampling was performed in the EA-5 area, resulting in additional modifications to the targeted removal limits and volume in that area.

1.2.5 Delineation of Dioxin-Impacted Soils

Table L-2 of the ROD does not include a cleanup level for dioxin in soils, but indicates that one will be developed. Section V.C.1.i of the SOW calls for further assessment of dioxin impacts in soil following implementation of the ISTR component of the remedy; this was reflected in the Soil Investigation Plan (Attachment I to the RDWP). To address the SIP requirements for further dioxin sampling, and toward the goal of developing an appropriate cleanup goal with the USEPA and CT DEEP, a conceptual site model and work plan for additional dioxin characterization was submitted on August 24, 2015. Since that time, extensive soil sampling and analyses have been performed to better define the nature and extent of dioxin in soils in the vicinity of the Site. Through March 2016, this included the collection and analysis of 74 samples from 50 locations. The resulting data are summarized on Table 1 and Figure 2.

In a memorandum dated December 30, 2014, Arcadis derived and supported a proposed cleanup level of 50 picograms per gram [pg/g, or parts per trillion (ppt)] expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin Toxic Equivalents (2,3,7,8-TCDD TEQ) for dioxin in soil at the SRSNE Site. That value was subsequently approved by the USEPA in a memorandum dated March 30, 2015. However, CT DEEP rejected that proposed criterion in a memorandum to the USEPA dated March 26, 2015. Pending additional data collection and evaluation, Arcadis developed and proposed a recreational-based cleanup goal for soils, along with supporting rationale. The recreational-based criterion (34 ppt TEQ) was identified in a memorandum dated February 5, 2016, and provided to the agencies on February 9, 2016. That value was subsequently approved by the CT DEEP as an additional polluting substance and alternative criteria, as documented in a memorandum to de maximis dated March 16, 2016.

Despite approval of a 50 ppt TEQ soil cleanup level by the USEPA and a 34 ppt TEQ soil cleanup level by the CT DEEP, the SRSNE Site Group is targeting the removal of soils exceeding 30 ppt TEQ as the basis for the remedial design. This concentration (30 ppt TEQ) is consistent with concentrations detected along the former railroad bed in areas unaffected by the SRSNE site, and thus considered representative of local "background" conditions. The delineated extent of soils exceeding this target cleanup level is shown on Figure 2, and includes two areas. One area is located to the south of the planned RCRA Cap limits and generally surrounds the former railroad corridor. The other represents a slight eastward extension of EA-5 on the Cianci Property in the vicinity of the drainage pipe discharge. Accordingly, the remedial approach presented herein includes excavating soils within these two areas, consolidating the excavated soils beneath the cap, and backfilling the excavated areas will be restored with clean fill. This approach is reflected in the Design Drawings included in Appendix A hereto.

Since the time of the February and March 2016 memoranda deriving and approving a Site-specific soil cleanup level for dioxin, additional soil samples have been collected for the primary purpose of confirming the horizontal and vertical extent of soils exceeding the target cleanup level (30 ppt TEQ). Pre-delineation of these areas is critical because it will not be practical to perform confirmation sampling in the dioxin removal areas based on the following considerations:

- Dioxin analyses require approximately three weeks from the time of sampling to the receipt of data, and faster turnaround time is prohibitively costly. The need to collect and await data for confirmation samples would cause delays in the work sequence and leave excavation areas open and exposed for undue periods.
- The dioxin-based excavation area adjacent to EA-5 on the Cianci Property is located within the floodplain of the Quinnipiac River where it will be necessary to excavate, backfill, and restore as quickly as possible to minimize the potential for flooding or erosion of the excavated area.
- While some limited degree of flexibility is built into the design, the grading plan for the RCRA Cap area reflects a specific expectation of soil volume to be consolidated beneath the cap area. Having advanced certainty of the removal limits minimizes the potential for substantial volume variations that could affect the cap design.

For the target soil excavation area to the south of the cap area (Figure 2), the area is delineated by 11 sample locations and encompasses an additional eight interior locations outside the RCRA cap limits. Dioxin data are available at multiple and/or deeper depth increments for 13 of these 19 locations. Eight of those locations indicate that the extent of soils exceeding 30 ppt TEQ does not extend beyond a depth of 6 inches, and the other five locations confirm that soils exceeding 30 ppt TEQ do not extend beyond 12 inches. As a conservative measure, the target excavation depth in this area will be 1 foot, and the existing data confirm removal beyond this depth will not be required to achieve the target removal.

For the EA-5 soil removal area on the Cianci Property, pre-delineation of the dioxin removal area was implemented as part of a supplemental investigation that included sampling throughout the EA-5 excavation area. This additional investigation was intended to fully pre-delineate the extent of removal in the EA-5 area for both dioxin and non-dioxin constituents. The objectives and scope of that investigation were summarized in a memorandum dated April 25, 2016, and the results were summarized in a memorandum dated June 29, 2016 (copies of both documents are provided in Appendix D). As indicated in the summary memorandum, the resulting data indicate that the planned removal limits in that area will address soils exceeding the target soil cleanup level for dioxin.

1.3 Document Format

The remainder of this document is organized into eight sections that detail the subject design components. The sections are briefly identified and described as follows:

- **Section 2 – Overview of Design Components:** provides an overview of the remedial construction activities planned as part of this remedial component.
- **Section 3 – Site Preparation and Support:** describes the various site-preparation and support components associated with implementing the work.
- **Section 4 – HCTS Modification – NTCRA 1 Area:** describes the design basis and approach for modifying the NTCRA 1 sheet pile wall to allow groundwater to migrate beyond the wall now that ISTR activities have been completed in the Operations Area source zone.
- **Section 5 – Soil Excavation and Consolidation:** Summarizes the various areas where soil excavation is planned outside the RCRA cap limits, with consolidation of those soils beneath the RCRA cap.
- **Section 6 – RCRA Cap:** Summarizes the planned cap limits and basis, cap components and thicknesses, the integration of the rails-to-trails pathway across the cap area, and the modified drainage features associated with the cap design. It also discusses plans for the incorporation of a solar power array within the cap area.
- **Section 7 – Rails to Trails – Beyond the RCRA Cap Area:** Presents design information associated with construction of the paved rails-to-trails pathway between Lazy Lane and Curtiss Street outside the RCRA cap limits.
- **Section 8 – Restoration of Habitats:** Presents details regarding wetland mitigation and restoration of vegetated habitat conditions in affected areas, to the extent possible.
- **Section 9 – Operation and Maintenance Plan:** summarizes the preliminary operation and maintenance (O&M) requirements associated with the site remediation components discussed herein.
- **Section 10 – References:** lists documents cited herein.

Various supporting information is also provided in a series of appendices to this design report. In particular, this includes Design Drawings (Appendix A) and Technical Specifications (Appendix E) that describe the applicable design and construction requirements. Supporting engineering calculations for various design elements are provided in Appendix F.

Reference is also provided to the separately bound Remedial Action Work Plan (RAWP) for RCRA Cap construction activities. The RAWP provides additional information regarding the implementation of and schedule for the various construction activities.

2 OVERVIEW OF DESIGN COMPONENTS

As indicated in Section 1, this document provides design-related information associated with excavation and consolidation of impacted soils on the Cianci property, construction of a RCRA Subtitle C cap in the former SRSNE Operations Area, and other related activities to be implemented in conjunction with this phase of remedy implementation. An overview of the key aspects of the design is as follows:

- Site preparation activities such as clearing, installation of erosion control measures, relocation of perimeter fencing, establishment of construction support facilities, removal of abandoned utilities, and drainage system modifications.
- Modifications to the NTCRA 1 sheet pile wall to allow for future subsurface groundwater flow beyond the wall once capture of the groundwater is no longer needed in this area. The modifications include a permeable trench and collection piping along the upgradient side of the wall, pipe penetrations through the wall, valves to open or close the sheet pile penetrations if/as needed, permeable trenches along the downgradient side of the sheet pile wall, and placement of fill to help maintain the water table below ground surface under the modified conditions.
- Excavation of various soils located outside of the planned cap limits, consolidation of those soils beneath the cap, and backfill of the excavation areas. Soils to be excavated from outside the cap limits include the five Cianci property excavation areas identified in the ROD (as modified based on delineation sampling), dioxin-impacted surficial soils exceeding cleanup goals, and existing soil/debris piles associated with prior remedial construction phases. A borrow pit will also be excavated adjacent to the Quinnipiac River floodplain to offset lost floodplain storage capacity associated with the NTCRA 1 fill area, and also to provide a portion of the fill for the NTCRA 1 fill area.
- Construction of a RCRA cap within the former SRSNE Operations Area, including a component of the rails to trails path that will traverse the RCRA cap.
- Construction of a rails to trails path extending from Lazy Lane to Curtiss Street outside the limits of the RCRA cap.
- Site mitigation, restoration, and stabilization activities. This includes measures to address wetland areas impacted by the RCRA cap and NTCRA 1 modifications, restoration of ecological habitats (to the extent possible) upon completion of the work, provision of temporary erosion and sedimentation controls to stabilize post-construction conditions, and post-restoration monitoring to ensure performance standards are met.

Design-related details associated with each of these activities are further discussed in the following sections.

3 SITE PREPARATION AND SUPPORT

This section discusses the various site preparation and support activities necessary to support the remedial construction. This includes establishment of Contractor support areas (e.g., office trailer, parking and staging areas, utility services, etc.), as well as initial site preparation activities (establishment of work limits, erosion and sedimentation control measures, perimeter fence relocation, decommissioning of certain existing utilities in the work area, providing for drainage during and following construction activities, monitoring well modifications, and Site access).

3.1 Design Objectives

The design objectives of this component include:

- Provide onsite office space, parking, staging, utilities, and support areas to facilitate the construction.
- Establish work limits and limits of site clearing.
- Establish erosion and sedimentation controls in accordance with ARARs and best management practices.
- Relocate perimeter fencing – and/or establish temporary fencing and controls – as needed to control Site access and be consistent with anticipated post-construction Site uses.
- Establish an equipment cleaning area where materials and equipment can be cleaned after handling impacted materials and before handling clean materials or otherwise being removed from the site.
- Properly decommission and/or remove abandoned utility connections that formerly serviced the ISTR operations and that were not removed as part of the ISTR demobilization.
- Provide for drainage accommodating construction and post-construction periods.
- Modify existing monitoring wells as needed to support revised surface grades, and decommission wells that are no longer needed or interfere with the remedial construction activities.
- Provide a revised access route from the groundwater treatment building to the NTCRA 2 extraction well area to accommodate the revised surface grades intended for the NTCRA 1 area.

3.2 Construction Support

The target areas for project-related parking and Contractor office trailer are shown on the design drawings (Appendix A). The Contractor will be responsible for providing a functional office trailer with electric and water supply, phone, internet service, and sanitary facilities. These areas and services will be established as part of the mobilization process and be maintained for the duration of the project. The Contractor will also establish work zones, decontamination/cleaning areas (including as discussed in Section 3.6), and support zones in support of the project.

3.3 Work Limits and Clearing

The anticipated limits of work are shown on the design drawings (Appendix A). The Contractor will be responsible for providing sufficient survey controls to define and work within this areas. The work limits will also serve as limits of vegetative clearing where needed to implement the work. As shown on the drawings, the work limits also serve as a basis for locating perimeter erosion control measures.

Brush and limbs cleared to facilitate the work will be chipped and stored on site (outside of the floodplain area) for use as landscaping or erosion control material. Larger trees will be cut into lengths no greater than 12 feet and stockpiled in an onsite location to be designated by the Site Manager.

3.4 Erosion and Sedimentation Controls

Before initiating clearing, excavation or capping activities, appropriate erosion control measures will be installed to minimize the potential for migration of soils into or out of disturbed areas due to stormwater runoff. These measures will include, at a minimum, the installation of catch basin inlet protection at existing catch basins and the placement of silt fencing along the perimeter of the proposed cap, around active excavation areas, and downgradient of proposed fill areas. Erosion and sedimentation controls will be installed in accordance with the requirements of the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control. Target locations are illustrated on the design drawings (Appendix A), and modifications/supplemental measures will be placed as needed based on site conditions and in response to project changes (e.g., expanded excavation areas).

Erosion and sedimentation control devices will be monitored and maintained, and modified or expanded throughout the duration of the project, as necessary, based on site conditions and activities. These measures will be maintained for the duration of the project until such time that the final surface cover installed during site restoration activities is established.

3.5 Perimeter Fencing

The main portion of the Site where the capping, grading and excavation activities will take place is presently secured from unauthorized access by perimeter chain link fencing. Gates are located on the north side of the Site at the main entrance driveway to the groundwater treatment building and at the end of the paved road west of the rails to trails section. Two other gates are located at the south side of the Site; one along the former railroad right-of-way and the other at the end of the gravel maintenance drive that traverses the eastern half of the Site.

Prior to commencement of the construction activities, a portion of the existing chain link fence along the southeast side of the Site will be relocated to allow access to an area where the NTCRA 1 grade modifications will take place.

As part of the restoration activities, a permanent chain link fence will be erected along the right-of way on both sides of the rails to trails segment that crosses the cap area. Access to the cap area on the west side of the rails to trails pathway will be through the gate at the end of the paved drive on the north side of the cap and access to cap and NTCRA 1 area on the east side of the rails to trails segment will be through the main entrance driveway to the groundwater treatment building.

3.6 Equipment Cleaning Area

Equipment that has been used for excavation and handling of impacted materials – including soils excavated from outside the cap for consolidation beneath the cap – will be subject to cleaning prior to relocating to an area outside the remediation area (i.e., exclusion/contaminant reduction zones), before handling fill materials after having handled impacted materials, and prior to departing from the site. Equipment cleaning will be performed in a designated area that is, at a minimum, underlain by an impermeable barrier sloped to a collection sump. The anticipated design and location of the equipment cleaning area are indicated in the Design Drawings. Equipment cleaning requirements are further discussed in the RAWP.

3.7 Removal of Abandoned Utilities

Utilities previously installed to support the ISTR process equipment and treatment system will be abandoned and removed. These utilities include the electric, gas, water, communication and sanitary sewer services that serviced the ISTR equipment area. The status of each of these utilities is further discussed below. The utility locations are shown on Design Drawing 3 in Appendix A.

Electric Service - temporary utility poles, overhead electric lines, and power service were installed by Connecticut Light and Power (CL&P) from Curtiss Street along the former railroad right-of-way up to the southern portion of the Site. The overhead lines to the ISTR process equipment area have been removed and some of the temporary poles and overhead lines along the railroad right-of way remain in place. The temporary poles and lines are expected to be removed by CL&P prior to the start of construction.

Gas Service – a 2-inch gas service was installed on the north side of Lazy Lane by Yankee Gas Company from a connection to an existing gas main on Queen Street to the ISTR process equipment area. Yankee Gas has disconnected the gas pipeline, although the pipe is still present at the Site. For the purpose of this work, all sections of gas pipeline on the ISTR side of the concrete vault (located adjacent to the ISTR process equipment area) will be removed and the outlet pipe plugged with concrete grout on the supply side of the vault. The location of the gas service and the concrete utility vaults to be abandoned is shown on the Site Preparation Plan, Drawing 3, in the Design Drawings.

Water Service – a 2-inch water service that runs from a concrete vault in the former process equipment area to the water supply at the west side of the treatment building will be abandoned. In the treatment building, the water service backflow preventer will be removed and the service capped. The water service pipe will be removed from the concrete vault and the outlet pipe plugged with concrete grout.

Sewer Service – a 2-inch sewer service, sanitary sewer pump station, and meter vault were installed to convey ISTR treatment wastewater to the Town sewer main on Lazy Lane. The wastewater was pumped from the pump station manhole through a 2-inch diameter HDPE force to a 4 foot diameter precast concrete manhole and then conveyed by a 6-inch polyvinyl chloride (PVC) gravity pipe to the Town's sanitary sewer manhole. A separate concrete meter vault is located between the concrete vault in the former ISTR process equipment area and the 4 foot diameter precast concrete manhole. The piping, pumping equipment, and meter will be removed from the concrete vaults. The section of subgrade piping from the meter vault to the gravity drain manhole will be abandoned in place and plugged at both ends. The gravity drain manhole is being repurposed for use as part of the revised HCTS discharge to the sanitary sewer.

Communication – a telephone conduit and cable was also installed from a panel located in the former process equipment area to the treatment building. This utility will be abandoned by removing the cable from the conduit and cutting and capping the conduit below grade.

The existing service lines that connected to the process equipment on the service side of the vaults, and which were left in place and terminated above grade following completion of ISTR treatment, will be removed from the connection point back to the service vault. After the equipment and pipelines are removed from the concrete utility vaults/manholes and inlet and/or outlet pipes plugged, the concrete structures will be abandoned by removing the top slabs, punching holes in the bottom slabs, and filling the structures with concrete.

3.8 Drainage Modifications

Installation of the RCRA cap in the proposed configuration will require modifications to portions of the existing drainage swales at the perimeter of the proposed cap area. The perimeter swale on the south side of the cap will be regraded where the fill slopes from the cap impact the existing drainage channel and a new drainage swale will be installed on the east side of the cap. The existing drainage swale on the northwest side of the cap and existing maintenance road will not be impacted by the cap installation and will remain in the current condition.

The drainage flow from the existing swale located on the south side of the RCRA cap presently outlets to the east side of the existing railroad right-of-way and travels by overland surface flow to Wetland Areas C and D (see Design Drawing 2 in Appendix A) and ultimately to the Quinnipiac River. The placement of fills for the cap and rails to trails alignment will require that a new 15-inch HDPE culvert be placed below the rails to trails alignment to allow the flow from the swale to continue to drain to the east. Further, as discussed below, modification of the drainage pathway downgradient from the culvert will also be required as a result of planned grade modifications to the surface grades in the NTCRA 1 area.

A new drainage swale will be installed between the east side of the cap and the proposed NTCRA Area 1 soil mound grading (see Section 4). This swale will collect stormwater runoff from the cap area on the east side of the rails to trails alignment and the west side of the soil mound grading. The swale will drain north to a new catch basin inlet that will connect to an existing catch basin adjacent to the former ISTR process equipment area, which drains to a 30-inch diameter culvert that was installed for the Pre-ISTR construction (and which also discharges to the Quinnipiac River). The existing catch basin, which is located in the fill slope area just outside of the RCRA cap limits, will be converted to a manhole and the rim elevation adjusted to match the grades resulting from the RCRA cap fill slope.

No drainage modifications will be necessary for the rails to trails segment that is located north of the cap area since the drainage in this area was reconfigured during the Pre-ISTR construction. For the rails to trails segment south of the cap, the existing drainage features and patterns will be maintained. However, re-grading of the ditch located on the west side of the rails to trails will be necessary where the proposed rails to trails section width extends beyond the width of the existing rail bed.

In addition, the proposed NTCRA 1 area soil fill (Section 4) will eliminate Wetlands C and D (Section 8), and affect the drainage where the proposed 15-inch culvert draining the south perimeter swale (discussed above) would otherwise flow overland towards the Quinnipiac River. As a result, the drainage modifications will also include a manhole on the downgradient (east) side of the former railroad right-of-way, and a new drainage swale extending southeast and discharging to an existing drainage swale within the floodplain area. This manhole and swale configuration will minimize surface water recharge along the groundwater path between the NTCRA 1 containment wall and the NTCRA 2 pumping wells in anticipation of a future condition under which groundwater is allowed to bypass the NTCRA 1 sheet pile wall and be directed toward the NTCRA 2 recovery wells (Section 4). The manhole and swale configuration is shown on Design Drawing 6A in Appendix A.

3.9 Monitoring Well Modifications

Certain existing monitoring wells will require modification or decommissioning to accommodate the planned construction activities. In particular, several existing wells fall within the planned limits of the NTCRA 1 area grade modification and are expected to be maintained for post-construction monitoring. These wells may be fitted with riser extensions, as needed, to ensure they are above ground level and accessible for sampling under the modified surface grade conditions. A detail showing the typical well riser extension method is provided on Design Drawing 26 in Appendix A. The list of wells subject to riser extensions include CPZ-1, CPZ-1R, CPZ-2A, CPZ-3, CPZ-3R, CPZ-4A, CPZ-5, CPZ-5R, CPZ-6A, CPZ-7, CPZ-7R, MW-413, MW-415, MW-416, MW-902D, MW-902M, MW-908D, MWL-304, MWL-307, and P-5B. For each of these wells, the approximate riser extension length is indicated on Design Drawing 11 in Appendix A.

Certain wells will also be abandoned because they are no longer needed for monitoring purposes and/or interfere with the planned remedial activities. The wells to be abandoned include ISTR-1 through -6,[3] TW-08A, TW-08B, and TW-08D. Wells ISTR-1 through ISTR-6 are located within the portion of the former Operations Area that was subject to ISTR, and within the boundaries of the RCRA cap. Because these wells will not be needed for post-cap monitoring, they will be decommissioned prior to cap construction. Similarly, wells TW-08A, TW-08B, and TW-08D are located within the limits of the proposed RCRA cap and will be decommissioned as the point of compliance for groundwater specified in Section IV.A.1 of the SOW is the edge of the cap. Wells will be decommissioned consistent with the approach described in the Field Sampling Plan (Attachment B of the Remedial Design Project Operations Plan [Arcadis 2010e]).

The remediation contractor will be required to mark and protect wells not intended for decommissioning so that they are not damaged or lost in the course of construction activities. Wells that are damaged, lost or destroyed by the construction activities will be repaired or replaced as needed.

3.10 Maintenance Access

To accommodate access to the portion of the RCRA Cap west of the rails-to-trails pathway for the purposes of cover maintenance and access to the solar panel array, improvements will be made to the existing roadway that formerly serviced the SRSNE Operations Area. Due to the prior site work to accommodate the ISTR activities, and additional planned grade changes associated with the RCRA Cap, the area inside the perimeter fence is currently at a higher elevation than the existing road surface at the existing gate location. To transition from the existing road grade to the final cover surface, the new access

[3] Well ISTR-7 was also located within the ISTR area, but was damaged and decommissioned as part of the ISTR demobilization activities.

road entrance will ramp up from the existing road elevation to the cap at a maximum grade of 12%. The access road will continue at the 12% grade perpendicular to the 6H:1V cap slope to the plateau area where a vehicle parking and turnaround area will be located adjacent to the solar panel array. The entrance ramp from the existing road to a point between the perimeter fence and RCRA cap will be surfaced with asphalt pavement and the remaining section along the cap will be surfaced with stone/gravel. In addition, based on USEPA comments regarding the draft 100% design, geogrid will be incorporated beneath this access road and ramp to enhance the soil stability under loaded conditions. Details associated with this modified access are shown on Design Drawings 13, 27, and 28 in Appendix A. In addition, the existing fence and gate at this location will be modified such that the fence and gate accommodate the revised grade elevation of the access road.

4 HCTS MODIFICATION – NTCRA 1 AREA

Although not a ROD/SOW-required component of the Site remedy, modifications will be made in the vicinity of the NTCRA 1 sheet pile wall in anticipation of future operational modifications to the HCTS. The modifications will provide flexibility for future HCTS operations when extraction well operations in the NTCRA 1 area are no longer needed. At such time, pumping from the NTCRA 1 extraction wells will be discontinued and groundwater will be allowed to bypass the wall by gravity flow. Such operational modifications are anticipated based on the fact that the upgradient overburden source zone has been remediated via ISTR, and groundwater containment can be maintained at the downgradient NTCRA 2 collection system. Operational modifications to the HCTS are also consistent with SOW Sections IV.B.2 and V.C.4. Section IV.B.2 allows for modifications or enhancements to the HCTS that decrease the costs or time of system operation provided they are carried out in a protective, compliant, effective, and cost-effective manner, as determined by USEPA. Section V.C.4 allows for a containment/treatment evaluation and optimization study to identify potential post-ISTR modifications to the HCTS.

The NTCRA 1 area modifications include installation of collection trenches/pipes along a portion of the upgradient (west) side of the sheet pile wall, three penetrations through the wall, valves at the penetration points to allow flow control (if necessary), distribution trenches/pipes along the downgradient (east) side of the wall, and surface grade adjustments to facilitate surface drainage and maintain the water table below ground surface. These modifications are being made in conjunction with the RCRA cap construction to capitalize on the equipment and Contractor capabilities, reduce administrative requirements for future work, and to avoid re-work that might otherwise be required if the NTCRA 1 area modifications were instead implemented as a separate, future phase of work.

The development of the NTCRA 1 modifications, including the trench configuration and the grading plan, was supported by the existing MODFLOW model that was developed and utilized during prior design and evaluation steps. Specifically, the model was used to simulate various trench configurations and the associated effect on groundwater mounding and flow patterns downgradient of the sheet pile wall under future operational scenarios. Information regarding the development, calibration, and use of the regional MODFLOW model is provided in Appendix G.

4.1 Scope and Objectives

The design objectives of this component include:

- Providing infrastructure to support potential future cessation of pumping at the NTCRA 1 groundwater extraction wells;
- Modify the existing sheet piling to provide engineered perforations to allow groundwater to migrate through the barrier by gravity flow;
- Construct drainage trenches/pipes hydraulically connected to the sheet pile perforations inside (upgradient) and outside (downgradient) of the sheet pile to facilitate upgradient collection and downgradient distribution of groundwater;
- To the extent practical, maximize the extent to which groundwater that passes through the sheetpile wall via the trench system is directed towards the NTCRA 2 collection wells; and

- Re-grade the area with clean soil to help maintain the water table below grade during future gravity flow of groundwater through the sheet pile wall.

4.2 Sheet Pile Breach

The NTCRA 1 extraction system consists of an array of 12 overburden groundwater extraction wells (RW-1 through RW-12, of which RW-5 and -6 have been decommissioned) and a downgradient sheet pile wall that, in combination, hydraulically and physically contain overburden groundwater migrating from the former SRSNE Operations Area. Groundwater extracted by the NTCRA 1 extraction system is currently pumped directly to the groundwater treatment building for treatment prior to discharge to the Quinnipiac River. Future deactivation of the NTCRA 1 extraction wells will necessitate the breaching of the sheet pile containment wall so that the groundwater is allowed to flow by gravity to the downgradient side of the wall. Predictive groundwater flow simulations were performed using the same MODFLOW model that Arcadis previously used to evaluate potential groundwater flow conditions during thermal remediation. Based on the simulation results, the total expected groundwater flow rate of less than 10 gallons per minute (gpm) can flow freely (via gravity) through the NTCRA 1 sheet pile wall by implementing the following NTCRA 1 system modifications:

- Installation of 6-inch diameter perforated collection and distribution pipes in a minimum 4-foot deep trench along portions of the interior and exterior of the existing sheet pile wall. The trenches will be approximately 2.5' wide, lined with geotextile, and backfilled with pea gravel (material properties identified in Technical Specification Section 31 23 05 in Appendix E) fill to help ensure high permeability and free flow of groundwater. The trench configuration also includes four lateral extensions extending 60 feet south to enhance flow of the groundwater toward the NTCRA 2 collection wells.
- Three pipe penetrations through the sheet pile containment wall to allow groundwater to flow through the wall. The penetrations at the wall will include welded seals at the connections between these pipes and the sheet pile wall. The piping at the wall penetrations will also include valves at the surface that will allow the flow rate through the wall to be controlled, if necessary or desired. Note that only two penetrations are anticipated for use; the third is a contingent penetration.

4.3 Grade Modifications

In addition to the modifications discussed above, soil fill will be placed on the ground surface over a portion of the NTCRA 1 area. Note that before the installation of the NTCRA 1 sheet pile wall, the water table in the area was already shallow and ponded water was observed at ground surface on a seasonal basis. Raising the ground surface as part of the overall capping and earthwork activities described herein will help maintain the water table below the ground surface in the absence of NTCRA 1 groundwater pumping, under a future condition of free gravity flow. The horizontal and vertical extent of the grade modifications for the soil cover were identified based on groundwater flow simulations as discussed above.

The target grading design for the NTCRA 1 area soil fill is shown on Design Drawing 10 in Appendix A. The total fill volume in this area is approximately 6,330 CY. Placement of this fill zone will result in placement of approximately 400 CY of fill within the Quinnipiac River floodplain below the 100-year flood elevation (approx. 154.9 feet NGVD29). The fill in this area will be offset by the excavation of an area adjacent to the Quinnipiac River floodway, just south of Wetland G. This excavation area is shown on Design Drawing 10 in Appendix A; this excavation will increase the flood storage volume by approximately 460 CY to offset the fill-related loss. An evaluation of the net effect on wetland areas of the Site is provided in Section 8. Excavation of this area will also provide approximately 830 CY of soil fill that can be used toward the fill volume used to raise the grade in the NTCRA 1 area.

Imported fill material used for the remainder of the NTCRA 1 area grade modifications will be subject to grain size analyses (among other requirements) prior to approval. This is based on the fact that the model assumed a hydraulic conductivity of the fill material that is consistent with the existing shallow overburden soils. Accordingly, Section 31 23 05 of the Technical Specifications specifies the target grain-size distribution data NTCRA 1 area soil fill. These data must meet the specified grain size distribution or otherwise be approved by a hydrogeologist prior to the use of that material as fill within the NTCRA 1 area.

Following placement and grading, the soil fill material in the NTCRA 1 area will be revegetated as described in Section 8. In the longer term, this is anticipated to include re-establishment of a scrub/forested habitat. The selection of species and their specific placement can be better identified in the future once NTCRA 1 area HCTS modifications have been implemented and the modified hydraulic conditions are better defined. At that point, species best suited to the hydrologic conditions can be selected for planting to increase the long term survivability of the vegetation. Tree and shrub species to be planted in this area will be selected from the upland and wetland species listed on Design Drawing 14 in Appendix A). Additional native species appropriate for site conditions may be incorporated into the planting of this area. In the interim, the area will be restored with suitable grasses to maintain the lawn-type conditions that presently exist in this area.

Note also that the NTCRA 1 area soil fill will encompass portions of the existing access road between the treatment building and the NTCRA 2 extraction wells. As a result, a revised access road will be constructed for this reach. The revised configuration is shown on Design Drawing 13 in Appendix A.

5 SOIL EXCAVATION AND CONSOLIDATION

This component of the remedial scope involves the excavation and consolidation of soils from targeted areas outside the RCRA cap into the cap area prior to cap construction. The consolidated materials will be graded to achieve an appropriate subgrade for cap construction. The materials to be consolidated beneath the cap include soil/debris piles generated during prior remedial activities, soils to be excavated from the Cianci property excavation areas, dioxin-impacted soils from outside the planned RCRA cap limits, and other ancillary soils (e.g. from perimeter swale excavations/modifications). For certain areas, post-excavation confirmation sampling will be required, such that the design needs to accommodate potentially variable consolidation volumes.

5.1 Scope and Objectives

Section IV.A.2 of the SOW establishes the following Performance Standard applicable to soil and wetland soil at the Site:

> *Cleanup Levels for contamination in soil and wetland soil are specified by EPA in Table L-2 of the ROD… Cleanup Levels must be met at the completion of the Remedial Action for soil beyond the extent of the cap… and, in soil and wetland soil on the Cianci property (shown in Figure 7 of the ROD…), after excavation of hotspots. The depths to which these Soil and Wetland Soil Cleanup Levels apply will be in accordance with CT regulations which specify that DEC apply from the ground surface to a depth of 15 feet below the surface unless the soil is inaccessible as defined in the CT RSRs… PMC apply from the ground surface down to high water table as noted in the RSRs.*

Other pertinent design objectives associated with soil management discussed in this section include:

- Provide for management of stockpiled soil and debris generated in the course of prior remedial activities beneath the RCRA cap;
- Provide for excavation and consolidation of other impacted soils outside the cap limits (namely dioxin-impacted soils at concentrations above cleanup levels);
- Understanding the net volume of soils to be accommodated beneath the cap in order to plan for this volume as part of the subgrade design; and
- To the extent possible, provide a subgrade design that can accommodate some degree of additional soil volume in the event that confirmation sampling (Section 5.6) triggers additional soil excavation beyond the target limits.

5.2 Soil Piles

Existing soil/debris piles were produced in association with prior remedial construction phases. These soil/debris piles will be excavated to a minimum of 4 inches below pre-existing surface and consolidated under the proposed RCRA cap. It is not anticipated that confirmation sampling will be needed after these soil piles have been removed, as they were temporarily staged at these locations, and the staging locations are outside the limits of areas identified for soil removal based on prior sampling efforts.

A stockpile consisting of approximately 500 CY of soil, rock and concrete debris generated from the pre-ISTR and ISTR construction and demobilization is located on the southeast side of the cap area. This material will be excavated and consolidated as fill under the RCRA cap grading layer. Larger pieces of rock and/or concrete will be broken up and/or segregated and placed at the toe of the terraces where the fill below the cap is 3 feet or more in depth (see Design Drawing 7 in Appendix A). Loose metal, some of which is present within the debris pile, will be segregated and disposed prior to consolidating the debris beneath the cap area.

5.3 Cianci Property Excavation Areas

As a component of the remedial approach in the ROD, the five discrete areas on the Cianci Property exceeding applicable cleanup levels will be excavated and placed under the RCRA cap. Based on the results of pre-design and supplemental sampling activities (Appendices C and D), excavation of each of the five areas will initially extend to the horizontal and vertical limits depicted on Design Drawing 4 in Appendix A. Where necessary (see Section 5.6), removal limits will be confirmed via bottom and sidewall confirmatory samples or the depth-related applicability of the Pollutant Mobility Criteria (PMC) and/or RDEC, as discussed in the Post-Excavation Confirmatory Sampling Plan (Attachment G to the RDWP).

Due to its location within the Quinnipiac River floodplain, certain implementation-related controls have also been developed to facilitate the timely completion of excavation and restoration activities in the EA-5 excavation area. Those measures are discussed in Section 5.5.4 of the companion RAWP document.

5.4 Impacted Soils Outside Cap Limits

As discussed in Section 1.2.5, areas of dioxin-impacted exist outside the planned RCRA cap boundaries. The specific removal limits were developed in consideration of the existing soil analytical dataset, derivation of the CT DEEP-approved recreationally-based soil cleanup level (34 ppt dioxin), and the SRSNE Site Group's intent to target soils containing concentrations above a lower threshold (30 ppt dioxin) reflective of background concentrations indicated by nearby sampling. The resulting removal limits for dioxin-impacted spoils outside the planned cap limits are shown on Figure 2 and Design Drawing 4 in Appendix A. This includes an area of approximately 29,000 square feet south of the proposed cap boundaries, as well as an extension of Cianci Property excavation area EA-5 to encompass an area of approximately 1,320 square feet to the east of the SIP-delineated removal boundary. Based on existing data, the target excavation depth in each area will be 1 foot. This results in a target excavation volume of approximately 1,130 CY of dioxin-impacted soils to be consolidated beneath the cap.

Excavation areas outside the cap limits would be backfilled with clean fill and topsoil, and restored (to the extent possible) using pre-existing conditions as described in Section 8.

5.5 Ancillary Soils

Ancillary soils excavated for construction-related purposes will also be consolidated beneath the RCRA cap. This is anticipated to include approximately 190 CY of soil excavated as part of modifying the drainage swales along the east and south portions of the RCRA cap, as shown on Design Drawing 6 in Appendix A. It also includes approximately 580 CY of soils excavated to construct the collection and infiltration trenches along the NTCRA 1 sheetpile wall, as described in Section 4.

5.6 Confirmation Sampling and Contingent Excavation

The need for and scope of post-excavation sampling is a function of several factors, including the reason for the removal (i.e., dioxin or non-dioxin-impacted areas), the existing data, the depth of excavation, and the approach to post-excavation confirmation sampling described in the *Post-Excavation Confirmatory Sampling Plan* (Attachment G to the RDWP). For areas where planned soil removal is based on an exceedance of the soil cleanup level for dioxin (i.e., the excavation area to the south of the RCRA cap and the eastern extension of EA-5 on the Cianci Property), post-excavation sampling is not required. This is based on the fact that the dioxin-based removal areas were pre-delineated in order to, among other reasons, avoid long implementation delays associated with dioxin analysis in post-excavation samples. Pre-delineation of the dioxin-based removal areas was discussed in Section 1.2.5 and in Appendix D. Further, the data and intent to pre-delineate these area were presented to the USEPA and CT DEEP on May 11 and 12, 2016. USEPA approved the pre-delineation approach on May 16, 2016 and CT DEEP approved it on June 15, 2016.

The following subsections summarize the approach for post-excavation confirmation sampling in non-dioxin-based removal areas, followed by an evaluation of the need for and scope of post-excavation confirmation samples in each of the five Cianci property excavation areas.

5.6.1 Approach

The approach for confirmation sampling is outlined in the *Post-Excavation Confirmatory Sampling Plan* (Attachment G to the RDWP), which was developed prior to establishment of a site-specific soil cleanup level for dioxin, and thus has been applied to non-dioxin constituents where such constituents are the basis for establishing the removal area (i.e., EA1 through EA5 on the Cianci Property). That approach generally calls for post-excavation confirmatory samples to be collected from the bottom and/or sidewalls of each excavation to confirm that soils impacted above SOW-specified cleanup levels have been removed following excavation to targeted limits. If necessary based on the initial samples, further excavation and confirmatory sampling will be conducted until cleanup levels are achieved.

For each excavation area, sidewall samples will be collected as needed to provide at least one sample per 50 linear feet of excavated perimeter, with a minimum of three perimeter samples for each individual excavation area. To the extent possible, existing samples (including pre-design delineation samples; see Attachment I to the RDWP and Appendix C hereto) will serve as a basis for confirming excavation area.

The need for post-excavation bottom sampling will be determined based on the type of regulatory exceedance that prompted the excavation. In the event that bottom verification samples are required, samples will be collected at a frequency of one sample per 1,000 square feet of excavated area. Bottom samples will be collected from a depth of 0- to 1-foot below the bottom of the excavation.

For each area, confirmatory sampling will focus on the specific constituent(s) that triggered the need for excavation in that area. If an area is targeted for soil removal based on an exceedance of lead, then the sidewall and bottom samples will be analyzed for lead only. In areas where removal is based on exceedance of PMC-based standards, and the excavation does not extend below the seasonal low water table, the verification samples may initially be analyzed for total concentrations of the target constituents. If the total concentration (measured in milligrams per kilogram [mg/kg]) exceeds the applicable cleanup level for a PMC-based standard (measured in milligrams per liter [mg/L]), by a factor of more than 20, the verification sample would be analyzed for the target constituent(s) using the Synthetic Precipitation Leaching Procedure (SPLP) method. If the total concentration (mg/kg) is less than 20 times greater than the PMC-based standard (mg/L), the sample will be deemed to meet the PMC-based cleanup level.

If any sidewall confirmation sample exceeds applicable cleanup criteria for a constituent(s) of concern, as detailed in Table L-2 of the ROD, this will trigger excavation to extend out a minimum of ten feet horizontally from that sample. After the completion of this additional excavation, three new sidewall confirmation samples will be acquired and analyzed for the constituent(s) of concern that triggered the step-out. If one of these new samples exceeds cleanup criteria for that constituent(s), then an additional step-out will occur. This will take place until all confirmation samples return values below cleanup criteria for the constituent(s) of concern that initially triggered excavation.

If any bottom confirmation sample exceeds applicable cleanup criteria for a constituent(s) of concern, as detailed in Table L-2 of the ROD, this will trigger excavation to extend a minimum of one additional foot vertically. After the completion of this additional excavation, one new bottom confirmation samples will be acquired and analyzed for the constituent(s) of concern that triggered the additional vertical excavation. If the new sample exceeds cleanup criteria for that constituent(s), then additional vertical excavation will occur. This will take place until the bottom confirmation sample returns a value below cleanup criteria for the constituent(s) of concern that initially triggered excavation.

5.6.2 Evaluation

For areas EA1 through EA4, the need for and scope of post-excavation confirmation samples were evaluated in the course of developing this 100% Design Report so that the number and type of post-excavation confirmation samples could be anticipated and planned. This evaluation considered the existing delineation data (Appendix C) and the general approach for post-excavation sampling discussed in the *Post-Excavation Confirmatory Sampling Plan*. The resulting evaluation is presented in Table 2. As indicated on that table, each of these areas has sufficient delineation data to confirm the areal extent of removal at a frequency of greater than one sample per 50 feet of excavation perimeter such that no additional sidewall sampling is needed. However, one or more bottom verification samples will be required in EA-1 through EA-3 to achieve the target of one sample per 1,000 square feet of area. The target analytes for post-excavation bottom samples in each area indicated on Table 2. Table 2 also indicates the depths below which PMC- or DEC-based criteria would no longer apply. In the event that excavation extends below those depths, no further bottom sampling would be required.

Table 2 also indicates that no additional bottom samples will be required from EA-4. As shown on the Design Drawings, excavation will proceed to a depth of 4 feet in one portion and 2 feet in the remainder of this area. Two previously collected delineation samples (EA4-3 and EA4-4 collected at depths of 2-4 feet below grade) confirm the extent of removal for the 2-foot excavation area. The 4 foot excavation area extends below the depth at which the PMC and DEC criteria apply (given the expected ELUR for the site), such that no additional bottom sampling is required in that area. Note also that EA-4 is within the planned NTCRA 1 fill area such that the excavation depth of 4 feet relative to existing grade will be even deeper relative to proposed grade in this area.

In the course of performing a similar evaluation for EA5, it was determined that further pre-delineation sampling was warranted in that area to facilitate timely and efficient remedy implementation in this area due to its location within the floodplain. This was discussed with the USEPA and CT DEEP during a project coordination meeting on April 19, 2016. The scope and objectives of the sampling were summarized in a draft work plan memorandum dated April 25, 2016 (Appendix D), and the sampling was performed on April 28, 2016. The results were summarized in a memorandum dated June 29, 2016 (Appendix D). As indicated in that memorandum, EA-5 is pre-delineated for all target constituents with the exception of PCBs at two of the samples that were collected to represent the bottom of the planned excavation limits. Accordingly, the removal limits presented in this Design Report reflect an additional foot of planned excavation around those areas, with additional bottom and sidewall sampling within the extended removal areas as described in the June 29, 2016 memorandum.

Based on the evaluations presented above and in Table 2 and Appendix D, the planned scope of post-excavation confirmation sampling is summarized as follows:

Area	Sidewall Samples		Bottom Samples		Analyses
	#	Depth	#	Depth	
EA-1	0	N/A	2	2-3' bgs	SPLP Lead
EA-2	0	N/A	1	1-2' bgs	benzo(b)fluoranthene, benzo(k)fluoranthene
EA-3	0	N/A	1	2-3' bgs	benzo(b)fluoranthene, benzo(k)fluoranthene, PCBs, chromium (total and SPLP), cadmium (total and SPLP)
EA-4	0	N/A	0	N/A	N/A
EA-5 (DEL-B1 area)	3	2-3' bgs	2	3-4' bgs	PCBs
EA-5 (DEL-B10 area)	1	1-2' bgs	1	2-3' bgs	

The bottom samples from EA-5 will be collected from representative locations within the excavation area. The bottom samples from EA-2 and EA-3 will be collected from the approximate mid-point of the excavation area. The bottom and sidewall samples will be collected from the approximate locations indicated on Figure 3 from the June 29, 2016 memo included in Appendix D. All of the samples will be analyzed on a rush laboratory turnaround time to minimize potential project schedule delays or extended durations of open excavations. Should any of the samples indicated exceedances of the cleanup objectives, additional removal and subsequent confirmation samples will be implemented in accordance with the approach indicated above.

5.7 Volume Summary

The various sources and volumes of soil to be excavated and consolidated beneath the RCRA Cap as part of this work are summarized as follows:

Source/Area	Estimated Excavation Volume (CY)
Existing Soil Piles (plus 4” underlying soil)	540
Cianci Property Excavation Areas (based on target removal areas)	960
Dioxin-Impacted Soils outside Cap Limits	1,130
Perimeter Drainage Swale Modifications around Cap	190
Collection and Infiltration Trenches along NTCRA 1 sheetpile wall	580
Perimeter Anchor Trenches	200
Additional Excavation Based on Confirmation Samples	TBD
Total:	**3,600 CY (+)**

6 RCRA SUBTITLE C CAP

This component of the remedial scope involves construction of a RCRA Subtitle C cap in the Former Process Area of the Site.

6.1 Scope and Objectives

Section IV.B.1 of the SOW establishes the following Performance Standard applicable to the RCRA cap:

> *The cap shall be a low-permeability, multi-layer RCRA Subtitle C cap. It shall be designed, constructed and maintained to meet the requirements of the CT RSRs (as determined by EPA) for an "engineered control" and shall have a permeability of less than 1 x 10^{-6} cm/sec. The cap shall also be designed and constructed so as to be consistent with* Final Covers on Hazardous Waste Landfills and Surface Impoundments *(EPA/530-SW-89-047) and* Technical Memorandum: Revised Landfill Cap Design Guidance Proposed for Unlined Hazardous Waste Landfills in EPA Region I *(February 5, 2001)… No side slope will be graded more steeply than three horizontal to one vertical (3:1).*
>
> *Portions of the Operations Area and Railroad Right-of-way shall be filled with sub-base material and graded to provide positive drainage of surface water runoff from the new cap toward new drainage collection systems. Stormwater runoff from the capped areas that is discharged to the Quinnipiac River shall be managed in a manner that is consistent with ARARs. Cap design shall be consistent with the expected future land use of the Railroad Right-of-way as a public bike path.*

Section IV.B.1 of the SOW also states:

> *A vapor control system shall be a component of the cap, if EPA determines such a system is necessary as a result of pre-design studies. The basis for a determination that a vapor control system shall be required will include, but shall not be limited to, a demonstration that vapors are likely to migrate beyond the cap and be released at sufficient concentrations to pose an unacceptable risk.*

Based on the information presented in Section 1.2.2, it is not anticipated that a vapor control system will be a necessary cap component. As a result, the design does not presently include such a component pending USEPA review and concurrence.

Other pertinent design objectives associated with the RCRA cap design discussed in this section include:

- Address the pertinent design and performance requirements for a Subtitle C cap, as prescribed by 40 CFR 40 CFR 264.310;
- Accommodate the volume of materials anticipated to be consolidated beneath the cap, including the various soils and debris sources discussed in Section 5 (totaling approximately 3,600 CY as indicated in Section 5.7);
- Allow flexibility in the subgrade design to accommodate variations from the estimated soil consolidation volume that may result from post-excavation verification sampling in areas where such sampling may be required (e.g., the Cianci property excavation areas);

- Include provisions for restricting access from the publicly accessible rails-to-trails pathway onto the remainder of the cap or onto other areas of the Site;
- Allow for the possible future use of the cap area as a solar power generation array;
- Maintain access by the utility company to the relocated fiber optic line within the right-of-way established as part of the site preparation work; and
- Allow access for future maintenance of the cap area.

6.2 Basis for Cap Extent

The planned horizontal extent of the RCRA cap is shown on Design Drawing 3 in Appendix A. The limits shown thereon were developed based on the following considerations:

- To encompass “contaminated soil in the Operations Area and along the Railroad Right-of-Way” as generally prescribed in Section II.D of the SOW.
- To encompass historical soil samples in the Former Operations Area identified on Figures N-1 and N-2 of the 2005 Draft Feasibility Study (FS) as exceeding either CT (Remediation Standard Regulations) RSR Direct Exposure Criteria (DEC) or PMC values based on database review of soil data that existed at that time.
- An evaluation of soil data collected since the FS to ensure no samples collected since that time warrant modification of the cover limits (excluding those collected for delineation of dioxin impacts as discussed below). Subsequent sampling since that time has not identified any sample locations around the RCRA cap boundary that exceeds the standards described in Table L-2 of the ROD.
- To encompass the ISTR area.
- Although the preliminary extent of the RCRA cap identified in the ROD extended to encompass the Railroad right-of-way north of the Former Operations Area to Lazy Lane, this area was further investigated as part of pre-ISTR activities. As described in the Re-use of Excavated Material from Railroad Right of Way for ISTR Area Fill Memo (Arcadis 2010b), this portion of the right-of-way was instead excavated and consolidated within the thermal treatment area, and the excavated area was restored with clean fill. The proposed cap limits exclude the restored portion of the right-of-way, but abut the southern extent of that previously remediated area.
- To tie into existing physical features of the Site (i.e. access roads, the rails-to-trails pathway, pre-existing drainage features, etc.) for constructability and access purposes.

To a certain extent, the cap limits were also developed in consideration of existing data collected for the purpose of assessing and delineating the extent of potentially Site-related dioxin impacts in soil. Specifically, the proposed cap limits encompass two sample locations that indicated the highest dioxin concentrations (CDS-3 and -4 as shown on Figure 2). However, as discussed in Section 1.2.5, areas of potentially Site-related dioxin impacts outside the proposed cap limits will be excavated and consolidated beneath the cap, and the excavated areas will be restored with clean fill. This approach is based on the existing characterization data indicating that the dioxin impacts are limited to shallow surficial soils only, due to the likely transport routes (e.g., aerial deposition and surface runoff) and extremely low mobility of dioxins in the soil matrix. Therefore, the shallow impacted soils can be more readily removed and consolidated beneath the cap, rather than extending the cap extent to cover these shallow impacted soils.

6.3 Soil Consolidation and Grading

As noted in Section 5, soils excavated from various areas outside the cap limits will be consolidated within the RCRA cap area. The various excavation areas and volumes were summarized in Section 5.7 and total approximately 3,600 CY. The subgrade grading design shown on Drawing 5 in the Design Drawings (Appendix A) reflects this estimated consolidation volume. There is also the potential that the volume of excavation materials could increase as a result of post-excavation confirmation sampling, where required in certain of the Cianci property excavation areas. Accordingly, the current subgrade design was developed with flexibility to accommodate an additional 1,000 CY of soil without exceeding the minimum allowable surface slope of 4%.

Prior to consolidation of the excavated soils, the existing vegetated and concrete surfaces in the former ISTR area and within the cap limits will be prepared by clearing existing vegetation, breaking up the remaining lightweight concrete from the ISTR cover, grading and compacting the surfaces. The excavated soils will be placed in 12-inch maximum lifts and compacted to achieve a minimum density requirement for each lift.

The existing debris pile located south of the ISTR staging area (Design Drawing 2 in Appendix A) includes crushed concrete from the decommissioning of the slab that was used for the ISTR equipment staging. As shown on Design Drawing 7, that material will be placed at the toe of the existing terraced area in the western portion of the former SRSNE Operations Area. Placement of the debris in this area will maximize the separation depth between the debris and the overlying geocomposite materials that will comprise the RCRA Cap.

6.4 Cap Components

Except where alternative ground surfaces are needed in the solar area and rails-to-trails pathway (discussed in subsequent sections), the RCRA cap will be a minimum of 42 inches in thickness and, from bottom to top, the cap components will consist of a low permeability layer consisting of a geosynthetic clay liner and a 60 mil thick linear low density polyethylene (LLDPE) geomembrane, a drainage geocomposite, a 36-inch soil layer and a 6-inch layer of vegetated topsoil. The following is a description of the cap components:

- Geosynthetic Clay Liner – a geosynthetic clay liner (GCL) will be used for the bottom low permeability layer as recommended in the *Technical Memorandum: Revised Landfill Cap Design Guidance Proposed for Unlined Hazardous Waste Landfills in EPA Region I* for an alternative to a 12-inch thick compacted low permeability soil layer. The subgrade for the GCL layer will be graded to have flat areas with slopes of less than or equal to 6:1 (horizontal:vertical) to meet the slope requirements cited in the Technical Memorandum for use of an alternative GCL layer.
- 60 mil LLDPE Geomembrane – this layer will consist of a textured flexible LLDPE geomembrane for the top low permeability layer.

- Geocomposite Drainage Layer – a geocomposite consisting of two non-woven geotextiles heat-bonded to a drainage net with a hydraulic conductivity no less than 3 x 10^{-4} m^2/s will be used for the drainage layer. The geocomposite will be overlain by soil layers with a total depth of 42 inches to place the geocomposite below the maximum frost penetration depth as required by the EPA Region 1 Technical Memorandum.
- Protective Soil Layer – this layer will consist of a 36 inch layer of imported soil to help sustain vegetative growth and protect the underlying drainage and low permeability layers from frost damage and excessive loads.
- Vegetated Topsoil Layer – a 6-inch layer of topsoil will be placed as the surface cover to support vegetative growth.

6.5 Rails to Trails within Cap Area

A 530 foot section of the rails to trails path is located within the eastern portion of the RCRA cap area. The cap components within this section will be consistent with the remaining areas of the cap with the exception of the paved and stone trail surfaces. For the paved areas of the trail, the 6-inch vegetated topsoil layer and 6 inches of the protective soil layer will be replaced with a 9 inch aggregate subbase course and a 3 inch surface course consisting of either bituminous concrete for the paved trail or compacted stone screenings for the soft trail.

A chain link fence will be placed on both sides of the rails to trails path in the RCRA cap area to restrict access to the cap, Cianci property and NTCRA Treatment Building areas. The fence will incorporate a fence post footing design that will allow the posts to be placed without auguring holes in close proximity to the geosynthetic layers. The anticipated approach involves concrete blocks buried within the soil cover material that can be used to support the fence posts, as shown on Design Drawing 25 in Appendix A.

6.6 Solar Development

A portion of the RCRA cap, involving an area of approximately 65 by 260 feet, will be completed with a crushed stone surface to facilitate subsequent installation of a solar array. The solar array will be installed as a ground-mounted system, meaning that the panels and racks will be installed above ground and anchored with ballast weights rather than driven posts. Cap construction in this area will proceed in the same manner as the vegetated cap construction discussed above with the exception that the 6-inch topsoil layer will be replaced by a layer of geotextile overlain by 6 inches of nominal ¾-inch crushed stone. The crushed stone will provide a smooth surface for panel installation. It will also minimize maintenance requirements in the solar panel area because it will inhibit vegetative growth around the panels and provide erosion protection along panel drip lines. As part of this work, conduit will also be installed from the solar array pad to the existing groundwater treatment building to facilitate future installation of the necessary electrical wiring (Design Drawing 9). The conduit will extend into the building, but electrical installation and any wiring within the building will be implemented by the selected solar contractor. Installation of the pad and conduit as part of the cap construction will allow subsequent solar component installation to proceed without affecting or disturbing the cap. The necessary site preparation design has been developed in consultation with C-Tec Solar, although the specific design and installation of the solar array components is not part of the remedial design for the SRSNE Site; design and installation of the array and electrical components will be separately addressed by C-Tec Solar.

6.7 Drainage Features

The surface drainage from the approximately 2.2 acre cap plateau and slope area located on the west side of the rail to trails section will be collected in a 3 foot wide drainage swale that will drain to an existing catch basin inlet (installed for the pre-ISTR work) on the north side of the cap. The catch basin has an existing 24 inch diameter HDPE pipe outlet draining north to a drainage channel and the inlet of a 30 inch HDPE culvert (relocated for the pre-ISTR work) that drains east to the Quinnipiac River. The subsurface drainage from the geocomposite drainage layer in this portion of the cap will flow to a 8-inch perforated HDPE collection pipe located below the bottom of the 3 foot wide drainage swale. The collection pipe will drain north and connect to the existing catch basin on the north side of the cap. See Design Drawings 5 and 6 in Appendix A for cap subsurface and surface drainage features.

The surface drainage from the approximately 0.6 acre cap area on the east side of the rails to trails section will drain to a 2 foot wide swale located at the toe of the slope along the east edge of the cap. The flow in the swale will drain to the north and be intercepted by the inlet of a new 12 inch diameter HDPE culvert that will connect to a new manhole that will replace an existing catch basin (also installed for the pre-ISTR work) located at the northeast corner of the cap. The catch basin outlet is an existing 12 inch diameter HDPE pipe that drains to a tee connection with the existing 30 inch HDPE culvert draining east to the Quinnipiac River. In addition to the new pipe inlet connection, the existing catch basin will be removed and a new manhole installed to meet the final cap grades. The subsurface drainage from the geocomposite drainage layer in this portion of the cap will drain to the slope along the east edge of the cap through a rip rap toe treatment with perforated pipe, with the perforated pipe draining to the new manhole at the north end of the eastern drainage swale. See Detail 4 on Design Drawing 8 in Appendix A.

The perimeter swale on the south side of the cap will be realigned and regraded where the fill slopes from the cap impact the existing drainage channel. The drainage flow from realigned swale will drain to a new 15-inch HDPE culvert be placed below the rails to trails alignment to allow the flow from the swale to continue to drain to the east. A new manhole and swale will be installed to convey water from this point to the Quinnipiac River floodplain area, as described in Section 3.8.

The existing drainage swale on the northwest side of the cap and existing maintenance road will not be impacted by the cap installation and will remain in the current condition.

Drainage anchor trenches with 6-inch diameter perforated HDPE collection pipes will be installed on the north, south, and east sides of the cap to intercept drainage from the geocomposite drainage layer where the subgrade (liner) drains to the outside perimeter of the cap. The collection pipe on the south side will outlet to the realigned drainage swale to the south. The collection pipes on the north and east sides will drain to the new manhole to be installed at the north (downgradient) end of the eastern perimeter drainage swale. That manhole will divert the flow to the existing 30-inch diameter HDPE culvert that outlets to the Quinnipiac River floodplain. These features are shown on Design Drawings 5 and 6 in Appendix A. Note also that the collection pipes within the perimeter anchor trenches are not needed for the entire lengths of the anchor trenches; the start and end points are indicated on Design Drawing 5.

7 RAILS TO TRAILS – BEYOND RCRA CAP AREA

Although not a required component of the SRSNE Site remediation scope, the SRSNE Site Group has committed to constructing the section of the Farmington Heritage Canal Trail extending from Lazy Lane to Curtiss Street, including the section passing through the SRSNE RCRA cap (Section 6.5). This work will be completed in conjunction with the RCRA cap construction and associated work discussed in this design report.

7.1 Scope and Objectives

As described in Section 6.1, the SOW requires that the RCRA cap must accommodate use of the former railroad right-of-way as a bike path as a component of the local rails-to-trails system. The RCRA cap design accommodates this use. In addition, the SRSNE Site Group has committed to constructing the bike path outside the RCRA cap limits extending from Lazy Lane to Curtiss Street. Outside of the RCRA cap limits, the objective is to provide a suitable subbase and bike path consistent with the established design parameters for the rails-to-trails system. The trail design (i.e., configuration, section and details) used for this project are based on the typical details provided by the Town of Southington for the Linear Park Rails to Trails Project – Phase II (Cheshire Town Line to West Main Street) project.

7.2 Surface Preparation

The rails to trails path to the north side of the RCRA cap was constructed to the top of the aggregate subbase during the pre-ISTR phase of the project. Preparation of the surface for this section of the path will consist of clearing the vegetative growth within the 18 foot wide trail section and fine grading to attain the pavement subgrade elevation.

The rails to trails path to the south side of the RCRA cap is partially overgrown with small trees and brush and contains the old railroad section with wood railroad ties and railroad stone ballast remaining intact. Temporary utility poles that supported a temporary electrical supply for the ISTR system are still present along portions of the trail, but are slated to be removed by the utility provider prior to the start of this work. A portion of the trail has been overlain with gravel to improve access for installation of the temporary utility poles. Surface preparation for this section of the path will require clearing of the existing vegetation within the work limits, plus removal and disposal of the existing railroad ties. The area would then be graded and compacted to the widths and subgrade elevations shown on the cross sections in Design Drawings 19 through 24 (Appendix A). A 9 inch layer of aggregate subbase would be placed within the limits of 14 foot wide paved trail section after completion of grading operations and would be graded to attain the pavement subgrade elevation.

7.3 Surface Paving

The paved surface of the rails to trails path consists of a 10.5 feet wide paved trail section and a 3.5 feet wide soft trail section throughout the majority of the segment length. The paved trail section will be paved to a total depth of 3 inches with 1-1/2 inches of bituminous concrete wearing course and 1-1/2 inches of bituminous concrete binder course material. The soft trail section will be paved with 3 inches of stone screenings.

There is an existing pedestrian bridge crossing located just north of Curtiss Street. The surface paving will terminate at the concrete surface at the north and south ends of the bridge crossing. Neither the asphalt pavement nor stone screening will be placed across the bridge span.

Due to the limited width of the existing former railroad bed in the southern portion of the project area, the 3.5-foot wide soft trail will not be installed for the approximately 500-foot section extending north from Curtiss Street to Station 5+70 (see Design Drawing 17 in Appendix A). Widening of the path would require placement of fill along the existing east and/or west slopes of the railroad bed, and would include placement of fill within wetland and floodplain areas. The need for fill in those areas can be eliminated by carrying only the asphalt paved section of the path through this reach. In addition, the reduced width is consistent with the bridge crossing width where the path crosses the Quinnipiac River. Finally, eliminating the soft trail in this area facilitates the installation of fencing along the trail given the steep drop offs between the existing railroad bed grade and the surrounding wetland area.

7.4 Parking and Access

A paved parking area will provided at the west side of the Lazy Lane driveway entrance to the Site. A total of 18 parking spaces and one handicapped parking space will be available for the rails to trails users. A paved sidewalk will constructed for access to the rails to trails path.

7.5 Ancillary Features

Permanent erosion control blankets will be installed on the steep slopes (approximately 1.5 horizontal to 1 vertical) on both sides of the north and south approaches to the bridge located near Curtiss Street. In addition, a wood pedestrian rail will be installed on the approaches due to the steep slopes in this area. Wood rail fencing and bollards (or boulders where appropriate) will also be installed near the access points at Lazy Lane and Curtiss Street to deter vehicle access to the trail.

8 RESTORATION OF HABITAT

8.1 Wetland Identification, Mitigation, and Restoration

8.1.1 Wetland Identification

A 1992 study performed by HNUS on behalf of the USEPA identified six wetlands on the Site and the adjacent Town of Southington wellfield property. Those wetland boundaries were re-delineated by Blasland, Bouck & Lee in 1995 (BBL 1995) and again in 2009 by Arcadis (2010a) to confirm the wetland presence and to enable quantification of wetland impacts resulting from remedial activities. In addition, a mitigation wetland was constructed in 1996 in anticipation of potential impacts to other existing wetlands as a result of the NTCRA 1 construction and operation. Finally, an additional isolated wetland was identified as part of the 2009 wetland delineation activities. The wetland boundary delineations were performed in accordance with the federal delineation methodology in regulation at the time of the delineation and the CT DEEP hydric soil methodology (Ammann et al., 1991). The locations of seven wetlands (A, C, D, E, F, G, and H) are presented on Figure 3 (Wetland B is not located within the current Site boundaries). Descriptions of these identified wetlands are provided below.

Wetland A was identified as a 1.54-acre forested riparian wetland on the western floodplain of the Quinnipiac River (Figure 3). It is the largest wetland present on the Site, and it supports an understory of scrub-shrub and herbaceous plant communities. Dominant trees of Wetland A were deciduous and included river birch (*Betula nigra*), speckled alder (*Alnus incana*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), quaking aspen (*Populus tremuloides*), red oak, (*Quercus rubra*), and willow (*Salix* spp.). Subcanopy dominants included alder, river birch, and willow. The shrub layer was dominated by silky dogwood (*Cornus amomum*) and nannyberry (*Viburnum lentago*). The ground cover density reflected the degree of canopy closure, but was primarily in the 50% to 100% cover range.

Wetland C is a 0.07-acre forested inland wetland located in the southern portion of the Site in an isolated depression that temporarily ponds water (Figure 3). Dominant vegetation of Wetland C consisted of red maple, American elm, green ash, multiflora rose (*Rosa multiflora*), buckthorn (*Rhamnus cathartica*), and spicebush (*Lindera benzoin*). Wetland C had no visible inlets or outlets that could connect it to regulated Waters of the U.S. The functions and values Wetland C are limited by its small size and isolated hydrologic condition.

Similar to Wetland C, **Wetland D** is a small (0.02-acre) forested inland wetland located in the southern portion of the Site in an isolated depression that temporarily ponds water (Figure 3). Dominant vegetation of Wetland D consisted of red maple, green ash, multiflora rose, buckthorn, Russian olive (*Elaeagnus angustifolia*), spicebush, and honeysuckle (*Lonicera tatarica*). Wetland D had no visible inlets or outlets that could connect it to regulated Waters of the U.S. The functions and values Wetland C are limited by its very small size and isolated hydrologic condition.

Wetland E was a 0.16-acre shrub inland wetland formerly associated with a ditch adjacent to and east of the former railroad line that ran north/south across the Site, separating the Former SRSNE Operations Area from the Cianci property (Figure 3). Although the ditch itself was a man-made surface water drainage system that would not be regulated as a wetland, low elevation areas adjacent to the ditch that exhibited wetland characteristics outside of the main ditch were identified as wetlands. Dominant vegetation of Wetland E consisted of Russian olive, silky dogwood, multiflora rose, and willow shrubs, but a few red maple and cottonwood (*Populus deltoides*) trees occurred along the wetland edge. The primary function of the ditch when it was constructed was stormwater management for the railroad line when it was active. This wetland was eliminated at part of the pre-ISTR site preparation activities; it required fill to modify drainage and allow for the ISTR implementation in this portion of the Site.

Wetland F is a 0.08-acre shrub inland wetland located in the southeastern portion of the Site in a depression that temporarily ponds water (Figure 3). The dominant shrub of Wetland F was silky dogwood, and the herbaceous species jewelweed (*Impatiens capensis*) and jack-in-the-pulpit (*Arisaema triphyllum*) dominated the perimeter of the standing water. The functions and values Wetland F are limited by its small size.

Wetland G is a 0.29-acre wetland system that transitions from an herbaceous inland wetland to a forested inland wetland. This wetland was created as a mitigation wetland by excavating an oxbow channel west of and connected to the Quinnipiac River (Figure 3) (Detailed Wetlands Mitigation Design, Blasland, Bouck & Lee, Inc. September 1995). Vegetation of the inundated portions of the wetland were dominated by arrow arum (*Peltandra virginica*), arrowhead (*Sagittaria latifolia*), and blue flag (*Iris versicolor*). Woody vegetation of the transition zone between the herbaceous and forested inland wetland communities was dominated by river birch, speckled alder, gray dogwood (*Cornus racemosa*) buttonbush (*Cephalanthus occidentalis*), willows, and spicebush. Ground cover in the transition area was dominated by jewelweed, joe-pye-weed (*Eupatorium maculatum*), clearweed (*Pilea pumila*), goldenrods (*Solidago* spp), and reed canary grass (*Phalaris arundinacea*). The location and vegetative diversity of Wetland G support its ability to provide ecological functions for the Quinnipiac River and riparian wildlife. The direct connection of this wetland to the river and permanent presence of water also provide habitat for fish reproduction and rearing.

Wetland H is a small, 0.02-acre herbaceous inland wetland located near the center of the Site in an isolated depression that temporarily ponds water between the access road and the phytophreatic willow area (Figure 3). Dominant vegetation of Wetland H consisted of dark green bulrush (*Scirpus atrovirens*), reed canary grass, lurid sedge (*Carex lurida*), fox sedge (*Carex vulpinoidea*), and path rush (*Juncus tenuis*). Wetland H had no visible inlets or outlets that could connect it to regulated Waters of the U.S. The functions and values Wetland H are limited by its very small size and isolated hydrologic condition.

8.1.2 Wetland Impact Evaluation

In 1992, USEPA performed a Removal Action that removed soils from Wetland E. In 1995, the first non-time-critical removal action (NTCRA 1) was initiated, which consisted of the installation of 12 extraction wells and a downgradient hydraulic barrier wall in the Containment Area on the former Cianci property to contain overburden groundwater migrating southeastward from the Former SRSNE Operations Area. BBL (1995) evaluated the potential hydrologic effects of the NTCRA 1 work on the wetlands by conducting water table monitoring prior to and during operation of the NTCRA 1 Groundwater Containment System. The water table monitoring effort concluded that the operation of the NTCRA 1 Groundwater Containment System had negligible (if any), impact on the water table elevation in Wetland A. The operation of NTCRA 1 System was concluded to potentially impact the hydrology of Wetlands C, D, and F. It was predicted that the water table might be lowered beneath these wetlands and that the vegetation in these areas could potentially transition to upland communities (BBL 1995).

The status of Wetlands C, D, and F was re-evaluated during habitat characterization efforts performed by Arcadis in 2009. These wetlands were found to still exhibit vegetative, soil, and hydrologic characteristics that met the federal wetland criteria. Therefore, it was concluded that the NTCRA 1 groundwater pumping activities did not affect these wetlands and their status as wetlands was confirmed. Although it was unclear if the hydrology of the 0.16 acre Wetland E was affected by the NTCRA 1 work, the removal of soils from Wetland E by USEPA, resulted in USEPA concluding that Wetland E was lost and would require mitigation. Wetland E was located within the limits of the thermal treatment area and within the RCRA cap being installed under this phase of remedial activities. The loss of the 0.16 acres of Wetland E during the pre-ISTR site preparation activities was the only permanent loss of wetland acreage resulting from previous remedial activities at the Site.

Under the planned remedial activities discussed herein, three wetland areas on the Site, totaling 0.11 acres, will be permanently lost as a result of grading activities in the NTCRA 1 area, as discussed in Section 4.3 of this report. Soil fill will be placed to raise the grade elevation over a portion of the NTCRA 1 area to address predictive modeling that indicates that a slight degree of groundwater mounding will occur as a result of the groundwater flow modifications. Raising the ground surface in the predicted mounding area is intended to prevent expression of the groundwater at the ground surface. As a result of fill requirements to achieve the required grades, the entireties of Wetland C (0.07 acres[4]), Wetland D (0.02 acres), and Wetland H (0.02 acres) will be permanently lost. Design Drawing 13 of Appendix A shows the locations of these three areas.

Also under current remedial activities discussed herein, soil is to be removed from designated Cianci Property excavation areas and consolidated under the RCRA cap. Two of these areas are located within the limits of Wetland A. One area (EA-3) in Wetland A is approximately 0.02 acres and the other area (EA-5) is approximately 0.28 acres in size (see Design Drawings 4 and 13 in Appendix A). The removal of soils from these areas will result in temporary disturbance to approximately 0.30 acres of wetlands. These areas will be backfilled to pre-existing grade and restored as wetlands, as further described below.

8.1.3 Wetland Mitigation

A total of 0.31 acres of wetland mitigation credits were generated by enhancing and expanding Wetland A, including construction of an oxbow wetland (Wetland G) in the northwest corner of Wetland A (BBL 1995). The mitigation wetland is described in a wetland mitigation plan developed by BBL (1995) to mitigate the anticipated impacts to Wetlands C, D, E, and F in advance of their potential disturbance by future remedial activities. The mitigation wetland was monitored in 2007 and 2008 and was found to meet the performance standards for hydrology and for a minimum of 85% ground cover. The mitigation wetland size and ability to meet the federal wetland criteria was verified again in 2009 as part of Site habitat

[4] As shown on Design Drawing 13 in Appendix A, 0.06 acres of Wetland C is anticipated to be lost as a result of fill placement in the NTCRA 1 area. The remaining 0.01 acres is not subject to fill, but is conservatively assumed to be lost as a result of planned drainage modifications as discussed in Section 3.8.

characterization activities (Arcadis 2010a). Therefore, the 0.31 acres of “banked” mitigation wetland are available to mitigate wetland impacts resulting from previous and current remedial activities.

As discussed in Section 8.1.2 of this report, the 0.16 acres of Wetland E were permanently lost as a result of previous site remedial activities and the current RCRA cap design. This permanent wetland loss will be mitigated by applying 0.16 acres of the wetland mitigation acreage created by the mitigation wetland. Subtraction of 0.16 acres of mitigation wetland from the mitigation wetland results in 0.15 acres of mitigation wetland available for other wetland impacts on the Site.

In addition to Wetland E, three wetland areas on the Site, totaling 0.11 acres, will be permanently lost as a result of grading activities in the NTCRA-1 area. Design Drawing 13 of Appendix A shows the locations of these three wetland impact areas. The loss of these 0.11 acres of wetlands will be mitigated by applying an additional 0.11 acres of the mitigation wetland credit. As indicated in the following table, this results in a net credit of 0.04 wetland acres over the course of the project.

Wetland Balance Sheet

Wetland	Starting Size of Wetland (acres)	Wetland Loss (acres)		Wetland Mitigation Credits Gained (acres)	Final Size of Wetland (acres)
		Prior	This Project		
A	1.54	0	0	0.02	1.52
C	0.07	0	0.07*	0	0
D	0.02	0	0.02	0	0
E	0.16	0.16	0	0	0
F	0.08	0	0	0	0.08
G	0	0	0	0.29	0.29
H	0.02	0	0.02	0	0
Subtotals:	**1.89**	**0.16**	**0.11**	**0.31**	**1.93**
* See footnote on prior page			**Net Project Change (final minus starting acreage):**		**+0.04 (Gain)**

It is also anticipated that excavation and restoration of the borrow source area located along the northern banks of Wetlands A and G (Design Drawings 10 and 13) will also generate additional wetland area as part of this project. The portion of the borrow area below an elevation of 150 feet NGVD will be restored as a wetland area, and result in an expansion of Wetland G by approximately 0.04 acres. This is in addition to the benefit of providing additional flood storage mitigation to offset fill placement in the wetland area as part of the NTCRA 1 regrading plan.

Also under current remedial activities discussed herein, soil removal from two of the Cianci Property soil excavation areas will involve work within wetland areas. Based on the target removal limits, these excavations will result in temporary disturbances to 0.30 acres of wetlands. The need for subsequent confirmation sampling and, potentially, additional excavation, may increase the amount of temporary wetland disturbance relative to this initial area. The disturbed wetlands will be restored in-place and in-kind by backfilling to restore original grades, seeding, and planting. Because these wetlands are being restored in-place and in-kind, no additional mitigation is proposed for their temporary disturbance.

8.1.4 Wetland Restoration Design

As discussed above, two Cianci property excavation areas (EA-3 and EA-5) will result in temporary wetland impacts totalling approximately 0.30 acres. The locations of these areas are shown on Design Drawing 4 in Appendix A. These disturbed wetlands will be restored in-place and in-kind by backfilling to restore original grades, seeding, and planting. Portions of these excavations within wetland areas will be backfilled with general fill to within 1-foot of final grade. The uppermost 12 inches will be backfilled with high organic content topsoil and a wetland seed mix will be applied to establish ground cover and protect surface soils from erosion until the tree canopy develops. A mixture of several species of trees and shrubs will be planted to restore the wetland forest habitat. Species were selected for planting based on observations of their presence during site characterization activities and if they are native to Connecticut. Trees will be planted at 10-ft spacing in clumps of three of the same species. Shrubs will be planted at 5-ft spacing in clumps of five of the same species. The locations of the wetland forest habitats to be restored on the Site and the wetland planting schedule are shown on Design Drawings 13 and 14 in Appendix A.

Due to its location within the Quinnipiac River floodplain the EA-5 excavation area is particularly susceptible to erosion and sedimentation during the excavation period and until such time that the area is sufficiently restored. Additional implementation-related control measures will be implemented for this area during and following the excavation, as discussed in Section 5.5.4 of the RAWP. In addition, the restoration design calls for the installation of a temporary erosion control blanket to be installed in this area as part of the restoration. The erosion control blanket will minimize the potential for erosion of disturbed and/or backfilled soils until such time that the vegetation is re-established. The temporary erosion control material is indicated on Design Drawing 13 in Appendix A.

8.2 Habitat Restoration

Besides wetlands, other habitats were present on the Site prior to the initiation of remedial activities. These habitats were characterized in 2009 during the development of the Habitat Characterization Report, and re-evaluated in 2015 upon completion of the majority of the remedial work. The primary natural habitat that was disturbed on the Site was upland forest. Although not actually “natural” habitats, staging and support areas of the Site contained fields and open lawn areas that were routinely mowed during maintenance activities. The restoration design for the upland forest and staging and support areas are described in the following sections.

8.2.1 Upland Forest Restoration

The restoration design for disturbed upland forest habitats and their locations on the Site are shown on Drawing 13 of Appendix A. Upland forest was the dominant natural habitat and was found on the eastern portion of the Site between the riparian wetland corridor of the Quinnipiac River and developed portion of the Site, in the southern portion of the Site, along the eastern edge of the former railroad right-of-way, and along the southwestern property boundary (Arcadis 2010a). Dominant canopy species in this habitat were red maple, green ash, black cherry (*Prunus serotina*), and alder. Subcanopy dominants included red maple, black cherry, buckthorn, and American elm. The shrub layer was dominated by silky dogwood, nannyberry, alder, and green ash. Although there were some minor differences found within the forested upland communities observed on site, the differences were considered to be within the natural range of variability of the habitat and they were, therefore, not considered different habitat types.

Upland forest habitat will be restored by seeding and tree and shrub planting. A minimum of 6-inches of topsoil will be provided as a seeding medium in restored upland habitats. An upland seed mix promoting northeast pollinators will be applied to establish ground cover and protect surface soils from erosion until the tree canopy develops. An upland erosion control seed mix has been specified for portions of the upland forest habitat that occur on steep slopes. The erosion control seed mix will anchor the topsoil in place until the root systems of other vegetation serve this function.

A mixture of several species of trees and shrubs will be planted to restore the upland forest habitat. Species were selected for planting based on observations of their presence during site characterization activities and if they are native to Connecticut. Trees will be planted at 10-ft spacing in clumps of three of the same species. Shrubs will be planted at 5-ft spacing in clumps of five of the same species. The locations of the upland forest habitats to be restored on the Site and the upland forest planting plan are shown on Design Drawings 13 and 14 in Appendix A. Tree and shrub plantings will not be made in the AT&T fiber optic right-of-way to the north, west, and south of the RCRA cap area.

8.2.2 NTCRA 1 Soil Fill Area

It is anticipated that the NTCRA 1 soil fill area will ultimately be restored to a forested habitat to enhance the overall habitat quality of the Site and for aesthetic purposes. However, near-term changes in the hydrologic conditions resulting from the placement of fill, combined with long-term changes potentially resulting from future operational changes to the NTCRA 1 operations, is expected to result in variable groundwater levels. Such hydrologic changes may affect the types of trees best suited for restoration of this area. Accordingly, planting of woody and shrub species within this area will not be performed until the hydrology of this area stabilizes and the long-term conditions are better understood. At that time, trees and shrubs will be selected for planting in this area from the list of woody species currently proposed to be planted to restore forested wetlands and uplands of the Site (Drawing 14 of Appendix A). Additional species may be incorporated into the planting of this area that are better adapted to the Site-specific hydrologic conditions. The timing of this planting effort is yet to be determined, and will largely be a function of the timing of future operational modifications to the NTCRA 1 area. In the interim, the area will be restored with suitable grasses to maintain the lawn-type conditions that presently exist in this area.

8.2.3 Staging and Support Areas

Upland field habitat exists in portions of the Site as a result of prior development activities (including lawn mowing), as well as the use of certain areas for material and equipment staging areas during prior remedial activities. This habitat type occurs between the upland forest habitat along the east side of the Site and the portion of the Site developed with roads and buildings (Arcadis 2010a). Very little disturbance is planned for existing staging and support areas of the Site. One Cianci Property excavation area (EA-1) lies within a currently grassed area. There is the potential for additional disturbances to these maintained areas resulting from equipment operations and material and equipment staging during this planned final phase of remedial activities. These disturbances are not known and cannot be presented on drawings at this time. However, disturbances to currently grassed areas will consist of smoothing the ground surface and seeding with lawn seed. The restoration of the excavation area in an existing lawn area is shown on Drawing 13 of Appendix A.

8.2.4 Quinnipiac River Floodplain Compensation Area

Fill required to raise the grade elevation over a portion of the NTCRA 1 area in the floodplain of the Quinnipiac River will result in the loss of 400 CY of flood storage capacity. To compensate for the loss of flood storage, an area adjacent to the floodway, just south of Wetland G, will be excavated to increase the flood storage volume by approximately 460 CY. This excavation area will create a low, flat area and a relatively steep grade to meet existing adjacent topography (Design Drawing 10 in Appendix A). The flat portion of this excavation below elevation 150 feet will be seeded with the wetland seed mix and planted with wetland trees and shrubs due to its proximity and similar elevation to adjacent Wetland G. The steep embankment portion of the excavation area adjacent to the flat area will be seeded with the erosion control seed mix and planted with upland trees and shrubs. The vegetation restoration plan for floodplain compensation area is shown on Design Drawings 13 and 14 in Appendix A.

8.3 Temporary Erosion and Sediment Control Measures

General descriptions of temporary erosion and sediment control measures that are anticipated to be utilized during RCRA cap and rails-to-trails construction activities are presented below. Erosion and sediment control measures for the Site were developed in accordance with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control (Department of Environmental Protection Bulletin 34). Refer to Design Drawings 3 and 15 for approximate locations and details for construction of proposed erosion and sediment controls.

Silt Fence - will be used to reduce the potential for migration of suspended sediments from construction areas to off-site locations. Silt fencing will be installed on the perimeter of disturbed areas as shown on the Design Drawings.

Stone Check Dam - will be constructed to reduce the velocity of concentrated stormwater flows within the drainage channels and therefore reducing erosion of the channels. Stone check dams also temporarily pond storm water runoff and allow sediments to settle out. Stone check dams will be constructed in the steeper portions of the perimeter cap area swales, and rails to trails ditches in accordance with the materials and methods indicated on the drawings and in Section 5 of the Connecticut Guidelines for Soil Erosion and Sediment Control, titled, “Energy Dissipaters – Stone Check Dam”.

Drainage Inlet Protection – will be placed at catch basin and drainage inlets to prevent sediment from runoff entering the storm drainage system. Inlet protection may consist of a compost filter sock or a hay bale barrier installed around the perimeter of the catch basin or drainage inlet.

Temporary Diversions - will be installed as necessary to reduce the potential for migration of sediment-laden water off-site by conveying construction-related stormwater to on-site management areas.

Temporary Seeding - will be established to reduce the potential for erosion and sediment transport from disturbed or bare soil areas. Seeding will be performed in areas that have achieved final grade or are not scheduled for further construction activities within 14 calendar days. Temporary or long-term erosion control mats will be placed on slopes or other areas during time periods when conditions are not conducive to rapid germination and grass growth. Temporary and permanent seeding should occur within 24 hours of initial disturbance or achievement of final grade to reduce the need for scarification of the seedbed prior to seeding.

Mulching - provides immediate erosion control during the establishment of vegetation, moderation of seedbed conditions (e.g., temperature and moisture), and serves as a dust control measure. Mulching will be performed immediately following seeding (in areas not receiving erosion control mat) and conducted in accordance with the materials and methods indicated in Section 5-4-5 of the Connecticut Guidelines for Soil Erosion and Sediment Control, titled, “Non-Living Soil Protection – Mulch for Seed”.

Equipment Lay-Down/Material Staging Areas - are anticipated to be established in two primary areas for use during the work: one on the west side of the groundwater treatment building across from the gravel access road and another within a grass-covered area south of the groundwater treatment building. Silt fencing will be installed along the down-gradient perimeter of all laydown/material staging areas. Any impact to the existing ground surface south of the treatment building that results from temporary equipment staging will be repaired and the area will be reseeded as soon as practical following the completion of staging.

Polyethylene Tarps - will be used to cover stockpile areas where the site constraints make the use of alternative erosion controls (e.g., silt fence) impractical. Tarps will completely cover the pile, extend out from the base, and be secured in-place with sand bags (or similar means). Tarps will also be placed over the granular fill stockpile(s) (e.g., clean backfill pending final placement) at the end of each day’s work effort, and during significant rainfall events (i.e., capable of producing visible run-off from stock-pile areas).

Dust Control - will be performed to prevent the movement of dust from exposed soil surfaces. Water that is applied to exposed soils and access roads during construction shall be done without causing soil erosion.

Stabilized Construction Entrance – an existing stabilized construction entrance located on Lazy Lane will be the main construction entrance for the Site. The existing entrance will be upgraded and maintained as needed during construction to prevent tracking of dirt and mud onto public roadways.

Good housekeeping practices - will be implemented at the Site to minimize the potential for construction materials entering stormwater discharges from the Site. This will include, but may not be necessarily limited to: routine waste management activities, including the collection and disposal of trash, rubbish, construction waste and sanitary wastes; prompt cleanup of spills of liquid or dry materials (if any); and prompt cleanup of any sediments tracked by construction vehicles and/or transported by wind or stormwater from active work areas to other areas of the Site or nearby off-site areas.

8.4 Restoration Monitoring

The *Habitat Restoration Work Plan* (Arcadis 2010c) indicated that each restoration area would have a monitoring plan to verify that restoration meets the requirements of Section IV.B.4 of the SOW. SOW Section IV.B.4 requires the establishment of vegetative cover in disturbed areas within one year, a 70% rate of successful establishment of 80% of the planted species after three growing seasons, and the establishment of a stable vegetative community after five growing seasons. All areas seeded to restore original lawn areas or to minimize soil erosion will be visually monitored in the first growing season after seeding to evaluate the establishment of the desired ground cover. Areas exhibiting less than 70% ground cover will be re-seeded and monitoring will continue until vegetation-based performance standards are met. The restoration of natural forested wetland and upland habitats will be quantitatively monitored to generate data for the calculation of percent ground cover and percent survival of planted trees and shrubs to determine if performance standards are being met, or if adaptive management will need to be implemented to direct the restored habitats into long-term sustainability.

9 OPERATION AND MAINTENANCE PLAN

Minimal post-construction O&M requirements are anticipated in conjunction with the remedial components addressed in this Design Document. Post-construction O&M requirements are generally limited to periodic inspections of the RCRA cap and revegetated area, plus as-needed maintenance or repairs of any issues identified by the inspections. Inspection activities will generally include, but are not limited to the following items:

- the final cover system components;
- the stormwater management system components;
- restored vegetation areas; and
- site access and security features.

Visual inspections of the final cover system will be performed to identify evidence of settlement, soil erosion, slope failures, or exposure of the cover system geosynthetics. Evidence of settlement will be based on the visual occurrence of standing water (ponded runoff) or areas that appear to have stressed or silted vegetation that may be indicative of periodic ponding water conditions. Woody vegetation and shrubs (whose deeper penetrating roots may pose a risk to the cover system geosynthetics), protruding objects, burrowing animals, cracking, or the disturbance or loss of vegetation of covered areas will also be identified during inspections.

Post-construction inspections will also be performed to document and facilitate the re-establishment of vegetated areas. This will include monitoring ground cover, tree survival rates, and the presence of invasive species. Such inspections will trigger the need for adaptive management, such as supplemental plantings, invasive species control measures, or other measures intended to meet habitat restoration requirements while minimizing the occurrence of invasive species. It is anticipated that specific vegetation performance metrics and an invasive species control plan will be components of the site-wide, post-construction O&M Plan discussed below.

The components of the stormwater management system (e.g., swales, ditches, catch basins, culverts) will be visually inspected for signs of erosion and siltation, debris buildup, pipe inlet/outlet instability, and stressed or inadequate vegetation.

Site access controls will also be inspected for signs of damage or unauthorized entry. The inspections will also confirm that site access roads remain open and usable for accessing necessary work areas.

It is anticipated that periodic inspections will be performed on the following schedule:

- monthly from the completion of the construction until such time that three consecutive months of the growing season (April through October) have passed after construction;
- quarterly for the remainder of the first two years after construction; and
- semiannually (twice per year) for the remainder of the first five years following construction.

Provided the various components remain stable at that point, a reduced monitoring frequency (e.g., annual) may be requested. All formal inspections will be documented on a designated inspection log. The logs will be included in subsequent monthly progress reports and/or annual compliance reports as required by SOW Sections VIII.A and B.

Periodic maintenance of the access roadway surfaces may be required to maintain smooth, uniformly-sloped surfaces. Damaged security fencing and signs will be repaired or replaced to eliminate trespassing, if necessary.

When the need for repairs is identified – either through routine formal inspections or other incidental observations – repair work will be carried out in as timely a manner as practical. Examples of potential repair activities include, but are not limited to:

- replacement and revegetation of eroded soil areas;
- repair or replacement of damaged access control fencing;
- trimming or removal of vegetative growth along fencelines;
- repair of subsidence areas;
- safety improvements;
- cleaning of clogged drainlines or drainage channels;
- repair of damaged geosynthetic components; and
- placement of additional rip-rap or other erosion control measures.

In addition, maintenance of the RCRA cap area will include mowing of vegetated areas at least once per year. This is intended to prevent the establishment of deep-rooted vegetation that could affect the integrity of the cap components.

The O&M requirements described herein reflect the target 100% design level for the RCRA cap, ancillary construction, and habitat restoration for areas affected by prior and planned remedial activities. Additional or alternative O&M requirements may be identified based on the as-built (post-construction) conditions. Note also that de maximis anticipates preparing a comprehensive O&M Plan to address the requirements of SOW Section VI.I. That O&M Plan would address not only the cap-related O&M activities described herein, but other anticipated components of ongoing O&M for the overall Site (e.g., groundwater monitoring, operation of the HCTS, etc.). It is expected that the comprehensive O&M Plan will be prepared once all targeted construction activities are complete.

10 REFERENCES

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TABLES

Table 1 – Soil Dioxin TEQ Concentrations (2010 on)
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

Sample Location	Field Sample ID	Sample Date	Depth (ft. bgs)	2,3,7,8-TCDD TEQ[1] (pg/g, or ppt) (ND=1/2 RL)
BDS-01	P-BDS-01-SS-1 (0-1')	5/6/2010	0-1	1.32
BDS-02	O-BDS-02-SS-1 (0-1')	5/6/2010	0-1	0.763
BDS-03	O-BDS-03-SS-1 (0-1')	5/6/2010	0-1	0.358
BDS-04	W-BDS-04-SS-1 (0-1')	5/6/2010	0-1	0.628
BDS-05[2]	BD-1215201-02	12/15/2015	0-0.5	20.3
BDS-05	BDS-05-SS-12152015 (0-6)	12/15/2015	0-0.5	30.2
BDS-06	BDS-06-SS-12152015 (0-6)	12/15/2015	0-0.5	20.2
CDS-1	O-CDS-1-SS-1 (0-1')	5/6/2010	0-1	26.9
CDS-2	O-CDS-2-SS-1 (0-1')	5/6/2010	0-1	11.5
CDS-3	C-CDS-3-SS-1 (0-1')	5/6/2010	0-1	501
CDS-4	C-CDS-4-SS-1 (0-1')	5/6/2010	0-1	461
CDS-4[2]	DUP-SS-05062010-#1	5/6/2010	0-1	239
CDS-5	O-CDS-5-SS-1 (0-1')	5/6/2010	0-1	147
CDS-5A	CDS-5A-SS-08272015 (0-6")	8/27/2015	0-0.5	15.4
CDS-5B	CDS-5B-SS-10142015 (0-6)	10/14/2015	0-0.5	0.944
CDS-6	O-CDS-6-SS-1 (0-1')	5/6/2010	0-1	0.483
CDS-7	O-CDS-7-SS-1 (0-1')	5/6/2010	0-1	1.78
CDS-8	O-CDS-8-SS-1 (0-1')	5/6/2010	0-1	4.03
CDS-8A	CDS-8A-SS-08272015 (0-6")	8/27/2015	0-0.5	1.11
CDS-9	O-CDS-9-SS-1 (0-1')	5/6/2010	0-1	11.3
CDS-9A	CDS-9A-SS-08272015 (0-6")	8/27/2015	0-0.5	8.55
CDS-10	C-CDS-10-SS-1 (0-1')	5/6/2010	0-1	0.669
CDS-23	CDS-23-SS-08272015 (0-6")	8/27/2015	0-0.5	3.19
CDS-23	CDS-23-SS-08272015 (6-12")	8/27/2015	0.5-1	2.36
CDS-24	CDS-24-SS-08272015 (0-6")	8/27/2015	0-0.5	5.11
CDS-24	CDS-24-SS-08272015 (12-24")	8/27/2015	1-2	1.97
CDS-24	CDS-24-SS-08272015 (6-12")	8/27/2015	0.5-1	1.42
CDS-25	CDS-25-SS-08272015 (0-6")	8/27/2015	0-0.5	4.12
CDS-25	CDS-25-SS-08272015 (12-24")	8/27/2015	1-2	11.3
CDS-25	CDS-25-SS-08272015 (6-12")	8/27/2015	0.5-1	2.35
CDS-26	CDS-26-SS-08272015 (0-6")	8/27/2015	0-0.5	5.27
CDS-26	CDS-26-SS-08272015 (6-12")	8/27/2015	0.5-1	3.16
CDS-26[2]	DUP-1-SS-08272015	8/27/2015	0.5-1	3.75
CDS-27	CDS-27-SS-08272015 (0-6")	8/27/2015	0-0.5	28.5
CDS-27	CDS-27-SS-08272015 (6-12")	8/27/2015	0.5-1	16.6
CDS-27A	CDS-27A-SS-10142015 (0-6)	10/14/2015	0-0.5	32.3
CDS-27A	CDS-27A-SS-10142015 (6-12)	10/14/2015	0.5-1	6.60
CDS-27A[2]	DUP-1-SS-10142015 (6-12)	10/14/2015	0.5-1	6.57
CDS-27B	CDS-27B-SS-10142015 (0-6)	10/14/2015	0-0.5	42.6
CDS-27B	CDS-27B-SS-10142015 (6-12)	10/14/2015	0.5-1	11.8
CDS-28	CDS-28-SS-08272015 (0-6")	8/27/2015	0-0.5	17.5
CDS-28	CDS-28-SS-08272015 (6-12")	8/27/2015	0.5-1	4.17
CDS-28A	CDS-28A-SS-10142015 (0-6)	10/14/2015	0-0.5	2.89
CDS-28A	CDS-28A-SS-10142015 (6-12)	10/14/2015	0.5-1	1.53
CDS-29	CDS-29-SS-08272015 (0-6")	8/27/2015	0-0.5	2.64
CDS-29	CDS-29-SS-08272015 (6-12")	8/27/2015	0.5-1	2.01
CDS-33	CDS-33-SS-08282015 (0-6")	8/28/2015	0-0.5	1.27
CDS-33	CDS-33-SS-08282015 (6-12")	8/28/2015	0.5-1	0.591
CDS-35	CDS-35-SS-08312015 (0-6")	8/31/2015	0-0.5	25.1
CDS-36	CDS-36-SS-08272015 (0-6")	8/27/2015	0-0.5	1.66

Table 1 – Soil Dioxin TEQ Concentrations (2010 on)
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Southington, Connecticut

Sample Location	Field Sample ID	Sample Date	Depth (ft. bgs)	2,3,7,8-TCDD TEQ[1] (pg/g, or ppt) (ND=1/2 RL)
CDS-37	CDS-37-SS-08272015 (0-6")	8/27/2015	0-0.5	15.6
CDS-37A	CDS-37A-SS-10142015 (0-6)	10/14/2015	0-0.5	8.82
CDS-37B	CDS-37B-SS-10142015 (0-6)	10/14/2015	0-0.5	2.45
CDS-37C	CDS-37C-SS-10142015 (0-6)	10/14/2015	0-0.5	3.05
CDS-38	CDS-38-SS-11062015 (0-6)	11/6/2015	0-0.5	61.1
CDS-38	CDS-38-SS-11062015 (6-12)	11/6/2015	0.5-1	28.6
CDS-39	CDS-39 (12-24)	3/10/2016	1-2	5.24
CDS-39	CDS-39-SS-11062015 (0-6)	11/6/2015	0-0.5	44.9
CDS-39	CDS-39-SS-11062015 (6-12)	11/6/2015	0.5-1	49.6
CDS-40	CDS-40-SS-11062015 (0-6)	11/6/2015	0-0.5	7.50
CDS-40	CDS-40-SS-11062015 (6-12)	11/6/2015	0.5-1	2.84
CDS-41	CDS-41-SS-11062015 (0-6)	11/6/2015	0-0.5	31.7
CDS-41	CDS-41-SS-11062015 (6-12)	11/6/2015	0.5-1	4.28
CDS-42	CDS-42-SS-11062015 (0-6)	11/6/2015	0-0.5	4.69
CDS-43	CDS-43-SS-11062015 (0-6)	11/6/2015	0-0.5	12.9
CDS-44[2]	BD-1215201-01	12/15/2015	0-0.5	8.06
CDS-44	CDS-44-SS-12152015 (0-6)	12/15/2015	0-0.5	8.14
CDS-45	CDS-45-SS-12152015 (0-6)	12/15/2015	0-0.5	15.1
CDS-46	CDS-46-SS-12152015 (0-6)	12/15/2015	0-0.5	2.79
CDS-47	CDS-47-SS-12152015 (0-6)	12/15/2015	0-0.5	12.4
CDS-48	CDS-48-SS-12152015 (0-6)	12/15/2015	0-0.5	12.1
CDS-49	CDS-49-SS-12152015 (0-6)	12/15/2015	0-0.5	6.64
CDS-50	CDS-50-SS-12152015 (0-6)	12/15/2015	0-0.5	7.40
CDS-57	CDS-57 (0-6)	3/10/2016	0-0.5	10.3
CDS-57	CDS-57 (12-24)	3/10/2016	1-2	2.13
CDS-58	CDS-58 (0-6)	3/10/2016	0-0.5	19.9
CDS-58	CDS-58 (12-24)	3/10/2016	1-2	6.16
CDS-59	CDS-59 (0-6)	3/10/2016	0-0.5	16.3
CDS-59	CDS-59 (12-24)	3/10/2016	1-2	2.86
CDS-59[2]	DUPLICATE-03102016	3/10/2016	0-0.5	21.9
CDS-60	CDS-60 (12-24)	3/10/2016	1-2	2.89
CDS-61	CDS-61 (0-6)	3/10/2016	0-0.5	4.90
CDS-61	CDS-61 (12-24)	3/10/2016	1-2	8.64
C-EA5-2A	EA5-2A-SS-08312015 (0-2')	8/31/2015	0-2	1.64
C-EA5-4A	EA5-4A-SS-10142015 (0-6)	10/14/2015	0-0.5	51.3
C-EA5-6A	EA5-6A-SS-08312015 (0-2')	8/31/2015	0-2	5.22

Notes:

1. TEQ concentrations are calculated using World Health Organization (WHO) 2005 Mammalian Toxic Equivalence Factors (TEFs) with non-detect congeners assigned a value of one-half the reporting limit (ND=1/2RL).
2. Result of blind duplicate analysis

ft bgs = feet below ground surface
pg/g = picograms per gram, or parts per trillion (ppt)

Table 2
Post-Excavation Confirmation Sampling Summary for Cianci Excavation Areas 1 through 4
SRSNE Superfund Site, Southington, CT

ARCADIS Design & Consultancy for natural and built assets

Excavation Area	Type of Regulatory Exceedances	Target Constituents [1]	Target Excavation			Req'd # of Samples [2]		Existing # of Samples		# of Add'l Samples Req'd		Seasonal Low Water Table Depth (ft bgs) [3]	Bottom Samples Not Required Below: [3]
			Perimeter (linear ft)	Area (ft^2)	Depth	Sidewall	Bottom	Sidewall	Bottom	Sidewall	Bottom		
EA1	PMC	**SPLP Pb**	140	1,261	2 ft bgs	3	2	5	0	0	2	~ 4	4 ft bgs (PMC)
EA2	PMC	**SVOCs** (benzo[k]fluoranthene and benzo[b]fluoranthene)	115	812	1 ft bgs	3	1	4	0	0	1	~ 3	3 ft bgs (PMC)
	RDEC	**SVOC** (benzo[b]fluoranthene)											4 ft bgs (RDEC)
EA3	PMC	**SVOCs** (benzo[k]fluoranthene and benzo[b]fluoranthene) and **metals** (Cr)	120	916	1 ft bgs	3	1	4	0	0	1	~ 3	3 ft bgs (PMC)
	RDEC	**SVOCs** (benzo[k]fluoranthene and benzo[b]fluoranthene, **PCBs**, and **metals** (Cd and Cr)						5		0	1		4 ft bgs (RDEC)
EA4	PMC	**SVOCs** (2-Methylnaphthalene, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenzofuran, fluoranthene, indeno[1,2,3-cd] pyrene, phenanthrene, pyrene) and **VOCs** (ethylbenzene)	156	1,688	2 and 4 ft bgs	4	2	6	2 [4]	0	0 [4,5]	~ 1	1 ft bgs (PMC)
	RDEC	**SVOCs** (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and indeno[1,2,3-cd]pyrene											4 ft bgs (RDEC)

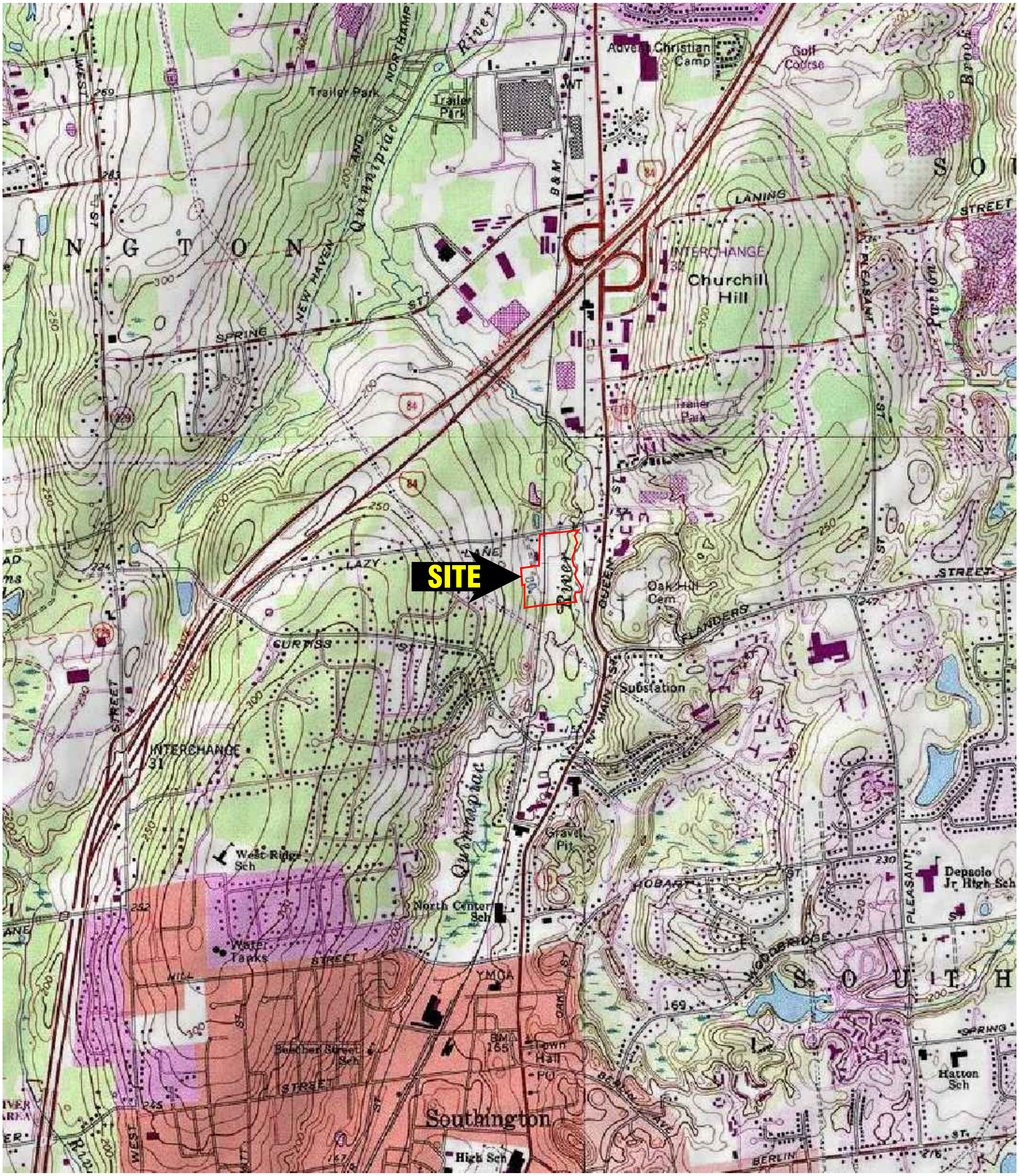
Notes:

ft bgs - feet below ground surface
in bgs - inches below grade surface
Cr - chromium
Be - beryllium
Pb - lead
Cd - cadmium

PMC - Pollutant Mobility Criteria
RDEC - Residential Direct Exposure Criteria
SVOCs - semi-volatile organic compounds
VOCs- volatile organic compounds
PCBs - polychlorinated biphenyls
SPLP - Synthetic Precipitation Leaching Procedures

1 - Target constituents refers to the constituent that exceeded cleanup goals in initial characterization sampling and therefore are subject to analysis in post-excavation verification samples.
2 - Required number of samples based on target removal limits based on delineation sampling and the following:
-- sidewall samples: one per 50 linear feet of sidewall and minimum of 3 per excavation area
-- bottom samples: one per 1,000 square feet of excavated area (no minimum)
In the event that excavation limits are modified (i.e., as a result of confirmation sampling) the number of sidewall and bottom verification samples would be modified accordingly
3 - As described in the Performance Standards (Section 2.5.3 of the RDWP), PMC-based standards apply to the depth of the seasonal low water table and RDEC based standards apply to a depth of 4 feet (with the expectation that an Environmental Land Use Restriction will be applied). Based on these criteria, these columns indicate the depth below which bottom verification samples will not be required because the associated PMC- or RDEC-based criteria no longer apply.
4 - Samples EA4-3 and EA4-4 at depths of 2-4 ft bgs serve as vertical delineation of the 2-foot removal area.
5 - The 4-ft excavation area in EA4 extends below the depth at which PMC and DEC criteria apply, so confirmation of the vertical extent of removal is not needed in this area.

FIGURES



SOURCE: TOPO!
QUAD: MERIDEN, CT
DATE: 1992

0 2000' 4000'
GRAPHIC SCALE

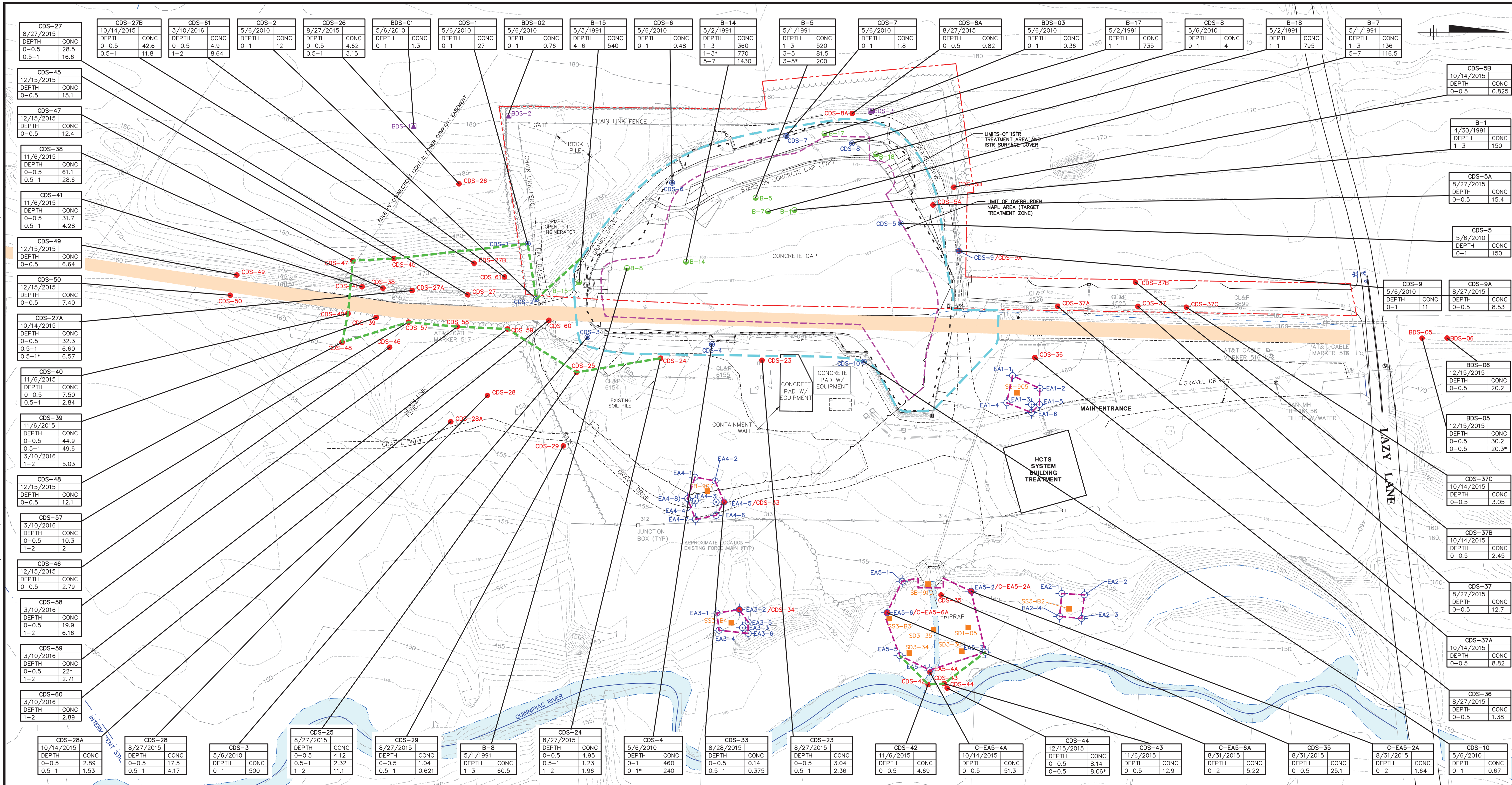
SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

CITY: MANCHESTER DIV/GROUP: ENVCAD DB: B.SMALL PM: TM:
G:\ENVCAD\Manchester\ACT\B0054634\0001\Site Location Map.dwg LAYOUT: 1 SAVED: 2/26/2016 2:45 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 2/26/2016 2:45 PM BY: SMALL, BRIAN



LEGEND:

- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- CONTOUR INDEX (162)
- CONTOUR INTERMEDIATE (160)
- ELECTRIC LINE
- GAS LINE
- OVERHEAD UTILITY LINE
- TELEPHONE LINE
- WATER LINE
- CHAINLINK FENCE
- SANITARY SEWER
- SHEET PILE CONTAINMENT WALL
- TARGET REMOVAL LIMITS BASED ON SIP DELINEATION SAMPLING
- TARGET REMOVAL LIMITS BASED ON DIOXIN SAMPLING
- PRELIMINARY RCRA CAP LIMITS (SEE NOTE 6)
- PRELIMINARY RAILTRAIL PAVING BOUNDARY
- CATCH BASIN
- UTILITY POLE
- SIP — SOIL INVESTIGATION PLAN
- BACKGROUND DIOXIN SAMPLE LOCATION PER SIP (2010)
- 1991 DIOXIN SOIL SAMPLE LOCATION

CAP DELINEATION SAMPLES

- PRIOR (2010) CAP DELINEATION SAMPLE LOCATION (SIP PHASE I & II)
- ADDITIONAL DIOXIN SAMPLE LOCATION

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SOIL SAMPLE LOCATION
- DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. SAMPLE DEPTHS ARE NOTED IN FEET BELOW GROUND SURFACE.
3. CONC = ANALYTICAL CONCENTRATIONS ARE FOR 2,3,7,8-TCDD TOXIC EQUIVALENCY (TEQ) ASSUMING A VALUE OF 1/2 THE REPORTING LIMIT FOR NON-DETECT CONGENERS, AND USING THE ESTIMATED MAXIMUM POSSIBLE CONCENTRATION WHERE APPLICABLE.
4. ALL UNITS REPORTED IN PICOGRAMS PER GRAM (pg/g) OR PARTS PER TRILLION (ppt).
5. * = ANALYTICAL RESULTS OF BLIND DUPLICATE SAMPLES
6. PRELIMINARY RCRA CAP LIMITS ARE SUBJECT TO CHANGE BASED ON ADDITIONAL DELINEATION SAMPLING RESULTS AND ENGINEERING DESIGN.
7. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.
8. ADDITIONAL SOIL SAMPLES WERE COLLECTED FOR THE PURPOSE OF THE DIOXIN INVESTIGATION, BUT ULTIMATELY NOT ANALYZED BASED ON THE ITERATIVE DELINEATION APPROACH. SAMPLE LOCATIONS THAT WERE COLLECTED BUT NOT ANALYZED ARE NOT SHOWN ON THIS FIGURE. AS A RESULT, THERE ARE GAPS IN THE CONSECUTIVE SAMPLE ID NUMBERING.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

DIOXIN SOIL SAMPLE LOCATIONS

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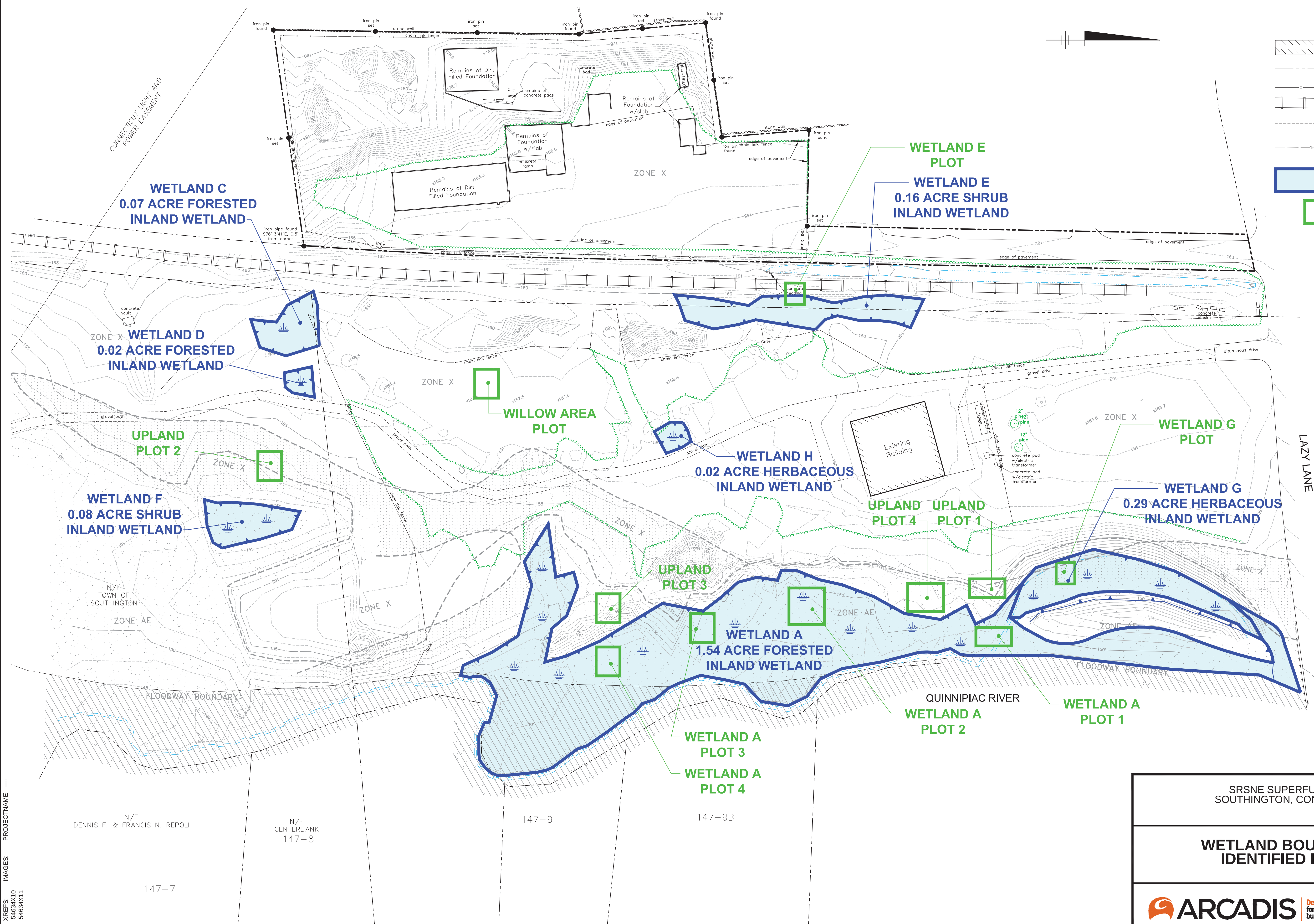
FIGURE 2



LEGEND

- EXISTING BUILDING
- APPROXIMATE SITE PROPERTY LINE
- EXISTING FENCE
- FORMER RAILROAD
- EXISTING CONTOUR MINOR
- EXISTING CONTOUR MAJOR
- WETLAND IDENTIFIED IN 2009
- TREE SURVEY PLOT LOCATION

NOTES:

1. BASEMAP INFORMATION SHOWN ON THIS DRAWING TAKEN FROM TOPOGRAPHIC SURVEY DATED JANUARY 13, 2009 BY CONKLIN AND SOROKA, INC.
2. ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
3. FLOOD BOUNDARY LOCATIONS WERE COMPILED FROM FLOOD INSURANCE RATE MAP, HARTFORD COUNTY CONNECTICUT (ALL JURISDICTIONS), PANEL 582 OF 675, MAP NUMBER 09003C0582F WITH AN EFFECTIVE DATE OF SEPTEMBER 26, 2008.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

WETLAND BOUNDARIES IDENTIFIED IN 2009

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FIGURE
3

CITY: SYRACUSE DIV/GROUP: ENVCAD DB: P. LISTER K. SARTORI L. FORAKER LD: PIC: G. CAMERON PM: J. HOLDEN TM: J. HOLDEN LYR: ON=*;OFF=*REF*
G:\ENVCAD\Manchester\ACT\B0054634\0001\54634G02.DWG LAYOUT: 3 SAVED: 2/26/2016 3:01 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 2/26/2016 3:05 PM BY: SMALL, BRIAN
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APPENDIX A

Design Drawings

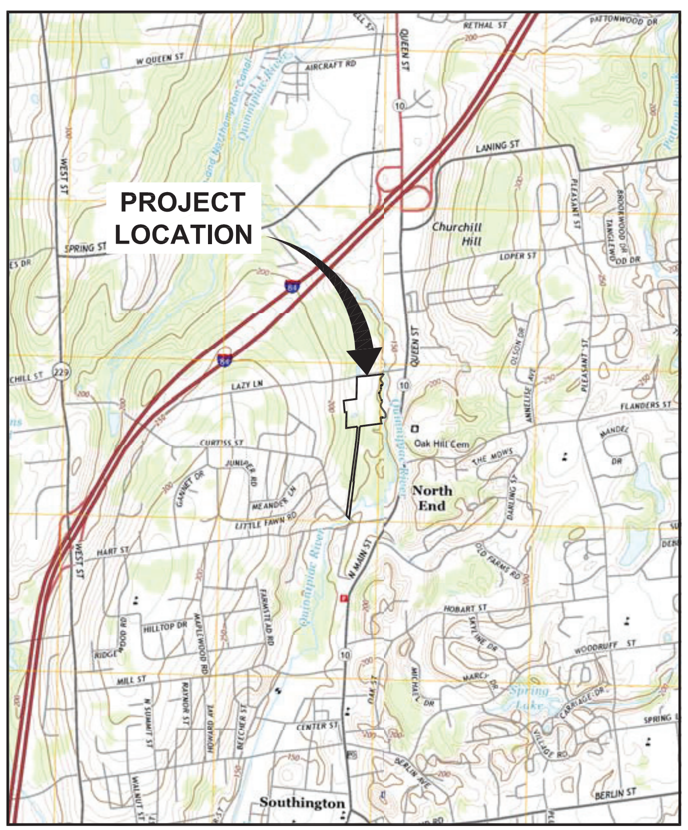
100% DESIGN DRAWINGS

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE

SOUTHINGTON, CONNECTICUT

RCRA CAP DESIGN

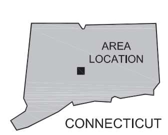
OCTOBER 2016



REFERENCE: BASE MAP USGS 7.5 MINUTE QUADRANGLE

LOCATION MAP

0 2000' 4000'
GRAPHIC SCALE



ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

INDEX TO DRAWINGS

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CT_New_Britain_20150609_TM_geo.tif
CT_Southington_20150529_TM_geo.tif

GENERAL NOTES:

1. EXISTING SITE FEATURES AND TOPOGRAPHIC INFORMATION WAS COMPILED FROM FIELD SURVEY INFORMATION BY CONKLIN AND SOROKA, INC. JANUARY 13, 2009 AND PEREIRA ENGINEERING, LLC JULY 11, 2014 AND DECEMBER 7, 2015.
2. THE ELEVATIONS DEPICTED HEREON ARE BASED UPON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).
3. NORTH AS DEPICTED HEREON IS BASED UPON CONNECTICUT STATE COORDINATE SYSTEM NAD27.
4. ALL LOCATIONS INCLUDING PROPERTY LINES ARE APPROXIMATE, REFLECT AVAILABLE INFORMATION, ARE PROVIDED FOR REFERENCE ONLY, AND ARE SUBJECT TO FIELD VERIFICATION. EASEMENTS MAY NOT BE SHOWN.
5. THE LOCATIONS OF ALL STRUCTURES/UTILITIES SHOWN ARE APPROXIMATE. INFORMATION RELATED TO SUBSURFACE CONDITIONS SHOULD BE CONSIDERED AS GENERALLY REPRESENTATIVE AND SHOULD NOT BE RELIED UPON AS A COMPLETE DEPICTION OF SITE CONDITIONS. ADDITIONAL SITE FEATURES MAY BE PRESENT THAT ARE NOT SHOWN. THE CONTRACTOR WILL VERIFY ALL EXISTING CONDITIONS, INCLUDING ABOVE–GRADE AND SUBSURFACE FEATURES WHETHER OR NOT SHOWN OR OTHERWISE DESCRIBED IN THE DOCUMENTS.
6. THE CONTRACTOR WILL COMPLY WITH ALL REQUIREMENTS OF ANY ISSUED PERMITS AND ANY APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS.
7. THE CONTRACTOR SHALL CALL "CBYD" (1–800–922–4455 OR 811) A MINIMUM OF 48 HOURS IN ADVANCE OF ANY EXCAVATION, BORING, AND/OR DIGGING TO DETERMINE THE LOCATION OF UNDERGROUND UTILITIES.
8. THE CONTRACTOR SHALL PROMPTLY NOTIFY THE OWNER AND ENGINEER, UPON DISCOVERY, AND BEFORE CONDITIONS ARE FURTHER DISTURBED, OF PHYSICAL CONDITIONS AT THE SITE WHICH DIFFER MATERIALLY FROM THOSE INDICATED ON THE CONSTRUCTION DOCUMENTS AND CONTRACT DRAWINGS. THE CONTRACTOR SHALL PROMPTLY, AFTER DISCOVERING, GIVE WRITTEN AND ORAL NOTICE TO THE OWNER AND ENGINEER OF DELAYS IN PROJECT SCHEDULE DUE TO EQUIPMENT MALFUNCTION, WEATHER, OR GENERAL FAILURE TO MEET PRODUCTION STANDARDS.
9. NO SEDIMENT & EROSION CONTROL DEVICES MAY BE REMOVED WITHOUT PRIOR APPROVAL FROM THE ENGINEER. STABILIZE ANY DISTURBED AREA AS SOON AS POSSIBLE BY PERMANENT OR TEMPORARY MEANS.
10. THE CONTRACTOR SHALL AT ALL TIMES KEEP THE CONSTRUCTION AREA FREE FROM ACCUMULATIONS OF WASTE MATERIALS OR RUBBISH; AND PRIOR TO COMPLETION OF THE WORK, REMOVE ANY RUBBISH FROM THE PREMISES AND ALL TOOLS, EQUIPMENT, AND MATERIALS.
11. ALL TEMPORARY STOCKPILES AND EXCESS MATERIAL SHALL BE REMOVED TO AN APPROVED SPOIL SITE. ALL BORROW MATERIAL SHALL BE OBTAINED FROM AN APPROVED SOURCE.
12. PERFORM ALL WORK IN ACCORDANCE WITH THE TERMS AND CONDITIONS OF THE CONTRACT AS DISCUSSED IN THE REMEDIAL ACTION WORK PLAN, 100% DESIGN REPORT, AND ASSOCIATED TECHNICAL SPECIFICATIONS, UNLESS OTHERWISE SPECIFIED IN SUBSEQUENT WRITTEN DOCUMENTATION FROM THE ENGINEER.
13. ALL EXCAVATION AND SURFACE PENETRATIONS WITHIN 10 FEET OF FIBER OPTIC LINE SHALL BE COORDINATED WITH AND PERFORMED AS DIRECTED BY THE UTILITY OWNER (AT&T).
14. WETLAND BOUNDARY DELINEATION SHOWN ON THE BASEMAPPING IS BASED ON A FIELD SURVEY PERFORMED BY ARCADIS IN JULY 2009.
15. EXISTING AND PROPOSED CONTOUR ELEVATION EQUALS ONE FOOT

ACRONYMS AND ABBREVIATIONS:

AMSL	ABOVE MEAN SEA LEVEL
APPROX	APPROXIMATE
CONC.	CONCRETE
CMP	CORRUGATED METAL PIPE
DIA	DIAMETER
E	EASTING
ELEV.	ELEVATION
FLG.	FLANGED
FT	FEET
H: V	HORIZONTAL: VERTICAL
HDPE	HIGH DENSITY POLYETHYLENE
IN	INCHES
LLDPE	LINEAR LOW DENSITY POLYETHYLENE
MAX	MAXIMUM
MIN	MINIMUM
MW	MONITORING WELL
N	NORTHING
NAD27	NORTH AMERICAN DATUM, 1927
NGVD29	NATIONAL GEODETIC VERTICAL DATUM, 1929
NTCRA	NON TIME CRITICAL REMOVAL ACTION
PE	PLAIN END
PC	POINT OF CURVATURE
PI	POINT OF INTERSECTION
PT	POINT OF TANGENCY
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
TEMP	TEMPORARY
TYP.	TYPICAL

LEGEND:

EXISTING:

- PROPERTY BOUNDARY
- 166 EXISTING GRADE CONTOUR (1–FOOT CONTOUR INTERVAL)
- GRAVEL ROAD
- FLOODWAY BOUNDARY
- RIVER/STREAM LINE
- E ELECTRIC LINE
- D DISCHARGE LINE
- G GAS LINE
- OH OVERHEAD LINE
- W WATER LINE
- ST STORM DRAIN
- S SEWER LINE
- FM FORCE MAIN LINE
- FO FIBER OPTIC LINE
- T TELEPHONE
- SOIL PILE
- EXISTING BUILDING
- TREE LINE
- RW–7 INFLUENT LINE WITH RECOVERY WELL
- CPZ–7R MONITORING WELL LOCATION
- MONITORING WELL TO BE ABANDONED BY OTHERS
- WETLAND BOUNDARY
- NTCRA 1 STEEL SHEETPILE WALL
- STONE WALL
- FENCE
- ELECTRIC PULL BOX
- FIBER OPTIC PULL BOX
- HYDRANT
- MECHANICAL BOX
- UTILITY/TELEPHONE POLE AND ACCESS
- SANITARY SEWER MANHOLE
- STORM SEWER MANHOLE
- CONCRETE

PROPOSED:

- 6" DIAMETER PERFORATED PIPE
- APPROXIMATE LIMIT OF WORK
- ASPHALT RESTORATION COVER
- CHAIN–LINK FENCE OVER CAP
- DECONTAMINATION PAD
- X / XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER
- CP–1 EXCAVATION CONTROL POINT
- GRAVEL COLLECTION TRENCH
- 156 GROUNDWATER ELEVATION CONTOUR (FT AMSL) (DASHED WHERE INFERRED)
- INLET PROTECTION
- LIMIT OF CAP AND SUBGRADE GRADING
- LIMIT OF FINAL GRADING
- V NTCRA 1 VALVE
- PEDESTRIAN FENCE
- PERMANENT EROSION CONTROL BLANKETS
- PROPOSED ANCHOR TRENCH
- PROPOSED COLLECTION PIPE AND FLOW DIRECTION
- 150 PROPOSED CONTOUR (1–FOOT CONTOUR INTERVAL)
- PROPOSED CULVERT
- PROPOSED DRAINAGE ANCHOR TRENCH AND FLOW DIRECTION
- E PROPOSED ELECTRICAL CONDUIT TRENCH
- 1' PROPOSED EXCAVATION AREA AND REMOVAL DEPTH
- PROPOSED GRADE BREAK
- PROPOSED GRAVEL ACCESS ROAD
- PROPOSED PRECAST CONCRETE MANHOLE
- PROPOSED ROCK/BOULDER LOCATION
- PROPOSED RIPRAP OUTLET PROTECTION
- PROPOSED SOLAR PANEL
- 161.3 PROPOSED SPOT ELEVATION
- PROPOSED SWALE AND FLOW DIRECTION
- REMOVABLE BOLLARD
- RCRA GRAVEL PAD IN SOLAR DEVELOPMENT AREAS
- RIGHT OF WAY
- SANDBAGS
- STATION LINE
- SILT FENCE
- STABILIZED CONSTRUCTION ENTRANCE
- STONE CHECK DAM
- TEMPORARY CONSTRUCTION FENCE
- TEMPORARY STREAM BYPASS PIPE SYSTEM

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANCIS LYR:ON=*;OFF=*REF*
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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

LEGEND, ABBREVIATIONS, AND GENERAL NOTES

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

LEGEND:

- PROPERTY BOUNDARY
- 166 EXISTING GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- GRAVEL ROAD
- RIVER/STREAM LINE
- E ELECTRIC LINE
- D DISCHARGE LINE
- G GAS LINE
- OH OVERHEAD LINE
- W WATER LINE
- ST STORM DRAIN
- S SEWER LINE
- FM FORCE MAIN LINE
- FO FIBER OPTIC LINE
- T TELEPHONE
- SOIL PILE
- EXISTING BUILDING
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- STONE WALL
- FENCE
- ELECTRIC PULL BOX
- FIBER OPTIC PULL BOX
- HYDRANT
- MECHANICAL BOX
- UTILITY/TELEPHONE POLE AND ACCESS
- SANITARY SEWER MANHOLE
- STORM SEWER MANHOLE
- CONCRETE

NOTES:

1. THE ISTR TREATMENT AREA IS COVERED WITH LOW STRENGTH, LOW DENSITY CONCRETE THAT IS NO LONGER INTACT FOLLOWING DEMOBILIZATION OF ISTR EQUIPMENT.
2. THE APPROXIMATE 100-YR. FLOOD ELEVATION IS BASED ON FLOOD INSURANCE RATE MAP (FIRM) NUMBER 09003C0582F (EFFECTIVE DATE: SEPTEMBER 26, 2008). THE FIRM FLOOD ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). THE FLOOD ELEVATION SHOWN ON THE DRAWINGS HAS BEEN CONVERTED FROM NAVD88 DATUM TO NGVD29 DATUM.

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF*
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1"=50' 50' 0 50' 100'

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
JEFFREY HOLDEN		
Professional Engineer's No. 0023403		
State: CT	Date Signed	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

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RCRA CAP 100% DESIGN

EXISTING SITE PLAN

GENERAL

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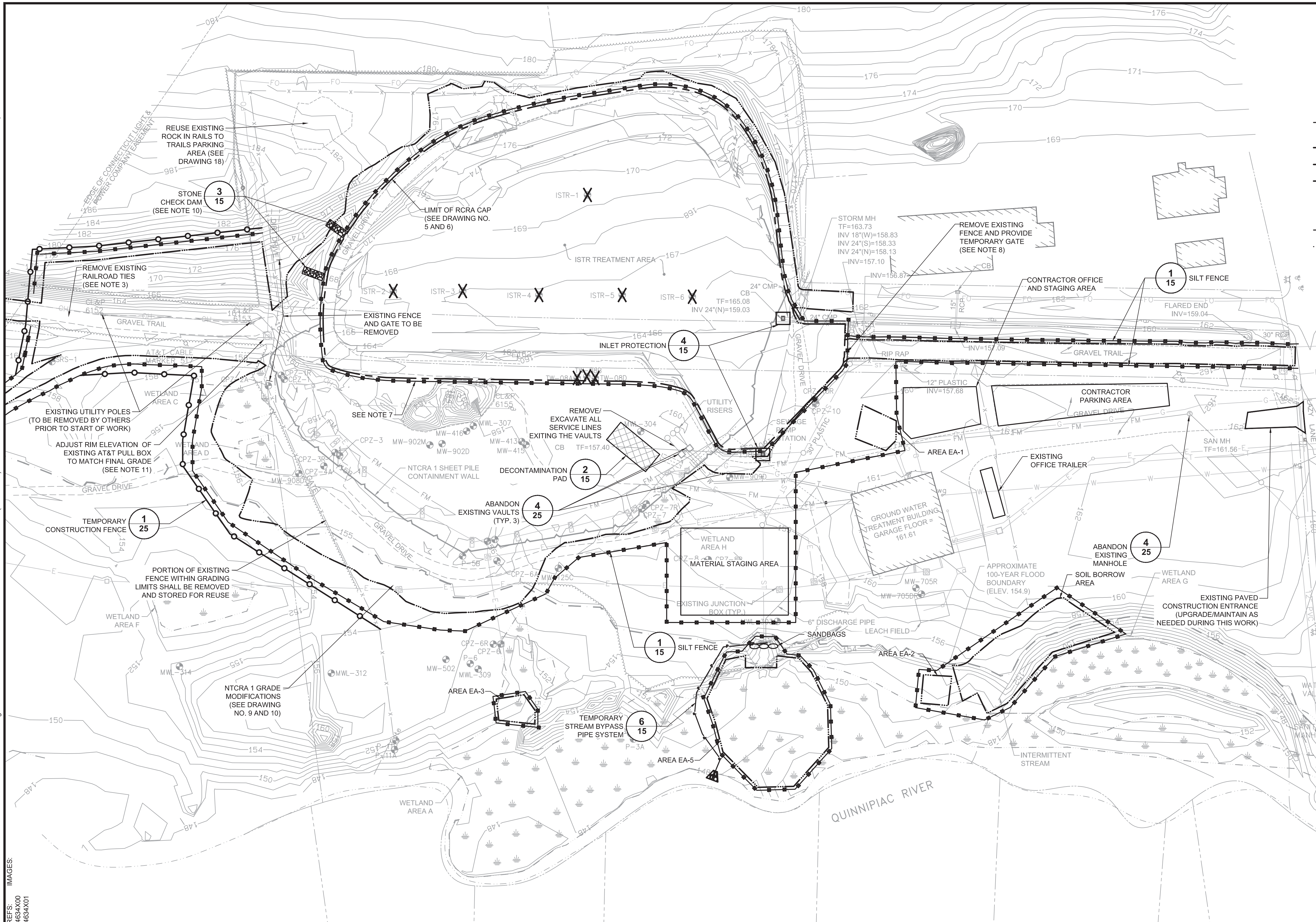
2



LEGEND:

- MONITORING WELL TO BE ABANDONED BY OTHERS
- INLET PROTECTION (4/15)
- SILT FENCE (1/15)
- LIMIT OF GRADING
- LIMIT OF RCRA CAP
- TEMPORARY CONSTRUCTION FENCE (1/25)
- STONE CHECK DAM (3/15)
- TEMPORARY STREAM BYPASS PIPE SYSTEM (4/27)
- SANDBAGS
- RIPRAP
- DECONTAMINATION PAD (2/15)
- X / X-X: DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. LOCATION OF EROSION AND SEDIMENT CONTROL FEATURES MAY VARY BASED ON SITE CONDITIONS ENCOUNTERED AT THE TIME OF CONSTRUCTION. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES ARE SHOWN ON THE RAILS TO TRAILS SITE PLAN DRAWINGS.
3. REMOVE EXISTING RAILROAD TIES FROM RAIL TO TRAILS SECTION FROM CAP AREA TO CURTISS STREET. CONTRACTOR SHALL DISPOSE OF EXISTING TIES AT AN OFFSITE DISPOSAL FACILITY APPROVED BY THE OWNER.
4. WORK LIMITS SHALL BE 5 FEET FROM THE GRADING LIMIT OR AT THE SILT FENCE/CONSTRUCTION FENCE LOCATION WHERE SHOWN.
5. ALL EXISTING MONITORING WELLS SHALL BE PROTECTED FROM DAMAGE DURING CONSTRUCTION ACTIVITIES. ANY DAMAGE SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE.
6. CLEAR AND GRUB AS NEEDED WITHIN WORK AREA TO IMPLEMENT THIS WORK.
7. INSTALL SILT FENCE AT RCRA CAP LIMITS PRIOR TO CONSOLIDATION OF EXCAVATED FILL MATERIALS IN THE CAP AREA AND LEAVE FENCE IN PLACE UNTIL UPGRADIENT CONSOLIDATION AREAS ARE CAPPED OR EXPOSURE OF CONSOLIDATED MATERIALS TO STORMWATER RUNOFF IS ELIMINATED.
8. TEMPORARY GATE SHALL BE OF SIMILAR CONSTRUCTION TO EXISTING SITE PERIMETER FENCING. THE GATE SHALL BE LOCKABLE AND OF SUFFICIENT WIDTH TO ALLOW FOR PASSAGE OF CONSTRUCTION EQUIPMENT.
9. CONTRACTOR TO VERIFY EXISTING DRAIN CATCH BASIN LOCATION, AS WELL AS RIM AND INVERT ELEVATIONS PRIOR TO COMMENCEMENT OF DRAINAGE WORK AND ORDERING OF DRAIN PIPE AND STRUCTURE MATERIALS. ANY DISCREPANCIES IDENTIFIED BY THE CONTRACTOR SHALL BE BROUGHT TO THE ATTENTION OF THE CONSTRUCTION MANAGER.
10. INSTALL DITCH CHECK DAMS UPON COMPLETION OF FINAL GRADING FOR PROPOSED CHANNEL AS SHOWN ON DRAWING 6.
11. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD, KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANCIS LYR:ON=*;OFF=*REF*
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XREFS: 54634X00 54634X01 IMAGES:

1"=50' — 50' 0 50' 100'

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

FOR FINAL 100% DESIGN

ARCADIS — Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT
RCRA CAP 100% DESIGN

SITE PREPARATION PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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PO BOX 66
SYRACUSE, NEW YORK
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3

EXCAVATION CONTROL POINT	NORTHING	EASTING
1	286749.00	565539.32
2	286776.52	565541.83
3	286780.02	565512.37
4	286751.65	565510.66
5	286682.84	565272.24
6	286713.74	565284.47
7	286723.74	565274.47
8	286724.25	565254.41
9	286690.05	565238.33
10	286584.59	565624.32
11	286620.72	565623.30
12	286656.06	565584.01
13	286638.32	565507.82
14	286603.51	565491.53
15	286603.51	565503.52
16	286571.99	565503.52
17	286571.99	565491.47
18	286552.16	565495.42
19	286533.15	565534.62
20	286549.20	565588.32
21	286323.10	565556.60
22	286359.45	565560.50
23	286359.45	565546.40
24	286348.48	565530.86
25	286320.51	565535.15
26	286293.48	565417.84
27	286319.41	565413.02
28	286329.41	565396.37
29	286318.11	565369.86
30	286293.05	565365.20
31	286283.88	565392.00
32	286293.48	565394.81
33	286319.41	565396.37
34	286276.02	565212.23
35	286145.04	565234.24
36	286058.63	565180.03
37	285995.83	565177.15
38	285934.78	565171.48
39	285851.79	565196.71
40	285859.15	565160.75
41	285865.12	565094.62
42	285916.68	565092.04
43	286083.90	565073.54
44	286094.43	565142.75
45	286156.30	565086.09
46	286625.58	565494.02
47	286654.82	565541.63
48	286604.95	565516.32
49	286587.6783	565562.8300
50	286626.7583	565582.7171
51	286586.6092	565606.4111

LEGEND:

- LIMIT OF RCRA CAP
- 1' PROPOSED EXCAVATION AREA AND REMOVAL DEPTH (SEE NOTE 9)
- 8 EXCAVATION CONTROL POINT

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. EXCAVATED MATERIAL FROM AREAS SHOWN ON THIS DRAWING SHALL BE CONSOLIDATED BENEATH RCRA CAP AND USED TO CREATE CAP SUBGRADE (SHOWN ON DRAWING 5).
3. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING SAFE AND ADEQUATE VEHICLE/EQUIPMENT ACCESS AND EGRESS TO THE EXCAVATION AREA TO FACILITATE THE EXCAVATION OF MATERIALS TO THE HORIZONTAL AND VERTICAL LIMITS IDENTIFIED ON THIS DRAWING OR AS DIRECTED BY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE APPROPRIATELY SIZED VEHICLES/EQUIPMENT TO EXCAVATE, LOAD, AND TRANSPORT WASTE MATERIALS.
4. ALL DEWATERING, STABILIZATION, MIXING, SEGREGATION, AND/OR SIZE REDUCTION OF EXCAVATED MATERIALS SHALL BE CONDUCTED WITHIN THE LIMITS OF THE EXCAVATION AREA. DUST SUPPRESSION SHALL BE EMPLOYED, AS NECESSARY AND TO THE SATISFACTION OF THE OWNER/ENGINEER, DURING THESE ACTIVITIES.
5. THE CONTRACTOR SHALL USE APPROPRIATE MEANS AND METHODS TO TRANSPORT EXCAVATED MATERIALS TO THE RCRA CAP AREA WITHOUT SPILLAGE OF SOILS OR LIQUIDS.
6. THE OWNER OR OWNER'S REPRESENTATIVE WILL PERFORM WORK ZONE AND PERIMETER AIR MONITORING FOR ORGANIC VAPORS AND PARTICULATES DURING ALL INTRUSIVE AND/OR POTENTIAL DUST GENERATING ACTIVITIES (E.G., INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES, GRADING, TRENCHING, SHORING, ETC.). CONTRACTOR SHALL MODIFY PROCEDURES OR PROVIDE CONTROLS AS DIRECTED TO MAINTAIN COMPLIANCE WITH PROJECT SPECIFIED ACTION LEVELS.
7. THE CONTRACTOR SHALL HAVE APPROPRIATE TRAFFIC CONTROLS (E.G., FLAG MEN, SIGNS, ETC.) IN PLACE AND SHALL COORDINATE THE HAULING OF IMPORTED BACKFILL MATERIAL ON PUBLIC ROADWAYS.
8. DEBRIS TO BE CONSOLIDATED BENEATH THE CAP SHALL BE SIZED TO LESS THAN 6" IN LARGEST DIMENSION AND SHALL NOT CONTAIN LOOSE OR PROTRUDING METAL. THE DEBRIS PILE SHALL BE REMOVED TO APPROXIMATELY 4" BELOW SURROUNDING GRADE AND RESTORED WITH 4" OF TOPSOIL OR OTHER MEASURES AS SPECIFIED ON DRAWING 13. LARGER DEBRIS SHALL BE CONSOLIDATED AT THE BASE OF TERRACE LOCATIONS AS SHOWN ON DRAWING 7.
9. CERTAIN EXCAVATION AREAS ARE SUBJECT TO BOTTOM AND/OR SIDEWALL CONFIRMATION SAMPLING UPON REMOVAL TO TARGET LIMITS. CONFIRMATION SAMPLING WILL BE PERFORMED BY OTHERS, BUT THE CONTRACTOR SHALL FACILITATE THE SAMPLING AND ANTICIPATE THAT ADDITIONAL REMOVAL MAY BE REQUIRED BASED ON SAMPLE RESULTS.
10. POTENTIALLY IMPACTED WATER GENERATED DURING THE PROJECT (E.G., FROM WATER TABLE DEPRESSION, THE DEWATERING OF SOILS, DECONTAMINATION OF EQUIPMENT, ETC.) SHALL BE COLLECTED, CONTAINERIZED, AND CONVEYED FOR SUBSEQUENT TREATMENT.

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XREFS: 54634X00 54634X01 IMAGES:

50' 0 50' 100'
1"=50'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
JEFFREY HOLDEN		
Professional Engineer's No. 0023403		
State: CT	Date Signed	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

EXCAVATION PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

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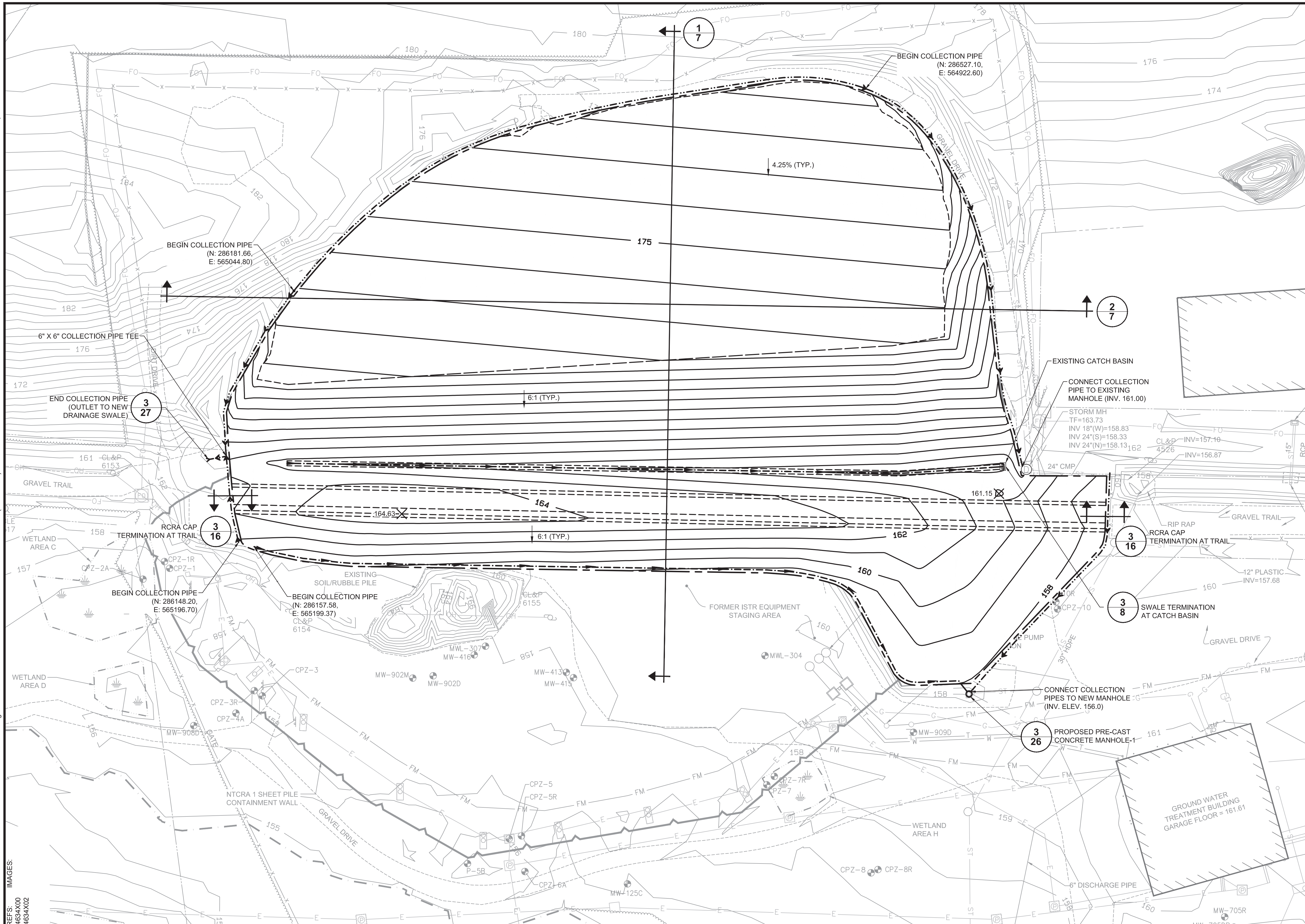

LEGEND:

- 150 — PROPOSED SUBGRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF RCRA CAP AND SUBGRADE GRADING
- PROPOSED ANCHOR TRENCH
- PROPOSED DRAINAGE ANCHOR TRENCH AND FLOW DIRECTION
- PROPOSED COLLECTION PIPE AND FLOW DIRECTION
- PROPOSED PRE-CAST CONCRETE MANHOLE (3/26)
- 161.15 X PROPOSED SUBGRADE SPOT ELEVATION
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED GRADES/ELEVATIONS SHOWN REPRESENT TOP OF SUBGRADE (I.E., BOTTOM OF GEOSYNTHETICS) AFTER CONSOLIDATION OF TARGET EXCAVATION AREAS AND GRADING.
3. ELECTRONIC FILES CONTAINING SURVEY CONTROL POINTS AND LAYOUT FOR THE RCRA CAP AND SITE GRADING WILL BE FURNISHED TO CONTRACTOR FOLLOWING AWARD OF THE PROJECT.

30' 0 30' 60'
1"=30'

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

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ARCADIS U.S., INC.

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RCRA CAP 100% DESIGN

CAP SUBGRADE GRADING PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

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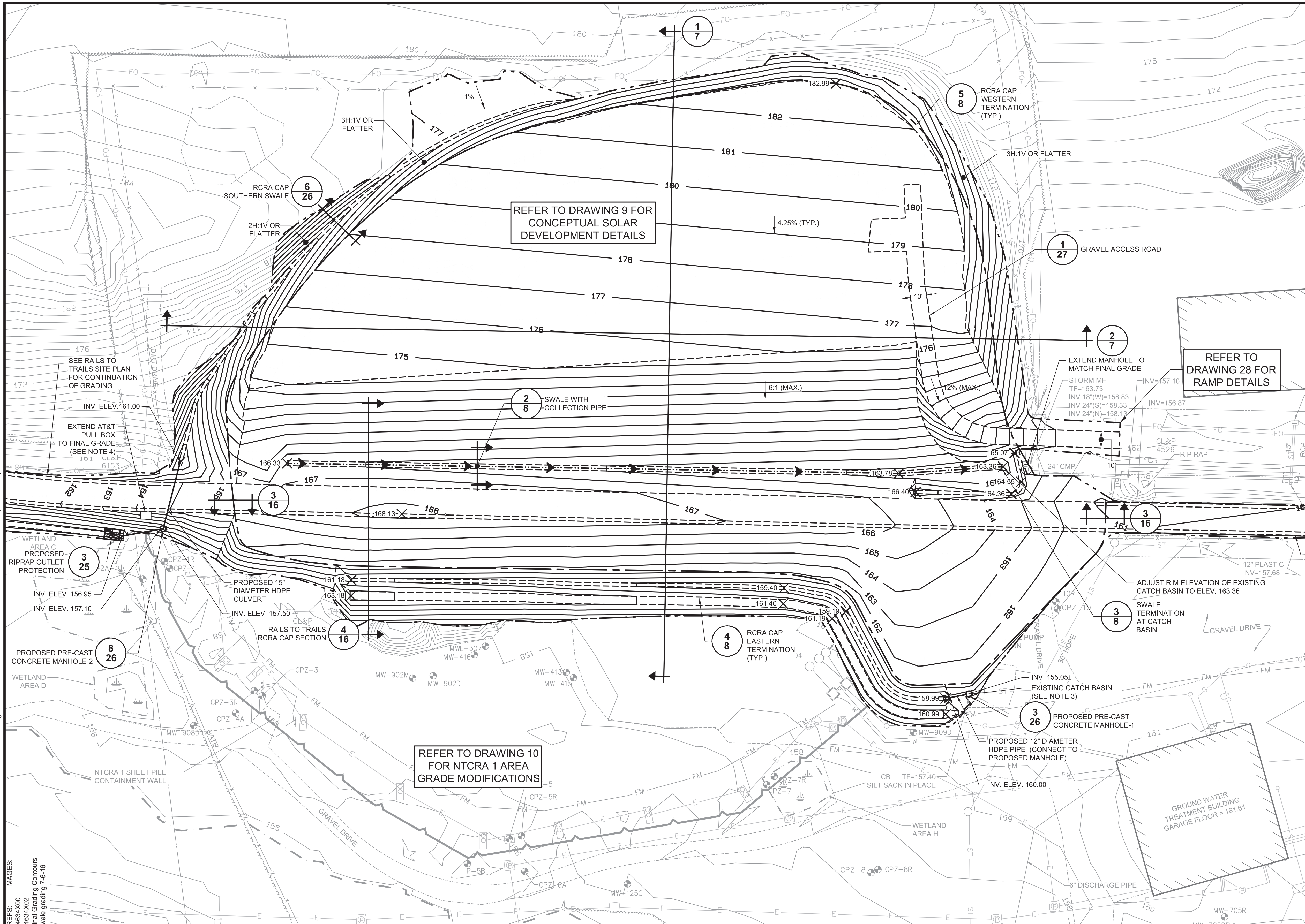

LEGEND:

- 150 — PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF FINAL GRADING
- LIMIT OF RCRA CAP
- PROPOSED SWALE AND FLOW DIRECTION (2/8)
- PROPOSED CULVERT
- PROPOSED PRE-CAST CONCRETE MANHOLE (3/26) (8/26)
- PROPOSED RIPRAP OUTLET PROTECTION (3/25)
- 161.15 × PROPOSED FINAL GRADE SPOT ELEVATION
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. REMOVE EXISTING CATCH BASIN AND INSTALL NEW MANHOLE.
4. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD, KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF* G:\ENVCAD\Manchester\ACT\B0054634\0001\03900\DWG\CONTRACT\54634G06.dwg LAYOUT: 6 SAVED: 10/10/2016 5:05 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: LD2B-PDF PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 10/14/2016 11:53 AM BY: SMALL, BRIAN

XREFS: 54634X00 54634X02 IMAGES: Final Grading Contours swale grading 7-6-16

30' 0 30' 60'
1"=30'

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

FOR FINAL 100% DESIGN

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SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT
RCRA CAP 100% DESIGN

CAP FINAL GRADING AND DRAINAGE PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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TEL. 315.446.9120

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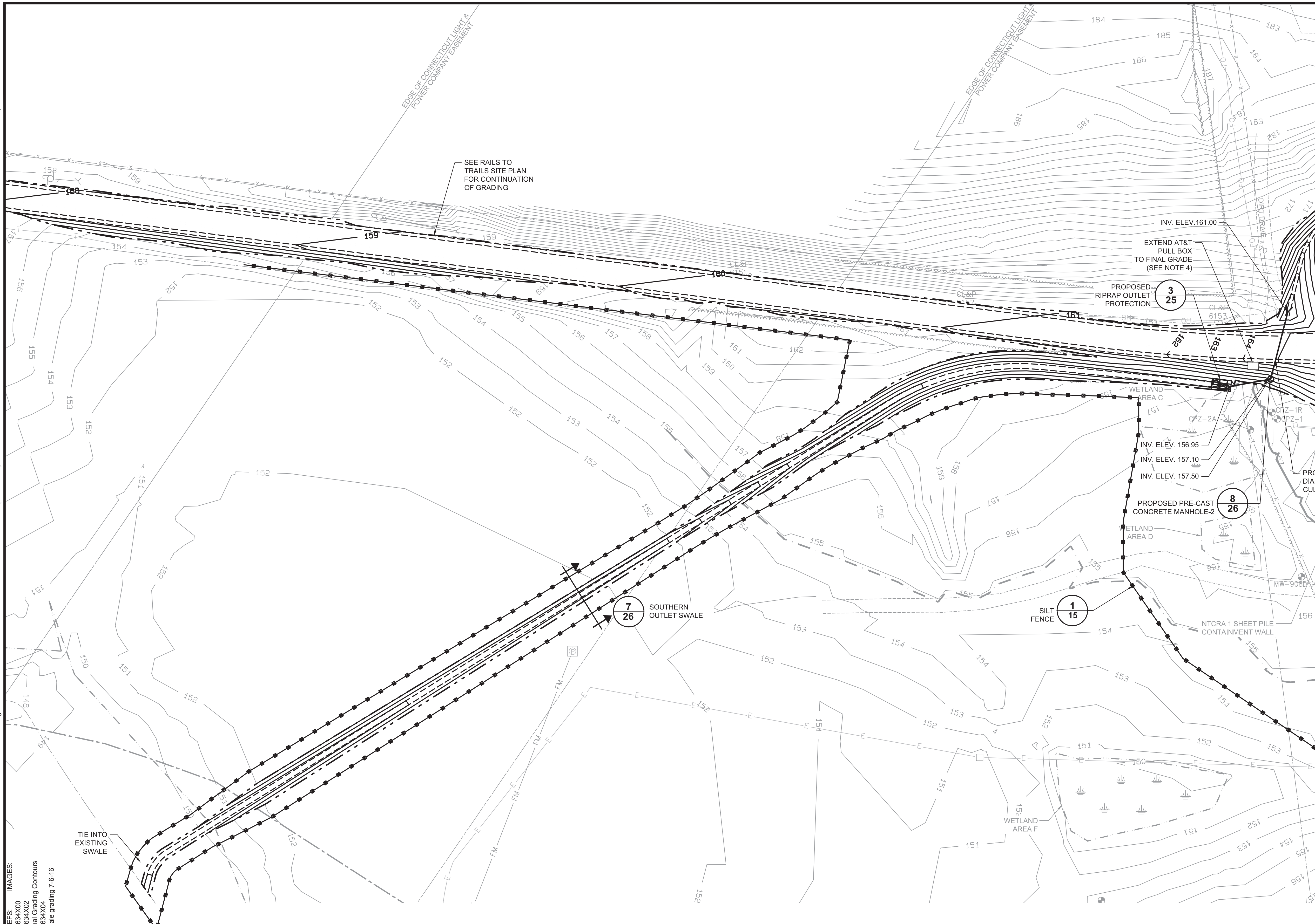

LEGEND:

150	PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
	PROPOSED GRADE BREAK
	LIMIT OF FINAL GRADING
	SILT FENCE (1/15)
	PROPOSED PRE-CAST CONCRETE MANHOLE (8/26)
	PROPOSED CULVERT
	PROPOSED RIPRAP OUTLET PROTECTION
X/XX	DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. REMOVE EXISTING CATCH BASIN AND INSTALL NEW MANHOLE.
4. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

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30' 0 30' 60'
1"=30'

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Professional Engineer's Name: JEFFREY HOLDEN		
Professional Engineer's No.: 0023403		
State: CT	Date Signed	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

FOR FINAL 100% DESIGN

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RCRA CAP 100% DESIGN

FINAL GRADING AND DRAINAGE PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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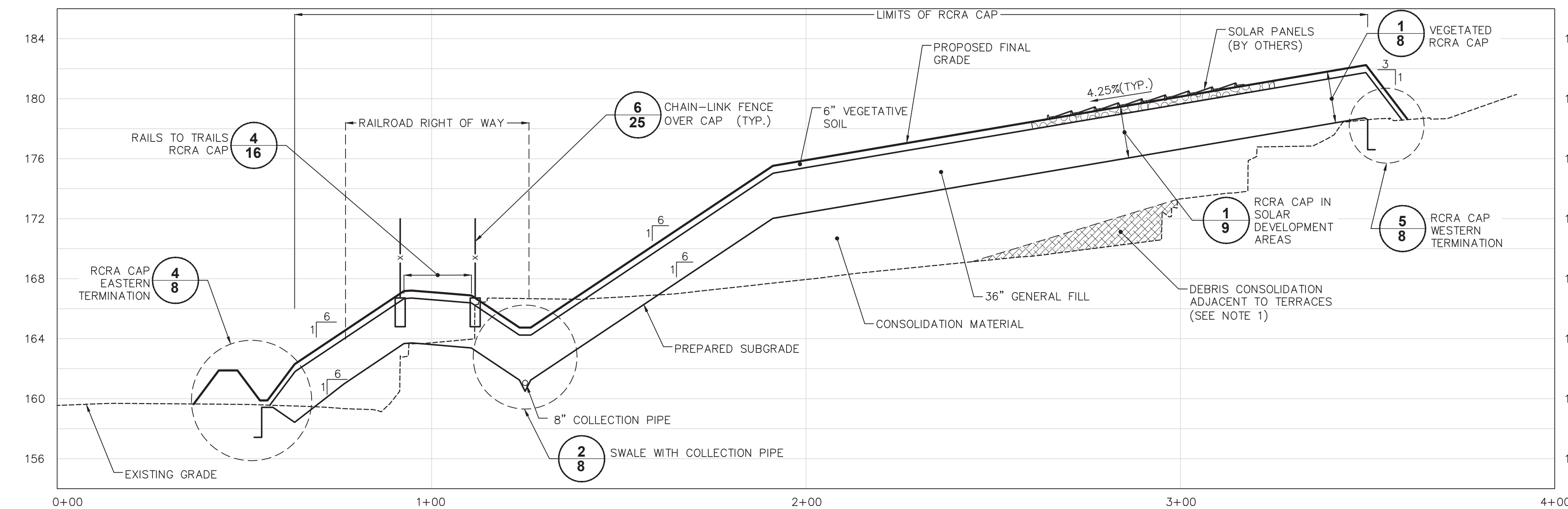
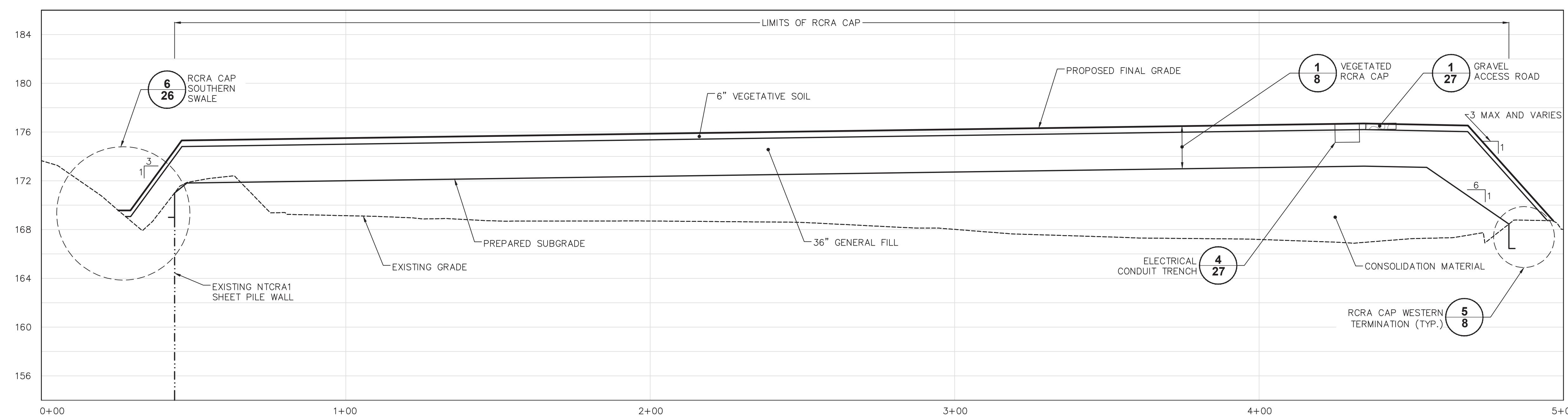


CROSS SECTION 1

0 20' 40'
HORIZONTAL SCALE: 1"=20'
0 5' 10'
VERTICAL SCALE: 1"=5'



CROSS SECTION 2

0 20' 40'
HORIZONTAL SCALE: 1"=20'
0 5' 10'
VERTICAL SCALE: 1"=5'

NOTES:

1. CONSOLIDATE OVERSIZE MATERIAL (>3" IN LARGEST DIMENSION) FROM DEBRIS PILES AND EXCAVATION AREAS ADJACENT TO TERRACES.

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SCALE(S) AS INDICATED

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Professional Engineer's Name: JEFFREY HOLDEN
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CAP CROSS SECTIONS

GENERAL

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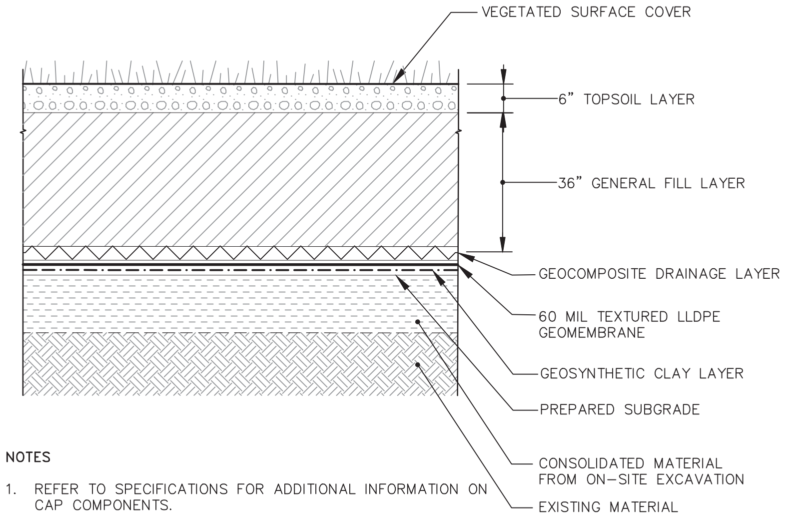
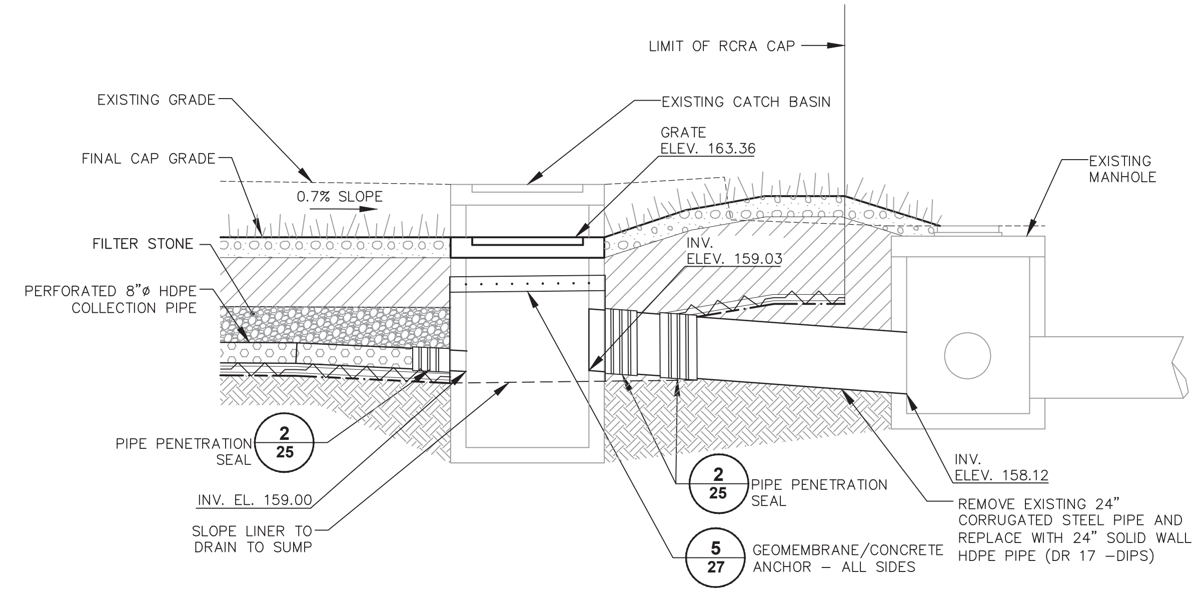


NOTES

1. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION ON CAP COMPONENTS.
2. THE TOTAL THICKNESS OF FILL MATERIALS ABOVE THE ENGINEERED BARRIER GEOSYNTHETICS SHALL BE A MINIMUM OF 42". THE CONTRACTOR SHALL DEMONSTRATE (THROUGH SURVEY AND TEST HOLE THICKNESS MEASUREMENTS) THE ACHIEVEMENT OF THIS MINIMUM THICKNESS IN ACCORDANCE WITH THE PROJECT REQUIREMENTS.

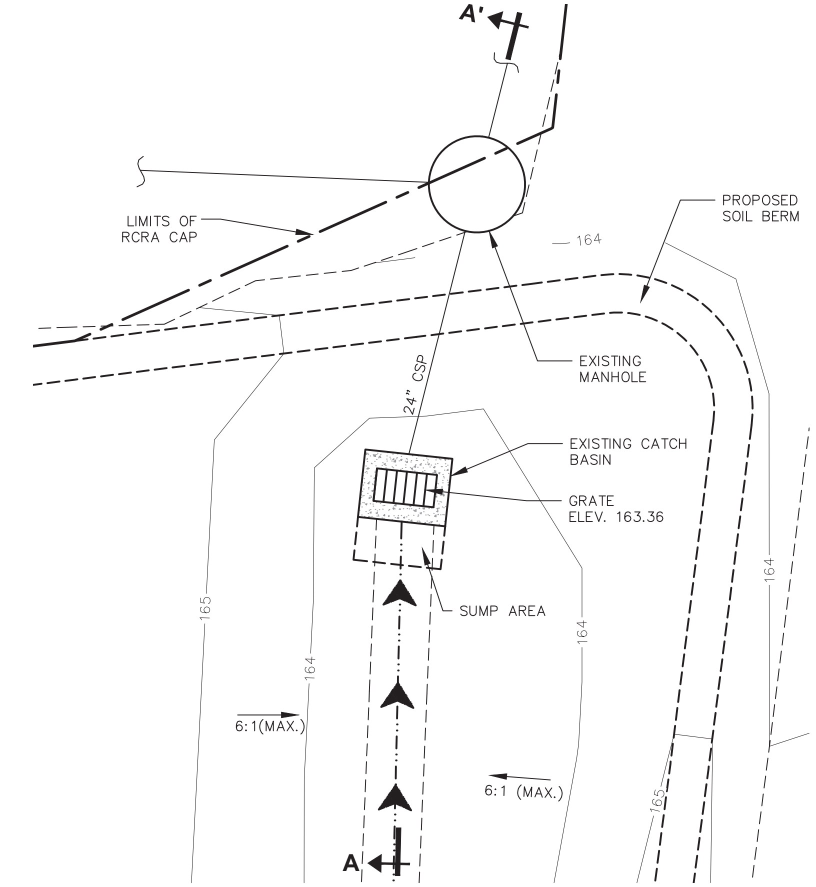
VEGETATED RCRA CAP 1

NOT TO SCALE



SECTION A-A'

NOT TO SCALE

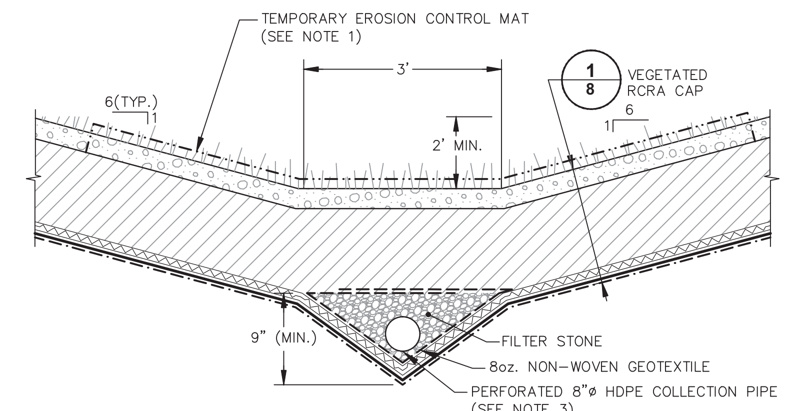


PLAN

SCALE: 1"=5'

SWALE TERMINATION AT CATCH BASIN 3

NOT TO SCALE

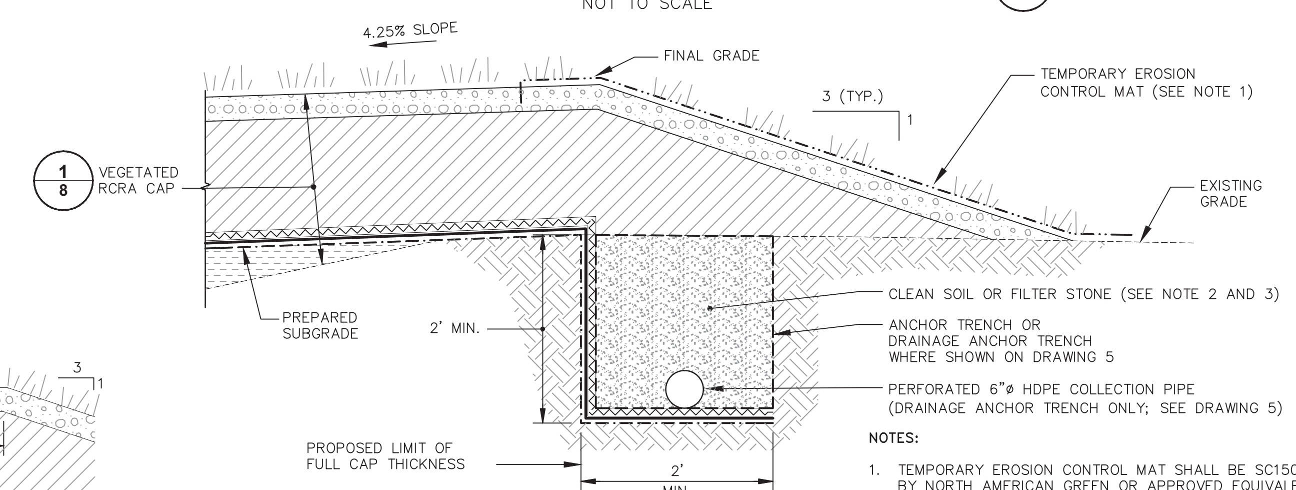


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. MINIMUM DITCH INVERT GRADIENT SHALL BE 0.7%.
3. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT.

SWALE WITH COLLECTION PIPE 2

NOT TO SCALE

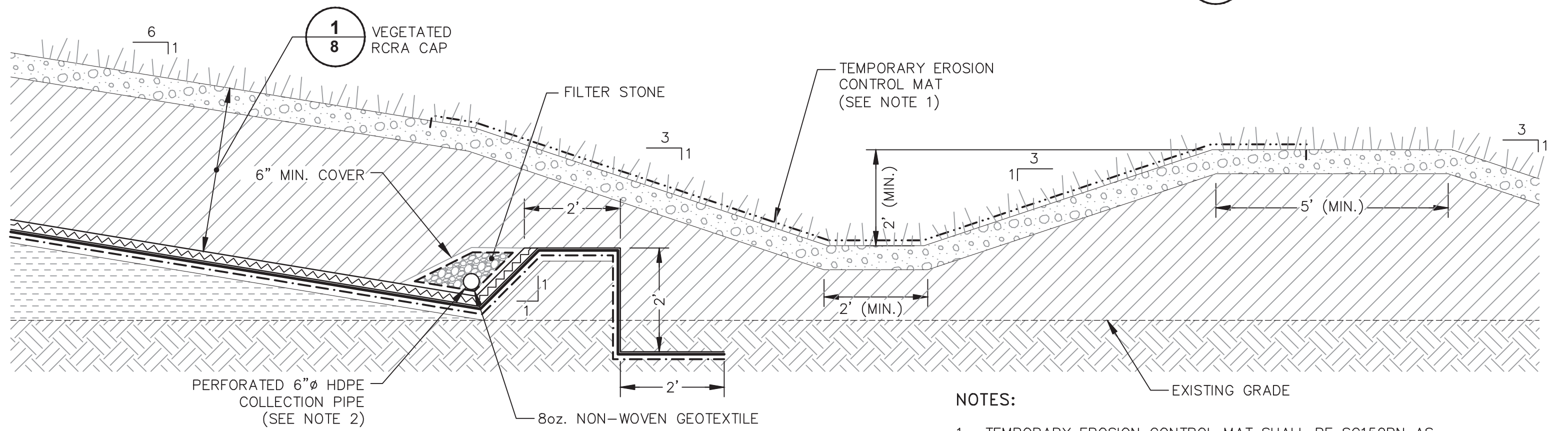


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.
2. ANCHOR TRENCH SHALL BE BACKFILLED WITH CLEAN SOIL FILL.
3. DRAINAGE ANCHOR TRENCH SHALL BE BACKFILLED WITH FILTER STONE WRAPPED IN NON-WOVEN FILTER GEOTEXTILE OVERLAPPED THE FULL WIDTH OF THE TRENCH.
4. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT. MINIMUM PIPE SLOPE SHALL BE 0.5%. COLLECTION PIPE FITTINGS, ELBOWS, AND CONNECTIONS SHALL BE MADE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RCRA CAP WESTERN TERMINATION 5

NOT TO SCALE



NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT.

RCRA CAP EASTERN TERMINATION 4

NOT TO SCALE

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF*
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SCALE(S) AS INDICATED

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

CAP DETAILS

GENERAL

ARCADIS Project No. B0054634.0001.03900

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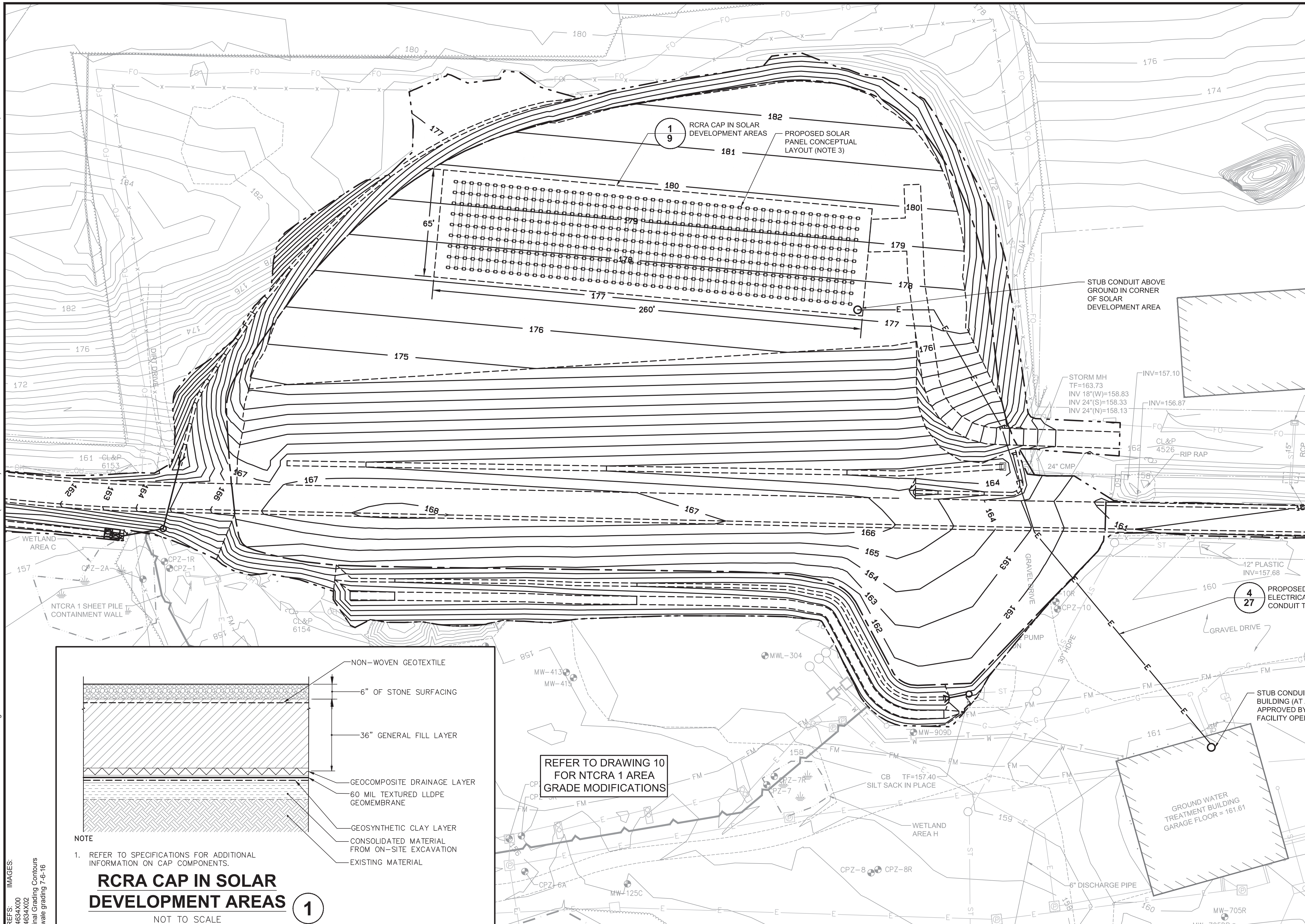

LEGEND:

- 150 — PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- E — PROPOSED ELECTRICAL CONDUIT TRENCH
- LIMIT OF FINAL GRADING
- LIMIT OF RCRA CAP
- PROPOSED SOLAR PANEL
- X / XX — DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. PROPOSED SOLAR LAYOUT SHOWN FOR CLARITY. THIS CONTRACT INCLUDES CONSTRUCTION OF GRAVEL PAD AREA AND INSTALLATION OF CONDUIT ONLY. SOLAR COMPONENTS TO BE INSTALLED BY OTHERS AS PART OF FUTURE CONTRACT.

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD, KLS LD: B.DeCLERCQ PIC:/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF*
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XREFS: 54634X00 54634X02 Final Grading Contours swale grading 7-6-16 IMAGES:

30' 0 30' 60'
1"=30'

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Professional Engineer's Name: JEFFREY HOLDEN		
Professional Engineer's No.: 0023403		
State: CT	Date Signed:	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

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SOLAR PANEL CONCEPTUAL LAYOUT PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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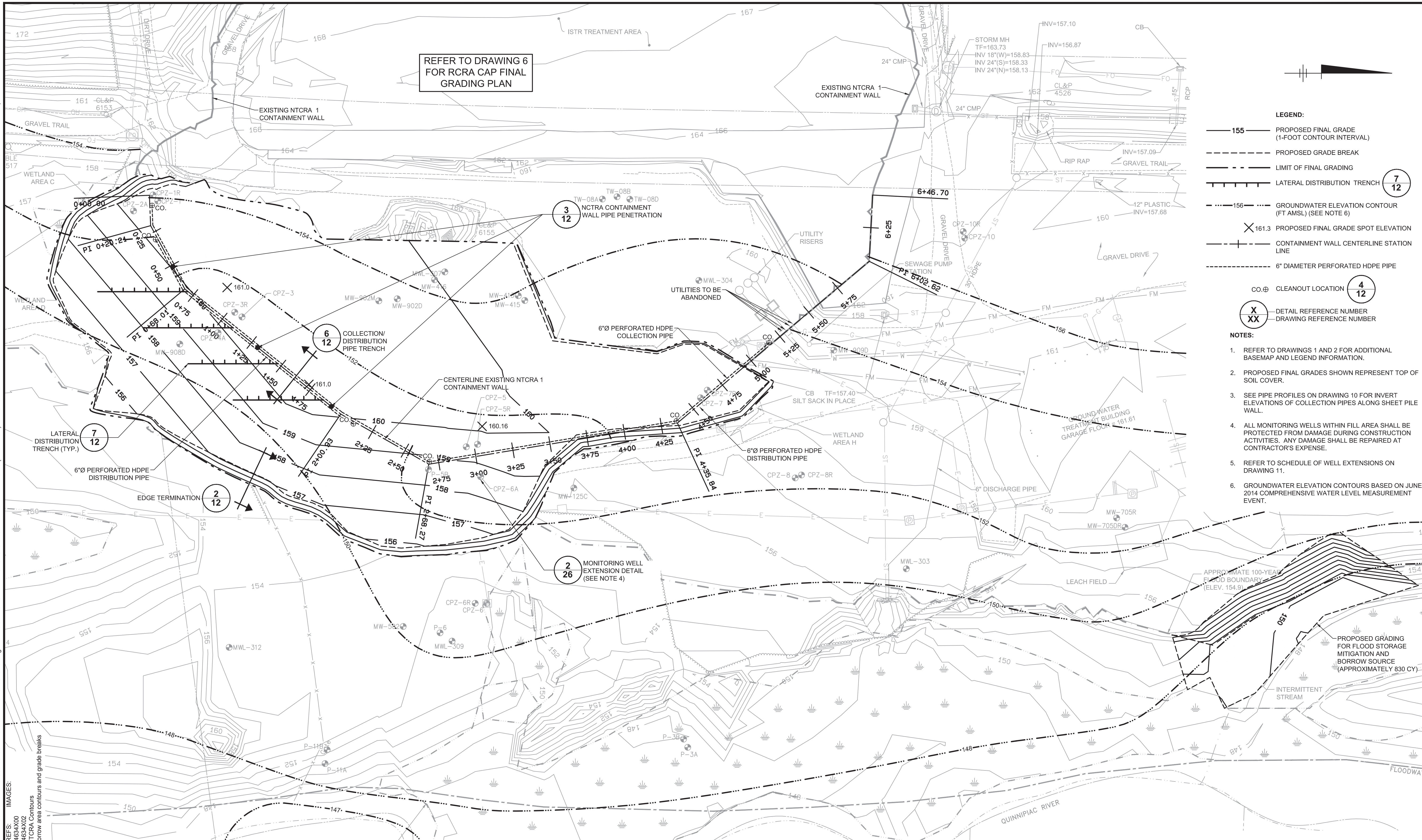

LEGEND:

155	PROPOSED FINAL GRADE (1-FOOT CONTOUR INTERVAL)
	PROPOSED GRADE BREAK
	LIMIT OF FINAL GRADING
	LATERAL DISTRIBUTION TRENCH (7/12)
156	GROUNDWATER ELEVATION CONTOUR (FT AMSL) (SEE NOTE 6)
X 161.3	PROPOSED FINAL GRADE SPOT ELEVATION
	CONTAINMENT WALL CENTERLINE STATION LINE
	6" DIAMETER PERFORATED HDPE PIPE
CO.	CLEANOUT LOCATION (4/12)
X/XX	DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF SOIL COVER.
3. SEE PIPE PROFILES ON DRAWING 10 FOR INVERT ELEVATIONS OF COLLECTION PIPES ALONG SHEET PILE WALL.
4. ALL MONITORING WELLS WITHIN FILL AREA SHALL BE PROTECTED FROM DAMAGE DURING CONSTRUCTION ACTIVITIES. ANY DAMAGE SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE.
5. REFER TO SCHEDULE OF WELL EXTENSIONS ON DRAWING 11.
6. GROUNDWATER ELEVATION CONTOURS BASED ON JUNE 2014 COMPREHENSIVE WATER LEVEL MEASUREMENT EVENT.

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XREFS: 54634X00 54634X02 IMAGES: NTCRA Contours borrow area contours and grade breaks

30' 0 30' 60'
1"=30'

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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NTCRA 1 AREA GRADE MODIFICATIONS

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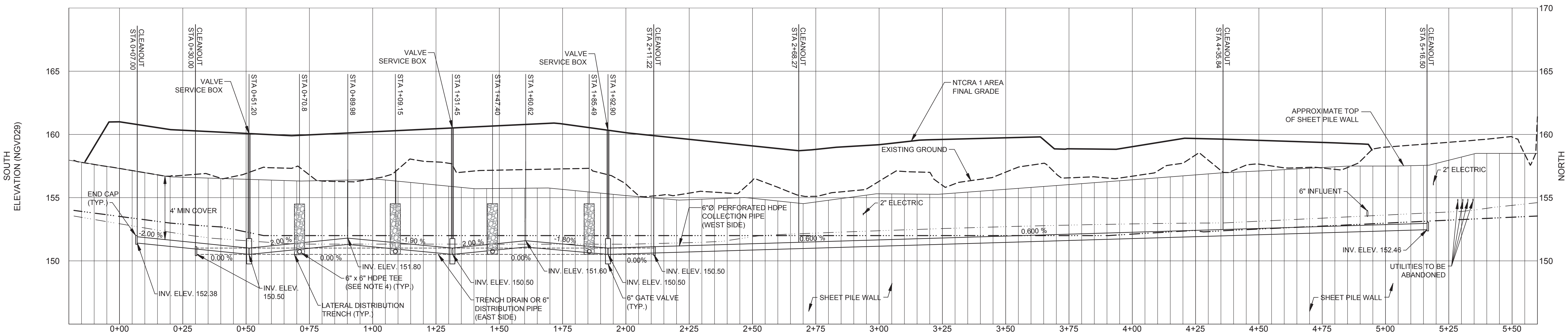

SCHEDULE OF WELL EXTENSIONS

WELL ID	CURRENT MPE (FEET)	PROPOSED GRADE (FEET)	APPROX. EXTENSION LENGTH (FEET)
CPZ-1	159.64	160.99	3.9
CPZ-1R	161.12	160.98	2.4
CPZ-2A	156.34	160.26	6.4
CPZ-3	159.21	160.74	4.0
CPZ-3R	160.70	160.66	2.5
CPZ-4A	159.44	159.81	2.9
CPZ-5	158.68	159.46	3.3
CPZ-5R	158.30	159.58	3.8
CPZ-6A	158.05	159.62	4.1
CPZ-7	159.40	159.47	2.6
CPZ-7R	158.58	159.43	3.3
MW-413	160.49	159.74	1.8
MW-415	160.75	159.73	1.5
MW-416	159.98	160.01	2.5
MW-902D	159.96	160.24	2.8
MW-902M	160.39	160.35	2.5
MW-908D	159.85	158.56	1.2
MWL-304	159.90	157.87	0.0
MWL-307	159.14	159.95	3.3
P-5B	154.91	158.55	6.14

NOTES:

1. MPE - MEASURING POINT ELEVATION
2. WELL EXTENSIONS TARGET A STICK-UP HEIGHT OF 2 TO 3 FEET ABOVE PROPOSED GRADE.
3. SEE WELL EXTENSION DETAIL ON DRAWING 26.
4. PROVIDE 6" x 6" HDPE TEE AND STUB DISTRIBUTION PIPE INTO LATERAL TRENCH WITH 5' OF 6" DIAMETER PERFORATED PIPE AND END CAP.

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VERTICAL SCALE 4' 0 4' 8'

HORIZONTAL SCALE 20' 0 20' 40'

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No.	Date	Revisions	By	Ckd
1	08/08/16	ADDENDUM NO. 1- REVISED PIPE START STATIONING	JEM	JSH

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JEM
Designed by: NWF | Drawn by: BS | Checked by: JEM

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NTCRA 1 AREA PIPE PROFILES

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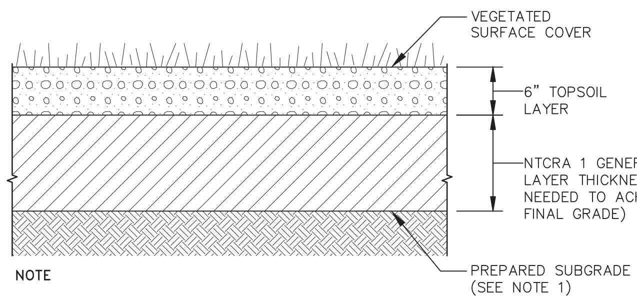
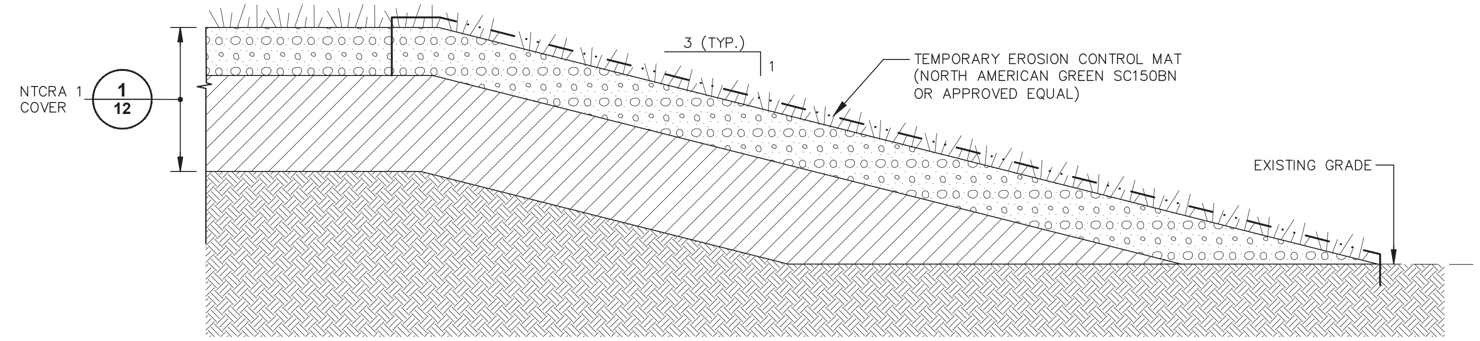


NOTE

1. PREPARED SUBGRADE SHALL BE COMPRISED OF IN-PLACE OR ON-SITE SOILS AND SHALL BE CLEARED OF ALL VEGETATION AND DEBRIS AND COMPACTED BY PROOF-ROLLING. THE SUBGRADE SHALL BE ACCEPTABLE WHEN DEFORMATIONS CAUSED BY A ROLLER ARE NOT DEEPER THAN 1 INCH. ALL SOFT OR WET MATERIALS THAT CONTINUE TO DEFORM MORE THAN 1 INCH SHALL BE REMOVED AND REPLACED.

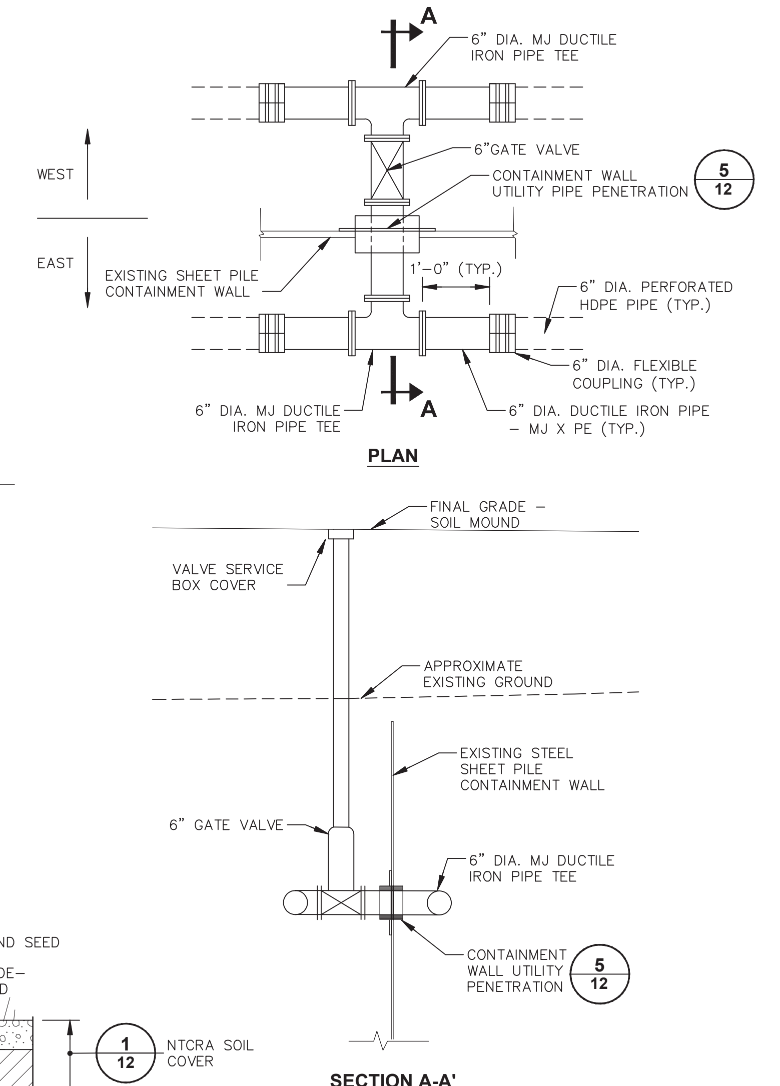
NTCRA 1 SOIL COVER (1)

NOT TO SCALE



TYPICAL NTCRA 1 AREA EDGE TERMINATION DETAIL (2)

NOT TO SCALE

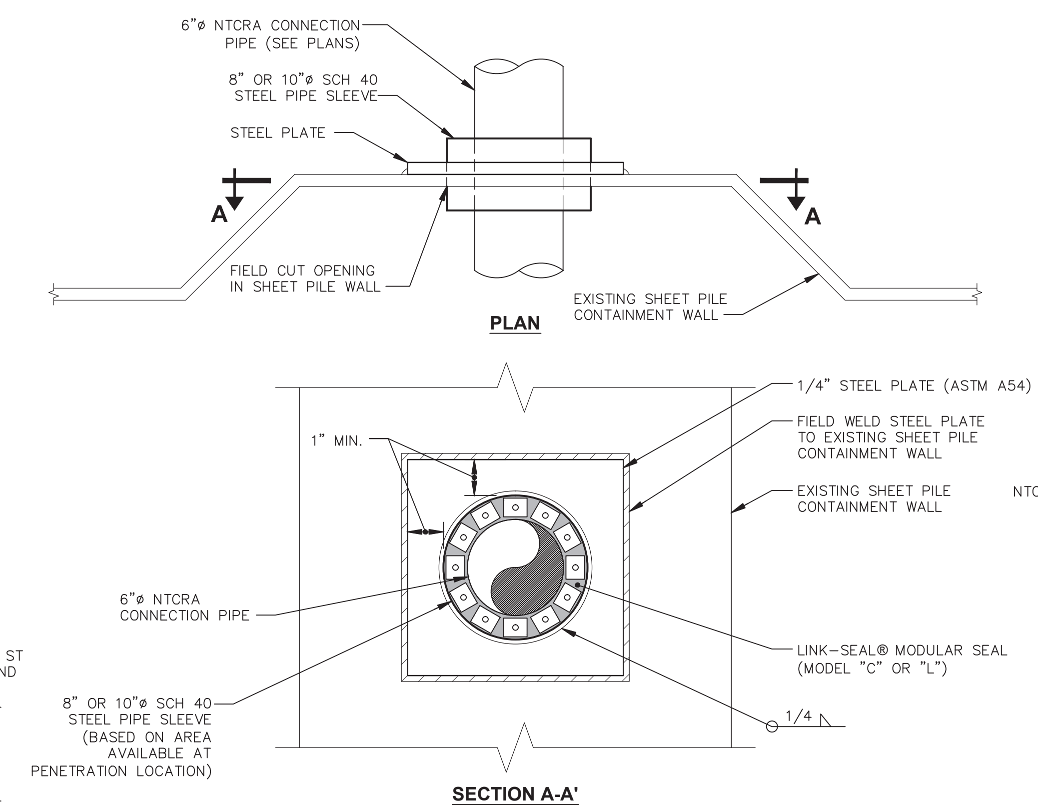


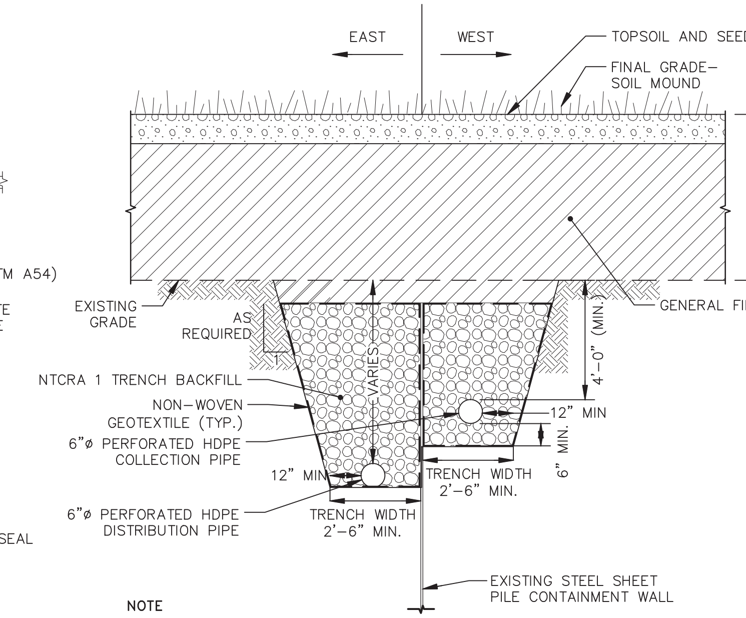
NOTES

1. DUCTILE IRON PIPE AND FITTINGS SHALL BE MECHANICAL JOINT (MJ) PIPE CONFORMING TO THE REQUIREMENTS OF ANSI/AWWAC110 AND ANSI/AWWAC111.

NCTRA CONTAINMENT WALL PIPE CONNECTION DETAIL (3)

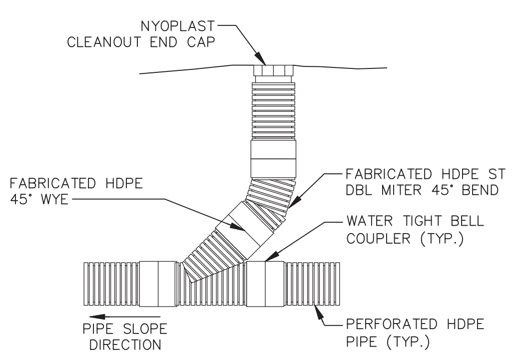
NOT TO SCALE





NOTE

1. PERFORATED HDPE COLLECTION PIPES SHALL BE CORRUGATED SINGLE WALL PIPE WITH SOIL TIGHT JOINTS. PERFORATIONS SHALL BE AASHTO CLASS II WITH A MINIMUM INLET AREA OF 1.0 IN²/LF.
2. A MINIMUM OF 1 FOOT CLEARANCE SHALL BE MAINTAINED BETWEEN THE EDGE OF THE TRENCH AND ADJACENT UNDERGROUND FACILITIES.



CLEANOUT DETAIL (4)

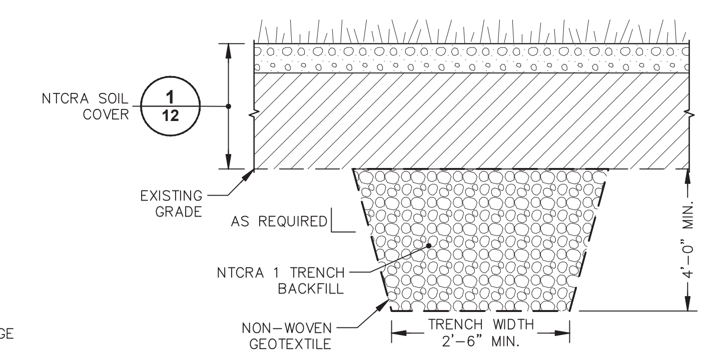
NOT TO SCALE

CONTAINMENT WALL UTILITY PIPE PENETRATION (5)

NOT TO SCALE

COLLECTION/DISTRIBUTION PIPE TRENCH (6)

NOT TO SCALE



LATERAL DISTRIBUTION TRENCH (7)

NOT TO SCALE

SCALE(S) AS INDICATED

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

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CT		ALL
Designed by	Drawn by	Checked by
NWF	BS	JEM

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NTCRA 1 AREA DETAILS

GENERAL

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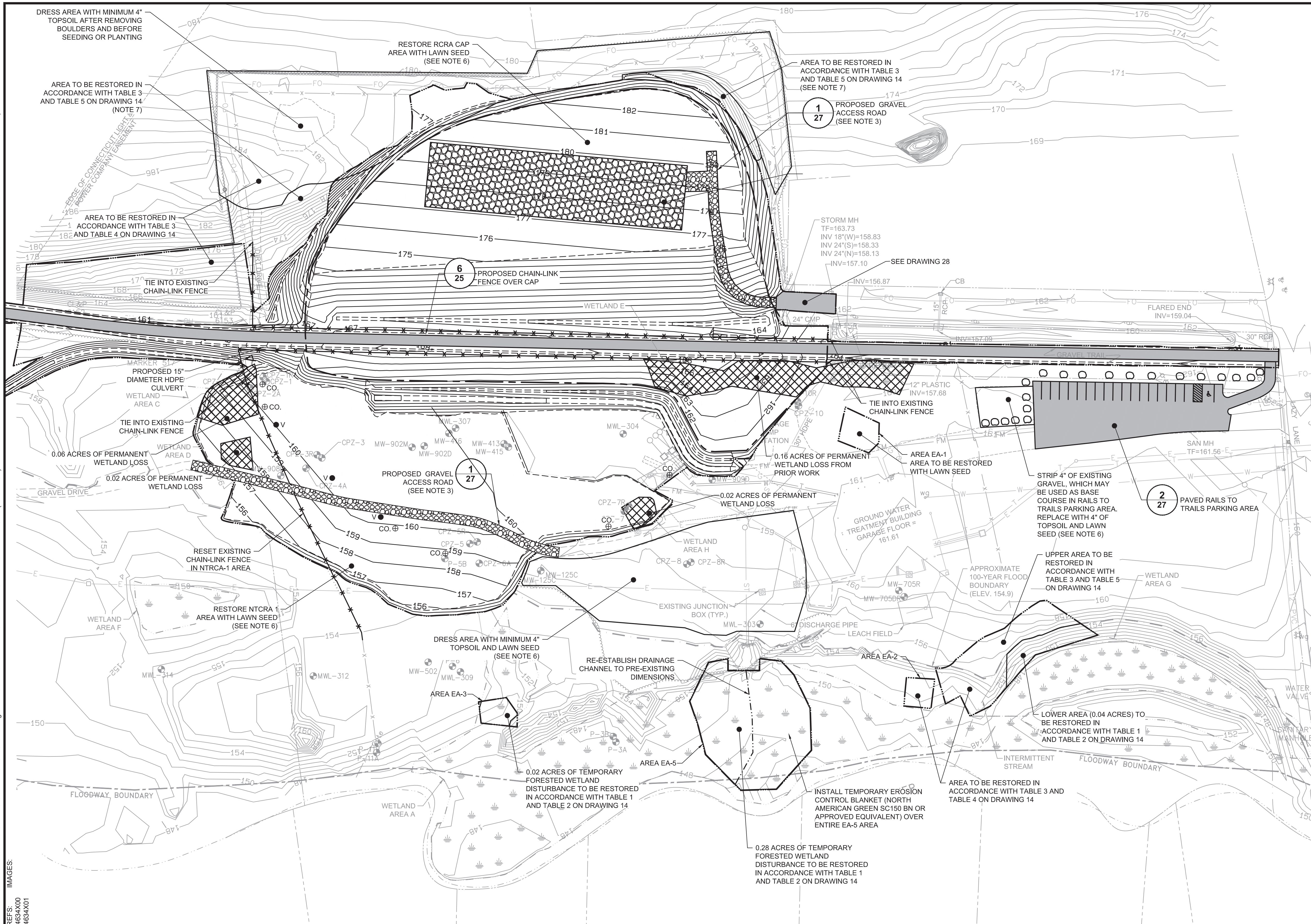

LEGEND:

- APPROXIMATE LIMIT OF WORK
- LIMIT OF RCRA CAP
- 150 PROPOSED FINAL GRADE/RESTORATION CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- PROPOSED CHAIN-LINK FENCE OVER CAP (6/26)
- PROPOSED ROCK/BOULDER LOCATION
- PROPOSED ASPHALT PAVEMENT LIMITS
- PROPOSED GRAVEL ACCESS ROAD (1/27)
- RCRA STONE SURFACING IN SOLAR DEVELOPMENT AREAS (1/9)
- WETLAND LOSS AREA
- CO. CLEANOUT LOCATION
- V NTCRA 1 VALVE
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. SEE DRAWING 14 FOR PLANTING SCHEDULE WITH SEED MIX AND PLANTING TABLES.
3. TOP SURFACE OF ACCESS ROAD SHALL MATCH THE FINAL GRADE OF ADJACENT AREAS.
4. REUSE EXISTING ROCK/BOULDERS FROM AREA ON SOUTHWEST SIDE OF CAP AS SHOWN ON DRAWING 3. SPACING SHALL BE WIDE ENOUGH TO ALLOW PEDESTRIAN AND BICYCLE PASSAGE BETWEEN BOULDERS, BUT NOT WIDE ENOUGH TO ALLOW PASSAGE OF MOTORIZED VEHICLES.
5. EXCAVATION AREAS EA-1 AND EA-2 TO BE BACKFILLED TO WITHIN 4" OF ORIGINAL GRADE WITH GENERAL FILL AND 4" OF TOPSOIL TO RE-ESTABLISH ORIGINAL GRADE PRIOR TO PLANTING. AREAS EA-3 AND EA-5 (RESTORED WETLANDS) TO BE BACKFILLED TO WITHIN 12" OF ORIGINAL GRADE WITH GENERAL FILL AND 12" OF TOPSOIL TO RE-ESTABLISH ORIGINAL GRADE PRIOR TO PLANTING.
6. LAWN AREAS SHALL BE RESTORED WITH THE FOLLOWING SEED MIXTURE: 65% KENTUCKY BLUEGRASS; 20% PERENNIAL RYE GRASS AND 15% FESLUE. THE SEED MIXTURE WILL BE SEEDED AT A RATE OF 150 POUNDS PER ACRE.
7. TREES AND SHRUBS SHALL NOT BE PLANTED WITHIN THE RIGHT-OF-WAY FOR THE FIBER OPTIC LINE.
8. ANCILLARY AREAS DISTURBED IN THE COURSE OF THE WORK (EG. STAGING AREAS, TEMPORARY CHECK DAMS, AND TEMPORARY ACCESS POINTS) SHALL BE RESTORED CONSISTENT WITH SURROUNDING AREAS AT NO ADDITIONAL COST TO THE OWNER.

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1"=50' — 50' 0 50' 100' — GRAPHIC SCALE

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Designed by	Drawn by	Checked by
NWF	BS	JEM

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SITE RESTORATION PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

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TABLE 1 FORESTED WETLAND WOODY PLANT PLANTING SUMMARY						
SPECIES	**COMMON NAME**	**WETLAND INDICATOR STATUS**	**PLANTING DENSITY (STEMS/ACRE)**	**PLANT SIZE**	**SPACING**	**PLANTING DIRECTIONS**
HERBACEOUS COVER						
WETLAND SEED MIX (TABLE 2)			18 LBS/ACRE	SEED	RANDOM BROADCAST	SEE TECHNICAL SPECIFICATION
SHRUBS						
LINDERA BENZOIN	SPICEBUSH	FACW	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN MOIST PORTIONS OF UPLAND RESTORATION AREAS
SALIX DISCOLOR	PUSSY WILLOW	FACW	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES THROUGHOUT UPLAND RESTORATION AREAS
VIBURNUM DENTATUM	ARROWWOOD	FAC	220	1–GALLON CONTAINER		
VIBURNUM LENTAGO	NANNYBERRY	FAC	220	1–GALLON CONTAINER		
CORNUS AMOMUM	SILKY DOGWOOD	FACW	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN DRIER PORTIONS OF UPLAND RESTORATION AREAS
SAMBUCUS CANADENSIS	ELDERBERRY	FACW				
ALNUS INCANA	ALDER	FACW	220			
TOTAL SHRUBS/ACRE			1320			
TREES						
ACER RUBRUM	RED MAPLE	FAC	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	PLANT IN CLUMPS OF 3 IN WETTER CONDITIONS
BETULA NIGRA	RIVER BIRCH	FACW	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES THROUGHOUT RESTORATION AREA
ACER SACCHARINUM	SILVER MAPLE	FACW	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
FRAXINUS PENNSYLVANICA	GREEN ASH	FACW	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
SALIX NIGRA	BLACK WILLOW	OBL	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
CARPINUS CAROLINIANA	HORNBEAM	FAC	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN DRIER AREAS OF THE RESTORATION AREA
TOTAL TREES/ACRE			420			

TABLE 2 WETLAND SEED MIX		
SPECIES	**COMMON NAME**	**INDICATOR**
CAREX LURIDA	LURID SEDGE	OBL
CAREX SCOPARIA	BLUNT BROOM SEDGE	FACW
VERBENA HASTATA	BLUE VERVAIN	FACW
CAREX LUPULINA	HOP SEDGE	OBL
SCIRPUS ATROVIRENS	GREEN BULRUSH	OBL
PANICUM RIGIDULUM	REDTOP PANIC GRASS	FACW
DESCHAMPSIA CESPITOSA	TUFTED HAIRGRASS	FACW
BIDENS ARISTOSA	TICKSEED SUNFLOWER/BUR MARIGOLD	FACW
ELEOCHARIS PALUSTRIS	CREEPING SPIKE RUSH	OBL
JUNCUS EFFUSUS	SOFT RUSH	FACW
CAREX CRINITA	FRINGED SEDGE	OBL
MIMULUS RINGENS	SQUARE STEMMED MONKEY FLOWER	OBL
ASTER PUNICEUS	SWAMP ASTER	OBL
EUPATORIUM PERFOLIATUM	BONESET	FACW
GLYCERIA CANADENSIS	RATTLESNAKE GRASS	OBL
ASCLEPIAS INCARNATA	SWAMP MILKWEED	OBL
HELENIUM AUTUMNALE	COMMON SNEEZEWEED	FACW
PENTHORUM SEDOIDES	DITCH STONECROP	OBL

(NEW ENGLAND WETMIX MIX FROM NEW ENGLAND WETLAND PLANTS, OR EQUIVALENT) APPLICATION RATE: 18 LBS/ACRE, 2500 SQ. FT./LB.

TABLE 4 UPLAND SEED MIX	
SPECIES	**COMMON NAME**
SCHIZACHYRIUM SCOPARIUM	LITTLE BLUESTEM
COREOPSIS LANCEOLATA, COASTAL PLAIN NC ECOTYPE	LANCELEAF COREOPSIS
LUPINUS POLYPHYLLUS	BIGLEAF LUPINE
CHAMAECRISTA FASCICULATA (CASSIA F.), PA ECOTYPE	PARTRIDGE PEA, PA ECOTYPE
AGASTACHE FOENICULUM	ANISE (LAVENDER) HYSSOP
PENSTEMON LAEVIGATUS, PA ECOTYPE	APPALACHIAN BEARDTONGUE, PA ECOTYPE
ASCLEPIAS SYRIACA, PA ECOTYPE	COMMON MILKWEED, PA ECOTYPE
HELIANTHUS MAXIMILIANII	MAXIMILIAN'S SUNFLOWER
MONARDA FISTULOSA	WILD BERGAMOT
BAPTISIA AUSTRALIS, SOUTHERN WV ECOTYPE	BLUE FALSE INDIGO, SOUTHERN WV ECOTYPE
PYCNANTHEMUM TENUIFOLIUM	SLENDER MOUNTAINMINT
TRADESCANTIA OHIENSIS, PA ECOTYPE	OHIO SPIDERWORT, PA ECOTYPE
EUPATORIUM PERFOLIATUM, PA ECOTYPE	BONESET, PA ECOTYPE
A. UROPHYLLUS) (SYMPHYOTRICHUM UROPHYLLUM), PA ECOTYPE	ARROWLEAF (SAGITTATE) ASTER, PA ECOTYPE (ASTER SAGITTIFOLIUS
ASTER NOVAE–ANGLIAE (SYMPHYOTRICHUM N.), PA ECOTYPE	NEW ENGLAND ASTER, PA ECOTYPE
(SOLIDAGO SPECIOSA, SOUTHERN WV ECOTYPE	SHOWY GOLDENROD, SOUTHERN WV ECOTYPE
VERNONIA NOVEBORACENSIS, PA ECOTYPE	NEW YORK IRONWEED, PA ECOTYPE

(XERCES NORTHEASTERN POLLINATOR MIX FOR UPLAND & MEADOW SITES, OR EQUIVALENT.) APPLICATION RATE: 8 LBS/ACRE.

TABLE 3 UPLAND FOREST WOODY PLANT PLANTING SUMMARY						
SPECIES	**COMMON NAME**	**WETLAND INDICATOR STATUS**	**PLANTING DENSITY (STEMS/ACRE)**	**PLANT SIZE**	**SPACING**	**PLANTING DIRECTIONS**
HERBACEOUS COVER						
UPLAND SEED MIX (TABLE 4)			30 LBS/ACRE	SEED	RANDOM BROADCAST	SEE TECHNICAL SPECIFICATION
UPLAND EROSION CONTROL SEED MIX (TABLE 5)			35 LBS/ACRE	SEED	RANDOM BROADCAST	SEE TECHNICAL SPECIFICATION
SHRUBS						
LINDERA BENZOIN	SPICEBUSH	FACW	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN MOIST PORTIONS OF UPLAND RESTORATION AREAS
CORNUS RACEMOSA	GRAY DOGWOOD	FAC	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES THROUGHOUT UPLAND RESTORATION AREAS
VIBURNUM DENTATUM	ARROWWOOD	FAC	220	1–GALLON CONTAINER		
VIBURNUM LENTAGO	NANNYBERRY	FAC	220	1–GALLON CONTAINER		
CORNUS AMOMUM	SILKY DOGWOOD	FACW	220	1–GALLON CONTAINER	AT LEAST 5–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN DRIER PORTIONS OF UPLAND RESTORATION AREAS
PRUNUS VIRGINIANA	CHOKE CHERRY	FACU	220	1–GALLON CONTAINER		
TOTAL SHRUBS/ACRE			1320			
TREES						
ACER RUBRUM	RED MAPLE	FAC	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES IN MOIST PORTIONS OF UPLAND RESTORATION AREAS
PRUNUS SEROTINA	BLACK CHERRY	FACU	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	PLANT IN CLUMPS OF 3 SAME SPECIES THROUGHOUT UPLAND RESTORATION AREAS
QUERCUS ALBA	WHITE OAK	FACU	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
QUERCUS RUBRA	RED OAK	FACU	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
JUGLANS NIGRA	BLACK WALNUT	FACU	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
JUNIPERUS VIRGINIANA	EASTERN RED CEDAR	FACU	70	5–GALLON CONTAINER	AT LEAST 10–FT APART	
TOTAL TREES/ACRE			420			

NOTE: SHRUBS AND TREES SHALL NOT BE PLANTED IN THE RIGHT–OF–WAY FOR THE FIBER OPTIC LINE.

TABLE 5 UPLAND EROSION CONTROL SEED MIX	
SPECIES	**COMMON NAME**
FESTUCA RUBRA	CREEPING RED FESCUE
ELYMUS CANADENSIS	CANADA WILD RYE
LOLIUM MULTIFLORUM	ANNUAL RYEGRASS
LOLIUM PERENNE	PERRENIAL RYEGRASS
BOUTELOUA GRACILIS	BLUE GRAMA
SCHIZACHYRIUM SCOPARIUM	LITTLE BLUESTEM
SORGHASTRUM NUTANS	INDIAN GRASS
AGROSTIS SCABRA	ROUGH BENTGRASS/TICKLEGRASS
AGROSTIS PERENNANS	UPLAND BENTGRASS

(NEW ENGLAND EROSION CONTROL/RESTORATION MIX FOR DRY SITES FROM NEW ENGLAND WETLAND PLANTS, OR EQUIVALENT) APPLICATION RATE: 35 LBS/ACRE, 1250 SQ. FT./LB.

SCALE(S) AS INDICATED

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

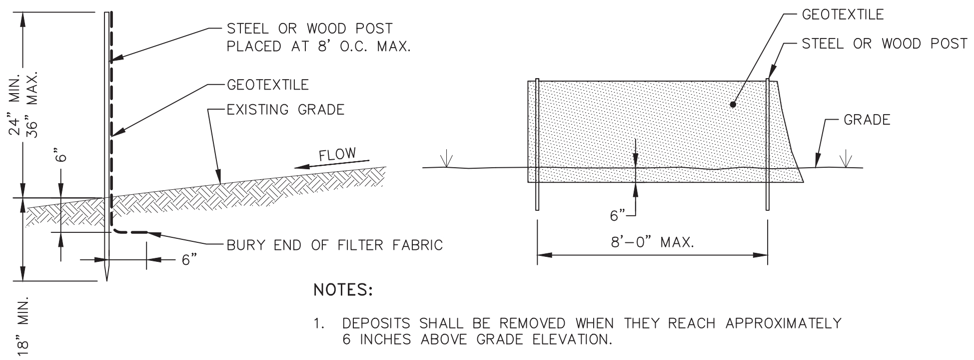
ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT
RCRA CAP 100% DESIGN

SITE RESTORATION PLANTING SCHEDULE

GENERAL

ARCADIS Project No. B0054634.0001.03900
Date OCTOBER 2016
ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

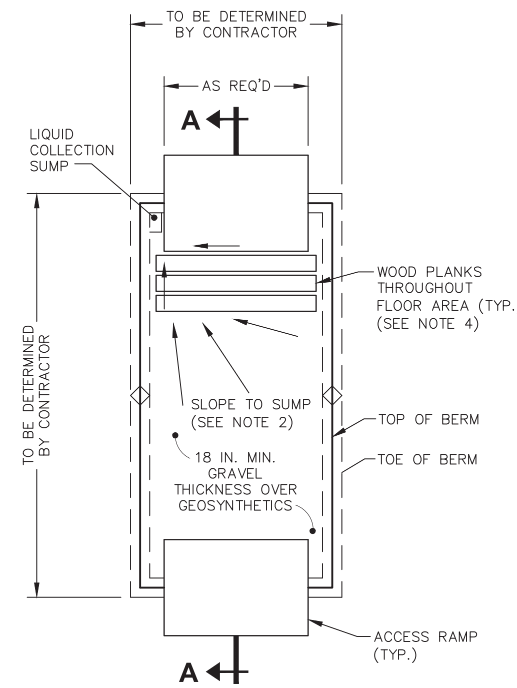


NOTES:

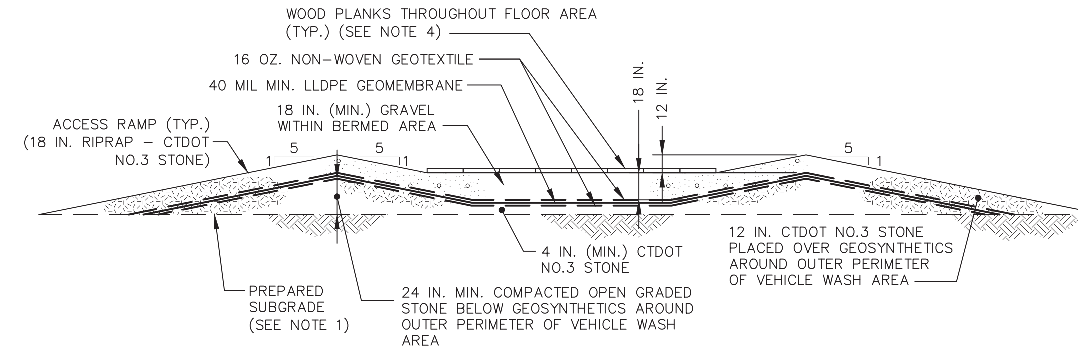
1. DEPOSITS SHALL BE REMOVED WHEN THEY REACH APPROXIMATELY 6 INCHES ABOVE GRADE ELEVATION.
2. THE SILT FENCE WILL REMAIN IN PLACE UNTIL A VEGETATIVE STAND IS ESTABLISHED.
3. THE SILT FENCE WILL BE USED FOR TEMPORARY EROSION AND SEDIMENTATION CONTROL ONLY.

SILT FENCE (1)

NOT TO SCALE



PLAN



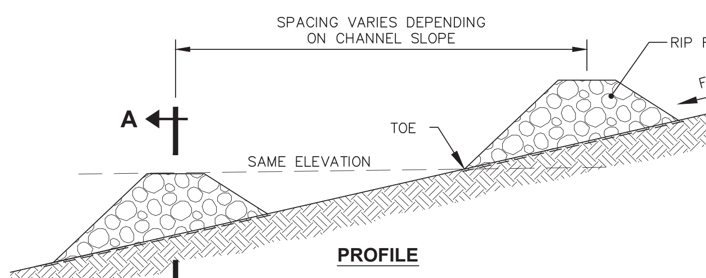
SECTION A-A

NOTES:

1. SUBGRADE SURFACE SHALL BE UNIFORM AND FREE OF DELETERIOUS MATERIALS (E.G., SHARP STONES, WOODY DEBRIS, ETC.) THAT COULD DAMAGE THE LLDPE LINER.
2. THE VEHICLE WASH AREA (INCLUDING LLDPE LINER) SHALL BE SLOPED TOWARD A COLLECTION SUMP TO FACILITATE THE REMOVAL OF LIQUIDS. LIQUIDS SHALL BE PUMPED FROM THE COLLECTION SUMP TO AN ON-SITE STORAGE TANK.
3. COMPACTION OF CRUSHED STONE SHALL BE SUFFICIENT DENSITY TO PROVIDE A FIRM AND UNIFORM SURFACE. PLACEMENT AND COMPACTION OF CRUSHED STONE ABOVE GEOSYNTHETICS SHALL BE PERFORMED IN A MANNER AND USING APPROPRIATE EQUIPMENT THAT AVOIDS DAMAGING THE GEOSYNTHETICS.
4. WOOD PLANKS SHALL BE PLACED ABOVE THE GRAVEL LAYER THROUGHOUT THE WORKING SURFACE OF THE VEHICLE WASH AREA TO PROVIDE A STABLE SURFACE FOR VEHICLES AND EQUIPMENT. WOOD PLANKS DAMAGED DURING USE SHALL BE REPLACED TO MAINTAIN A STABLE WORKING SURFACE.
5. UPON COMPLETION OF CONSTRUCTION, THE VEHICLE WASH AREA (INCLUDING GEOSYNTHETICS AND FILL MATERIALS) SHALL BE REMOVED AND TRANSPORTED OFF-SITE FOR DISPOSAL.

DECONTAMINATION PAD (2)

NOT TO SCALE



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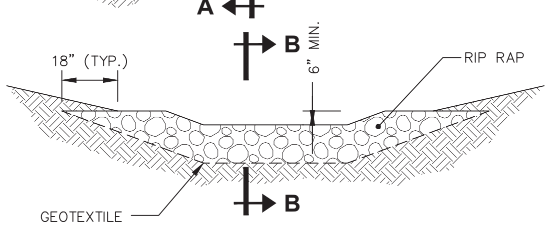
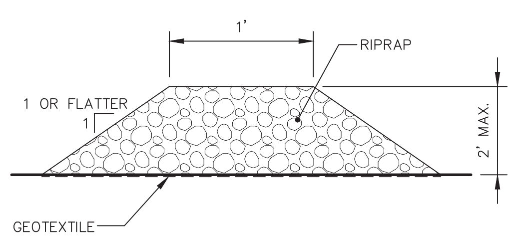


SECTION A-A
VIEW LOOKING UPSTREAM



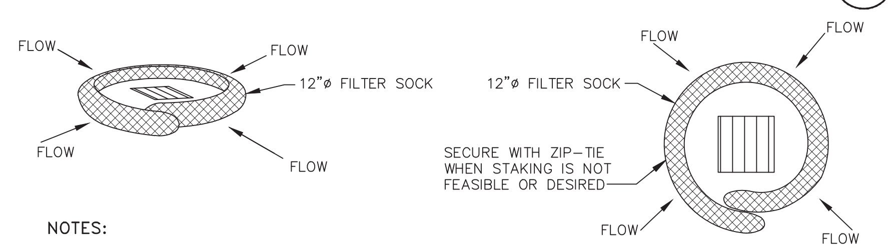
SECTION B-B

NOTES:

1. SET SPACING OF CHECK DAMS SUCH THAT THE ELEVATION OF THE CREST OF THE DOWNSTREAM DAM IS AT THE SAME ELEVATION AS THE TOE OF THE UPSTREAM DAM.
2. KEY STONE INTO THE DITCH BANKS AND EXTEND INTO THE ABUTMENTS A MINIMUM OF 18" TO PREVENT FLOW FROM FLANKING THE CHECK DAM.
3. ACCUMULATED SEDIMENTS SHOULD BE REMOVED FROM BEHIND CHECK DAM WHEN SEDIMENT HAS ACCUMULATED TO 1/2 THE HEIGHT OF THE CHECK DAM. STONE MATERIAL SHOULD BE REPLACED AND CHECK DAM RESTORED TO ITS ORIGINAL DIMENSIONS AFTER REMOVAL OF SEDIMENT.

STONE CHECK DAM (3)

NOT TO SCALE

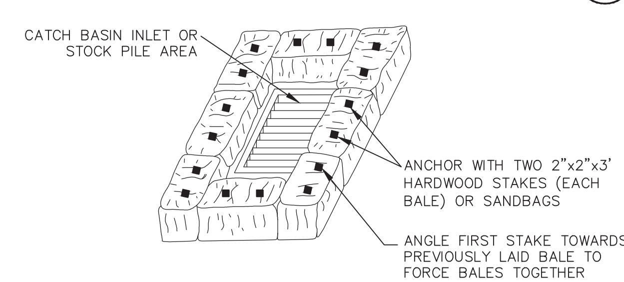


NOTES:

1. FILTER SOCK SHALL BE 12"ø FILTREXX SOXX AND FILLED WITH FILTREXX FILTER MEDIA OR APPROVED EQUAL. FILTREXX SOXX SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
2. ANCHORING STAKES SHALL BE SIZED, SPACED, AND BE OF A MATERIAL THAT EFFECTIVELY SECURES THE FILTER SOCK. STAKE SPACING SHALL BE A MAXIMUM OF THREE FEET.
3. OVERLAP ENDS OF FILTER SOCK PER MANUFACTURER'S RECOMMENDATIONS.

FILTER SOCK DROP INLET PROTECTION (4)

NOT TO SCALE

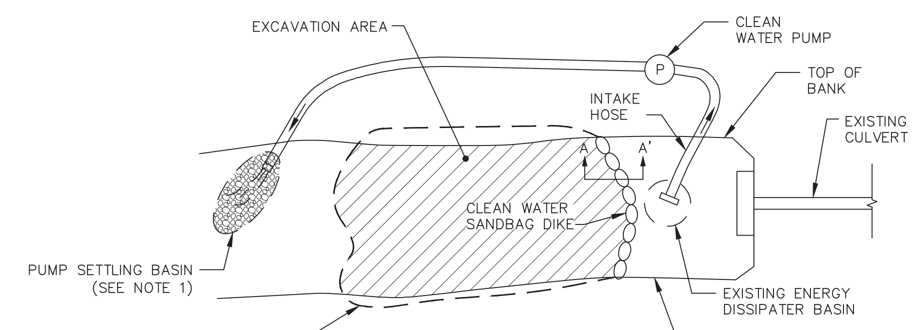


NOTES:

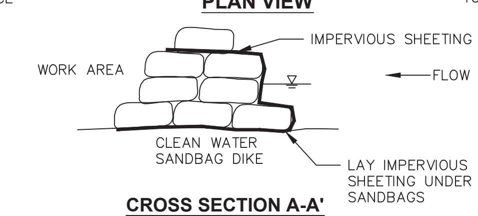
1. CONDITION SHOWN IS REPRESENTATIVE OF HAY BALE INSTALLATION ON A SOIL/GRAVEL SURFACE. FOR INSTALLATION ON A PAVED/CONCRETE SURFACE, POSITION BALES AROUND CATCH BASIN INLET AND PLACE SAND BAGS ON TOP OF BALES TO KEEP THEM IN PLACE.
2. ALL EXCAVATED SOIL AND DEBRIS THAT IS STOCKPILED SHALL BE PLACED ON POLYETHYLENE LINERS IN DESIGNATED AREAS

HAY BALE INSTALLATION AT CATCH BASINS AND STOCKPILES (5)

NOT TO SCALE



PLAN VIEW



CROSS SECTION A-A'

NOTES:

1. SIZE PUMP SETTLING BASIN IN ACCORDANCE WITH THE CONNECTICUT GUIDELINES FOR SOIL EROSION AND SEDIMENT CONTROL.
2. THE CONTRACTOR SHALL MONITOR LOCAL WEATHER REPORTS AND SHALL SCHEDULE THE CONSTRUCTION ACTIVITIES REQUIRING BYPASS PUMPING DURING A DRY PERIOD AS PRACTICAL.
3. THE CONTRACTOR SHALL BEGIN HIS WORK AND SHALL CONTINUE IN AN EXPEDITIOUS MANNER TO COMPLETE THE EXCAVATION AND CULVERT RELOCATION WORK IN THE SHORTEST, PRACTICAL TIME FRAME.
4. THE CONTRACTOR SHALL PROVIDE PUMPS OF ADEQUATE SIZE TO HANDLE THE PEAK FLOW AND TEMPORARY DISCHARGE PIPING TO ENSURE THAT THE TOTAL FLOW OF THE DRAINAGE CHANNEL CAN BE SAFELY DIVERTED AROUND THE WORK AREA. BYPASS PUMPING SYSTEMS WILL BE REQUIRED TO BE OPERATED 24 HOURS PER DAY.
5. THE CONTRACTOR SHALL DIVERT THE FLOW AROUND THE WORK AREA IN MANNER THAT WILL NOT CAUSE DAMAGE TO PUBLIC OR PRIVATE PROPERTY, WATER RESOURCES, WETLANDS, OR OTHER NATURAL RESOURCES.
6. REMOVE SAND BAGS AND PUMP DISCHARGE RIPRAP AT COMPLETION OF WORK.

TEMPORARY STREAM BYPASS SCHEMATIC (6)

NOT TO SCALE

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

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RCRA CAP 100% DESIGN

TEMPORARY SEDIMENT AND EROSION CONTROL DETAILS

GENERAL

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Date OCTOBER 2016

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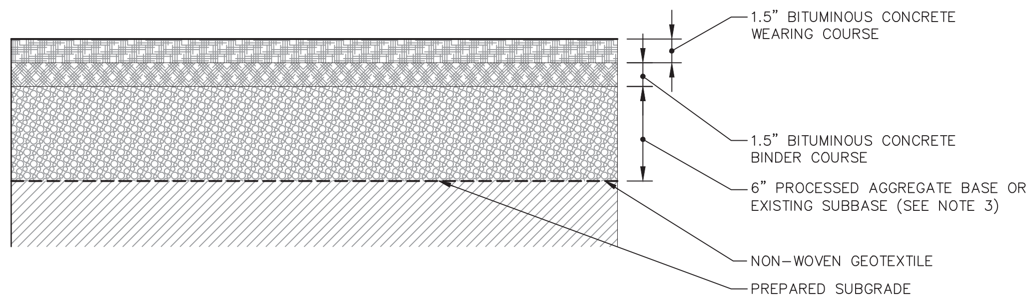
TEL. 315.446.9120

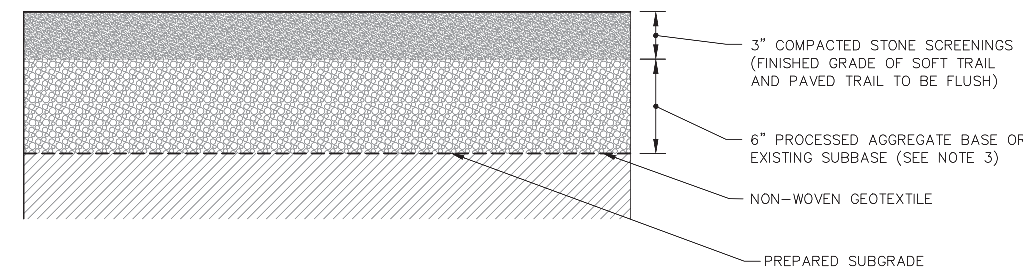


PAVED TRAIL (1)

NOT TO SCALE

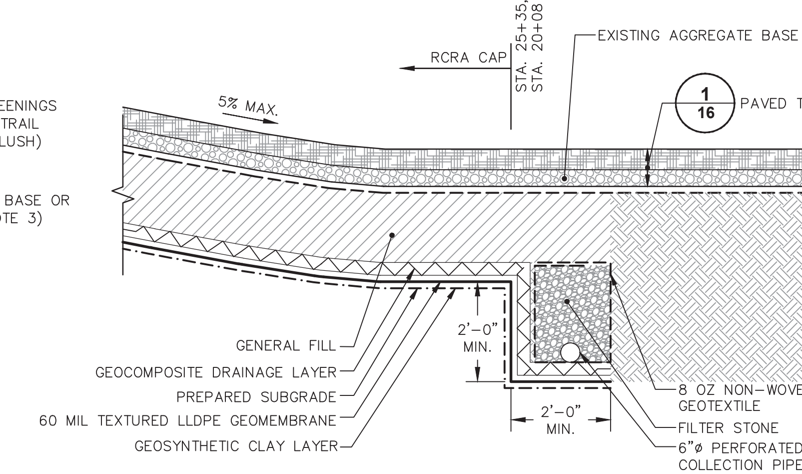
NOTES:

1. ASPHALT SURFACE COURSE SHALL CONFORM TO REQUIREMENTS OF CONNECTICUT DEPARTMENT OF TRANSPORTATION (CDOT) STANDARD SPECIFICATION SECTION 4.06 OF BITUMINOUS CONCRETE.
2. PROCESSED AGGREGATE BASE SHALL CONFORM TO THE MATERIAL REQUIREMENTS OF CDOT STANDARD SPECIFICATION SECTION 3.04.
3. AGGREGATE BASE MATERIAL WAS INSTALLED BETWEEN STA. 25+35 AND STA. 29+95 UNDER A PREVIOUS CONTRACT. CONTRACTOR SHALL SUPPLEMENT AS NEEDED TO ACHIEVE DESIGN SUBGRADE.



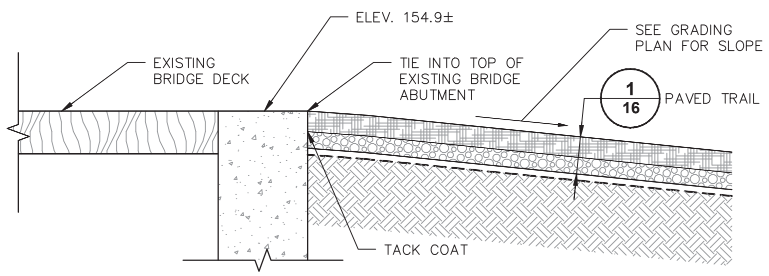
SOFT TRAIL (2)

NOT TO SCALE



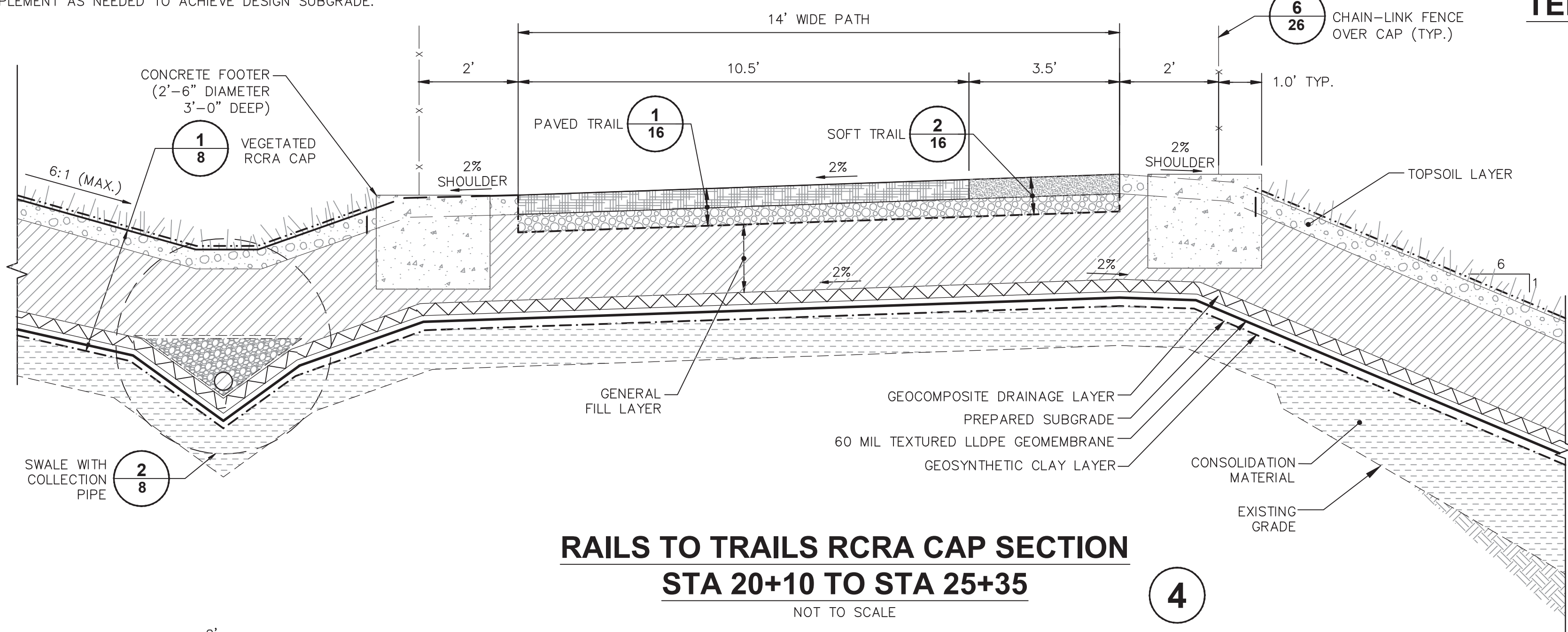
TYPICAL RCRA CAP TERMINATION AT TRAIL (3)

NOT TO SCALE



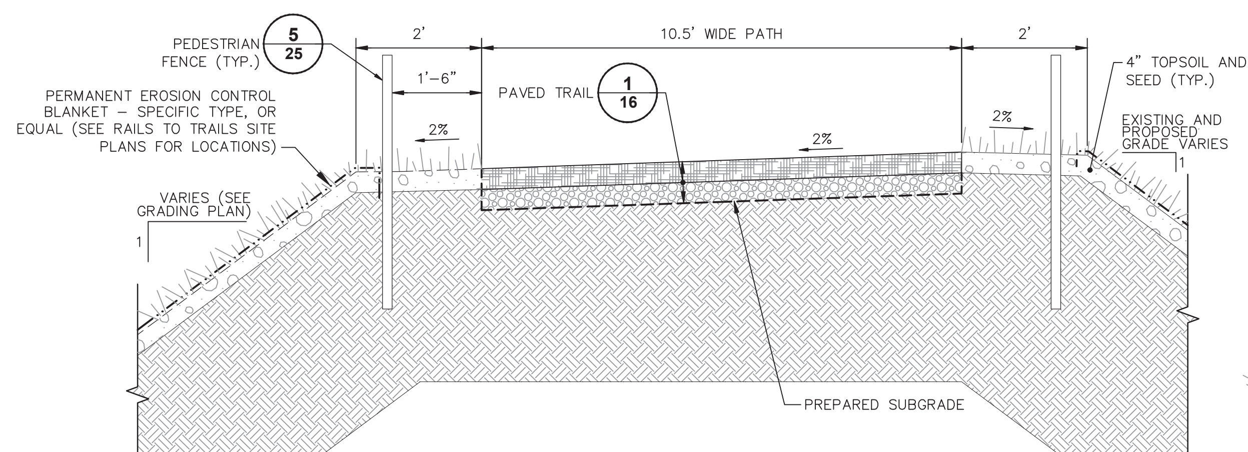
RAILS TO TRAILS TERMINATION AT EXISTING BRIDGE (5)

NOT TO SCALE



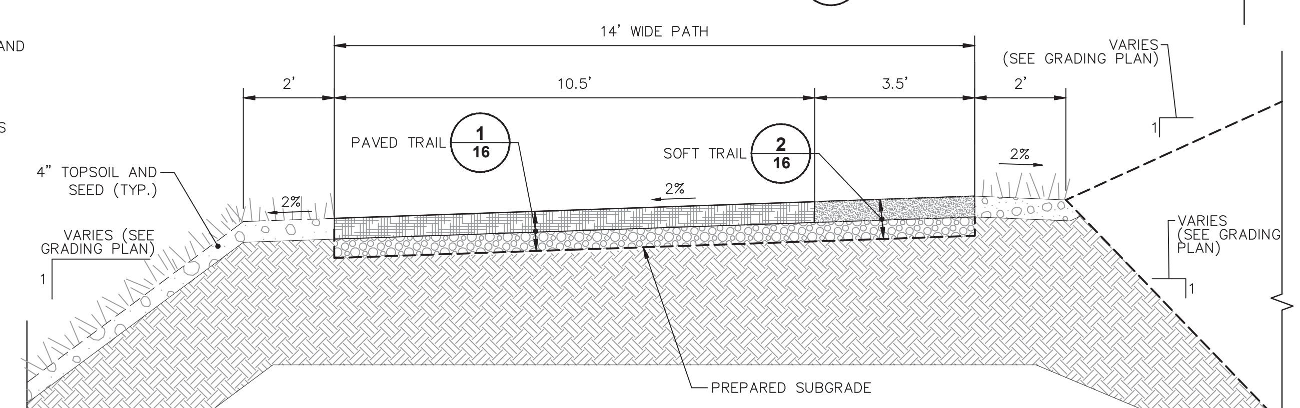
RAILS TO TRAILS RCRA CAP SECTION STA 20+10 TO STA 25+35 (4)

NOT TO SCALE



RAILS TO TRAILS SECTION OUTSIDE RCRA CAP STA 0+32 TO STA 5+50 (6)

NOT TO SCALE



RAILS TO TRAILS SECTION OUTSIDE RCRA CAP STA 5+70 TO STA 20+10 STA 25+35 TO STA 29+95 (7)

NOT TO SCALE

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN		
Professional Engineer's No.: 0023403		
State: CT	Date Signed	Project Mgr.: JEM
Designed by: NWF	Drawn by: BS	Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

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RAILS TO TRAILS TYPICAL SECTIONS

GENERAL

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Date OCTOBER 2016

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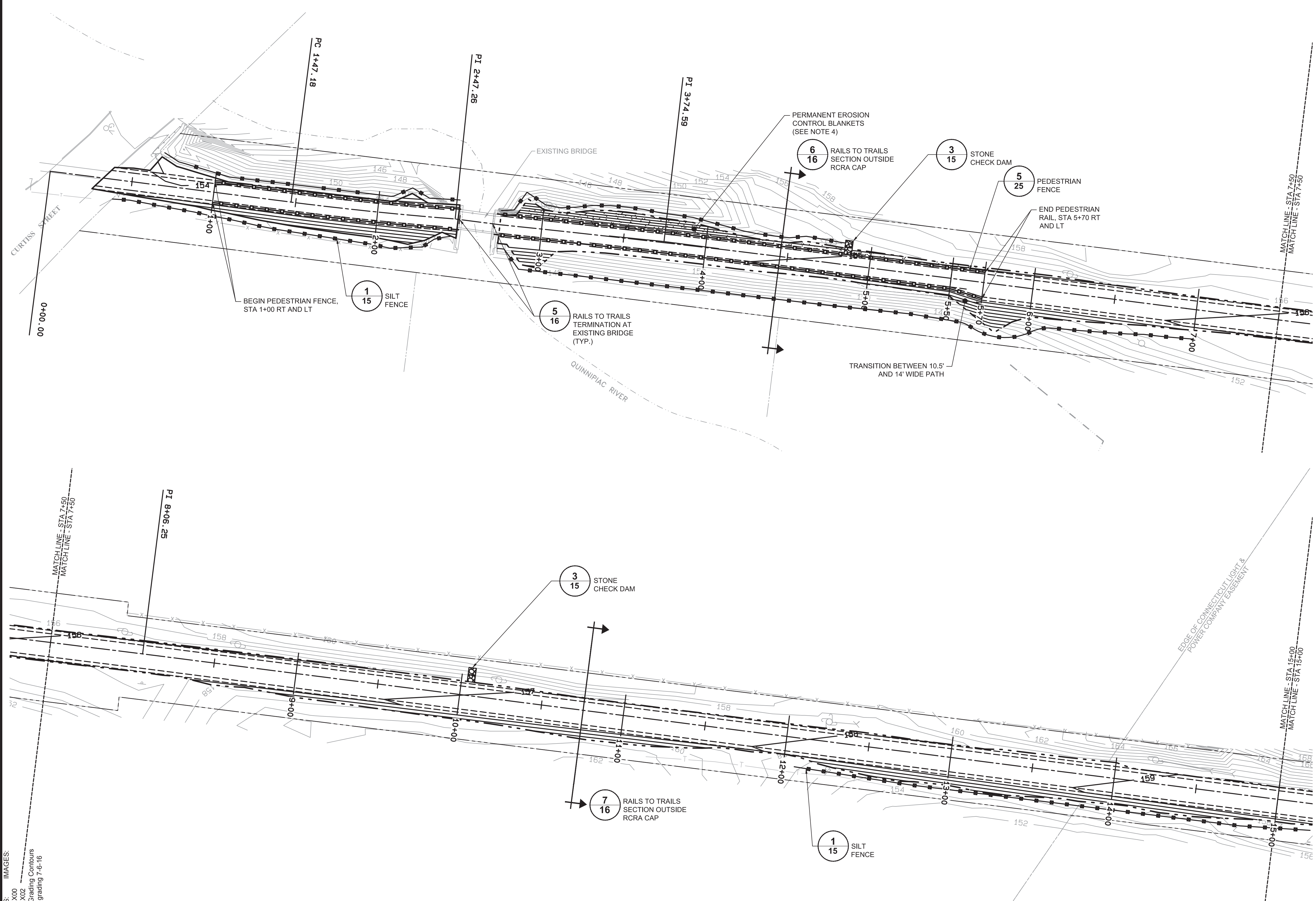

LEGEND:

- PROPERTY BOUNDARY
- EXISTING WOOD FENCE
- 155 EXISTING CONTOUR (1-FOOT CONTOUR INTERVAL)
- 155 PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF FINAL GRADING
- RIGHT OF WAY
- STATION LINE
- SILT FENCE 1/15
- PEDESTRIAN RAIL 5/25
- STONE CHECK DAM 3/15
- PERMANENT EROSION CONTROL BLANKETS (SEE NOTE 4)
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RAILS TO TRAILS FINAL GRADE.
3. LOCATION OF EROSION AND SEDIMENT CONTROL FEATURES MAY VARY BASED ON SITE CONDITIONS ENCOUNTERED AT THE TIME OF CONSTRUCTION.
4. INSTALL AND ANCHOR EROSION CONTROL BLANKETS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS IN AREAS WHERE SLOPE IS 1.5:1 OR GREATER.

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD, KLS LD: B.DeCLERCQ PIC/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF* G:\ENVCAD\Manchester\ACT\B0054634\0001\03900\03900\DWG\CONTRACT\54634G17.dwg LAYOUT: 17 SAVED: 10/10/2016 5:05 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: LD2B-PDF PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 10/14/2016 11:54 AM BY: SMALL, BRIAN

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Professional Engineer's Name		
JEFFREY HOLDEN		
Professional Engineer's No. 0023403		
State: CT	Date Signed	Project Mgr.: JPH
Designed by: NWF	Drawn by: BS	Checked by: JEM

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ARCADIS U.S., INC.

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RCRA CAP 100% DESIGN

RAILS TO TRAILS SITE PLAN - 1

GENERAL

ARCADIS Project No. B0054634.0001.03900
Date OCTOBER 2016
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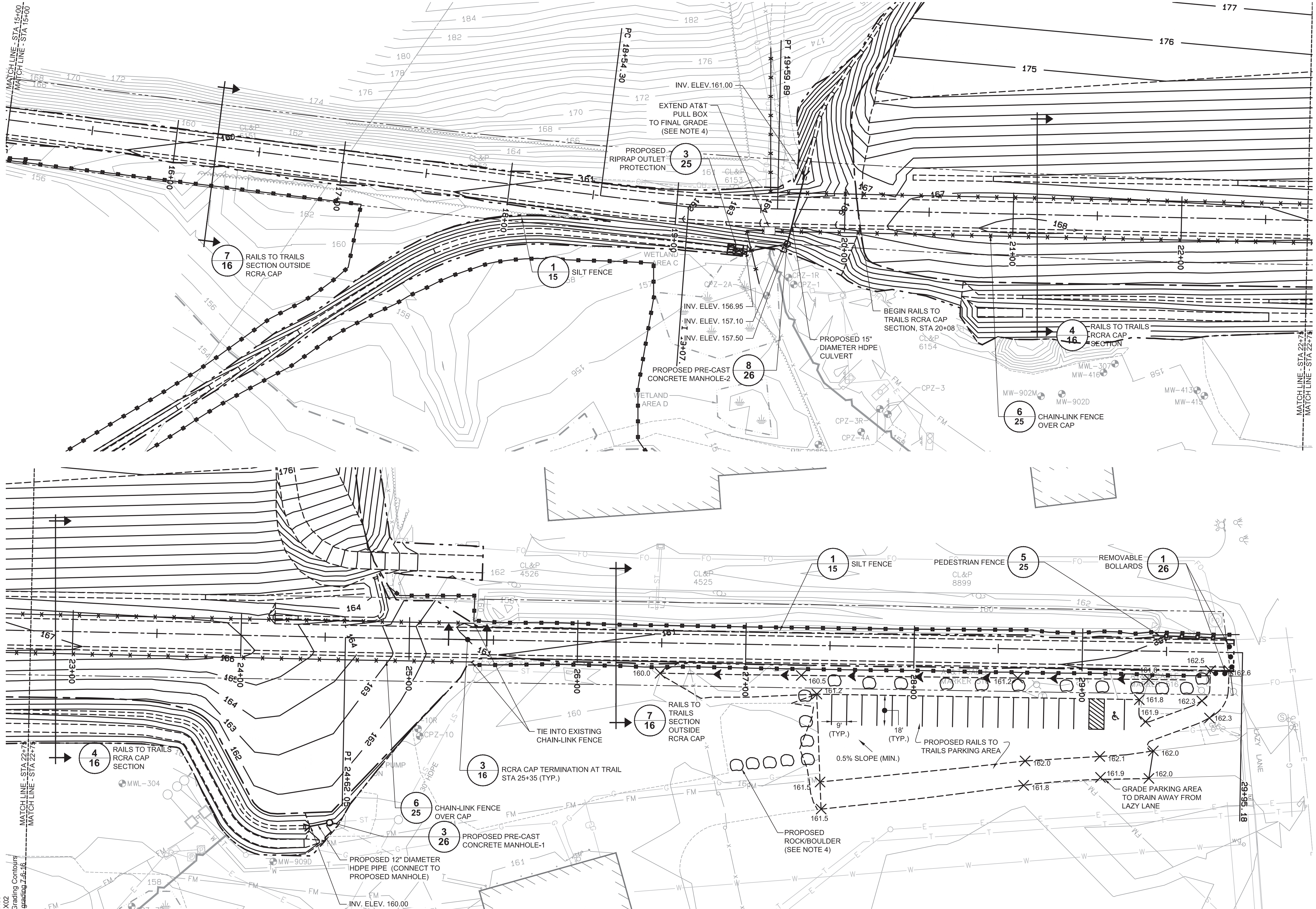

LEGEND:

- PROPERTY BOUNDARY
- 155 EXISTING CONTOUR (1-FOOT CONTOUR INTERVAL)
- 155 PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- 161.92 PROPOSED FINAL GRADE SPOT ELEVATION
- LIMIT OF RCRA CAP
- LIMIT OF FINAL GRADING
- RIGHT OF WAY
- STATION LINE
- PROPOSED SWALE WITH FLOW DIRECTION
- SILT FENCE 1/15
- PEDESTRIAN FENCE 5/25
- CHAIN-LINK FENCE 6/25 AND 5/25
- PRE-CAST CONCRETE MANHOLE 3/26
- REMOVABLE BOLLARD (SEE NOTE 5) 1/26
- PROPOSED ROCK/BOULDER LOCATION (SEE NOTE 4)
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RAILS TO TRAILS FINAL GRADE.
3. LOCATION OF EROSION AND SEDIMENT CONTROL FEATURES MAY VARY BASED ON SITE CONDITIONS ENCOUNTERED AT THE TIME OF CONSTRUCTION.
4. REUSE EXISTING ROCK/BOULDERS FROM AREA ON SOUTHWEST SIDE OF CAP AS SHOWN ON DRAWING 3. SPACING SHALL BE WIDE ENOUGH TO ALLOW PEDESTRIAN AND BICYCLE PASSAGE BETWEEN BOULDERS, BUT NOT WIDE ENOUGH TO ALLOW PASSAGE OF MOTORIZED VEHICLES.
5. BOLLARDS SHALL BE EVENLY SPACED ACROSS ENTRANCE TO PAVED RAILS TO TRAILS AND PARKING AREA WALKWAY

CITY: SYRACUSE, NY DIV/GROUP: ENV/CAD DB: BD,KLS LD: B.DeCLERCQ PIC:/PM: TM: N.FRANGIS LYR:ON=*;OFF=*REF* G:\ENVCAD\Manchester\ACT\B0054634\0001\03900\03900\DWG\CONTRACT\54634G18.dwg LAYOUT: 18 SAVED: 10/10/2016 4:44 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: LD28-PDF PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 10/14/2016 11:54 AM BY: SMALL, BRIAN

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JPH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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RCRA CAP 100% DESIGN

RAILS TO TRAILS SITE PLAN - 2

GENERAL

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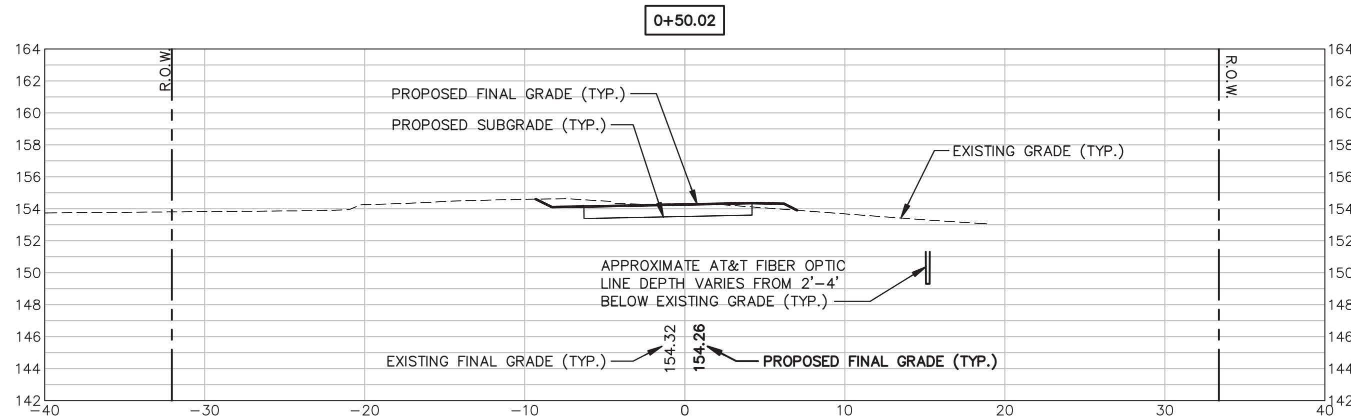

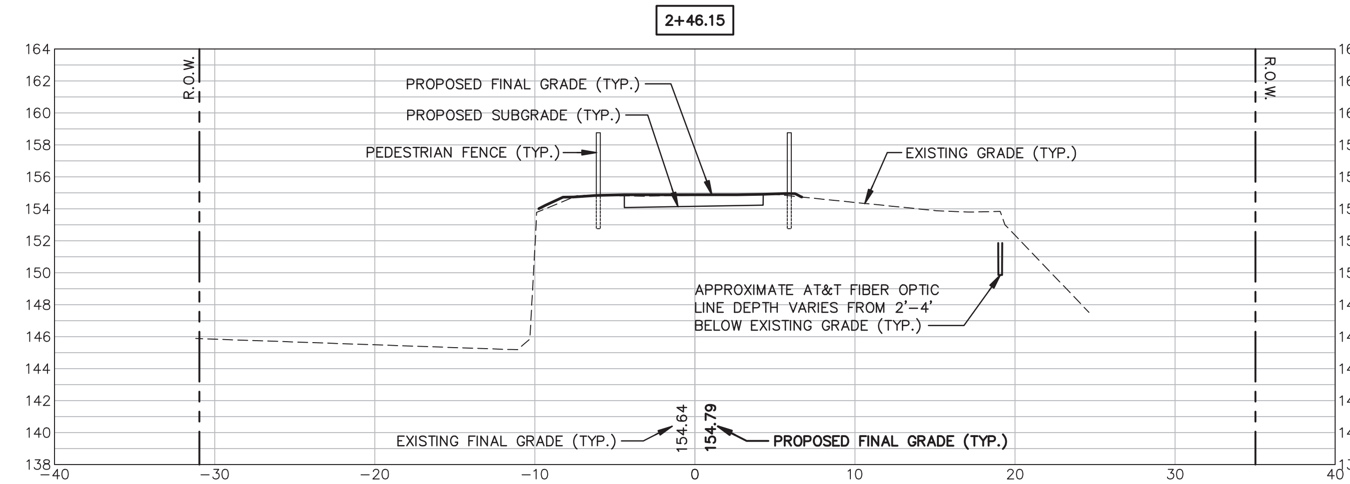

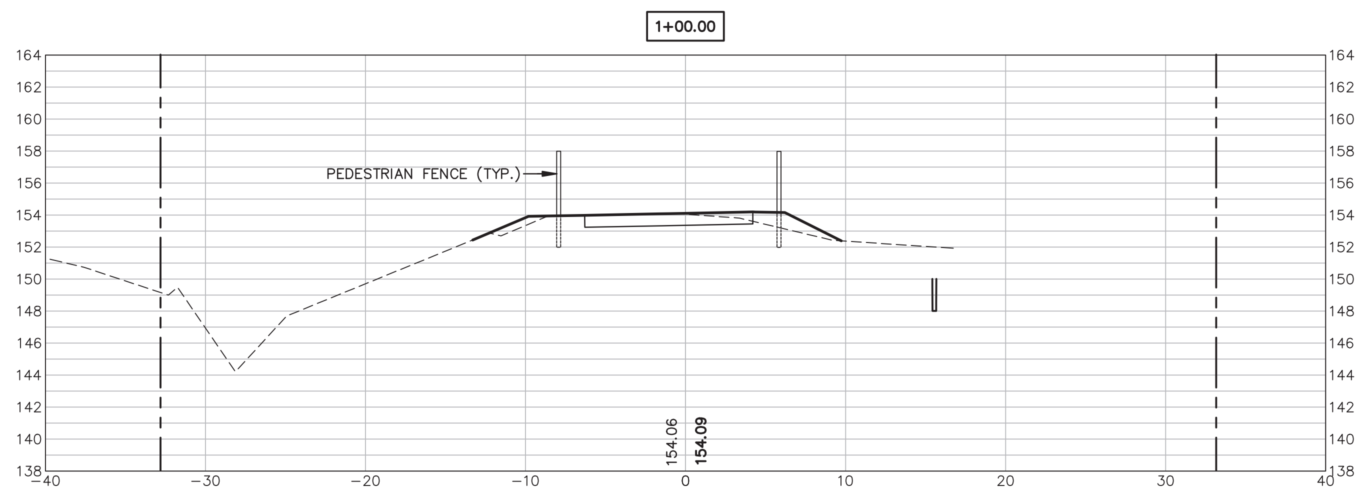

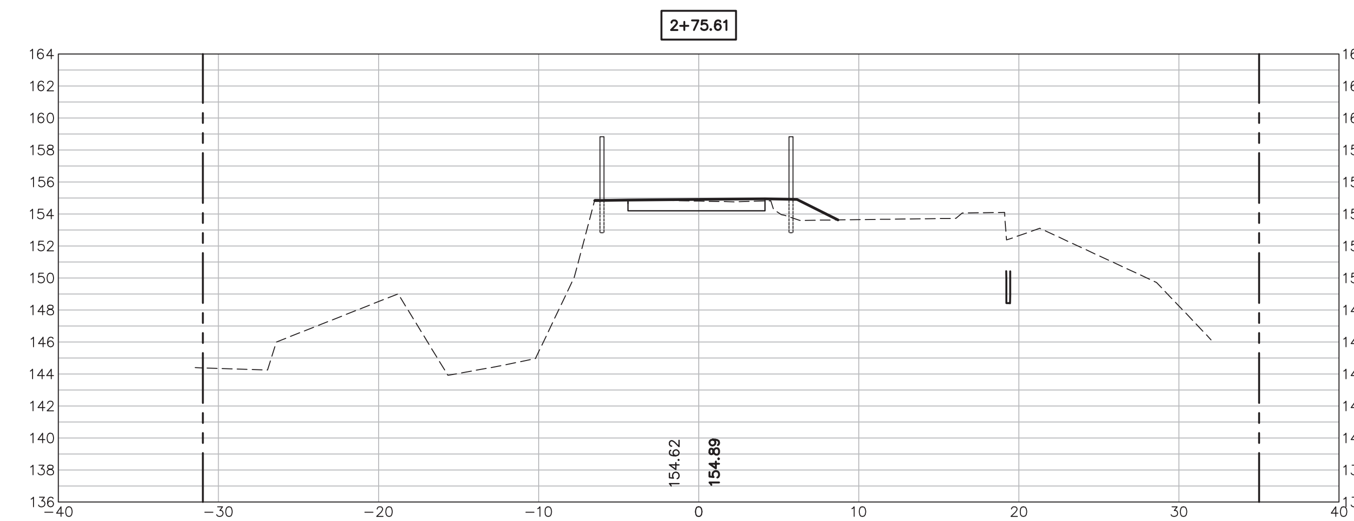

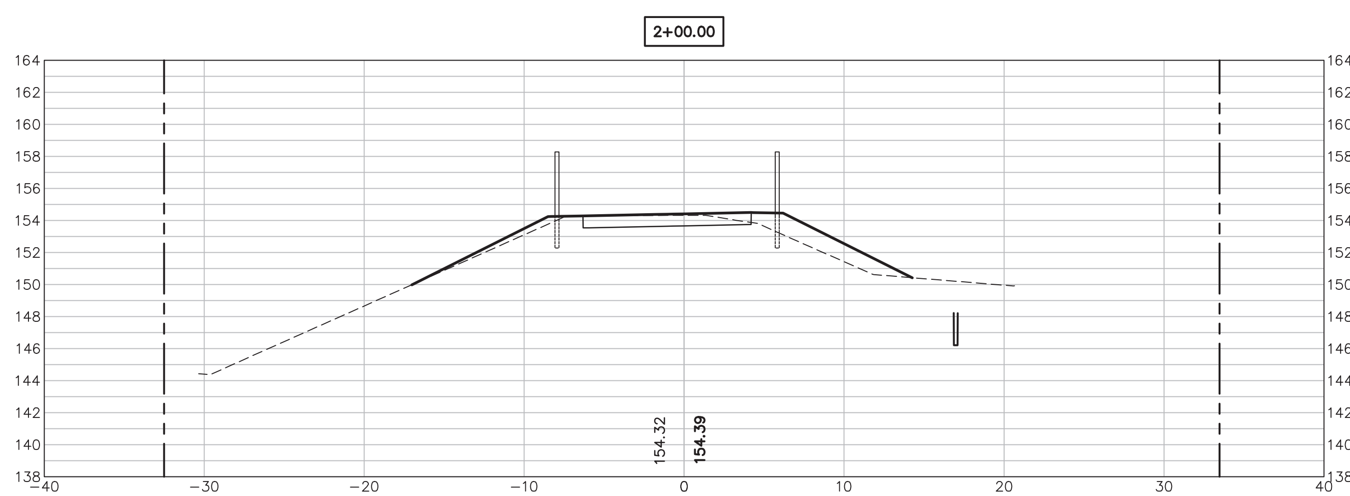

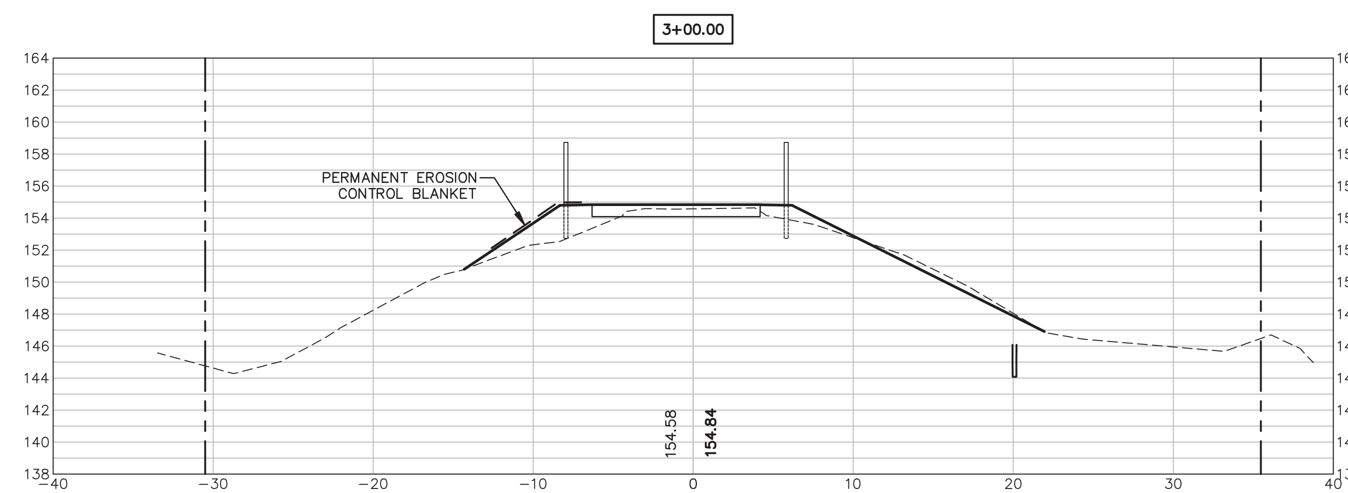

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Professional Engineer's No.: 0023403

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CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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ARCADIS U.S., INC.

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RCRA CAP 100% DESIGN

RAILS TO TRAILS CROSS-SECTIONS - 1

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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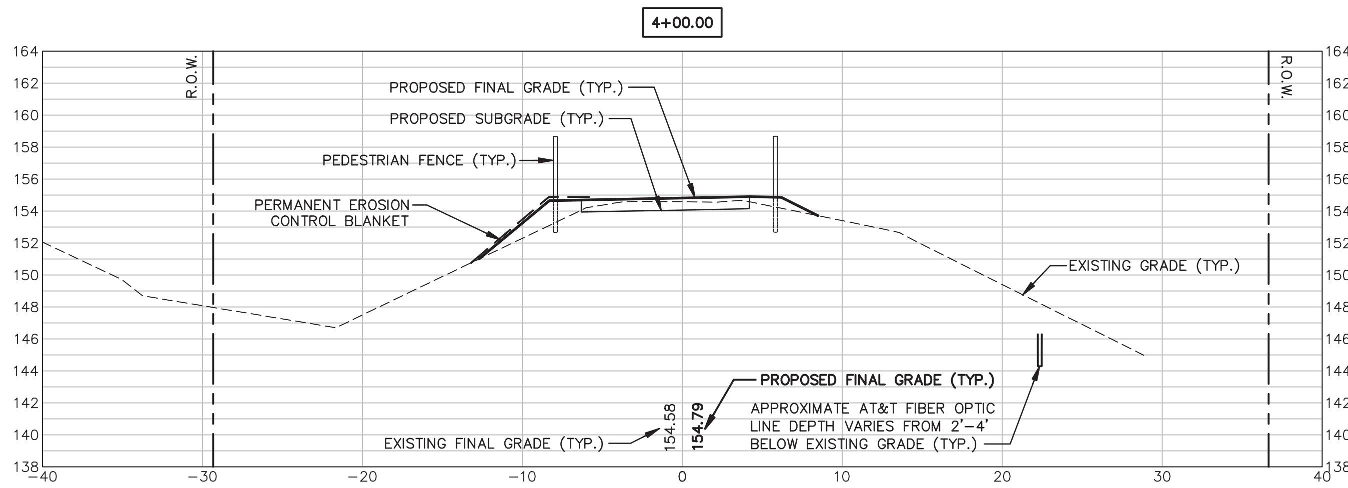

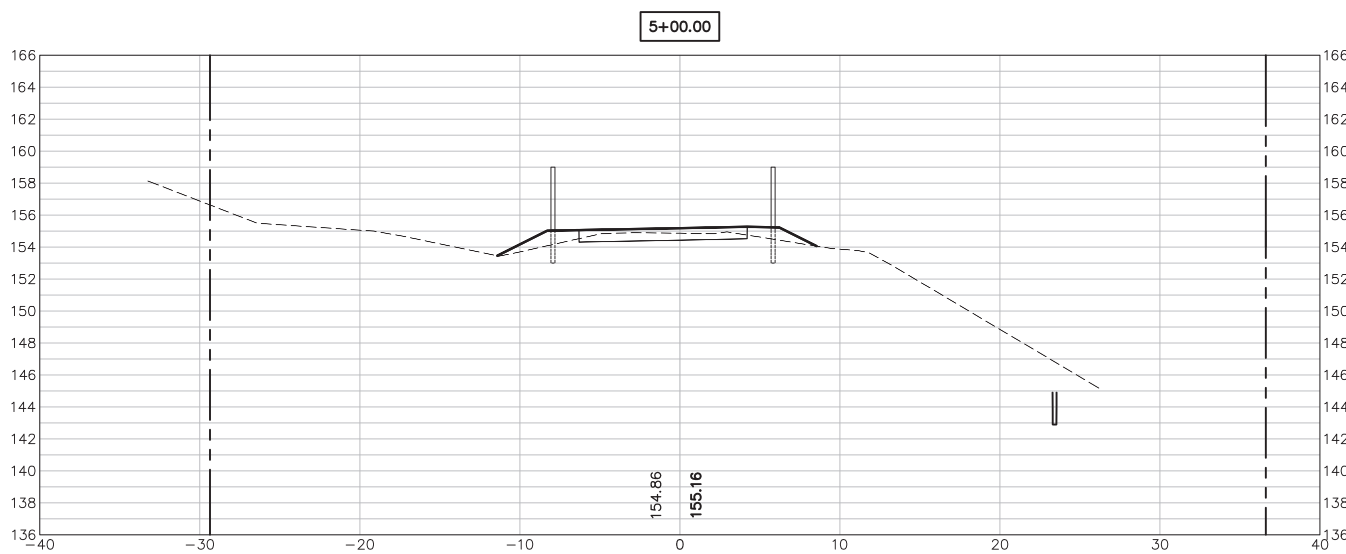

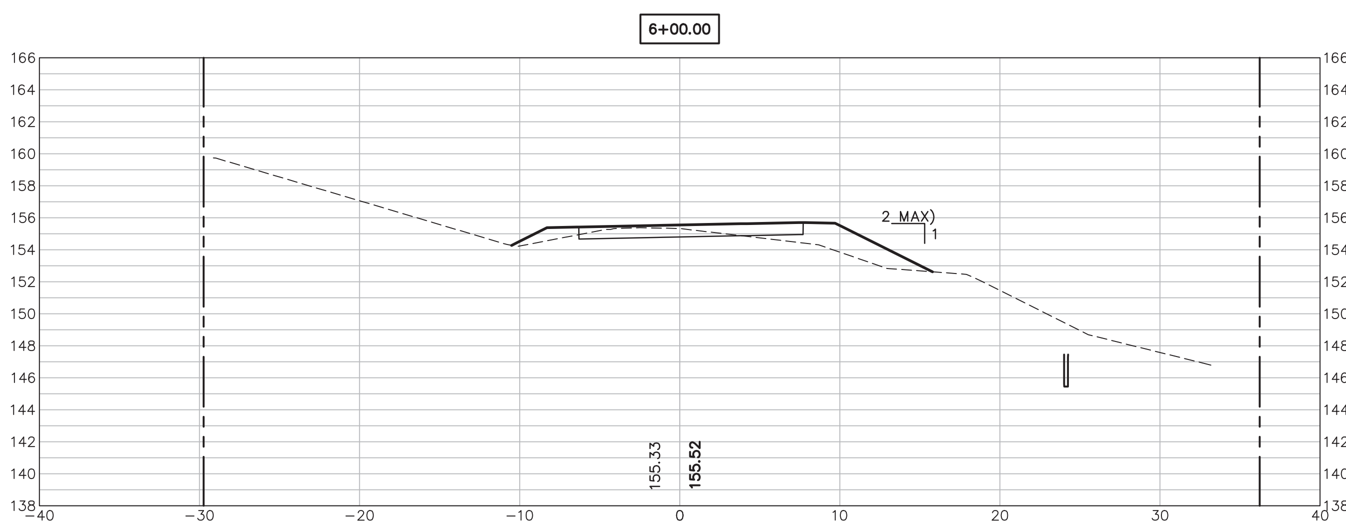

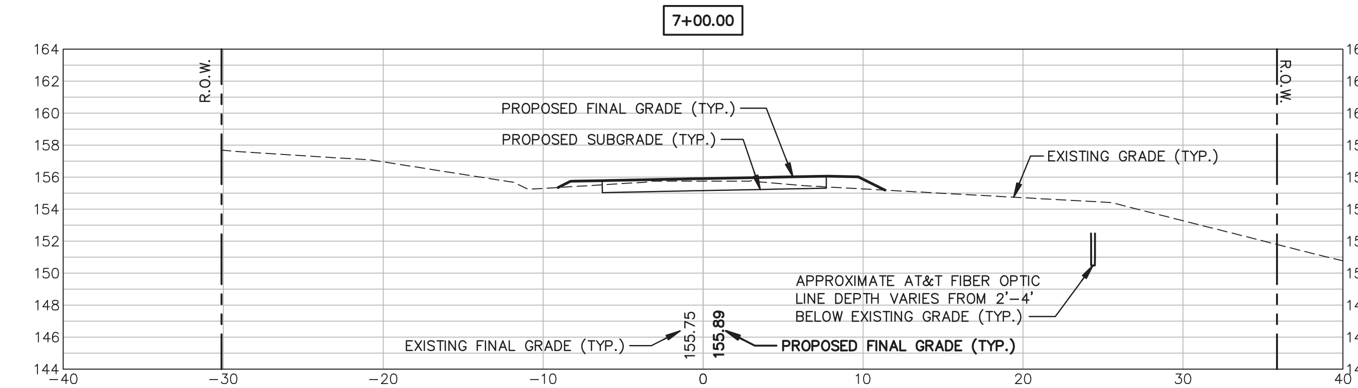

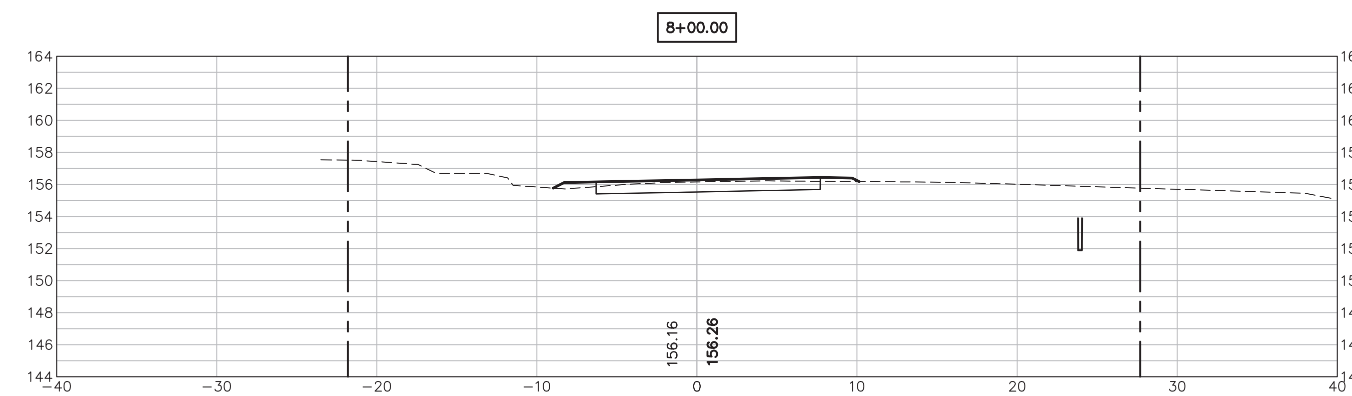

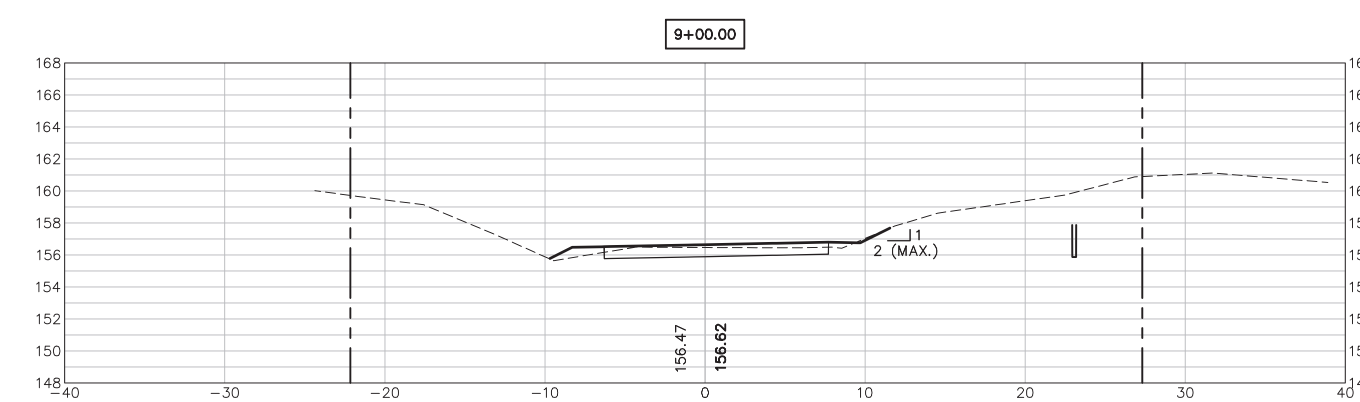

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IMAGES:
XREFS: 54634X00

1"=6' 6' 0 6' 12'

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Professional Engineer's Name: **JEFFREY HOLDEN**
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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RAILS TO TRAILS CROSS-SECTIONS - 2

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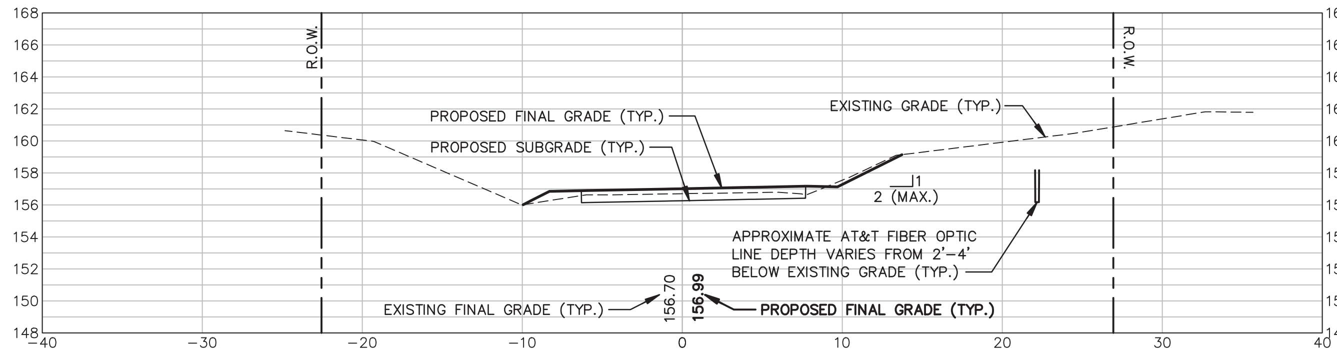
10+00.00



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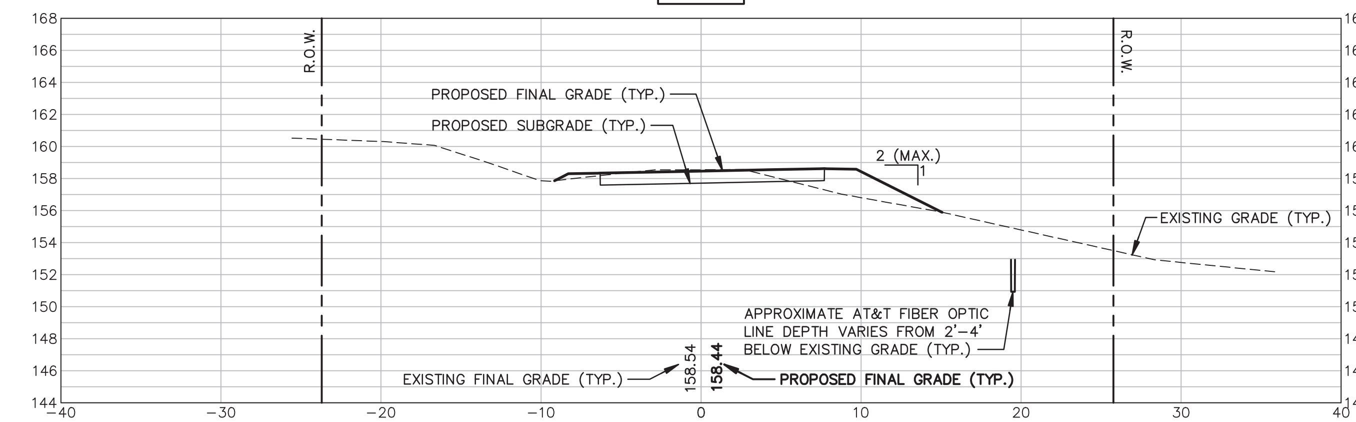

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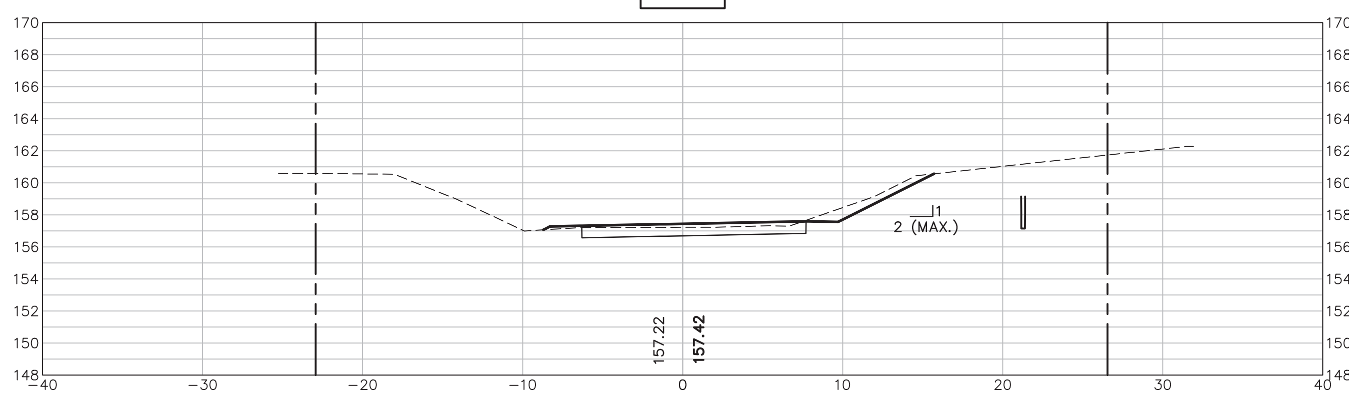

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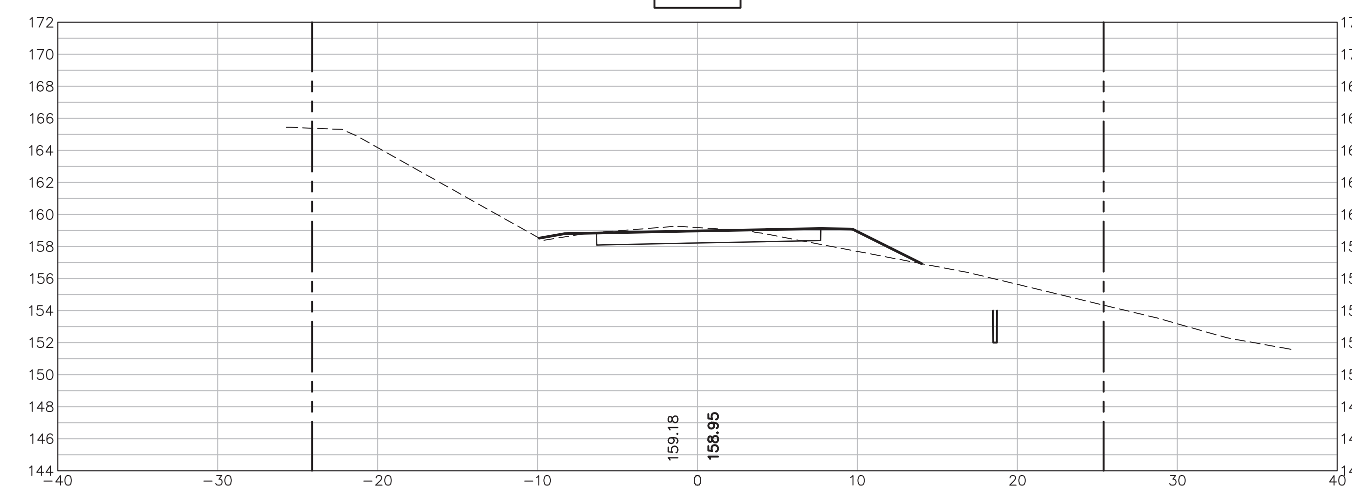

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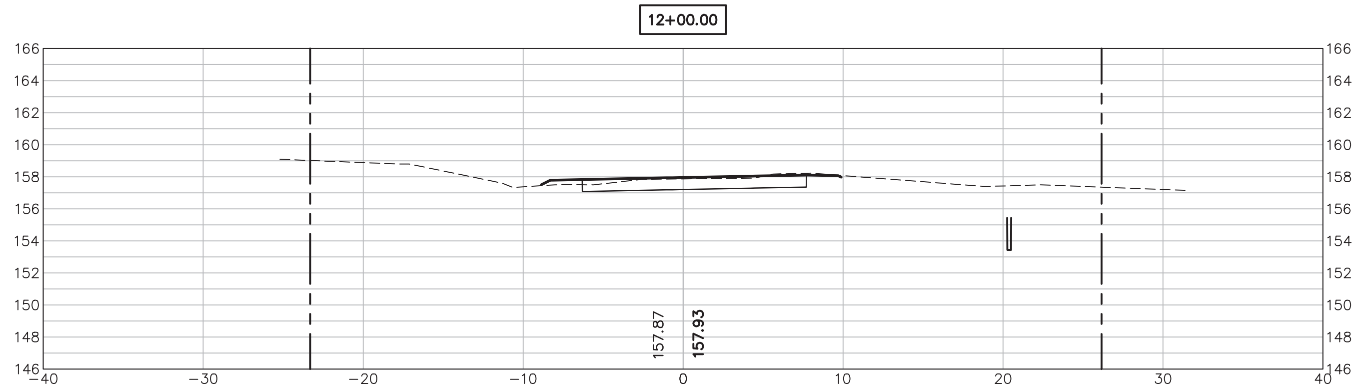

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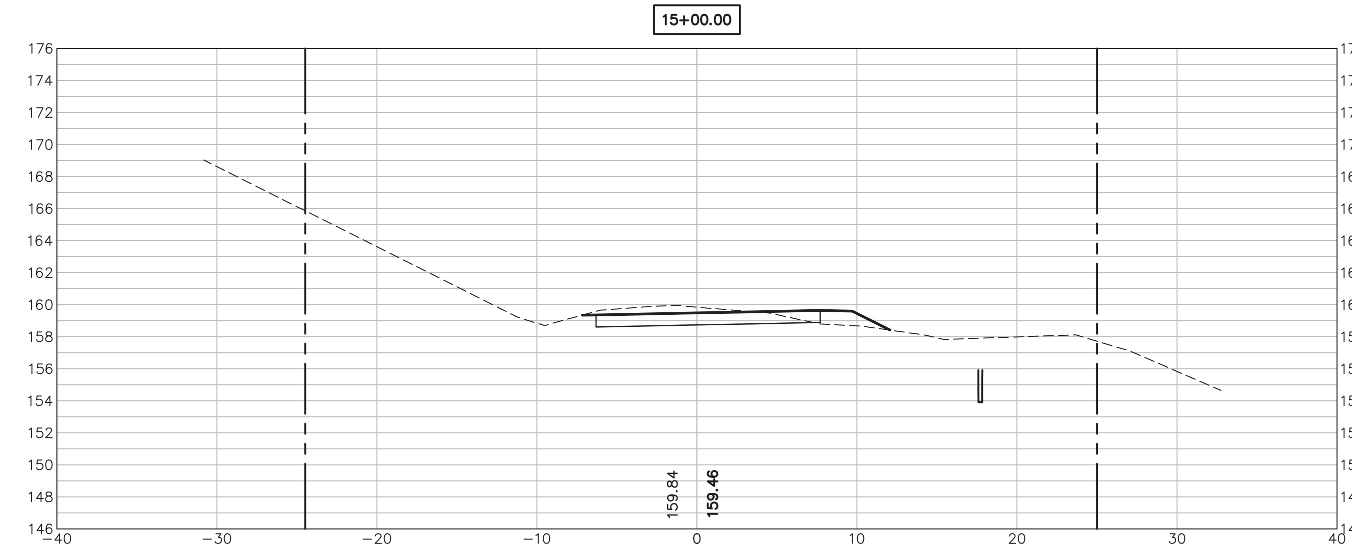

1"=6' 6' 0 6' 12'

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Designed by	Drawn by	Checked by
NWF	BS	JEM

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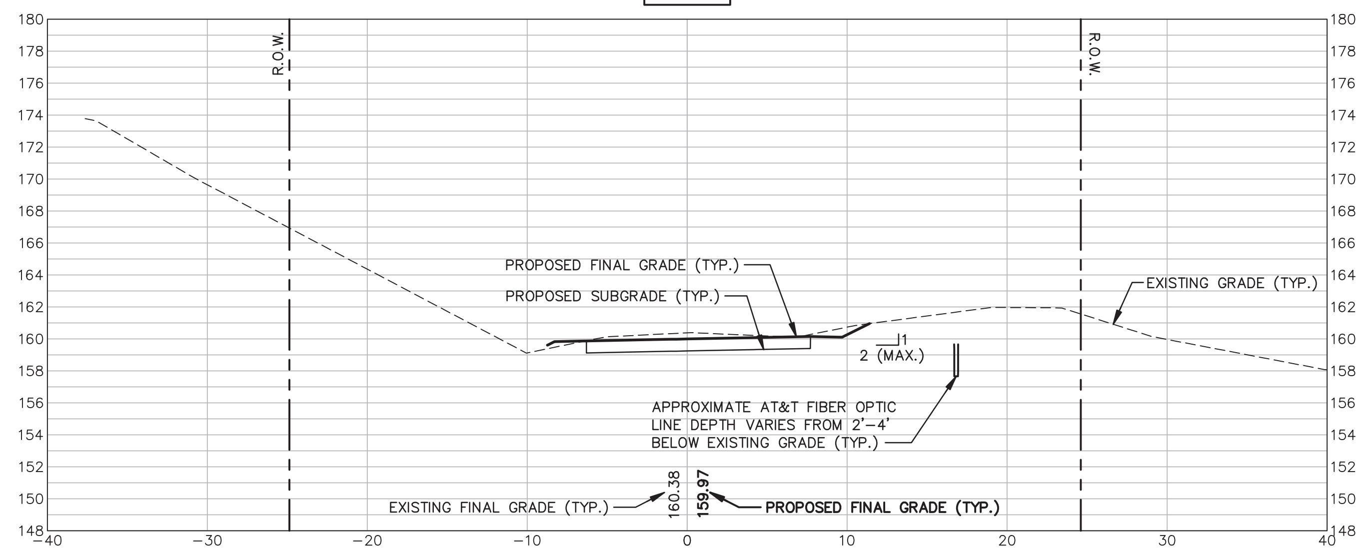

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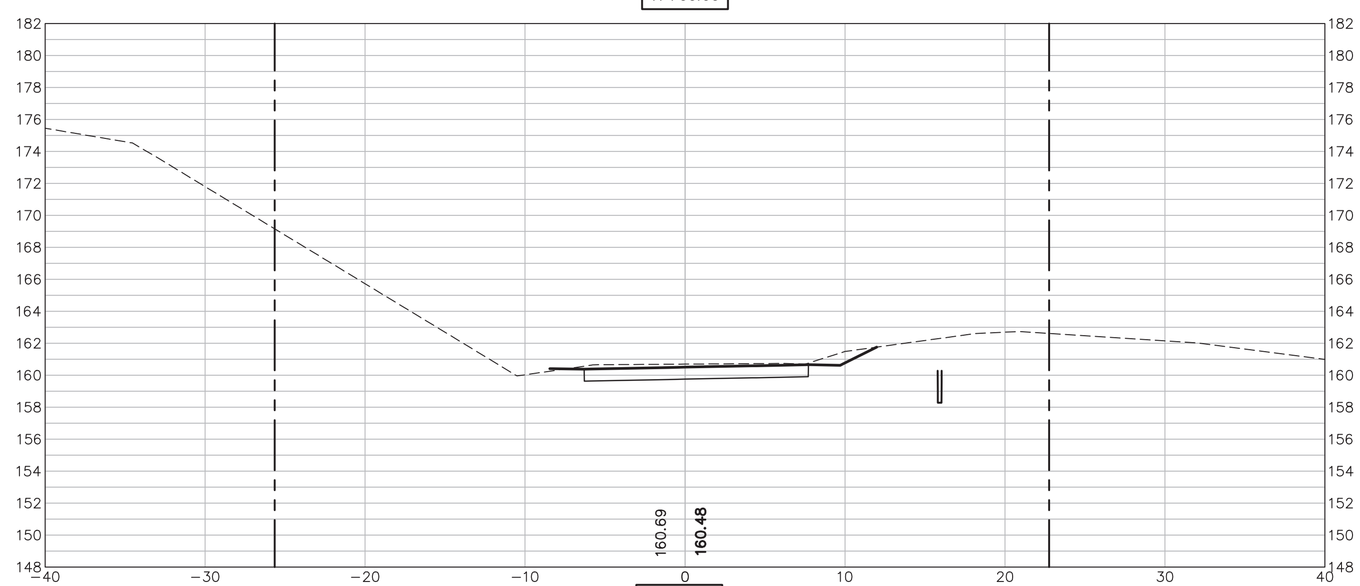

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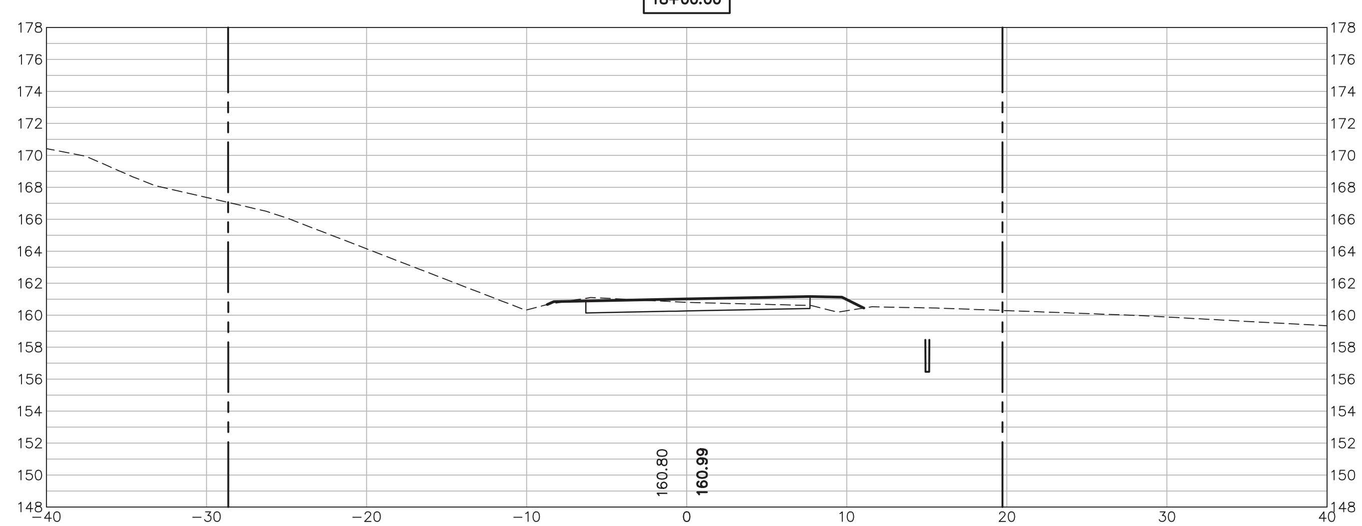

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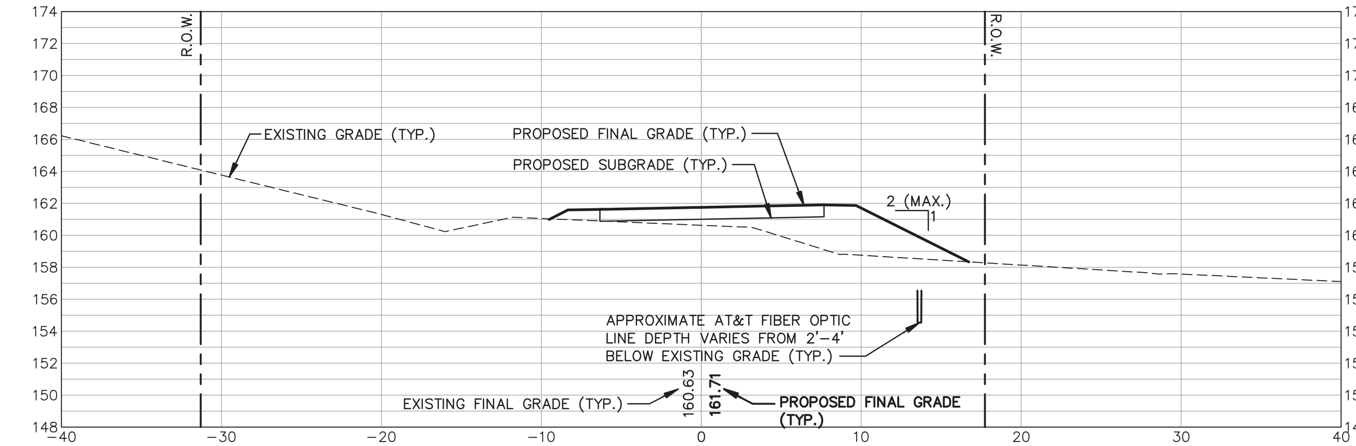

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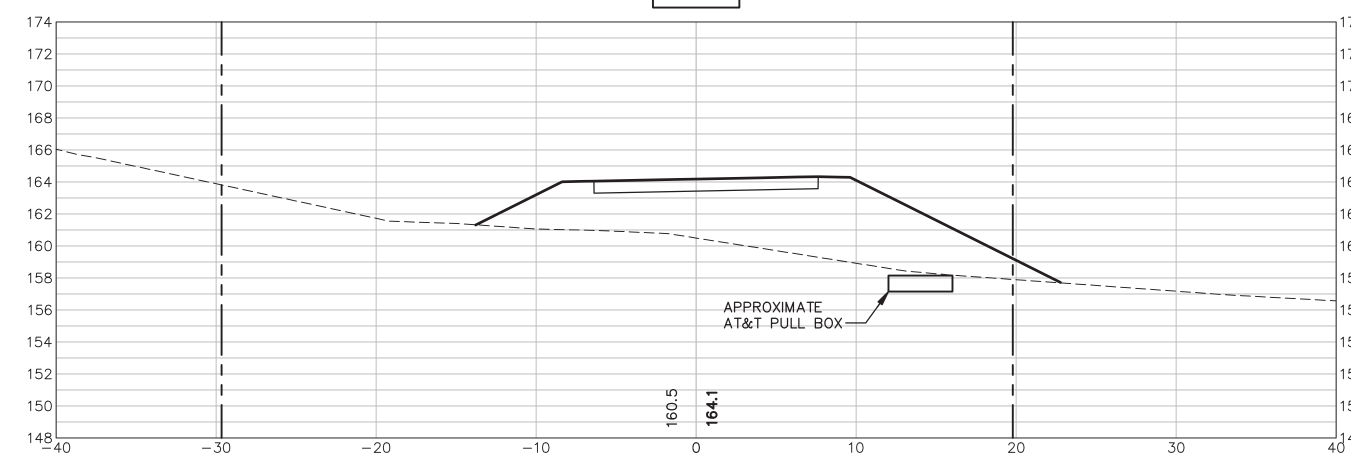

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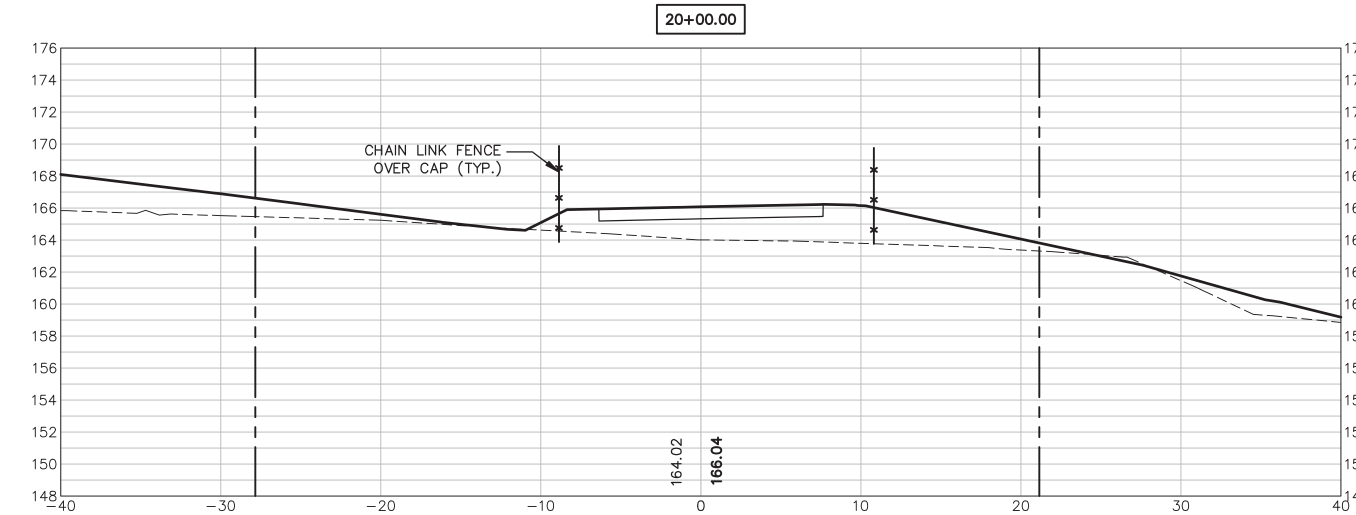

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Professional Engineer's No.: 0023403

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CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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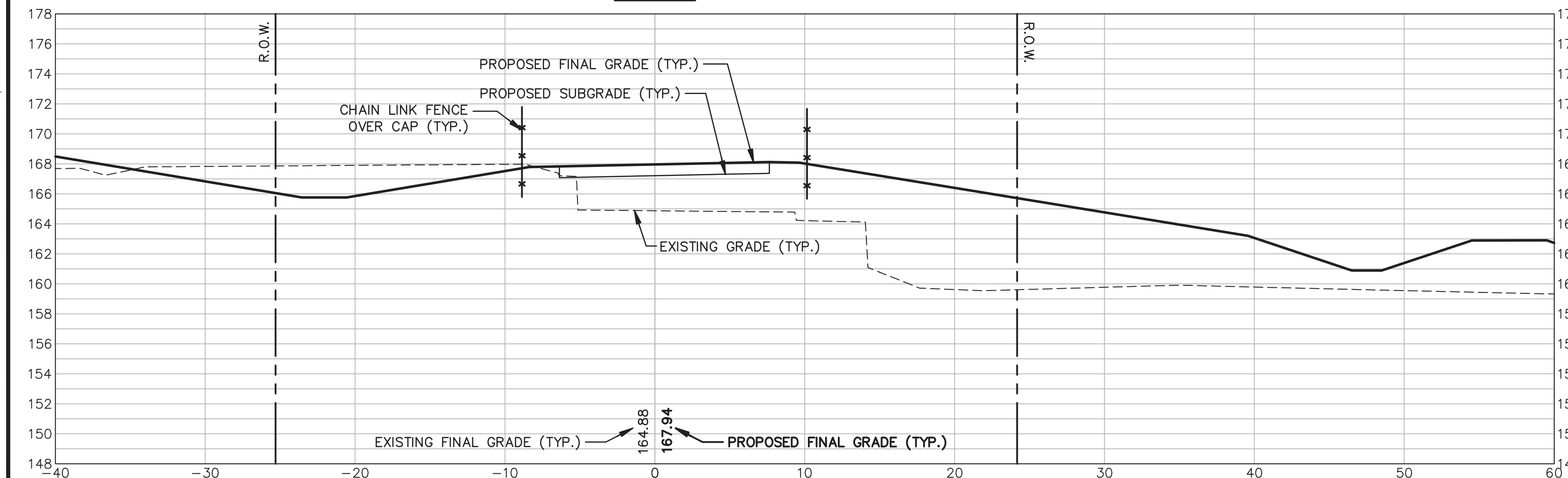
21+00.00



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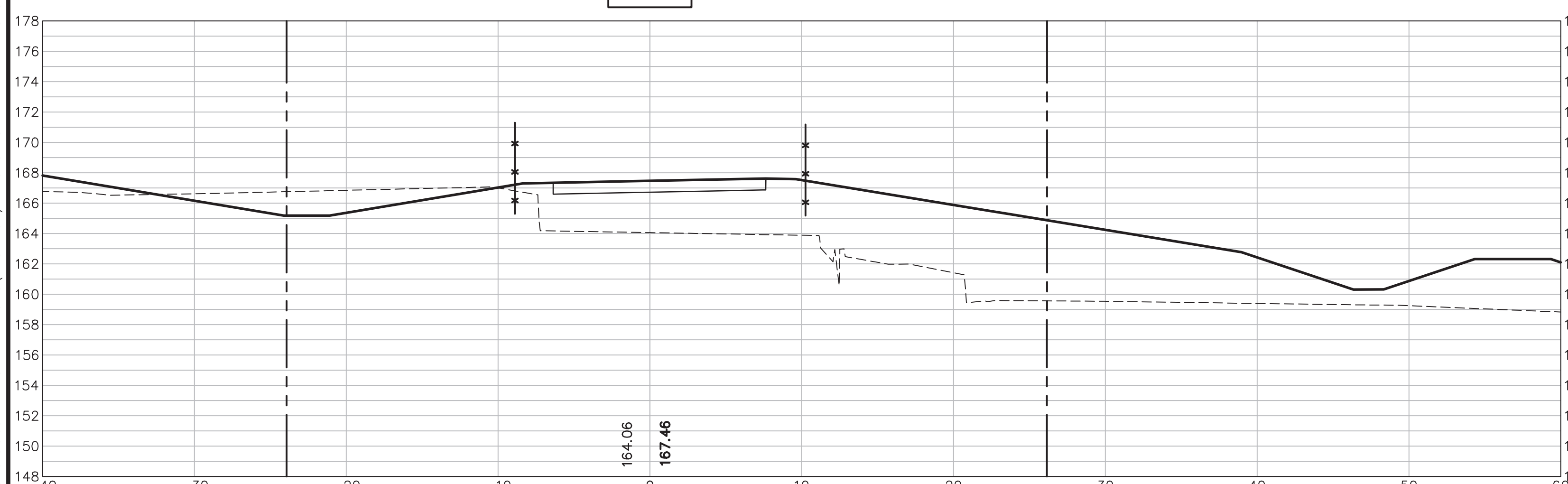

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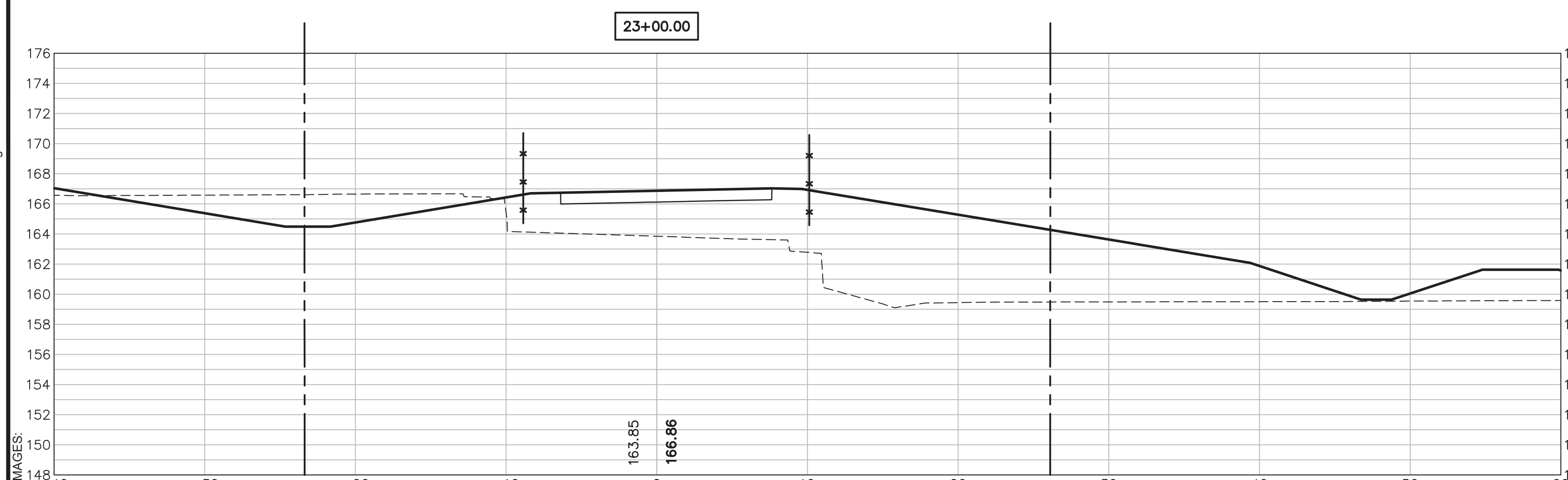

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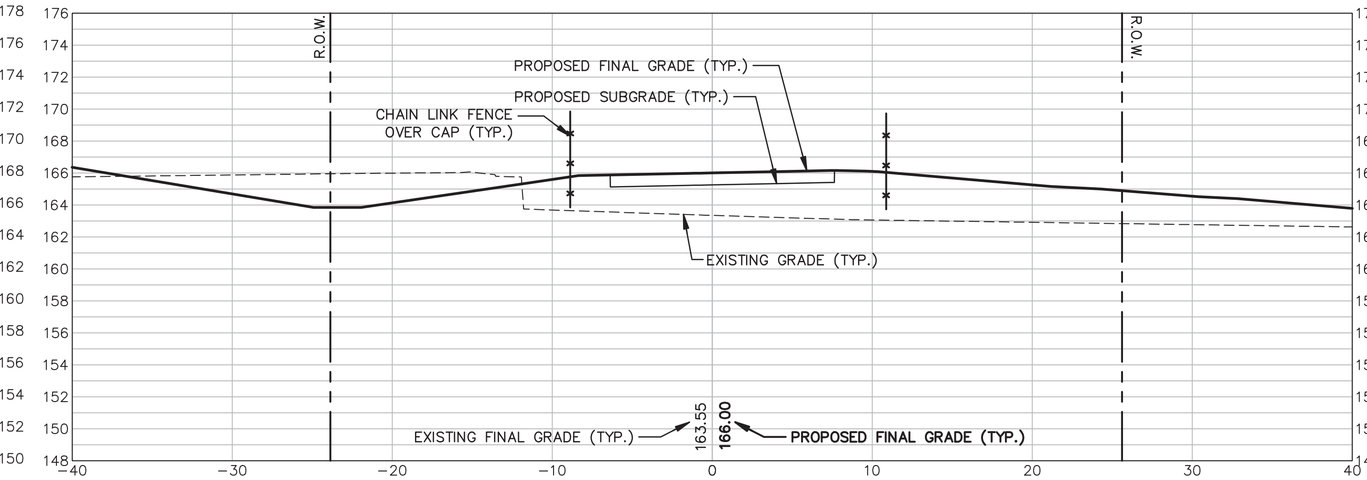

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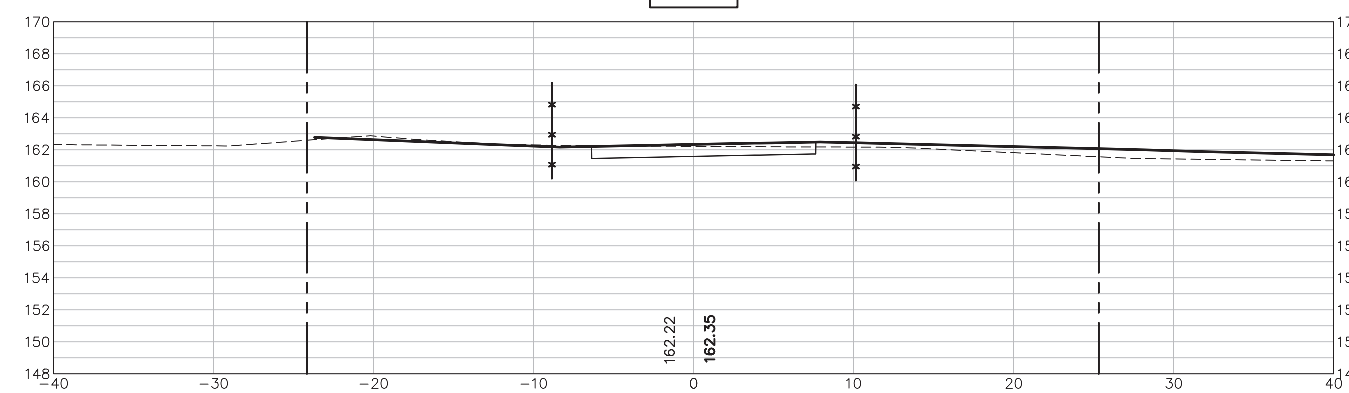

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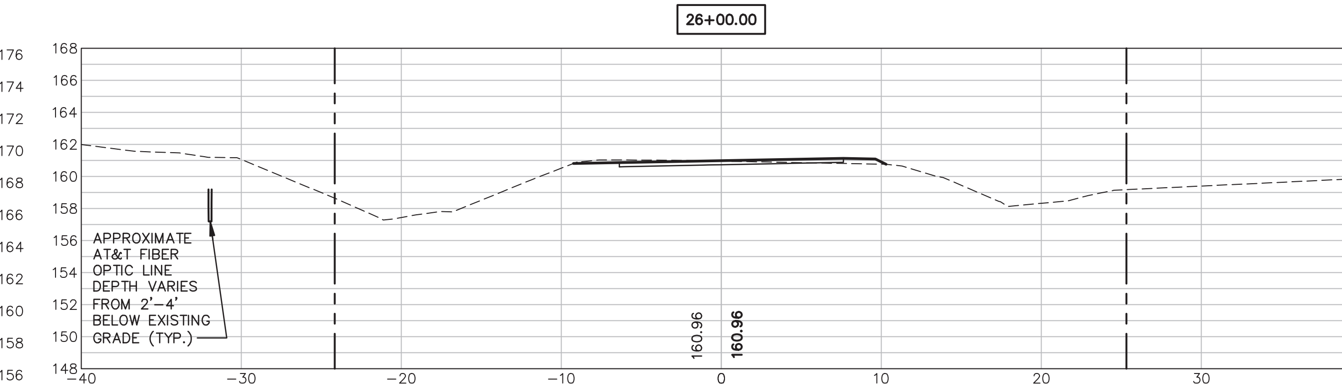

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403
State: CT | Date Signed: | Project Mgr.: JH
Designed by: NWF | Drawn by: BS | Checked by: JEM

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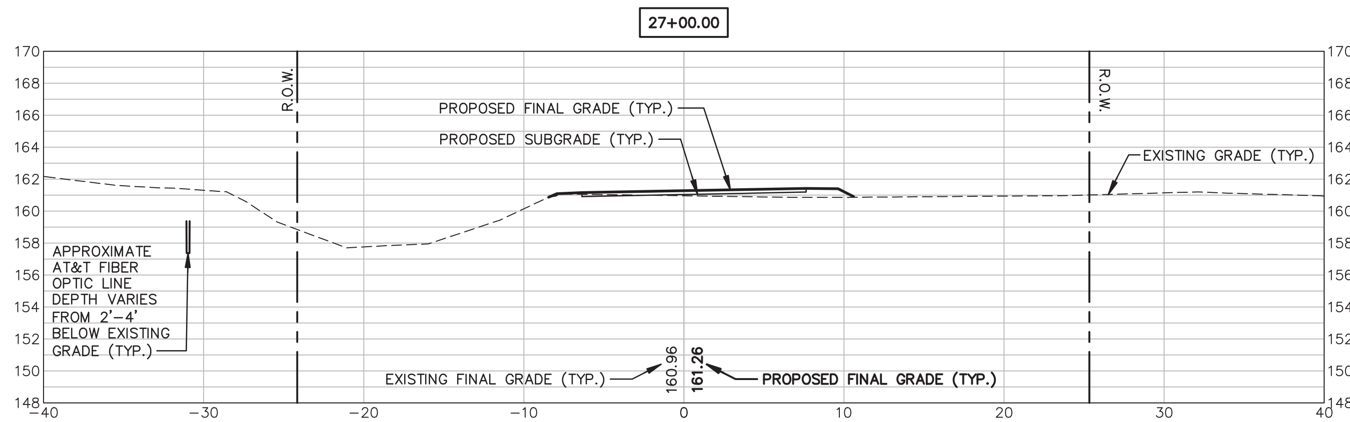

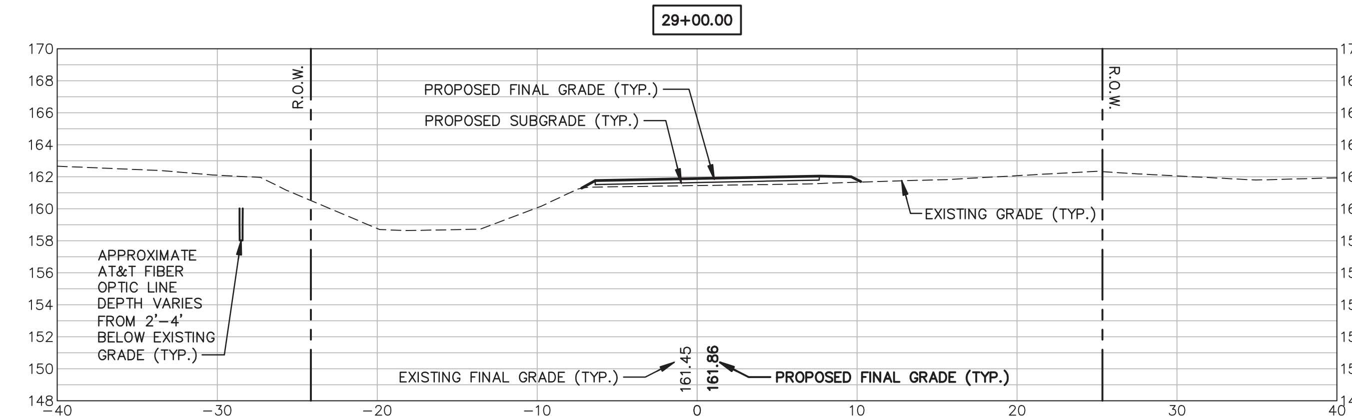

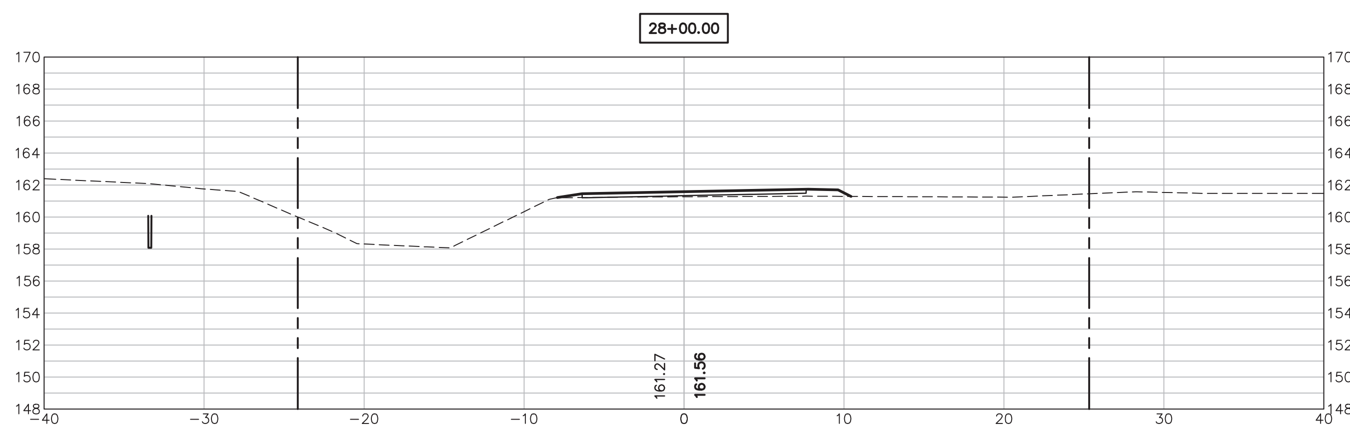

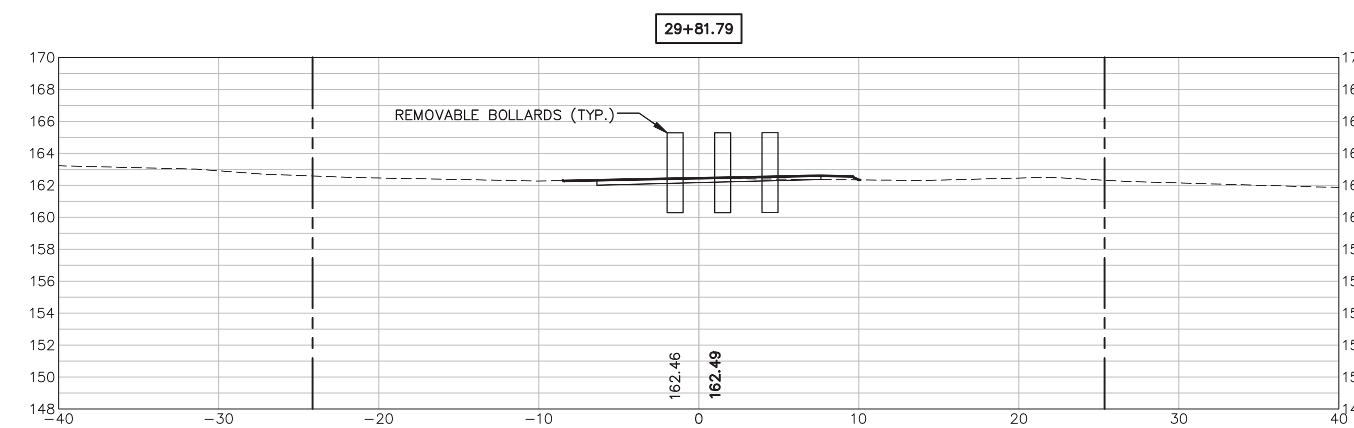

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

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CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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RAILS TO TRAILS CROSS-SECTIONS - 6

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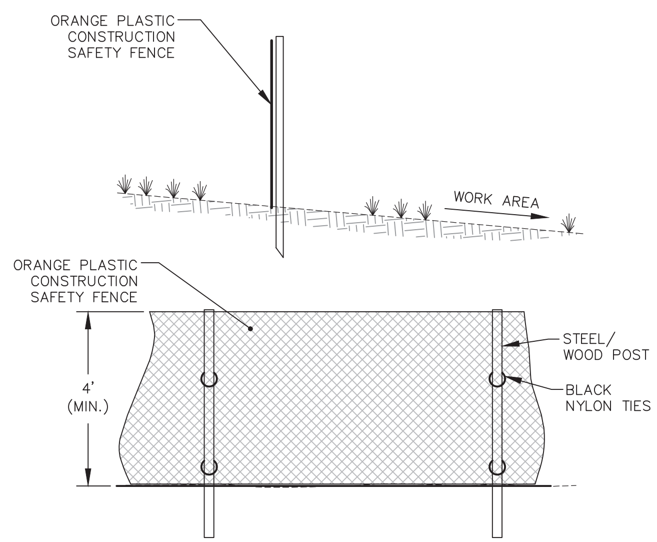
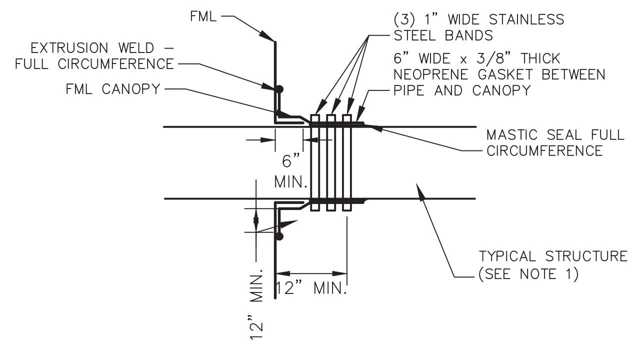


TEMPORARY CONSTRUCTION FENCE (1)

NOT TO SCALE

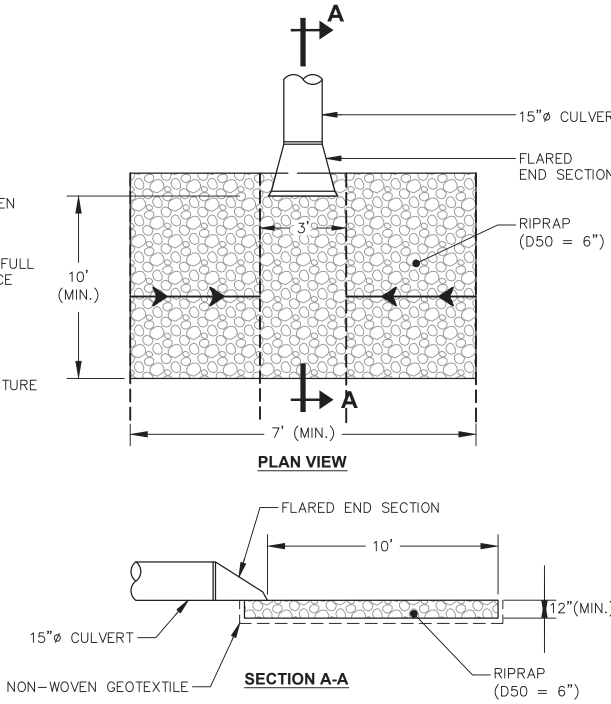


NOTE:

1. STRUCTURES THAT REQUIRE PENETRATION THROUGH THE GEOSYNTHETICS (I.E., DRAINAGE STRUCTURES) SHALL HAVE PENETRATION SEALS.

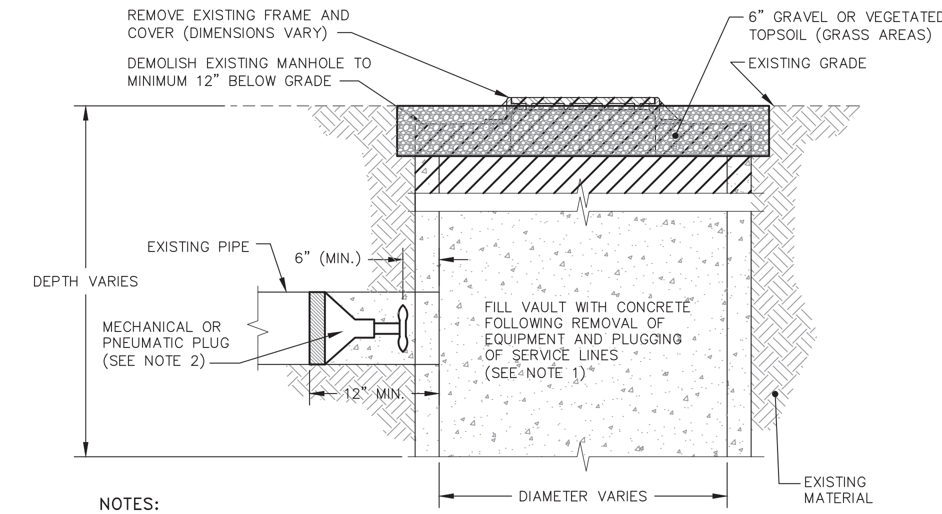
PIPE PENETRATION SEAL (2)

NOT TO SCALE



TYPICAL RIPRAP OUTLET PROTECTION DETAIL (3)

NOT TO SCALE

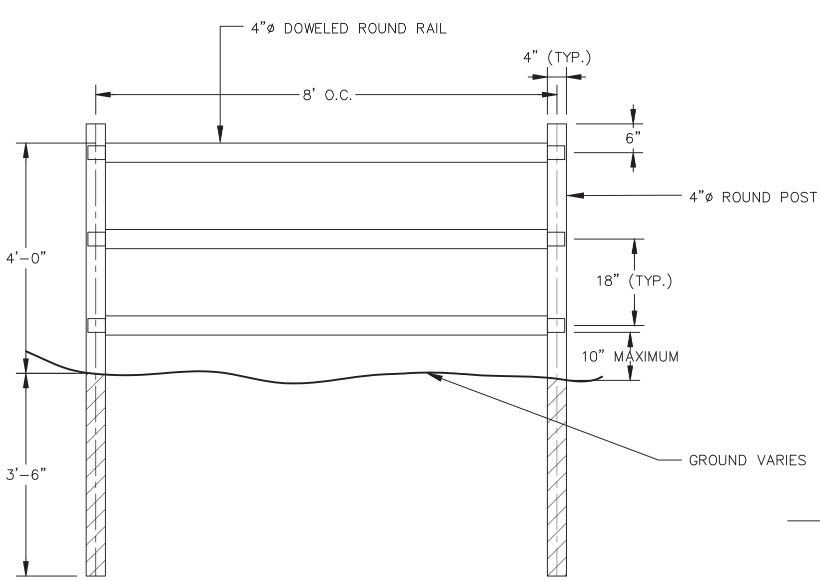


NOTES:

1. AS AN ALTERNATE TO ABANDONING THE MANHOLE BY FILLING WITH CONCRETE, THE CONTRACTOR MAY OPT TO PUNCTURE THE MANHOLE FLOOR SO THAT IT CANNOT CONTAIN STANDING WATER, SEAL THE PIPE OPENING WITH SEWER PLUG AND NON–SHRINK GROUT, BRICK, BLOCK OR MORTAR, AND FILL THE MANHOLE WITH GENERAL FILL.
2. PRIOR TO INITIATING UTILITY ABANDONMENT ACTIVITIES, THE CONTRACTOR SHALL SUBMIT PRODUCT INFORMATION FOR CONCRETE, BRICK, BLOCK, MORTAR, OR NON–SHRINK GROUT AND SEWER PLUGS FOR REVIEW.

TYPICAL MANHOLE/VAULT ABANDONMENT DETAIL (4)

NOT TO SCALE

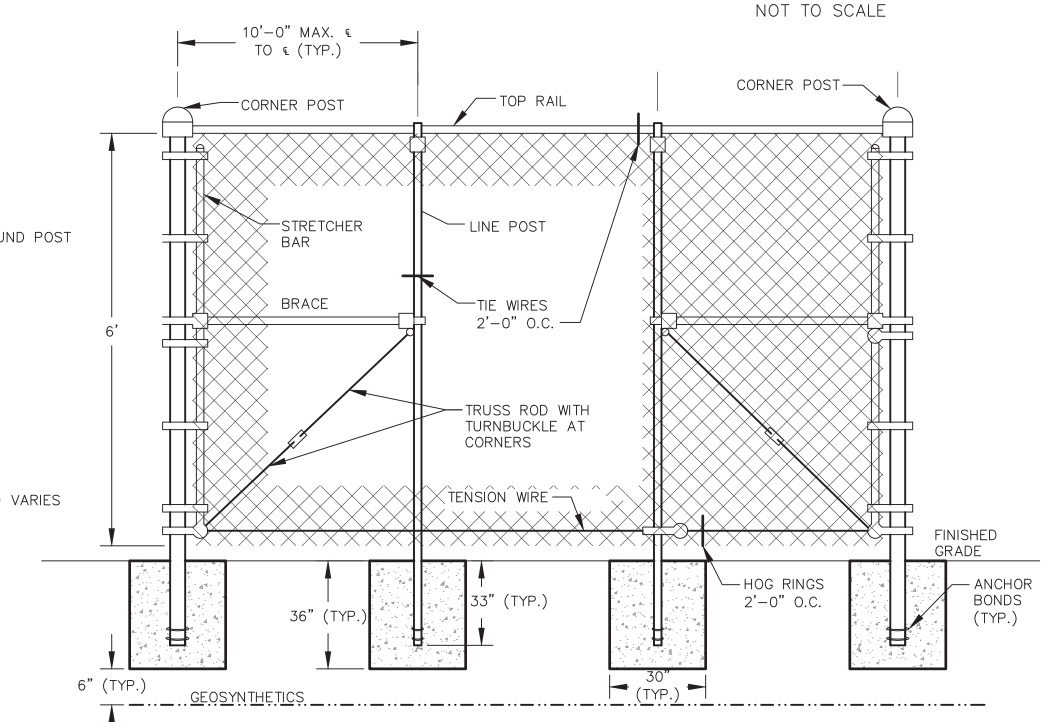


NOTES:

1. NORTHERN WHITE CEDAR POST AND RAIL FENCE IS TO BE USED IN AREAS ALONG TRAIL WHERE SHOWN ON DRAWINGS 17 AND 18.
2. ALL FENCING IS TO BE OFFSET 2–FT. FROM EDGE OF PAVEMENT UNLESS OTHERWISE SHOWN ON PLANS. ALL PROPOSED FENCE LOCATIONS ARE TO BE FIELD VERIFIED BY ENGINEER PRIOR TO ORDERING AND INSTALLATION.
3. TOP RAIL SHALL BE A MINIMUM OF 48" HIGH ABOVE THE PAVED TRAIL SURFACE.

PEDESTRIAN FENCE (5)

NOT TO SCALE

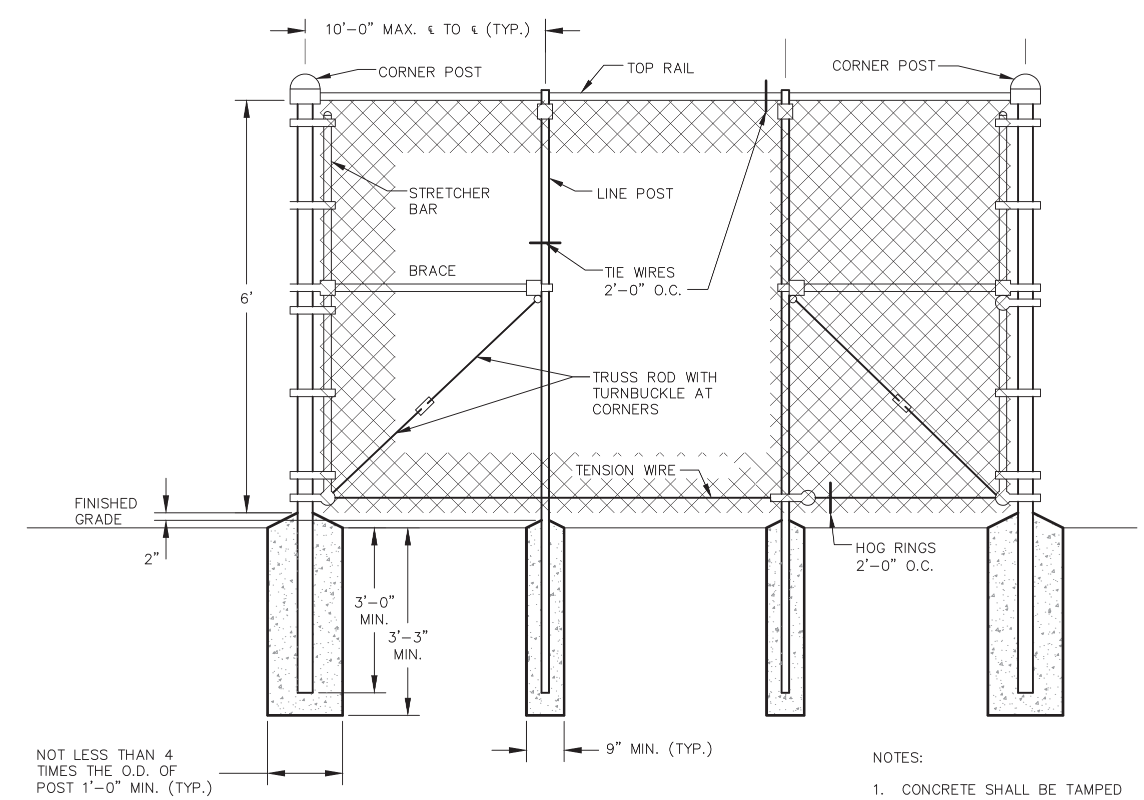


NOTES:

1. CONCRETE SHALL BE TAMPED AND RODDED IN PLACE.

CHAIN-LINK FENCE OVER CAP (6)

NOT TO SCALE



NOTES:

1. CONCRETE SHALL BE TAMPED AND RODDED IN PLACE.

CHAIN-LINK FENCE (7)

NOT TO SCALE

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SCALE(S) AS INDICATED

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MISCELLANEOUS DETAILS - 1

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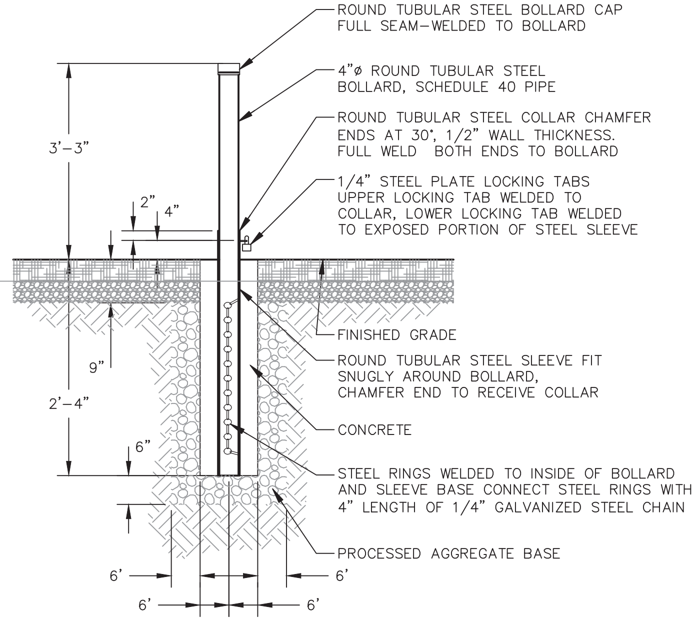
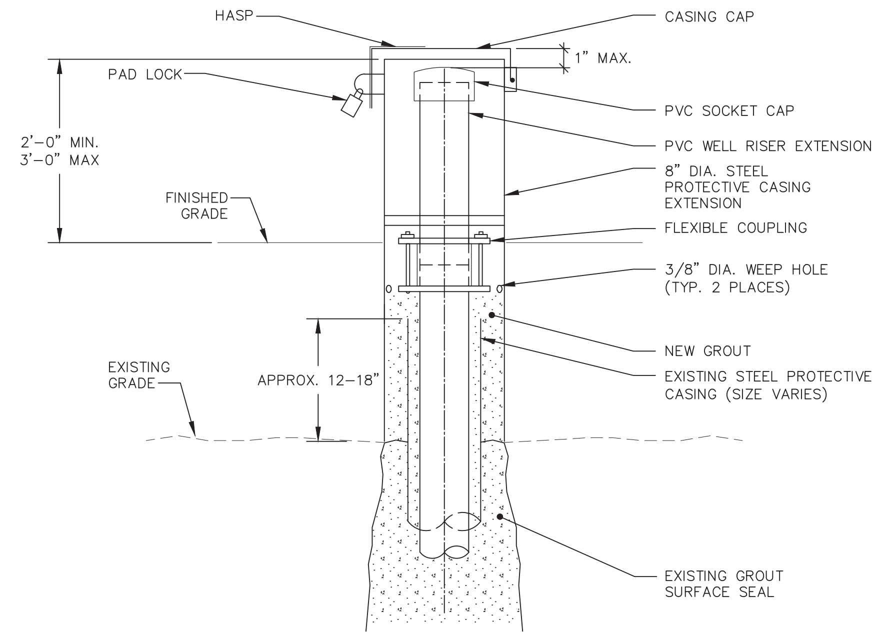


NOTES:

1. FABRICATE AND ASSEMBLE STEEL BOLLARD AND GALVANIZE AS UNIT.
2. FIT LOCKING TABS WITH ONE BRASS LOCKED SIZED ACCORDINGLY FOR EACH BOLLARD. ALL LOCKS SHOULD BE KEYED WITH IDENTICAL LOCK MECHANISMS AND FOUR KEYS SUPPLIED TO THE OWNER.

REMOVABLE BOLLARD DETAIL (1)

NOT TO SCALE

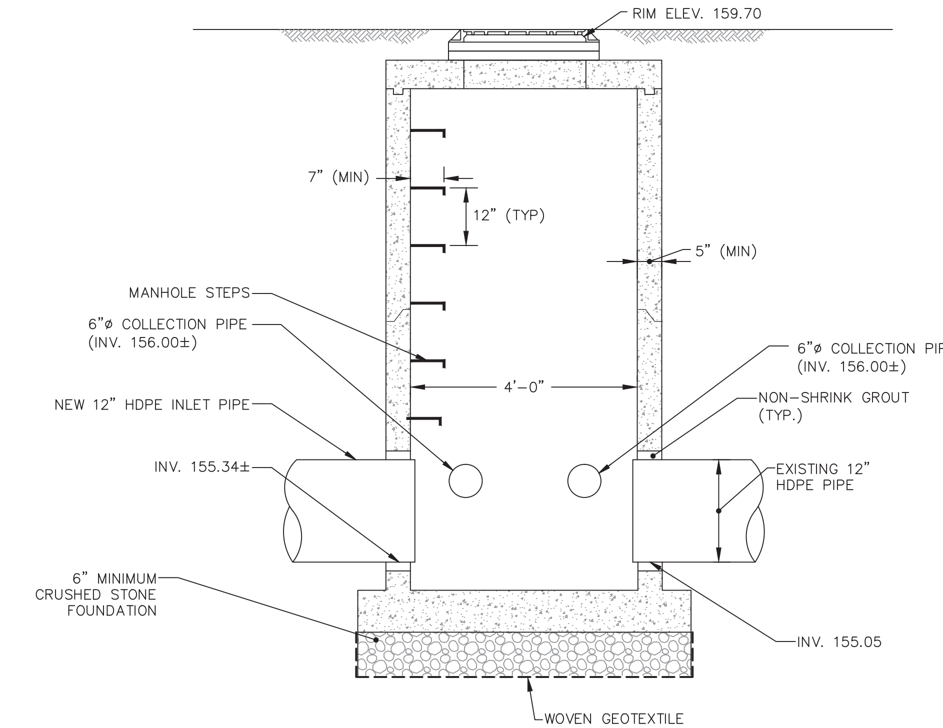


NOTE:

1. ALL WELL AND PIEZOMETER MODIFICATIONS SHALL BE COMPLETED BY A CERTIFIED WELL DRILLER LICENSED IN THE STATE OF CONNECTICUT.

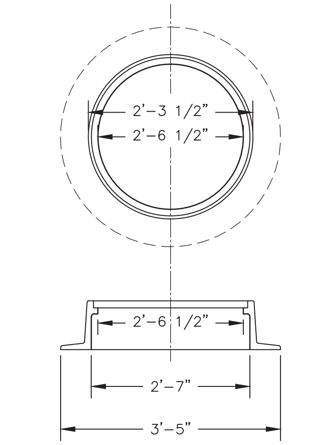
MONITORING WELL EXTENSION DETAIL (2)

NOT TO SCALE



PRECAST CONCRETE MANHOLE-1 (3)

NOT TO SCALE

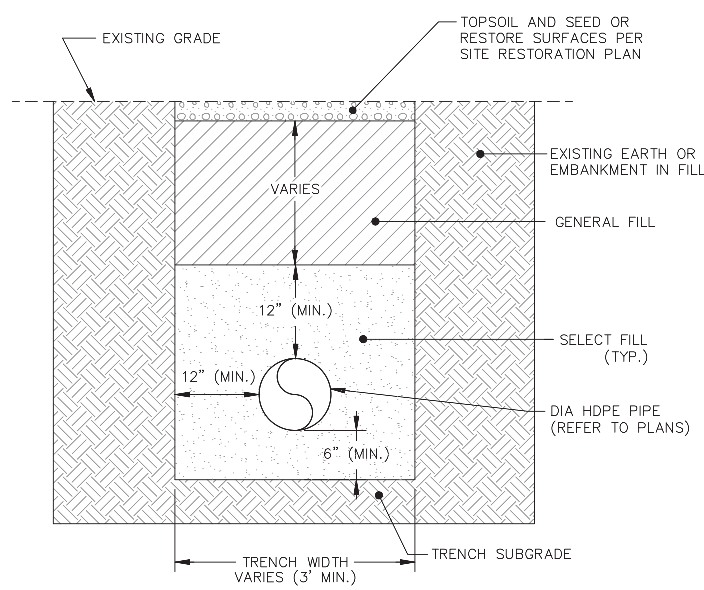


NOTE:

1. MANHOLE FRAME AND COVER SHALL CONFORM TO THE DETAILS SHOWN ON CONNECTICUT DOT STANDARD SHEET HW507_10.

MANHOLE FRAME AND COVER (4)

NOT TO SCALE

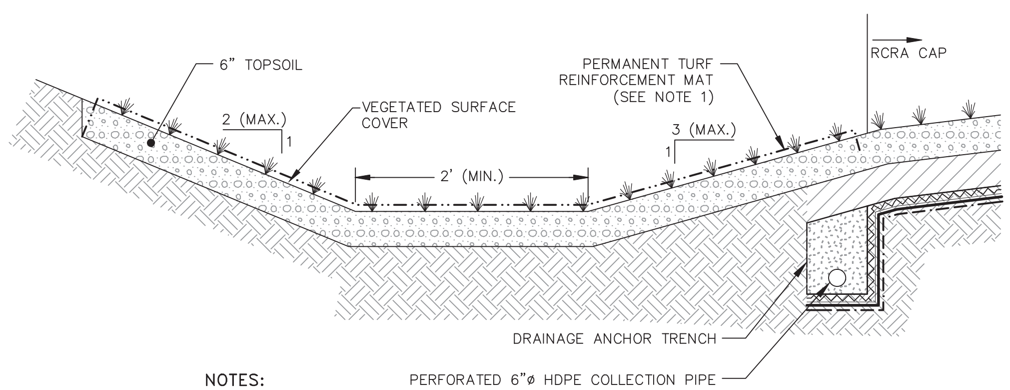


NOTES:

1. REFER TO TECHNICAL SPECIFICATION SECTION 32 23 05 FOR PLACEMENT AND COMPACTION REQUIREMENTS

STORMWATER PIPE TRENCH (5)

NOT TO SCALE

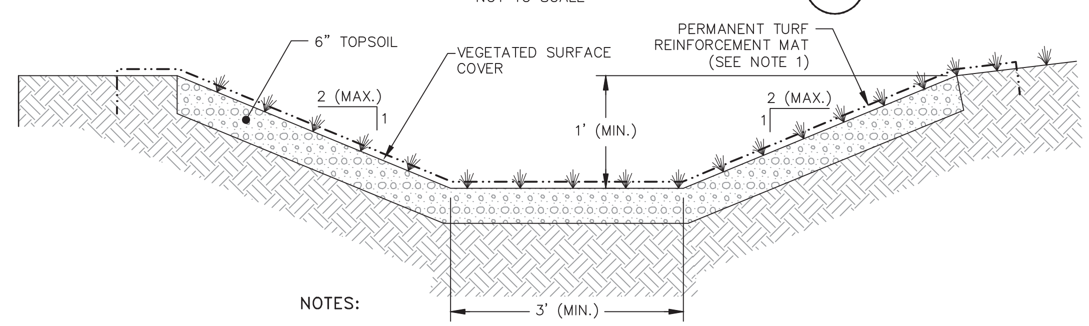


NOTES:

1. PERMANENT TURF REINFORCEMENT MAT SHALL BE SC250 AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.

RCRA CAP SOUTHERN SWALE (6)

NOT TO SCALE

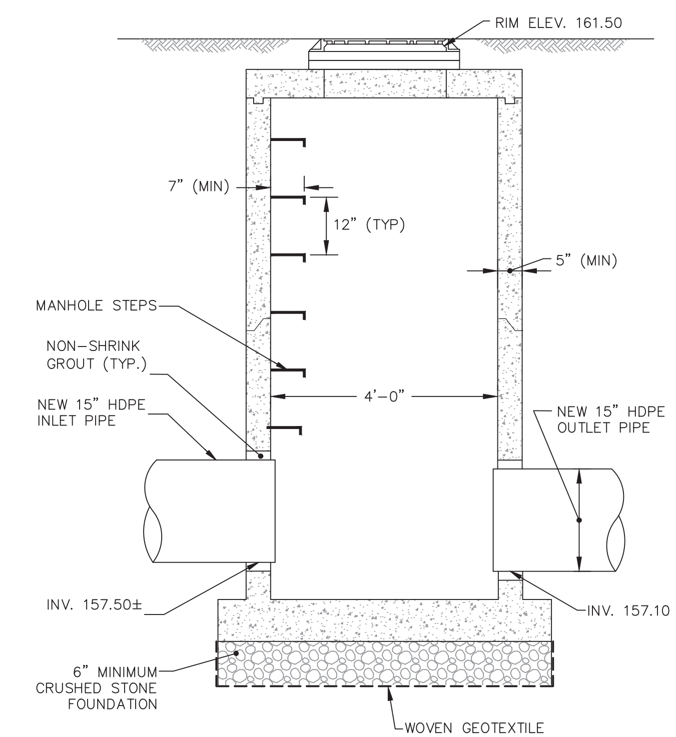


NOTES:

1. PERMANENT TURF REINFORCEMENT MAT SHALL BE SC250 AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.

SOUTHERN OUTLET (7)

NOT TO SCALE



PRECAST CONCRETE MANHOLE-2 (8)

NOT TO SCALE

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Professional Engineer's Name		
JEFFREY HOLDEN		
Professional Engineer's No. 0023403		
State: CT	Date Signed	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

MISCELLANEOUS DETAILS - 2

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
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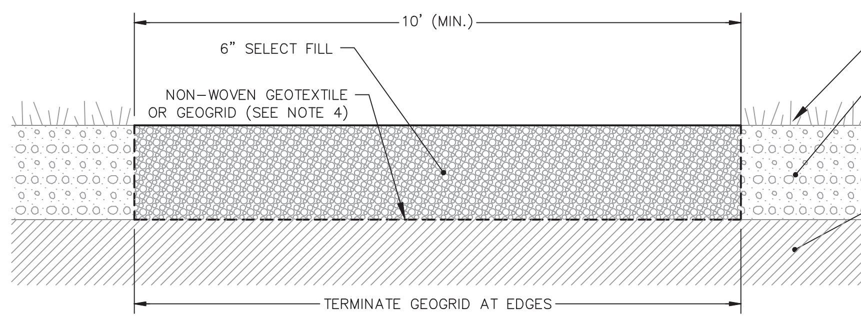
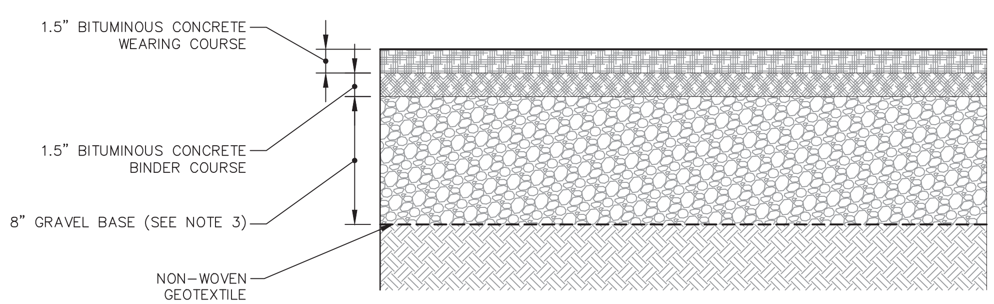


GRAVEL ACCESS ROAD (1)

NOT TO SCALE

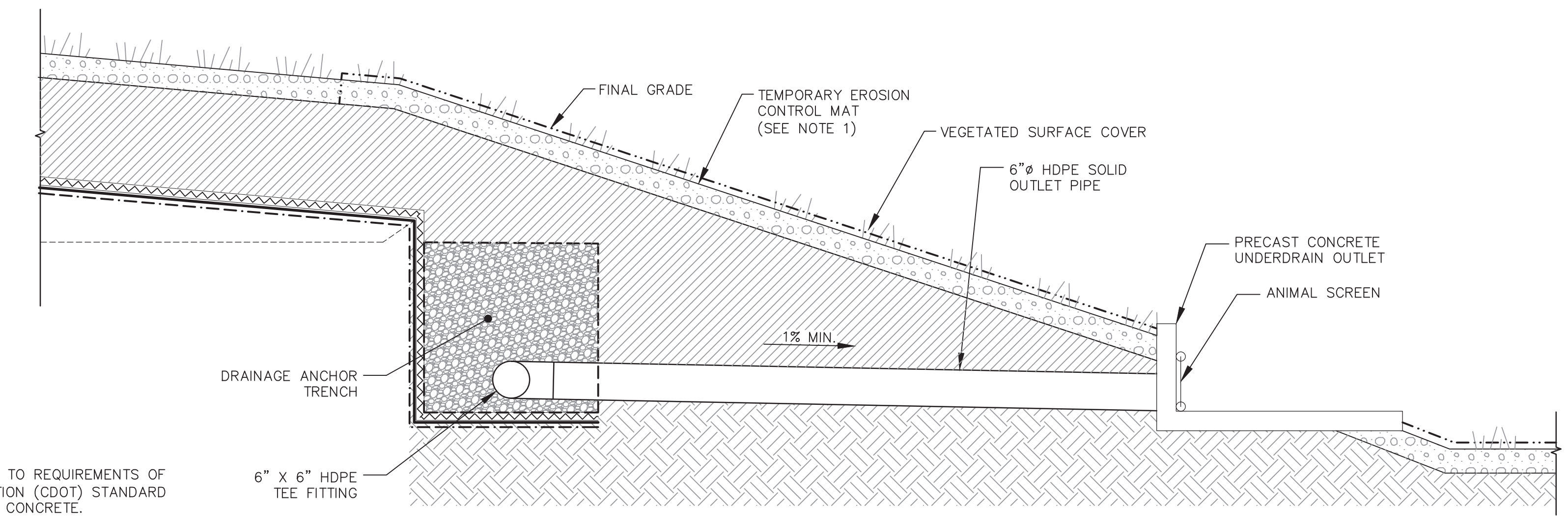


RAILS TO TRAILS PARKING AREA (2)

NOT TO SCALE

DETAIL 1 AND 2 NOTES:

1. ASPHALT SURFACE COURSE SHALL CONFORM TO REQUIREMENTS OF CONNECTICUT DEPARTMENT OF TRANSPORTATION (CDOT) STANDARD SPECIFICATION SECTION 4.06 OF BITUMINOUS CONCRETE.
2. PROCESSED AGGREGATE BASE SHALL CONFORM TO THE MATERIAL REQUIREMENTS OF CDOT STANDARD SPECIFICATION SECTION 3.04.
3. GRAVEL BASE SHALL CONSIST OF SUITABLE GRAVEL MATERIAL FROM EXISTING CONTRACTOR PARKING AREA SUPPLEMENTED WITH PROCESSED AGGREGATE BASE AS NEEDED.
4. GEOGRID SHALL BE INSTALLED AT THE RCRA CAP GRAVEL ACCESS ROAD AND NON-WOVEN GEOTEXTILE SHALL BE INSTALLED AT ALL OTHER ACCESS ROAD LOCATIONS.

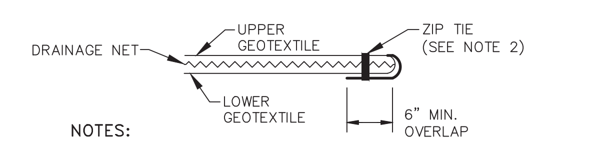


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. PRECAST CONCRETE UNDERDRAIN OUTLET SHALL CONFORM TO THE DETAILS SHOWN ON CONNECTICUT DOT STANDARD SHEET 751-B

COLLECTION PIPE OUTLET (3)

NOT TO SCALE

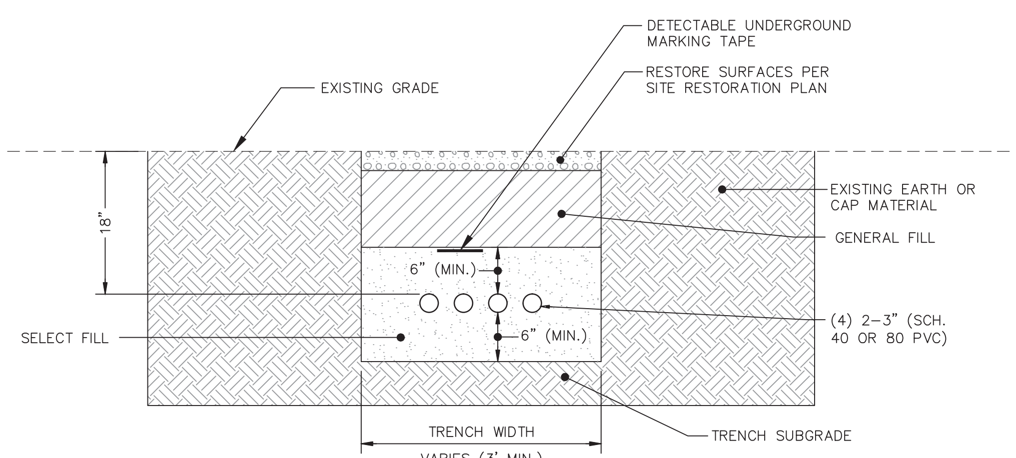


NOTES:

1. DRAINAGE NET AND LOWER GEOTEXTILE SHALL BE CUT SO THAT THE UPPER GEOTEXTILE MAY BE WRAPPED AROUND THE END OF THE GEOCOMPOSITE.
2. ZIP TIES SHALL BE PLACED EVERY 5 FEET ALONG THE EDGES OF THE GEOCOMPOSITE.

GEOCOMPOSITE TERMINATION (6)

NOT TO SCALE

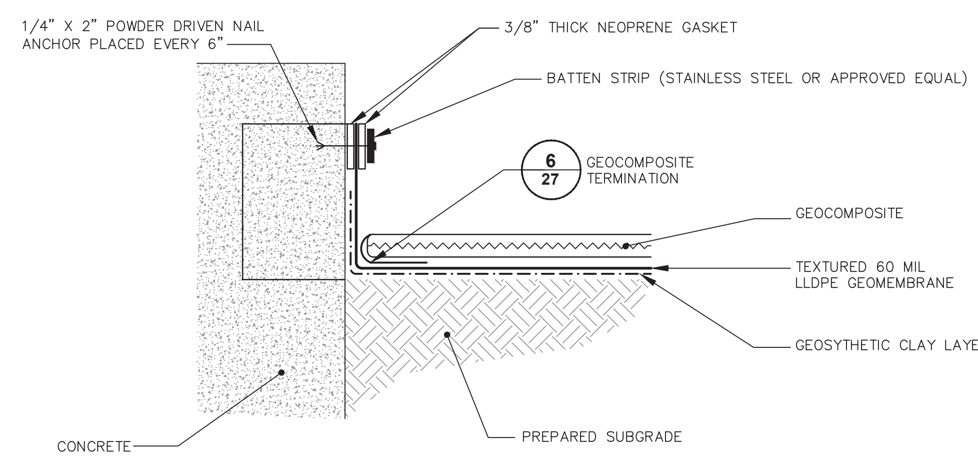


NOTES:

1. REFER TO TECHNICAL SPECIFICATION SECTION 31 23 05 FOR PLACEMENT AND COMPACTION REQUIREMENTS

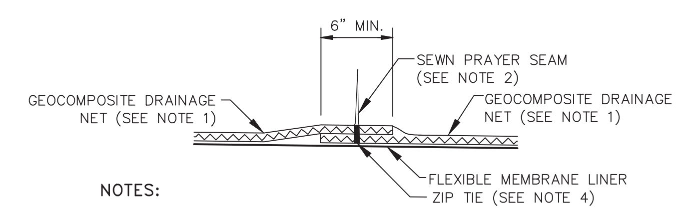
ELECTRICAL CONDUIT TRENCH (4)

NOT TO SCALE



GEOMEMBRANE/CONCRETE ANCHOR (5)

NOT TO SCALE



NOTES:

1. ALL GEOCOMPOSITE SHALL SINGLE DOWNSLOPE.
2. THE UPPER GEOTEXTILE COMPONENTS OF THE GEOCOMPOSITE LAYER SHALL BE OVERLAPPED SO THAT A PRAYER SEAM MAY BE SEWN ABOVE THE GEOCOMPOSITE OVERLAP.
3. IF GEOTEXTILE IS UNABLE TO BE OVERLAPPED WITHOUT CAUSING DAMAGE, A PATCH OF GEOTEXTILE SHALL BE HEAT BONDED TO THE TOP GEOTEXTILE LAYER OVER THE SEAM.
4. ZIP TIES SHALL BE PLACED EVERY 5 FEET ALONG ADJACENT PANELS AND EVERY 6 INCHES ALONG BUTT SEAMS AND IN ANCHOR TRENCHES.

TYPICAL GEOCOMPOSITE SEAM (7)

NOT TO SCALE

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JEM
Designed by	Drawn by	Checked by
NWF	BS	JEM

FOR FINAL 100% DESIGN

ARCADIS Design & Consultancy for natural and built assets

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RCRA CAP 100% DESIGN

MISCELLANEOUS DETAILS - 3

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date OCTOBER 2016

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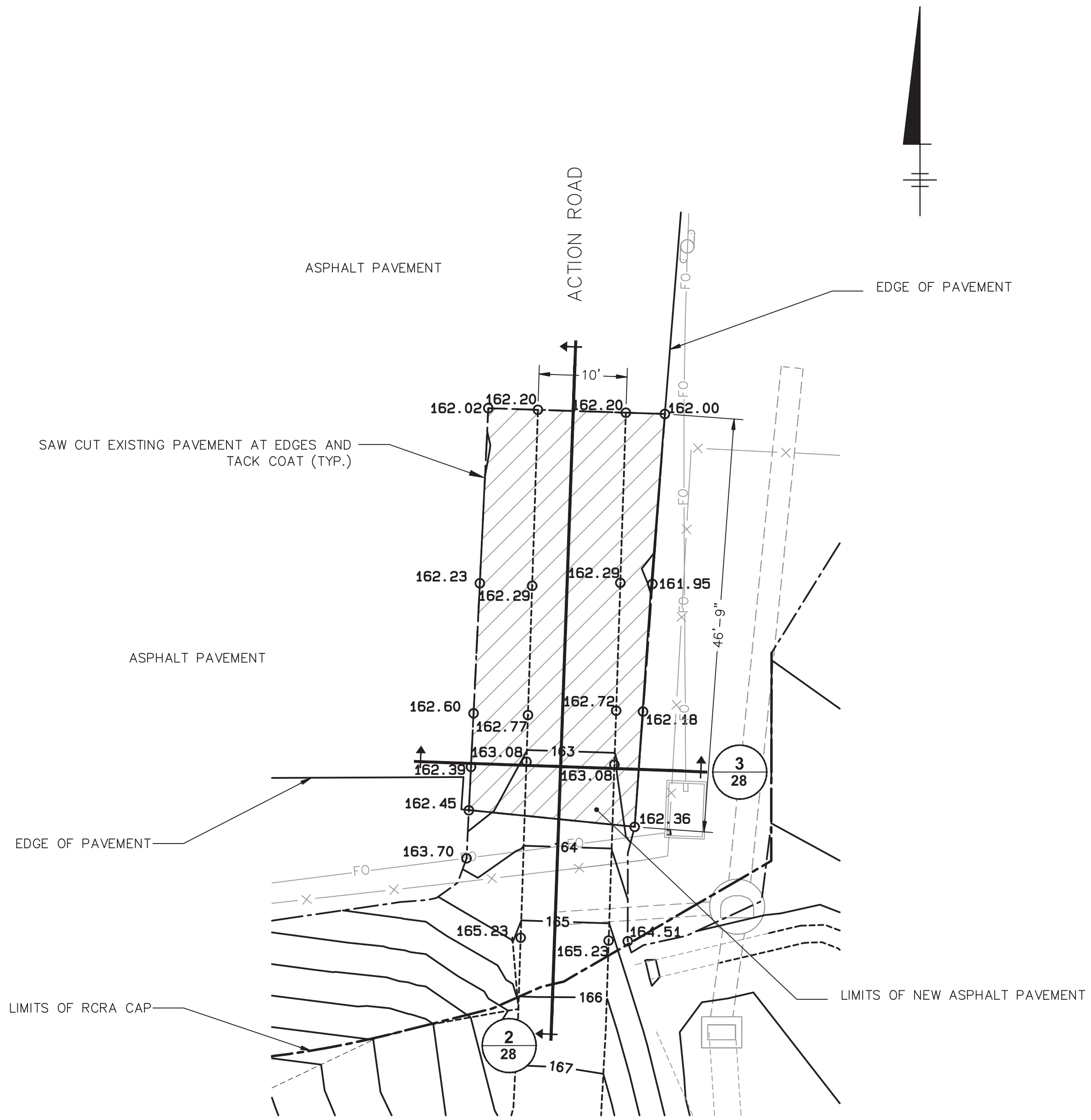
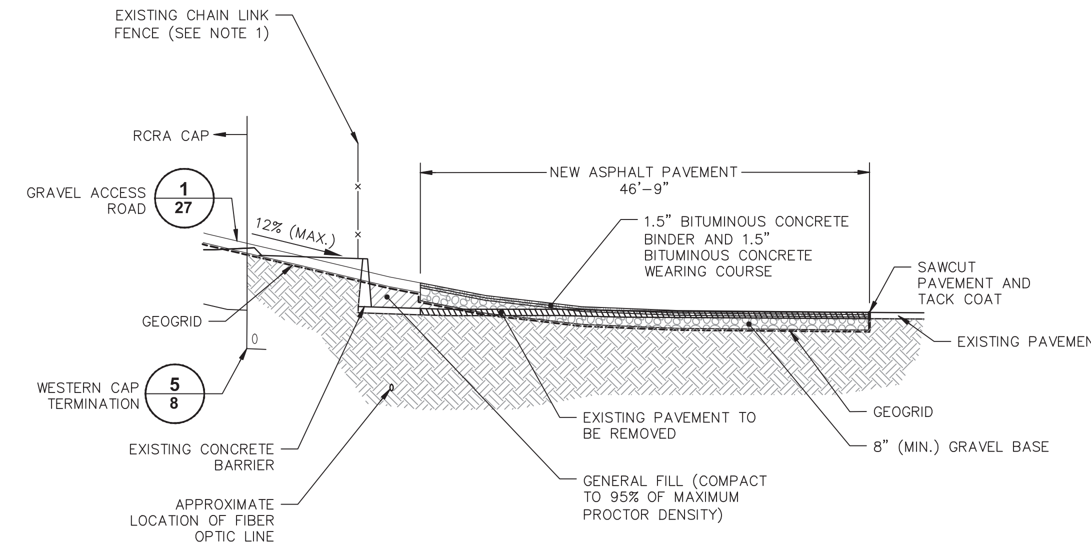


NOTES:

1. REFER TO DRAWINGS 1, 2 AND 6 FOR ADDITIONAL BASEMAP INFORMATION AND LEGEND.

ACCESS RAMP PLAN (1)

SCALE: 1"=10'

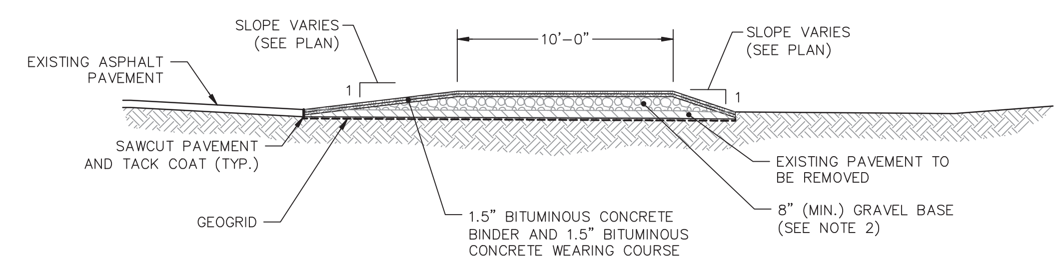


NOTES:

1. CONTRACTOR TO ADJUST EXISTING FENCE AND GATE TO ACCOMMODATE REVISED FINAL GRADE

RAMP PROFILE (2)

HORIZONTAL SCALE: 1"=10'
VERTICAL SCALE: 1"=5'



NOTES:

1. ASPHALT SURFACE COURSE SHALL CONFORM TO REQUIREMENTS OF CONNECTICUT DEPARTMENT OF TRANSPORTATION (CDOT) STANDARD SPECIFICATION SECTION 4.06 OF BITUMINOUS CONCRETE.
2. GRAVEL BASE SHALL CONSIST OF SUITABLE GRAVEL MATERIAL FROM CONTRACTOR PARKING AREA SUPPLEMENTED WITH PROCESSED AGGREGATE BASE AS NEEDED.

RAMP SECTION (3)

NOT TO SCALE

SCALE(S) AS INDICATED

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JEM
Designed by	Drawn by	Checked by
NWF	BS	JEM

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ARCADIS Design & Consultancy for natural and built assets

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SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT
RCRA CAP 100% DESIGN

ACCESS RAMP PLAN AND DETAILS

GENERAL

ARCADIS Project No. B0054634.0001.03900
Date OCTOBER 2016

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APPENDIX B

Habitat Characterization

MEMO

To:

Jeff Holden

From:

Anthony Esposito

Copies:

Arcadis of New York, Inc.
6723 Towpath Road
P O Box 66
Syracuse
New York 13214-0066
Tel 315 446 9120
Fax 315 449 0017

Date:

February 18, 2016

Arcadis Project No.:

B0054634.0000

Subject:

Habitat Characterization
SRSNE Superfund Site
Southington, Connecticut

On October 30, 2015, I visited the SRSNE Superfund Site in Southington, Connecticut to observe the extent of disturbance resulting from remedial activities completed on the site to date and to determine if any previously uncharacterized habitats were disturbed that would require characterization for restoration design purposes. The natural communities of the site were originally characterized during a site visit in 2009, prior to initiating the ROD-specified remedial activities. The results of that effort were included in a Habitat Characterization Report that was provided in Attachment H of the 2009 PIPP Design Report. The attached Figure 1 illustrates the locations and types of habitats that were identified during the original habitat characterization effort. During the 2015 site reconnaissance, habitat observations made in the field were compared to the information presented on this figure to identify areas that differed in habitat from that shown on the figure. The areal extent of the proposed RCRA cap was not included in this evaluation as habitat restoration will not be applicable to the cap area.

Most of the areas on the central-eastern portion of the Site that were used for access roads to the water treatment building and groundwater monitoring wells throughout the site that were initially observed in 2009 were still present in 2015 and remain in use (Figure 2). An area on the western portion of the site that was observed to be covered with pavement in 2009 differed in 2015 as this area was included in the In-Situ Thermal Remediation (ISTR) area. ISTR equipment was no longer present; broken concrete and unvegetated soil covered the majority of this area (Figure 3). This area is within the limits of the proposed RCRA cap. However, the area west of the anticipated RCRA cap limit was observed to be void of woody vegetation to the western property fenceline (Figure 4). In 2009, this area supported a diverse upland forest of deciduous hardwood trees that were characterized in the Habitat Characterization Report. This area was identified as a new area of natural habitat disturbance that will require restoration. The planting plan for the restoration of this area will be included in the RCRA Cap Design Report.

FIGURES

LEGEND:

- UPLAND OPEN FIELD
- DEVELOPED LAND
- UPLAND FOREST
- PHYTOPHREATIC WILLOWS
- FORMER RAILROAD CORRIDOR
- FORESTED RIPARIAN WETLAND "A"
- FORESTED INLAND WETLAND "C" AND "D"
- SHRUB INLAND WETLAND "E" AND "F"
- HERBACEOUS INLAND WETLAND "G" AND "H"
- PROPERTY LINE

NOTES:

1. HABITAT INSPECTION CONDUCTED ON JULY 1 AND 2, 2009.
2. AERIAL OBTAINED FROM GOOGLE EARTH – 2016.

0 120' 240'

GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

HABITAT CHARACTERIZATION REPORT

HABITAT MAP

ARCADIS Design & Consultancy for natural and built assets

EXHIBIT
1


Gravel access road to groundwater monitoring wells on south side of Site.


Gravel access road between water treatment building and southern portion of Site (Wetland H surrounded by silt fence to left).

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

HABITAT CHARACTERIZATION REPORT

2015 SITE PHOTOGRAPHS

ARCADIS

FIGURE
2

ISTR equipment staging area, looking southwest.

ISTR equipment staging area, looking northwest.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

HABITAT CHARACTERIZATION REPORT

2015 SITE PHOTOGRAPHS

ARCADIS

FIGURE
3


Northern portion of disturbed area in northwest corner of ISTR area, looking west.


Western portion of disturbed area along western boundary of ISTR area, looking south.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

HABITAT CHARACTERIZATION REPORT

2015 SITE PHOTOGRAPHS

ARCADIS

FIGURE
4

APPENDIX C

SIP Delineation Memo

MEMO

To:
Bruce Thompson
Jessie McCusker
de maximis, inc.

Copies:
Project File

Arcadis U.S., Inc.
160 Chapel Road
Suite 201
Manchester
Connecticut 06042-1625
Tel 860 645 1084
Fax 860 645 1090

From:
Jeffrey S. Holden, P.E., LEP

Date:
March 4, 2016

Arcadis Project No.:
B0054634.0001

Subject:
Summary of SIP Delineation for Cianci Property Excavation Areas
Solvents Recovery Service of New England, Inc. Superfund Site
Southington, Connecticut

This memorandum summarizes delineation-related soil sampling as proposed in the Soil Investigation Plan (SIP, Attachment I to the Remedial Design/Remedial Action [RD/RA] Work Plan). The purpose of these sampling activities was to further delineate soils subject to excavation from the five Cianci property removal areas identified in the Record of Decision. These areas are subject to excavation and consolidation beneath the RCRA cap. The delineation sampling was initiated in 2010, but was suspended during the preparation of In-situ Thermal Remediation (ISTR) activities. Sampling to complete the delineation of the five areas was performed between August 27 and 31, 2015.

SAMPLE COLLECTION AND ANALYSIS

SIP-related delineation sampling activities were first performed on May 4 through May 7, 2010. Once ISTR activities were completed, delineation sampling was then completed between August 27 and 31, 2015. Per the approach specified in the SIP, the delineation sampling included “step-out” locations where initial perimeter delineation samples did not achieve the delineation objective. The 2015 sampling also included re-sampling at some of the 2010 locations where additional analysis were required due to elevated mass analyses. Specifically, these samples were analyzed for select metals via synthetic precipitation leaching procedure (SPLP) analysis to compare to the Pollutant Mobility Criteria (PMC) in instances where total reported concentrations indicated the mathematical possibility that leachate-based standards could be exceeded. The attached Table 1 summarizes the rationale for the follow up delineation sampling performed in August 2015 and collection of additional soil volume.

All target soil sample locations were surveyed and staked prior to field sampling, and the soil boring locations are depicted in Figure 1. A total of 52 soil borings were advanced using a stainless steel hand auger and/or a post-hole digger. Soil samples were collected in 1 to 2 foot intervals (depending on the initial sample depth interval(s) that triggered delineation), visually inspected, and screened with a photoionization detector (PID). Upon completion of sampling activities, each boring was backfilled with native material. Soil samples were collected using a stainless steel hand auger and/or stainless steel hand trowel. The soil samples were collected in laboratory-cleaned jars as required for the analytical method, and submitted to Alpha Analytical (a Connecticut-certified laboratory). A total of 55 samples were submitted for laboratory analysis as part of the SIP-prescribed delineation process for the five Cianci Property excavation areas.

Equipment cleaning, sample management, laboratory analyses, and quality assurance/quality control (QA/QC) samples were conducted in accordance with applicable procedures outlined in the SIP, Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP).

SUMMARY AND CONCLUSIONS

Analytical results for the soil samples collected from excavation areas 1 through 5 are presented in Tables 2 through 6, respectively. Sample locations and analyses are discussed in detail below.

Please note the following convention when reviewing the tables, figures, and area-specific summaries. The first part of the sample designation (e.g., EA1-) indicates the specific excavation area within which the sample was collected. The second number indicates a sequential sample number for the delineation samples in that area. In some instances that number is followed by an “a.” For the purposes of delineating the Cianci property excavation areas, the “a” indicates that the sample was collected at a later date from the same sample location. This occurred in instances where resampling was necessary, such as to perform an SPLP analysis after the original sample indicated a potential PMC exceedance based on a mass result greater than 20 times the PMC value. For example, sample EA1-1a was taken from the same location as EA1-1 so that location could be analyzed via the SPLP because the original sample EA1-1 indicated the potential for a PMC exceedance based on the mass result. The “a” designations are not shown on the attached figures because the location is represented by the “non-a” location identifier.

Excavation Area 1

This area was initially subject to delineation for SPLP lead (Pb) based on the detection of this constituent in initial sample location SB-905 at a depth of 0-2 fbg (Table 2). Lead did not indicate the potential for exceedance of the PMC (i.e., mass results/20 greater than the PMC) in any of the initial four perimeter delineation samples around this location (EA1-1 through EA1-4). However, total concentrations of other metals detected at the perimeter locations did indicate potential for exceedances of the PMC. Subsequent SLPL analysis of samples from three of those locations (EA1-1, EA1-2, and EA1-4) confirmed no metals exceeded the PMC. The fourth initial perimeter result (EA1-3) exceeded the SPLP criterion for cadmium. Two subsequent step out samples (EA1-5 and EA1-6) were collected and analyzed for SPLP metals to delineate around EA1-3. Based on the results from the original four delineation locations proposed in the SIP plus two step-out samples, delineation of this excavation area is complete based on the boundary indicated on Figure 2. Based on the depth of the original sample plus the delineation samples, the target removal depth in this area is 2 fbg.

Excavation Area 2

This area was initially subject to delineation for semi-volatile organic compounds (SVOCs)[1] based on the detection of certain SVOC constituents in initial sample location SS3-B2 at a depth of 0- to 6-inches (Table 3). Concentrations of SVOCs detected at four perimeter locations EA2-1 through EA2-4 were below target delineation criteria for these constituents. Therefore, delineation of this removal area is considered complete based on the four delineation sample locations shown on Figure 3. Based on the depth of the original sample plus the delineation samples, the target removal depth in this area is 1 fbg.

Excavation Area 3

This area was initially subject to delineation for metals (chromium and cadmium), SVOCs, and PCBs based on the detected concentrations of these constituents in initial sample location SS3-B4 at a depth of 0- to 6-inches (Table 4). SVOC concentrations in the initial four perimeter delineation samples (EA3-1 through EA3-4) were below target delineation criteria, so further SVOC delineation was not required. Total metals concentrations detected in the initial four perimeter locations indicated potential for exceedances of the PMC (i.e., mass results/20 greater than the PMC). In addition, PCBs were detected above the Residential Direct Exposure Criteria (RDEC) in one of the four samples (EA3-3). Additional soil samples (EA3-1a, EA3-2a, EA3-4a, EA3-5, and EA3-6) were collected from 0-1 fbg for analysis of select metals via SPLP; all were below PMC criteria. In addition, delineation soil samples (EA3-5 and EA3-6) were analyzed for PCBs to delineate around EA3-3. Based on the results from the original and step-out samples, delineation of this excavation area is complete based on the boundary indicated on Figure 4. Based on the depth of the original sample plus the delineation samples, the target removal depth in this area is 1 fbg.

Excavation Area 4

This area was initially subject to delineation for selected SVOCs and ethylbenzene based on the detection of these constituents in initial sample location SB-907 (2-4’) (Table 5). Four perimeter delineation samples were initially collected (EA4-1 through EA4-4) at depth intervals of 0-2 and 2-4 fbg. EA4-1 and EA4-2 were below target delineation standards at each interval. EA4-3 and EA4-4 indicated PMC exceedances of bis(2-ethylhexyl)phthalate detected in the shallow (0-2’) interval, but not the deeper interval. Sample locations EA4-5 through EA4-8 were subsequently collected to delineate the bis(2-ethylhexyl)phthalate exceedances at EA4-3 and EA4-4 (0-2’), as well as the ethylbenzene exceedance at SB-907. Based on the results from the original and step-out samples, delineation of this excavation area is complete based on the boundary indicated on Figure 5. Based on the depth of the original sample plus the delineation samples, the target removal depth is 4 fbg in a portion of the area and 2 fbg in the remainder of the area, as shown on Figure 5.

Excavation Area 5

This area was initially subject to delineation for PCBs, bis(2-ethylhexyl)phthalate, and beryllium based on the detection of these constituents in initial sample locations SB-915, SD1-05, SD3-34 through SD3-36, and/or SS3-B3 (Table 6). Six delineation samples (EA5-1 through EA5-6) were collected around the perimeter of this area from the 0- to 2-foot depth interval and analyzed for the target constituents. PCBs and bis(2-ethylhexyl)phthalate below target criteria in each of these locations. Two of the locations (EA5-3

[1] The SIP also incorrectly indicated this area was to be delineated for manganese; manganese delineation was not required or performed.

and EA5-4) indicated potential exceedances of PMC criteria for beryllium, but subsequent SPLP analyses from these locations confirmed the soils did not exceed the PMC for beryllium. Based on the results from these samples, delineation of this excavation area is complete based on the boundary indicated on Figure 6. The target removal depth in this area is 0-2 fbg. Note also that the target removal limits reflect the fact that a portion of this area was excavated and consolidated in the thermal treatment area when the new outfall location was constructed during the pre-ISTR site preparation activities; the additional excavation in this area will abut the prior excavation boundary.

Based on the results of the constituents of concern at each excavation area, delineation endpoints have been achieved for each of the five Cianci Property excavation areas. In addition, method detection limits have been evaluated and compared to applicable criteria to assure compliance with the QAPP protocols.

Note that SIP delineation was performed for samples that exceeded one or more soil based cleanup levels as identified in the ROD and SOW based on prior soil sampling. Those samples did not include dioxin analyses. More recently, we have been engaged in soil sampling to delineate the extent of dioxin-affected soils in support of the RCRA Cap design and to address other SIP components. The ongoing dioxin evaluation included sampling in or adjacent to three of the five Cianci Property excavation areas (EA1, EA4, and EA5). Sampling adjacent to EA1 and within EA4 indicated no dioxin impacts within these areas at levels of potential concern. Dioxin concentrations above the target delineation objective were detected in samples collected from EA5, and dioxin-related delineation of this area remains ongoing. Data collected to date suggests that the extent of dioxin in this area may expand the removal beyond the delineation achieved based on non-dioxin constituents. Dioxin-related impacts were not suspected in EA2 based on the conceptual site model, and samples from this area were not analyzed for dioxin. A sample was collected from EA3, but was not analyzed because it was downgradient from and therefore contingent upon the results of the sample collected in EA4; because the sample in EA4 did not exceed the delineation objective, the sample from EA3 was not analyzed. Accordingly, of the five Cianci Property excavation areas, only the EA5 may be potentially affected by the additional consideration of dioxin as a delineation basis.

TABLES

Table 1 - Additional SIP Sampling Summary
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

Excavation Area	Original Sample Location Triggering Follow-Up	Follow-Up Sample ID	Sample Depth (ft bgs)	Analytical Parameter(s)	Rationale
1	EA1-1	EA1-1a	0-2	SPLP Ba, Be, Cr and Pb	EA1-1 mass results/20 greater than PMC; QAPP-specified reporting level not achieved for Pb
	EA1-2	EA1-2a	0-2	SPLP Ba, Be, Cr and Pb	EA1-2 mass results/20 greater than PMC; QAPP-specified reporting level not achieved for Pb
	EA1-3				Not recollecting from EA1-3 for metals because step-out samples needed to delineate Cd exceedance
		EA1-5	0-2	SPLP Ba, Be, Cd, Cr, Pb	EA1-3 mass results/20 greater than PMC; QAPP-specified reporting level not achieved for Pb; Collect 10' north of EA1-3
		EA1-6	0-2	SPLP Ba, Be, Cd, Cr, Pb	EA1-3 mass results/20 greater than PMC; QAPP-specified reporting level not achieved for Pb; Collect 10' east of EA1-3
	EA1-4	EA1-4a	0-2	SPLP Ba, Be, Cr and Pb	EA1-4 mass results/20 greater than PMC; QAPP-specified reporting level not achieved for Pb
2	NO ADDITIONAL SAMPLES REQUIRED IN EXCAVATION AREA 2; ALL RESULTS FROM PRIOR DELINEATION SAMPLING ARE BELOW CLEANUP LEVELS				
3	EA3-1	EA3-1a	0-1	SPLP Cr	EA3-1 mass results/20 greater than PMC
	EA3-2	EA3-2a	0-1	SPLP Cr	EA3-2 mass results/20 greater than PMC
	EA3-3				Not recollecting from EA3-3 for metals because step-out samples needed to delineate PCB exceedance
		EA3-5	0-1	PCBs; SPLP Cd, Cr	EA3-3 metals mass results/20 greater than PMC; Collect 10' northwest of EA3-3
		EA3-6	0-1	PCBs; SPLP Cd, Cr	EA3-3 metals mass results/20 greater than PMC; Collect 10' northeast of EA3-3
	EA3-4	EA3-4a	0-1	SPLP Cd, Cr	EA3-4 mass results/20 greater than PMC
4	SB-907	EA4-1a, EA4-2a, EA4-5, EA4-7	0-2 and 2-4	Ethylbenzene	To delineate ethylbenzene detected above PMC in original sample location (depth to groundwater ~3')
	EA4-3	EA4-5	0-2	bis(2-eh)P	Step-out sample; collect 10' north of EA4-3
		EA4-6	0-2	bis(2-eh)P	Step-out sample; collect east of EA4-3, on eastern side of gravel road
	EA4-4	EA4-7	0-2	bis(2eh)P	Step-out sample; collect east of EA4-4, on eastern side of gravel road
		EA4-8	0-2	bis(2eh)P	Step-out sample; collect 10' south/southeast of EA4-4
5	SB-915	N/A	2-4	bis(2eh)P	Sample is at outfall and depth to groundwater <2', so PMC not applicable; result (1.1Bppm) does not exceed DEC (44ppm)
	SD1-05, SD3-34, CD3-35, SS3-B3	EA5-1a, EA5-2a, EA5-3a, EA5-4a, EA5-5a, EA5-6a	0-2	bis(2eh)P	To delineate bis(2-ethylhexyl)phthalate detected in original sample locations
	EA5-3	EA5-3a	0-2	SPLP Be	EA5-3 mass results/20 greater than PMC
	EA5-4	EA5-4a	0-2	SPLP Be	EA5-4 mass results/20 greater than PMC

Be - beryllium
Cd - cadmium
Cr - chromium
Pb - lead
bis(2eh)P - bis(2-ethylhexyl)phthalate

Total samples: 26

Table 2 – EA1 Cap Delineation Soil Sample Results
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

					Original Sample Locations				2010 Delineation Sample Locations									
				Sample Location	SB-905				EA1-1		EA1-2		EA1-2		EA1-3		EA1-4	
				Field Sample ID	SB905(0-2')		SB905(2-4')		EA1-1-SS-1 (0-2')		EA1-2-SS-1 (0-2')		DUP-SS-05042010-#1		EA1-3-SS-1 (0-2')		EA1-4-SS-1 (0-2')	
				Sample Date	10/19/1999 9:20		10/19/1999 9:40		5/4/2010 13:40		5/4/2010 14:00		5/4/2010 0:00		5/4/2010 12:50		5/4/2010 13:15	
				Top Sample Depth (ft)	0		2		0		0		0		0		0	
				Bottom Sample Depth (ft)	2		4		2		2		2		2		2	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**														
Metals (Total)																		
Antimony	7440-36-0	mg/Kg	--	27	0.45	UN	0.44	UN	4.5	UJ	5.1	UJ	4.7	UJ	4.9	UJ	5	UJ
Arsenic	7440-38-2	mg/Kg	--	10	1.2	--	0.62	B	4.7	U	4.7	UJ	4.9	U	5	U	5.2	U
Barium	7440-39-3	mg/Kg	--	4700	21	B	15.8	B	75	--	52	--	45.6	--	45.5	--	60	--
Beryllium	7440-41-7	mg/Kg	--	2	0.25	B	0.22	U	0.58	J	0.38	J	0.39	J	0.38	J	0.54	J
Cadmium	7440-43-9	mg/Kg	--	34	0.11	U	0.11	U	1.4	UJ	1.6	UJ	1.4	UJ	0.36	J	1.5	UJ
Chromium	7440-47-3	mg/Kg	--		5.6	--	4.8	--	17.1	--	9.8	--	10	--	9.4	--	12	--
Lead	7439-92-1	mg/Kg	--	400	7.6	*N	2.1	*N	8.8	--	7	--	7.7	--	17	--	11.8	--
Metals (TCLP)																		
Barium	7440-39-3	mg/l	1	--	0.174	B	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	mg/l	0.004	--	0.002	U	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	mg/L	0.005	--	0.001	U	--	--	--	--	--	--	--	--	0.0052	J	--	--
Chromium	7440-47-3	mg/l	0.05	--	0.0072	B	--	--	--	--	--	--	--	--	--	--	--	--
Lead	7439-92-1	mg/l	0.015	--	0.0503	*	--	--	0.075	U	0.075	U	0.075	U	0.075	U	0.075	U

					2015 Delineation Sample Locations									
				Sample Location	EA1-1		EA1-2		EA1-4		EA1-5		EA1-6	
				Field Sample ID	EA1-1A-SS-08282015 (0-2')		EA1-2A-SS-08282015 (0-2')		EA1-4A-SS-08282015 (0-2')		EA1-5-SS-08282015 (0-2')		EA1-6-SS-08282015 (0-2')	
				Sample Date	8/28/2015 9:10		8/28/2015 9:20		8/28/2015 10:15		8/28/2015 9:55		8/28/2015 9:45	
				Top Sample Depth (ft)	0		0		0		0		0	
				Bottom Sample Depth (ft)	2		2		2		2		2	
Metals (SPLP)														
Barium	7440-39-3	mg/l	1	--	0.075	J	0.01	J	y	J	0.016	J	0.01	J
Beryllium	7440-41-7	mg/l	0.004	--	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U
Cadmium	7440-43-9	mg/l	0.005	--	--	--	--	--	--	--	0.005	U	0.005	U
Chromium	7440-47-3	mg/l	0.05	--	0.01	U	0.01	U	0.002	J	0.01	U	0.01	U
Lead	7439-92-1	mg/l	0.015	--	0.008	J	0.01	U	0.004	J	0.01	U	0.01	U

Notes:

U = Analyte not detected above the laboratory's Reporting Limit

J = Analyte result is estimated

B = Analyte was found in an associated blank, as well as in the sample

N= Analyte is presumed to be present

(orange) Total metals result (in mg/kg) excees 20 times the GA PMC (in mg/L), which suggests the potential for TCLP/SPLP result to exceed GA PMC.

(gray) exceedance of PMC

Table 3 – EA2 Cap Delineation Soil Sample Results
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

					Original Sample Location		Delineation Soil Samples							
				Sample Location	SS3-B2		EA2-1		EA2-2		EA2-3		EA2-4	
				Field Sample ID	SS3-B2-0006-01		EA2-1-SS-1 (0-1')		EA2-2-SS-1 (0-1')		EA2-3-SS-1 (0-1')		EA2-4-SS-1 (0-1')	
				Sample Date	12/9/1991		5/4/2010 16:40		5/4/2010 16:45		5/4/2010 16:50		5/5/2010 8:20	
				Top Sample Depth (ft)	0		0		0		0		0	
				Bottom Sample Depth (ft)	0.5		1		1		1		1	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**										
SVOCs														
2-Methylnaphthalene	91-57-6	ug/Kg	980	474000	560	U	320	U	310	U	350	U	380	U
4-Chloroaniline	106-47-8	ug/Kg	1000	270000	560	U	320	UJ	310	UJ	350	UJ	380	UJ
4-Methylphenol	106-44-5	ug/Kg	700	340000	0	R	320	U	310	U	350	U	380	U
Benzo[a]anthracene	56-55-3	ug/Kg	1000	1000	**250**	J	**20**	J	**51**	J	**91**	J	**95**	J
Benzo[a]pyrene	50-32-8	ug/Kg	1000	1000	**59**	J	26	UJ	**63**	J	**120**	J	**130**	J
Benzo[b]fluoranthene	205-99-2	ug/Kg	1000	1000	**1300**	--	**41**	J	**87**	J	**220**	J	**210**	J
Benzo[k]fluoranthene	207-08-9	ug/Kg	1000	8400	**1300**	--	320	U	**38**	J	**74**	J	**89**	J
Bis(2-ethylhexyl) phthala	117-81-7	ug/Kg	1000	44000	560	U	**36**	J	**33**	J	**63**	J	**57**	J
Chrysene	218-01-9	ug/Kg	1000	84000	**450**	J	**34**	J	**76**	J	**160**	J	**150**	J
Dibenzofuran	132-64-9	ug/Kg	1000	270000	560	U	320	U	310	U	350	U	380	U
Di-n-butyl phthalate	84-74-2	ug/Kg	14000	1000000	560	U	320	U	310	U	350	U	380	U
Di-n-octyl phthalate	117-84-0	ug/Kg	2000	1000000	560	U	320	U	310	U	350	U	380	U
Fluoranthene	206-44-0	ug/Kg	5600	1000000	**840**	--	**51**	J	**100**	J	**250**	J	**250**	J
Indeno[1,2,3-cd]pyrene	193-39-5	ug/Kg	1000	1000	**360**	J	320	U	**50**	J	**140**	J	**120**	J
Phenanthrene	85-01-8	ug/Kg	4000	1000000	**400**	J	**26**	J	**45**	J	**100**	J	**100**	J
Pyrene	129-00-0	ug/Kg	4000	1000000	**660**	--	**48**	J	**110**	J	**250**	J	**210**	J

Notes:
U = Analyte not detected above the laboratory's Reporting Limit
J = Analyte result is estimated
R = Refected, the reported result is unusable
exceedance of PMC
exceedance of RDEC and PMC

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Table 4 – EA3 Cap Delineation Soil Sample Results
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

					Original Sample Location		2010 Delineation Sample Locations							
					SS3-B4		EA3-1		EA3-2		EA3-3		EA3-4	
					SS3-B4-0006-01		EA3-1-SS-1 (0-1')		EA3-2-SS-1 (0-1')		EA3-3-SS-1 (0-1')		EA3-4-SS-1 (0-1')	
					12/9/1991 0:00		5/5/2010 13:40		5/5/2010 14:00		5/5/2010 14:15		5/5/2010 14:30	
					0		0		0		0		0	
					0.5		1		1		1		1	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**										
Metals (Total)														
Cadmium	7440-43-9	mg/Kg	--	34	45.3	--	1.5	U	1.5	U	8.1	--	0.84	J
Chromium	7440-47-3	mg/Kg	--	100	128	--	13.3	J	22	J	23.5	J	16.5	J
PCBs														
PCB-1016	12674-11-2	ug/Kg	--	--	64	UJ	22	U	21	U	120	U	22	U
PCB-1221	11104-28-2	ug/Kg	--	--	130	UJ	22	U	21	U	120	U	22	U
PCB-1232	11141-16-5	ug/Kg	--	--	64	UJ	22	U	21	U	120	U	22	U
PCB-1242	53469-21-9	ug/Kg	--	--	64	UJ	22	U	21	U	120	U	22	U
PCB-1248	12672-29-6	ug/Kg	--	--	64	UJ	22	U	21	U	120	U	22	U
PCB-1254	11097-69-1	ug/Kg	--	--	870	J	22	U	21	U	860	J	22	U
PCB-1260	11096-82-5	ug/Kg	--	--	360	J	22	U	21	U	490	--	6	J
PCB-1262	37324-23-5	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1268	11100-14-4	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--
PCBs, Total	1336-36-3	ug/Kg	--	1000	1230	--	ND	U	ND	U	1350	J	6	J
SVOCs														
2-Methylnaphthalene	91-57-6	ug/Kg	980	474000	650	UJ	340	U	330	U	370	U	350	U
4-Chloroaniline	106-47-8	ug/Kg	1000	270000	650	UJ	340	UJ	330	UJ	370	UJ	350	UJ
4-Methylphenol	106-44-5	ug/Kg	700	340000	650	UJ	340	U	330	U	370	U	350	U
Benzo[a]anthracene	56-55-3	ug/Kg	1000	1000	490	J	340	U	330	U	43	J	350	U
Benzo[a]pyrene	50-32-8	ug/Kg	1000	1000	740	J	19	J	330	U	63	J	350	U
Benzo[b]fluoranthene	205-99-2	ug/Kg	1000	1000	1800	J	31	J	330	U	78	J	37	J
Benzo[k]fluoranthene	207-08-9	ug/Kg	1000	8400	1800	J	340	U	330	U	370	U	350	U
Bis(2-ethylhexyl) phthalate	117-81-7	ug/Kg	1000	44000	650	UJ	33	J	330	U	180	J	41	J
Chrysene	218-01-9	ug/Kg	1000	84000	600	J	340	U	330	U	62	J	350	U
Dibenzofuran	132-64-9	ug/Kg	1000	270000	650	UJ	340	U	330	U	370	U	350	U
Di-n-butyl phthalate	84-74-2	ug/Kg	14000	1000000	650	UJ	340	U	330	U	370	U	350	U
Di-n-octyl phthalate	117-84-0	ug/Kg	2000	1000000	650	UJ	340	U	330	U	370	U	350	U
Fluoranthene	206-44-0	ug/Kg	5600	1000000	1100	J	38	J	330	U	77	J	39	J
Indeno[1,2,3-cd]pyrene	193-39-5	ug/Kg	1000	1000	650	UJ	340	U	330	U	85	J	31	J
Phenanthrene	85-01-8	ug/Kg	4000	1000000	540	J	20	J	330	U	39	J	20	J
Pyrene	129-00-0	ug/Kg	4000	1000000	800	J	29	J	330	U	120	J	47	J

					2015 Delineation Sample Locations									
				Sample Location	EA3-1		EA3-2		EA3-4		EA3-5		EA3-6	
				Field Sample ID	EA3-1A-SS-08282015 (0-1)		EA3-2A-SS-08282015 (0-1)		EA3-4A-SS-08282015 (0-1)		EA3-5-SS-08282015 (0-1)		EA3-6-SS-08282015 (0-1)	
				Sample Date	8/28/2015 14:55		8/28/2015 14:20		8/28/2015 14:50		8/28/2015 14:30		8/28/2015 15:05	
				Top Sample Depth (ft)	0		0		0		0		0	
				Bottom Sample Depth (ft)	1		1		1		1		1	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**										
Metals (SPLP)														
Cadmium	7440-43-9	mg/Kg	0.005	--	--	--	--	--	0.005	U	0.005	U	0.001	J
Chromium	7440-47-3	mg/Kg	0.05	--	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
PCBs														
PCB-1016	12674-11-2	ug/Kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1221	11104-28-2	ug/Kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1232	11141-16-5	ug/Kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1242	53469-21-9	ug/Kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1248	12672-29-6	ug/Kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1254	11097-69-1	ug/Kg	--	--	--	--	--	--	--	--	13.8	J	63.1	J
PCB-1260	11096-82-5	ug/Kg	--	--	--	--	--	--	--	--	18.7	J	91.8	J
PCB-1262	37324-23-5	ug/kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCB-1268	11100-14-4	ug/kg	--	--	--	--	--	--	--	--	36.2	U	446	U
PCBs, Total	1336-36-3	ug/Kg	--	1000	--	--	--	--	--	--	32.5	J	155	J

Notes:
U = Analyte not detected above the laboratory's Reporting Limit
J = Analyte result is estimated
(yellow) Total metals result (in mg/kg) excees 20 times the GA PMC (in mg/L), which suggests the potential for TCLP/SPLP result to exceed GA PMC.
(grey) exceedance of PMC
(green) exceedance of RDEC
(red) exceedance of RDEC and PMC

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Table 5 – EA4 Cap Delineation Soil Sample Results
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

					Original Sample Location				2010 Delineation Sample Locations									
Sample Location					SB-907		SB-907		EA4-1		EA4-1		EA4-4		EA4-4		EA4-2	
Field Sample ID					SB907(0-2.0)		SB907(2.0-4.0)		C-EA4-1-SB-1 (2-4')		C-EA4-1-SS-1 (0-2')		C-EA4-4-SB-1 (2-4')		C-EA4-4-SS-1 (0-2')		C-EA4-2-SB-1 (2-4')	
Sample Date					10/19/1999 15:20		10/19/1999 15:40		5/5/2010 10:00		5/5/2010 9:40		5/5/2010 11:50		5/5/2010 11:30		5/5/2010 10:45	
Top Sample Depth (ft)					0		2		2		0		2		0		2	
Bottom Sample Depth (ft)					2		4		4		2		4		2		4	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**														
SVOCs																		
2-Methylnaphthalene	91-57-6	ug/Kg	980	474000	400	U	3100	J	13	J	310	U	300	U	16	J	300	UJ
4-Chloroaniline	106-47-8	ug/Kg	1000	270000	400	U	4000	U	330	UJ	310	UJ	300	UJ	310	UJ	300	UJ
4-Methylphenol	106-44-5	ug/Kg	700	340000	400	U	4000	U	330	U	310	U	300	U	310	U	300	U
Benzo[a]anthracene	56-55-3	ug/Kg	1000	1000	160	J	5600	--	440	J	210	J	300	U	48	J	300	U
Benzo[a]pyrene	50-32-8	ug/Kg	1000	1000	180	J	4500	--	490	J	240	J	300	U	53	J	300	U
Benzo[b]fluoranthene	205-99-2	ug/Kg	1000	1000	220	J	5100	--	570	--	320	--	300	U	63	J	300	UJ
Benzo[k]fluoranthene	207-08-9	ug/Kg	1000	8400	76	J	700	--	200	J	120	J	300	U	310	U	300	U
Bis(2-ethylhexyl) phthalate	117-81-7	ug/Kg	1000	44000	830	B	400	U	45	J	65	J	300	U	3100	--	300	UJ
Chrysene	218-01-9	ug/Kg	1000	84000	160	J	5200	--	480	J	240	J	300	U	47	J	300	U
Dibenzofuran	132-64-9	ug/Kg	1000	270000	400	U	1300	J	330	U	310	U	300	U	310	U	300	U
Di-n-butyl phthalate	84-74-2	ug/Kg	14000	1000000	400	U	4000	U	330	U	310	U	300	U	46	J	300	U
Di-n-octyl phthalate	117-84-0	ug/Kg	2000	1000000	400	U	4000	U	330	U	310	U	300	U	430	--	300	U
Fluoranthene	206-44-0	ug/Kg	5600	1000000	210	J	9400	--	580	J	410	J	300	U	70	J	300	UJ
Indeno[1,2,3-cd]pyrene	193-39-5	ug/Kg	1000	1000	140	J	2300	J	640	J	160	J	300	U	92	J	300	U
Phenanthrene	85-01-8	ug/Kg	4000	1000000	200	J	20000	--	330	--	210	J	300	U	62	J	300	U
Pyrene	129-00-0	ug/Kg	4000	1000000	360	J	18000	--	980	J	380	J	300	U	110	J	23	J
VOCs																		
Ethylbenzene	100-41-4	ug/kg	10100	500000	2.3	J	13000	--	--	--	--	--	--	--	--	--	--	--

					2010 Delineation Sample Locations							
Sample Location					EA4-2		EA4-2		EA4-3		EA4-3	
Field Sample ID					C-EA4-2-SS-1 (0-2')		DUP-SS-05052010-#1		C-EA4-3-SB-1 (2-4')		C-EA4-3-SS-1 (0-2')	
Sample Date					5/5/2010 10:15		5/5/2010 0:00		5/5/2010 11:10		5/5/2010 11:00	
Top Sample Depth (ft)					0		2		2		0	
Bottom Sample Depth (ft)					2		4		4		2	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**								
SVOCs												
2-Methylnaphthalene	91-57-6	ug/Kg	980	474000	300	U	300	U	320	U	320	U
4-Chloroaniline	106-47-8	ug/Kg	1000	270000	300	UJ	300	UJ	320	UJ	320	UJ
4-Methylphenol	106-44-5	ug/Kg	700	340000	300	U	300	U	320	U	320	U
Benzo[a]anthracene	56-55-3	ug/Kg	1000	1000	300	U	300	U	320	U	20	J
Benzo[a]pyrene	50-32-8	ug/Kg	1000	1000	25	J	300	U	13	J	320	U
Benzo[b]fluoranthene	205-99-2	ug/Kg	1000	1000	31	J	300	U	320	U	320	U
Benzo[k]fluoranthene	207-08-9	ug/Kg	1000	8400	300	U	300	U	320	U	320	U
Bis(2-ethylhexyl) phthalate	117-81-7	ug/Kg	1000	44000	160	J	300	UJ	400	--	3000	--
Chrysene	218-01-9	ug/Kg	1000	84000	300	U	300	U	320	U	320	U
Dibenzofuran	132-64-9	ug/Kg	1000	270000	300	U	300	U	320	U	320	U
Di-n-butyl phthalate	84-74-2	ug/Kg	14000	1000000	300	U	300	U	320	U	76	J
Di-n-octyl phthalate	117-84-0	ug/Kg	2000	1000000	300	U	300	U	320	U	460	--
Fluoranthene	206-44-0	ug/Kg	5600	1000000	37	J	300	U	19	J	30	J
Indeno[1,2,3-cd]pyrene	193-39-5	ug/Kg	1000	1000	36	J	300	U	320	U	29	J
Phenanthrene	85-01-8	ug/Kg	4000	1000000	17	J	300	U	320	U	25	J
Pyrene	129-00-0	ug/Kg	4000	1000000	48	J	16	J	32	J	57	J
VOCs												
Ethylbenzene	100-41-4	ug/kg	10100	500000	--	--	--	--	--	--	--	--

Notes:
U = Analyte not detected above the laboratory's Reporting Limit
J = Analyte result is estimated
(grey shading) exceedance of PMC
(red shading) exceedance of PMC and RDEC

					2015 Delineation Sample Locations																			
Sample Location					EA4-1A		EA4-1A		EA4-2A		EA4-2A		EA4-5		EA4-5		EA4-6		EA4-7		EA4-7		EA4-8	
Field Sample ID					EA4-1A-SS-08312015 (0-2)		EA4-1A-SS-08312015 (2-4)		EA4-2A-SS-08312015 (0-2)		EA4-2A-SS-08312015 (2-4)		EA4-5-SS-08282015 (0-2)		EA4-5-SS-08282015 (2-4)		EA4-6-SS-08282015 (0-2)		EA4-7-SS-08282015 (0-2)		EA4-7-SS-08282015 (2-4)		EA4-8-SS-08282015 (0-2)	
Sample Date					8/31/2015 10:05		8/31/2015 10:10		8/31/2015 10:20		8/31/2015 10:25		8/28/2015 11:57		8/28/2015 13:47		8/28/2015 11:37		8/28/2015 10:55		8/28/2015 14:10		8/28/2015 11:05	
Top Sample Depth (ft)					0		2		0		2		0		2		0		0		2		0	
Bottom Sample Depth (ft)					2		4		2		4		2		4		2		2		4		2	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**																				
SVOCs																								
Bis(2-ethylhexyl) phthalate	117-81-7	ug/Kg	1000	44000	--	--	--	--	--	--	--	--	180	U	--	--	180	U	72	J	--	--	190	U
VOCs																								
Ethylbenzene	100-41-4	ug/kg	10100	500000	1.1	U	1.1	U	1	U	1	U	1.1	U	1.1	U	--	--	1.1	U	1.2	U	--	--

de maximis, inc. ARCADIS ddms

Table 6 – EA5 Cap Delineation Soil Sample Results
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

					Original Sample Locations																	
				Sample Location	SD1-05		SD1-05		SD3-34		SD3-34		SD3-35		SD3-35		SD3-35		SD3-35		SD3-35	
				Field Sample ID	SD1-05-0006-01		SD1-05-0006-01-D		SD3-34-0006-01		SD3-34-0006-02		SD3-35-0006-01		SD3-35-0006-02		SD3-35-0612-01		SD3-35-0612-02		SD3-35-1218-01	
				Sample Date	5/15/1990 0:00		5/15/1990 0:00		12/11/1991 0:00		12/18/1991 0:00		12/11/1991 0:00		12/19/1991 0:00		12/11/1991 0:00		12/19/1991 0:00		12/11/1991 0:00	
				Top Sample Depth (ft)	0		0		0		0		0		0		0.5		0.5		1	
				Bottom Sample Depth (ft)	0.5		0.5		0.5		0.5		0.5		0.5		1		1		1.5	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**																		
Metals (Total)																						
Beryllium	7440-41-7	mg/Kg	--	2	0.83	U	0.59	U	0.23	U	--	--	0.25	U	--	--	**0.42**	J	--	--	**0.43**	J
Metals (TCLP/SPLP)																						
Beryllium	7440-41-7	mg/l	0.004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																						
PCB-1016	12674-11-2	ug/Kg	--	--	120	U	610	U	--	--	240	U	--	--	45	UJ	--	--	40	UJ	--	--
PCB-1221	11104-28-2	ug/Kg	--	--	120	U	610	U	--	--	490	U	--	--	91	UJ	--	--	80	UJ	--	--
PCB-1232	11141-16-5	ug/Kg	--	--	120	U	610	U	--	--	240	U	--	--	45	UJ	--	--	40	UJ	--	--
PCB-1242	53469-21-9	ug/Kg	--	--	120	U	610	U	--	--	240	U	--	--	45	UJ	--	--	40	UJ	--	--
PCB-1248	12672-29-6	ug/Kg	--	--	120	U	610	U	--	--	240	U	--	--	45	UJ	--	--	40	UJ	--	--
PCB-1254	11097-69-1	ug/Kg	--	--	**870**	J	**1900**	J	--	--	**5000**	J	--	--	**920**	J	--	--	40	UJ	--	--
PCB-1260	11096-82-5	ug/Kg	--	--	250	U	1200	U	--	--	**1500**	J	--	--	**230**	J	--	--	40	UJ	--	--
PCBs, Total	1336-36-3	ug/Kg	--	1000	**870**	--	**1900**	--	--	--	**6500**	--	--	--	**1150**	--	--	--	40	UJ	--	--
SVOCs																						
Bis(2-ethylhexyl) phthalate	117-81-7	ug/kg	1000	44000	**6700**	J	**22000**	J*	**15000**	J	--	--	**10000**	J*	--	--	**100**	J	--	--	**490**	J

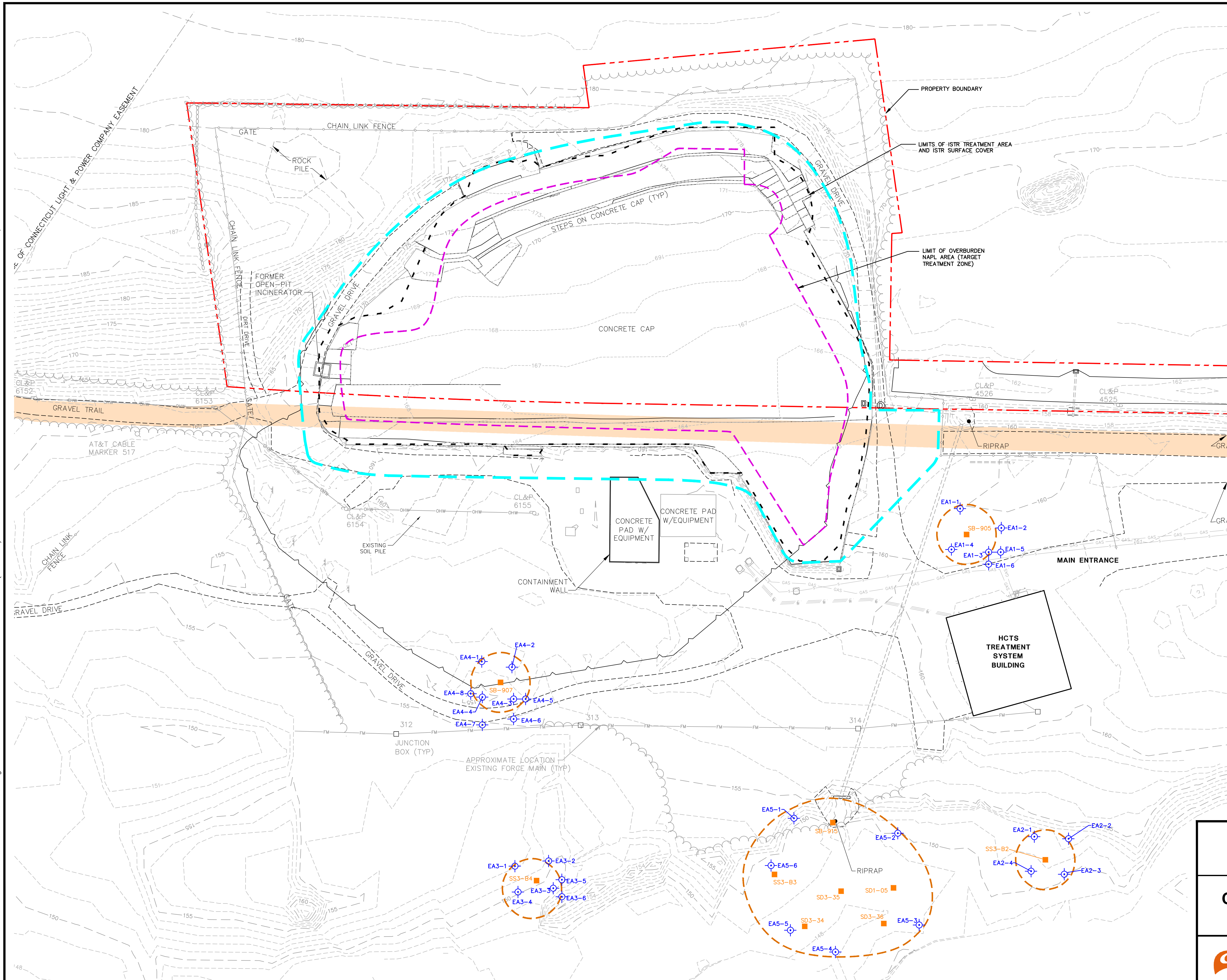
					Original Sample Locations												2010 Delineation Sample Locations					
				Sample Location	SD3-35		SD3-36		SD3-36		SS3-B3		SB-915		SB-915		EA5-1		EA5-6		EA5-1	
				Field Sample ID	SD3-35-1218-02		SD3-36-0006-01		SD3-36-0006-02		SS3-B3-0006-01		SB915(0-2.0)		SB915(2.0-4.0)		EA5-1-SS-1 (0-2')		EA5-6-SS-1 (0-2')		DUP-SS-05062010-#2	
				Sample Date	12/19/1991 0:00		12/11/1991 0:00		12/18/1991 0:00		12/9/1991 0:00		10/19/1999 14:00		10/19/1999 14:10		5/6/2010 17:00		5/6/2010 17:20		5/6/2010 0:00	
				Top Sample Depth (ft)	1		0		0		0		0		2		0		0		0	
				Bottom Sample Depth (ft)	1.5		0.5		0.5		0.5		2		4		2		2		2	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**																		
Metals (Total)																						
Beryllium	7440-41-7	mg/Kg	--	2	--	--	**2.2**	--	--	--	0.31	UJ	**0.65**	B	**0.87**	B	--	--	--	--	--	--
Metals (TCLP/SPLP)																						
Beryllium	7440-41-7	mg/l	0.004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																						
PCB-1016	12674-11-2	ug/Kg	--	--	39	UJ	--	--	61	U	52	UJ	230	U	32	U	21	U	22	U	21	U
PCB-1221	11104-28-2	ug/Kg	--	--	79	UJ	--	--	120	U	110	UJ	230	U	32	U	21	U	22	U	21	U
PCB-1232	11141-16-5	ug/Kg	--	--	39	UJ	--	--	61	U	52	UJ	230	U	32	U	21	U	22	U	21	U
PCB-1242	53469-21-9	ug/Kg	--	--	39	UJ	--	--	61	U	52	UJ	230	U	32	U	21	U	22	U	21	U
PCB-1248	12672-29-6	ug/Kg	--	--	39	UJ	--	--	61	U	52	UJ	230	U	32	U	21	U	22	U	21	U
PCB-1254	11097-69-1	ug/Kg	--	--	**230**	J	--	--	**360**	J	**1400**	J	**1100**	--	**310**	--	21	U	22	U	21	U
PCB-1260	11096-82-5	ug/Kg	--	--	**61**	J	--	--	**140**	J	**800**	J	**1100**	--	**260**	--	21	U	**20**	J	21	U
PCBs, Total	1336-36-3	ug/Kg	--	1000	**291**	--	--	--	**500**	--	**2200**	--	**2200**	--	**570**	--	ND	U	**20**	J	ND	U
SVOCs																						
Bis(2-ethylhexyl) phthalate	117-81-7	ug/kg	1000	44000	--	--	620	U	--	--	**1600**	--	**1000**	B	**1100**	B	--	--	--	--	--	--

					2010 Delineation Sample Locations								2015 Delineation Sample Locations											
				Sample Location	EA5-2		EA5-3		EA5-4		EA5-5		EA5-1A		EA5-2A		EA5-3A		EA5-4A		EA5-5A		EA5-6A	
				Field Sample ID	EA5-2-SS-1 (0-2')		EA5-3-SS-1 (0-2')		EA5-4-SS-1 (0-2')		EA5-5-SS-1 (0-2')		EA5-1A-SS-08312015 (0-2)		EA5-2A-SS-08312015 (0-2)		EA5-3A-SS-08312015 (0-2)		EA5-4A-SS-08312015 (0-2)		EA5-5A-SS-08312015 (0-2)		EA5-6A-SS-08312015 (0-2)	
				Sample Date	5/6/2010 16:40		5/7/2010 9:30		5/7/2010 9:15		5/7/2010 8:45		8/31/2015 10:28		8/31/2015 10:55		8/31/2015 10:48		8/31/2015 10:42		8/31/2015 10:35		8/31/2015 10:30	
				Top Sample Depth (ft)	0		0		0		0		0		0		0		0		0		0	
				Bottom Sample Depth (ft)	2		2		2		2		2		2		2		2		2		2	
Analyte	**CAS No.**	**Unit**	**GA PMC**	**RDEC**																				
Metals (Total)																								
Beryllium	7440-41-7	mg/Kg	--	2	--	--	**0.66**	J	**0.6**	J	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Metals (TCLP/SPLP)																								
Beryllium	7440-41-7	mg/l	0.004	--	--	--	--	--	--	--	--	--	--	--	--	--	0.005	U	0.005	U	--	--	--	--
PCBs																								
PCB-1016	12674-11-2	ug/Kg	--	--	23	U	26	U	26	U	22	U	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1221	11104-28-2	ug/Kg	--	--	23	U	26	U	26	U	22	U	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1232	11141-16-5	ug/Kg	--	--	23	U	26	U	26	U	22	U	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1242	53469-21-9	ug/Kg	--	--	23	U	26	U	26	U	22	U	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1248	12672-29-6	ug/Kg	--	--	23	U	26	U	26	U	22	U	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1254	11097-69-1	ug/Kg	--	--	23	U	26	U	26	U	**56**	--	--	--	--	--	--	--	--	--	--	--	--	--
PCB-1260	11096-82-5	ug/Kg	--	--	**7.3**	J	**120**	--	**49**	--	**51**	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs, Total	1336-36-3	ug/Kg	--	1000	**7.3**	J	**120**	--	**49**	--	**107**	--	--	--	--	--	--	--	--	--	--	--	--	--
SVOCs																								
Bis(2-ethylhexyl) phthalate	117-81-7	ug/kg	1000	44000	--	--	--	--	--	--	--	--	170	U	190	U	210	U	**130**	J	**94**	J	**130**	J

Notes:
U = Analyte not detected above the laboratory's Reporting Limit
J = Analyte result is estimated
Total metals result (in mg/kg) excees 20 times the GA PMC (in mg/L), which suggests the potential for TCLP/SPLP result to exceed GA PMC.
exceedance of PMC
exceedance of RDEC

FIGURES

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B.DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF*,TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\10000\54634G01.dwg LAYOUT: 1 SAVED: 2/29/2016 2:02 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/2/2016 11:27 AM BY: SMALL, BRIAN



LEGEND:

- SITE BOUNDARY
- 162 CONTOUR INDEX
- 160 CONTOUR INTERMEDIATE
- ELECTRIC LINE
- GAS LINE
- OVERHEAD UTILITY LINE
- TELEPHONE LINE
- WATER LINE
- CHAINLINK FENCE
- SANITARY SEWER
- SHEET PILE CONTAINMENT WALL
- ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION
- PRELIMINARY RCRA CAP LIMITS (SEE NOTE 2)
- PRELIMINARY RAILTRAIL PAVING BOUNDARY
- CATCH BASIN
- UTILITY POLE
- SIP SOIL INVESTIGATION PLAN

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SOIL SAMPLE LOCATION
- DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. PRELIMINARY RCRA CAP LIMITS ARE SUBJECT TO CHANGE BASED ON ADDITIONAL DELINEATION SAMPLING RESULTS AND ENGINEERING DESIGN.
3. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

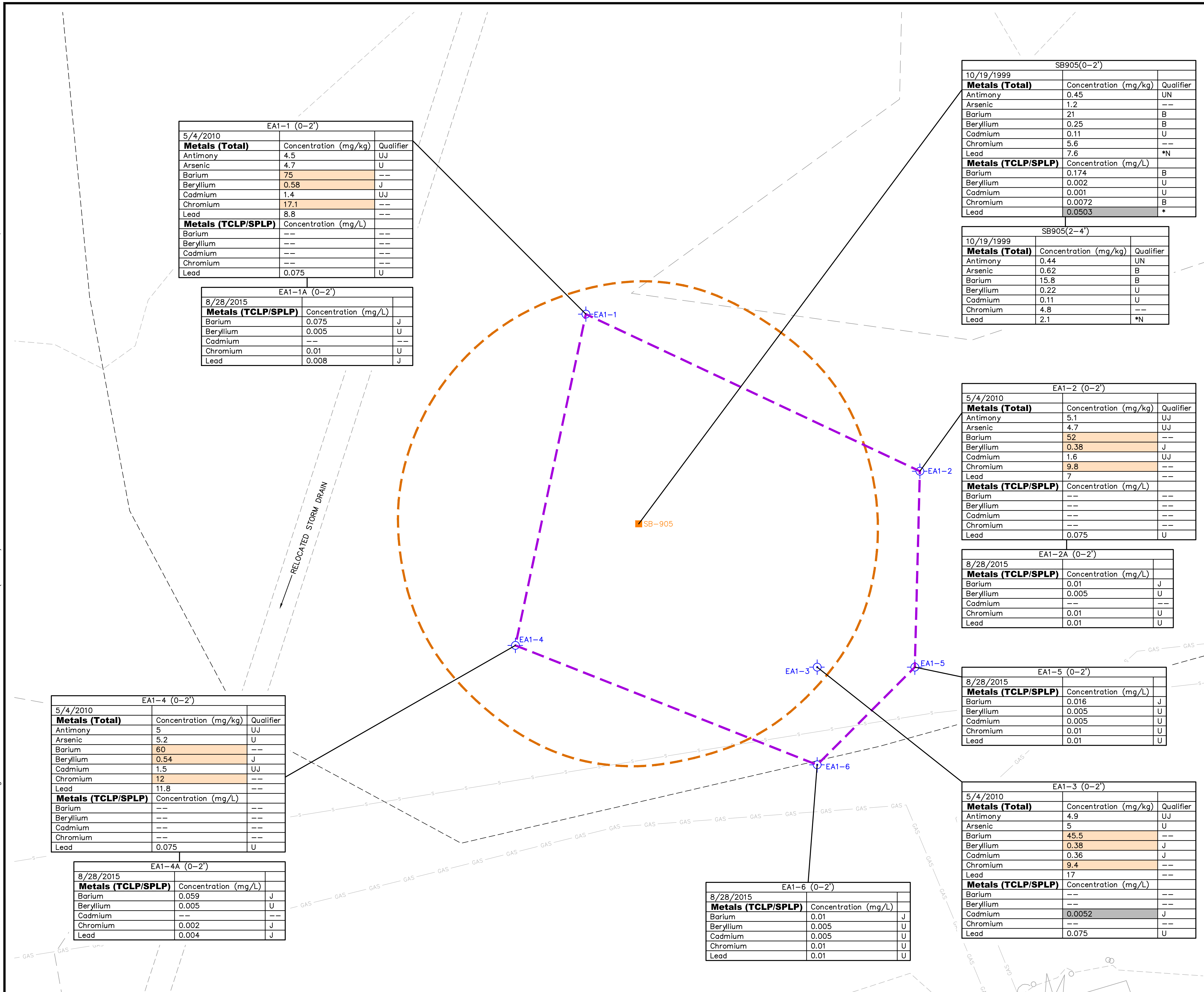
0 40' 80'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA SAMPLE LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1



EA1-1 (0-2')		
5/4/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	4.5	UJ
Arsenic	4.7	U
Barium	75	--
Beryllium	0.58	J
Cadmium	1.4	UJ
Chromium	17.1	--
Lead	8.8	--
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	--	--
Beryllium	--	--
Cadmium	--	--
Chromium	--	--
Lead	0.075	U

EA1-1A (0-2')		
8/28/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.075	J
Beryllium	0.005	U
Cadmium	--	--
Chromium	0.01	U
Lead	0.008	J

SB905(0-2')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	0.45	UN
Arsenic	1.2	--
Barium	21	B
Beryllium	0.25	B
Cadmium	0.11	U
Chromium	5.6	--
Lead	7.6	*N
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.174	B
Beryllium	0.002	U
Cadmium	0.001	U
Chromium	0.0072	B
Lead	0.0503	*

SB905(2-4')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	0.44	UN
Arsenic	0.62	B
Barium	15.8	B
Beryllium	0.22	U
Cadmium	0.11	U
Chromium	4.8	--
Lead	2.1	*N

EA1-2 (0-2')		
5/4/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	5.1	UJ
Arsenic	4.7	UJ
Barium	52	--
Beryllium	0.38	J
Cadmium	1.6	UJ
Chromium	9.8	--
Lead	7	--
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	--	--
Beryllium	--	--
Cadmium	--	--
Chromium	--	--
Lead	0.075	U

EA1-2A (0-2')		
8/28/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.01	J
Beryllium	0.005	U
Cadmium	--	--
Chromium	0.01	U
Lead	0.01	U

EA1-5 (0-2')		
8/28/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.016	J
Beryllium	0.005	U
Cadmium	0.005	U
Chromium	0.01	U
Lead	0.01	U

EA1-4 (0-2')		
5/4/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	5	UJ
Arsenic	5.2	U
Barium	60	--
Beryllium	0.54	J
Cadmium	1.5	UJ
Chromium	12	--
Lead	11.8	--
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	--	--
Beryllium	--	--
Cadmium	--	--
Chromium	--	--
Lead	0.075	U

EA1-4A (0-2')		
8/28/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.059	J
Beryllium	0.005	U
Cadmium	--	--
Chromium	0.002	J
Lead	0.004	J

EA1-6 (0-2')		
8/28/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	0.01	J
Beryllium	0.005	U
Cadmium	0.005	U
Chromium	0.01	U
Lead	0.01	U

EA1-3 (0-2')		
5/4/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Antimony	4.9	UJ
Arsenic	5	U
Barium	45.5	--
Beryllium	0.38	J
Cadmium	0.36	J
Chromium	9.4	--
Lead	17	--
Metals (TCLP/SPLP)	Concentration (mg/L)	
Barium	--	--
Beryllium	--	--
Cadmium	0.0052	J
Chromium	--	--
Lead	0.075	U

LEGEND:

CONTOUR INDEX

GAS LINE

SANITARY SEWER

ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION

TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION)

CIANCI EXCAVATION AREA SAMPLES

ORIGINAL SOIL SAMPLE LOCATION

DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = TOTAL METALS RESULT (IN mg/kg) EXCEEDS 20 TIMES THE GA PMC (IN mg/L), WHICH SUGGESTS THE POTENTIAL FOR TCLP/SPLP RESULT TO EXCEED GA PMC.
3. = EXCEEDANCE OF PMC
4. B = ANALYTE WAS FOUND IN AN ASSOCIATED BLANK, AS WELL AS IN THE SAMPLE
5. J = ANALYTE RESULT IS ESTIMATED
6. mg/kg = MILLIGRAMS PER KILOGRAM
7. mg/L = MILLIGRAMS PER LITER
8. N = ANALYTE IS PRESUMED TO BE PRESENT
9. PMC = POLLUTANT MOBILITY CRITERIA
10. SPLP = SYNTHETIC PRECIPITATION LEACHING PROCEDURE
11. TCLP = TOXICITY CHARACTERISTIC LEACHING PROCEDURE
12. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
13. * = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS
14. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 5' 10'

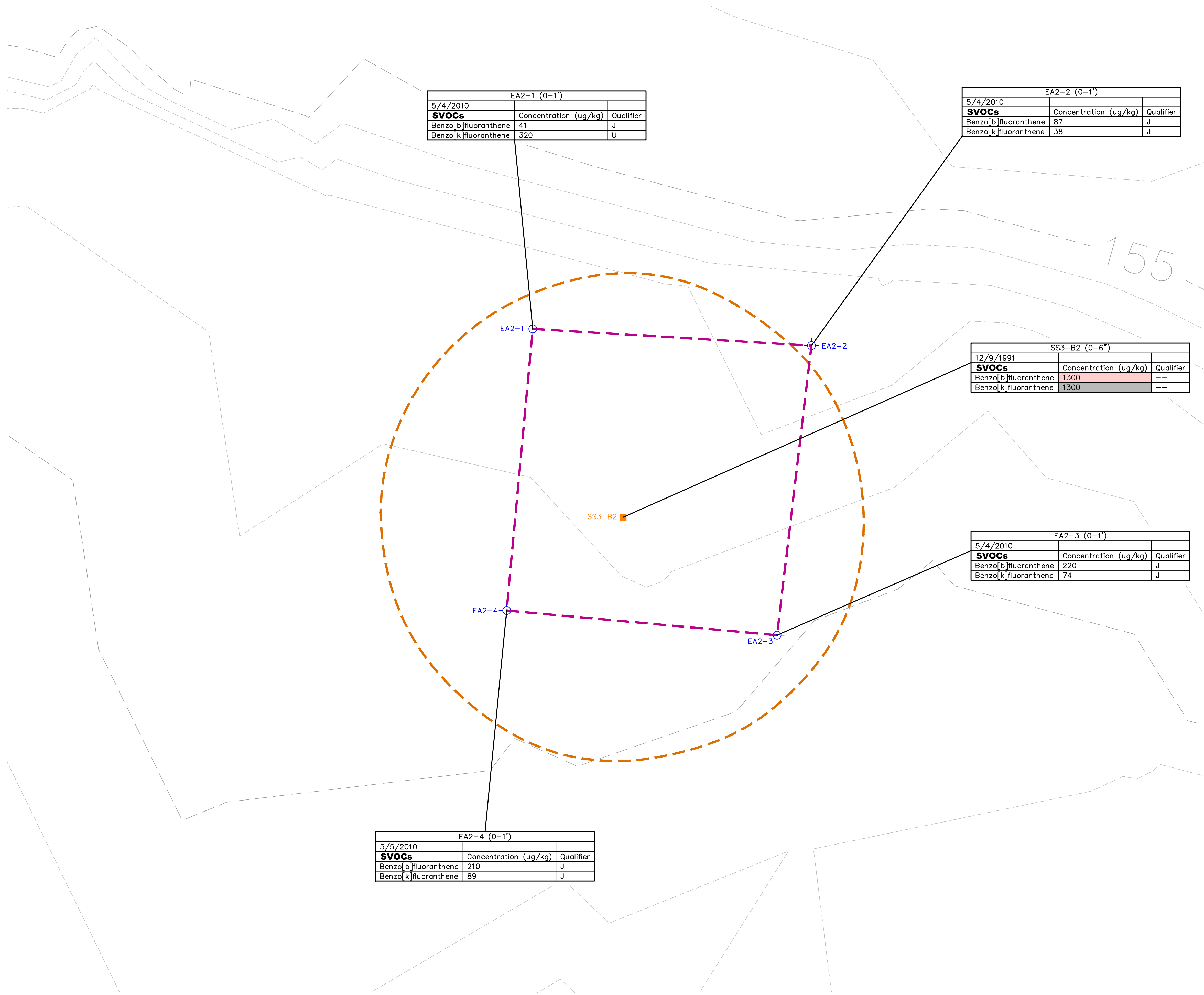
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA 1

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2



EA2-1 (0-1')		
5/4/2010		
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	41	J
Benzo[k]fluoranthene	320	U

EA2-2 (0-1')		
5/4/2010		
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	87	J
Benzo[k]fluoranthene	38	J

SS3-B2 (0-6")		
12/9/1991		
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	1300	--
Benzo[k]fluoranthene	1300	--

EA2-3 (0-1')		
5/4/2010		
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	220	J
Benzo[k]fluoranthene	74	J

EA2-4 (0-1')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	210	J
Benzo[k]fluoranthene	89	J

LEGEND:

155 CONTOUR INDEX

ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION

TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (1 FBG EXCAVATION)

CIANCI EXCAVATION AREA SAMPLES

ORIGINAL SOIL SAMPLE LOCATION

DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = EXCEEDANCE OF PMC
3. = EXCEEDANCE OF RDEC AND PMC
4. J = ANALYTE RESULT IS ESTIMATED
5. PMC = POLLUTANT MOBILITY CRITERIA
6. RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA
7. SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS
8. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
9. ug/kg = MICROGRAMS PER KILOGRAM
10. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 5' 10'
GRAPHIC SCALE

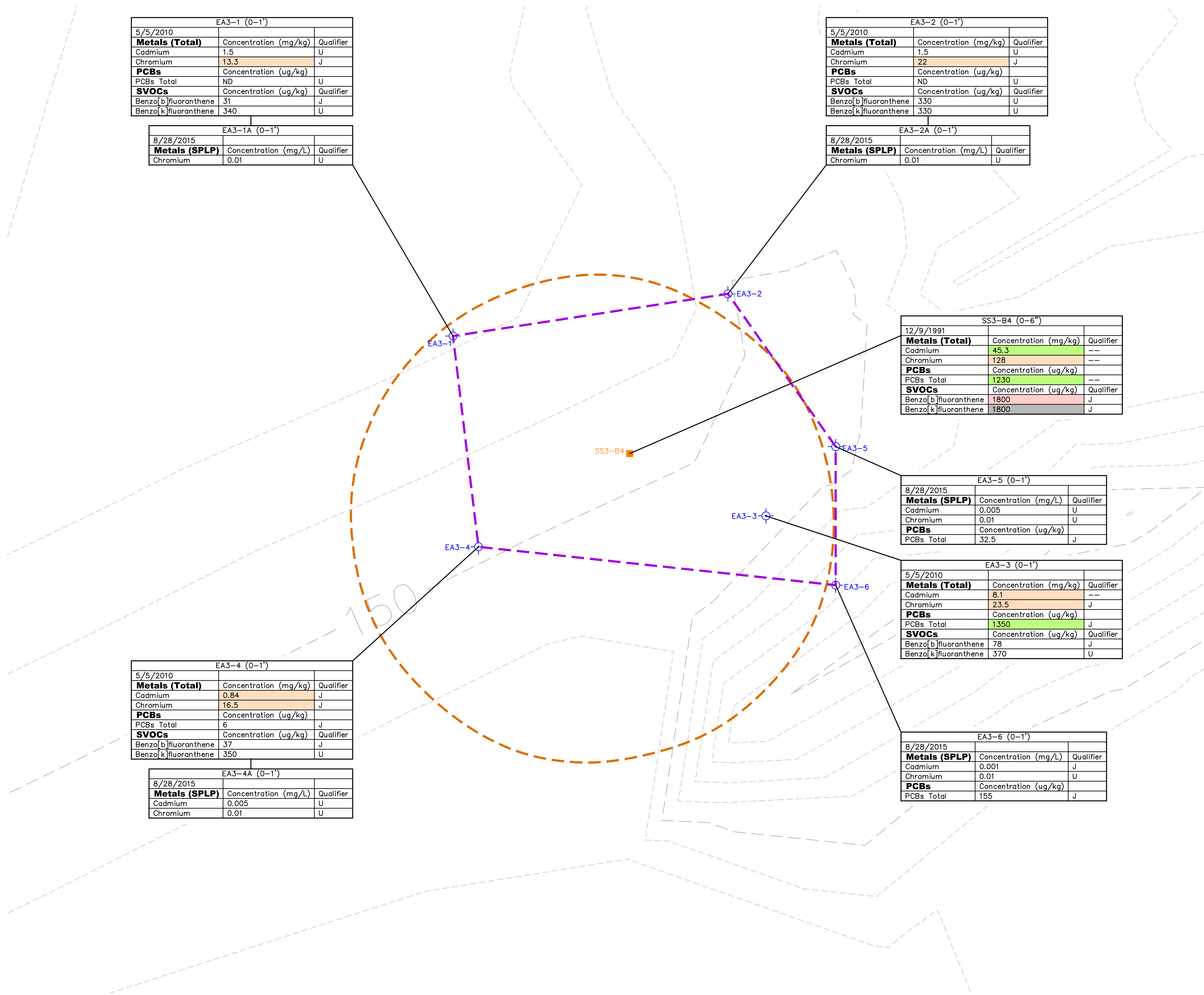
SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA 2

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B DECLERCQ LD: B DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF. |TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\01000\54634C03.dwg LAYOUT: 3 SAVED: 2/29/2016 2:10 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/2/2016 11:29 AM BY: SMALL, BRIAN



EA3-1 (0-1')		
5/5/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Cadmium	1.5	U
Chromium	13.3	J
PCBs	Concentration (ug/kg)	
PCBs Total	ND	U
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	31	J
Benzo[k]fluoranthene	340	U

EA3-1A (0-1')		
8/28/2015		
Metals (SPLP)	Concentration (mg/L)	Qualifier
Chromium	0.01	U

EA3-2 (0-1')		
5/5/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Cadmium	1.5	U
Chromium	22	J
PCBs	Concentration (ug/kg)	
PCBs Total	ND	U
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	330	U
Benzo[k]fluoranthene	330	U

EA3-2A (0-1')		
8/28/2015		
Metals (SPLP)	Concentration (mg/L)	Qualifier
Chromium	0.01	U

SS3-B4 (0-6")		
12/9/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Cadmium	45.3	--
Chromium	128	--
PCBs	Concentration (ug/kg)	
PCBs Total	1230	--
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	1800	J
Benzo[k]fluoranthene	1800	J

EA3-5 (0-1')		
8/28/2015		
Metals (SPLP)	Concentration (mg/L)	Qualifier
Cadmium	0.005	U
Chromium	0.01	U
PCBs	Concentration (ug/kg)	
PCBs Total	32.5	J

EA3-3 (0-1')		
5/5/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Cadmium	8.1	--
Chromium	23.5	J
PCBs	Concentration (ug/kg)	
PCBs Total	1350	J
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	78	J
Benzo[k]fluoranthene	370	U

EA3-4 (0-1')		
5/5/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Cadmium	0.84	J
Chromium	16.5	J
PCBs	Concentration (ug/kg)	
PCBs Total	6	J
SVOCs	Concentration (ug/kg)	Qualifier
Benzo[b]fluoranthene	37	J
Benzo[k]fluoranthene	350	U

EA3-4A (0-1')		
8/28/2015		
Metals (SPLP)	Concentration (mg/L)	Qualifier
Cadmium	0.005	U
Chromium	0.01	U

EA3-6 (0-1')		
8/28/2015		
Metals (SPLP)	Concentration (mg/L)	Qualifier
Cadmium	0.001	J
Chromium	0.01	U
PCBs	Concentration (ug/kg)	
PCBs Total	155	J

LEGEND:

150 CONTOUR INDEX

ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION

TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (1 FBG EXCAVATION)

CIANCI EXCAVATION AREA SAMPLES

ORIGINAL SOIL SAMPLE LOCATION

DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = TOTAL METALS RESULT (IN mg/kg) EXCEES 20 TIMES THE GA PMC (IN mg/L), WHICH SUGGESTS THE POTENTIAL FOR TCLP/SPLP RESULT TO EXCEED GA PMC.
3. = EXCEEDANCE OF PMC
4. = EXCEEDANCE OF RDEC AND PMC
5. = EXCEEDANCE OF RDEC
6. J = ANALYTE RESULT IS ESTIMATED
7. mg/kg = MILLIGRAMS PER KILOGRAM
8. mg/L = MILLIGRAMS PER LITER
9. PCBS = POLYCHLORINATED BIPHENYLS
10. PMC = POLLUTANT MOBILITY CRITERIA
11. RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA
12. SPLP = SYNTHETIC PRECIPITATION LEACHING PROCEDURE
13. SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS
14. TCLP = TOXICITY CHARACTERISTIC LEACHING PROCEDURE
15. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
16. ug/kg = MICROGRAMS PER KILOGRAM
17. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 5' 10'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA 3

ARCADIS Design & Consultancy for natural and built assets

FIGURE 4

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B.DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF (TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\00105\54634C04.dwg LAYOUT: 4 SAVED: 2/29/2016 2:08 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/2/2016 11:28 AM BY: SMALL, BRIAN

EA4-1 (0-2')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	310	U
Benzo[a]anthracene	210	J
Benzo[a]pyrene	240	J
Benzo[b]fluoranthene	320	--
Bis(2-ethylhexyl) phthalate	65	J
Chrysene	240	J
Dibenzofuran	310	U
Fluoranthene	410	J
Indeno[1,2,3-cd]pyrene	160	J
Phenanthrene	210	J
Pyrene	380	J

EA4-1 (2-4')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	13	J
Benzo[a]anthracene	440	J
Benzo[a]pyrene	490	J
Benzo[b]fluoranthene	570	--
Bis(2-ethylhexyl) phthalate	45	J
Chrysene	480	J
Dibenzofuran	330	U
Fluoranthene	580	J
Indeno[1,2,3-cd]pyrene	640	J
Phenanthrene	330	--
Pyrene	980	J

EA4-1A (0-2')		
8/31/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.1	U

EA4-1A (2-4')		
8/31/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.1	U

SB907 (0-2')		
10/19/1999		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	400	U
Benzo[a]anthracene	160	J
Benzo[a]pyrene	180	J
Benzo[b]fluoranthene	220	J
Bis(2-ethylhexyl) phthalate	830	B
Chrysene	160	J
Dibenzofuran	400	U
Fluoranthene	210	J
Indeno[1,2,3-cd]pyrene	140	J
Phenanthrene	200	J
Pyrene	360	J
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	2.3	J

SB907 (2-4')		
10/19/1999		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	3100	J
Benzo[a]anthracene	5600	--
Benzo[a]pyrene	4500	--
Benzo[b]fluoranthene	5100	--
Bis(2-ethylhexyl) phthalate	400	U
Chrysene	5200	--
Dibenzofuran	1300	J
Fluoranthene	9400	--
Indeno[1,2,3-cd]pyrene	2300	J
Phenanthrene	20000	--
Pyrene	18000	--
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1300	--

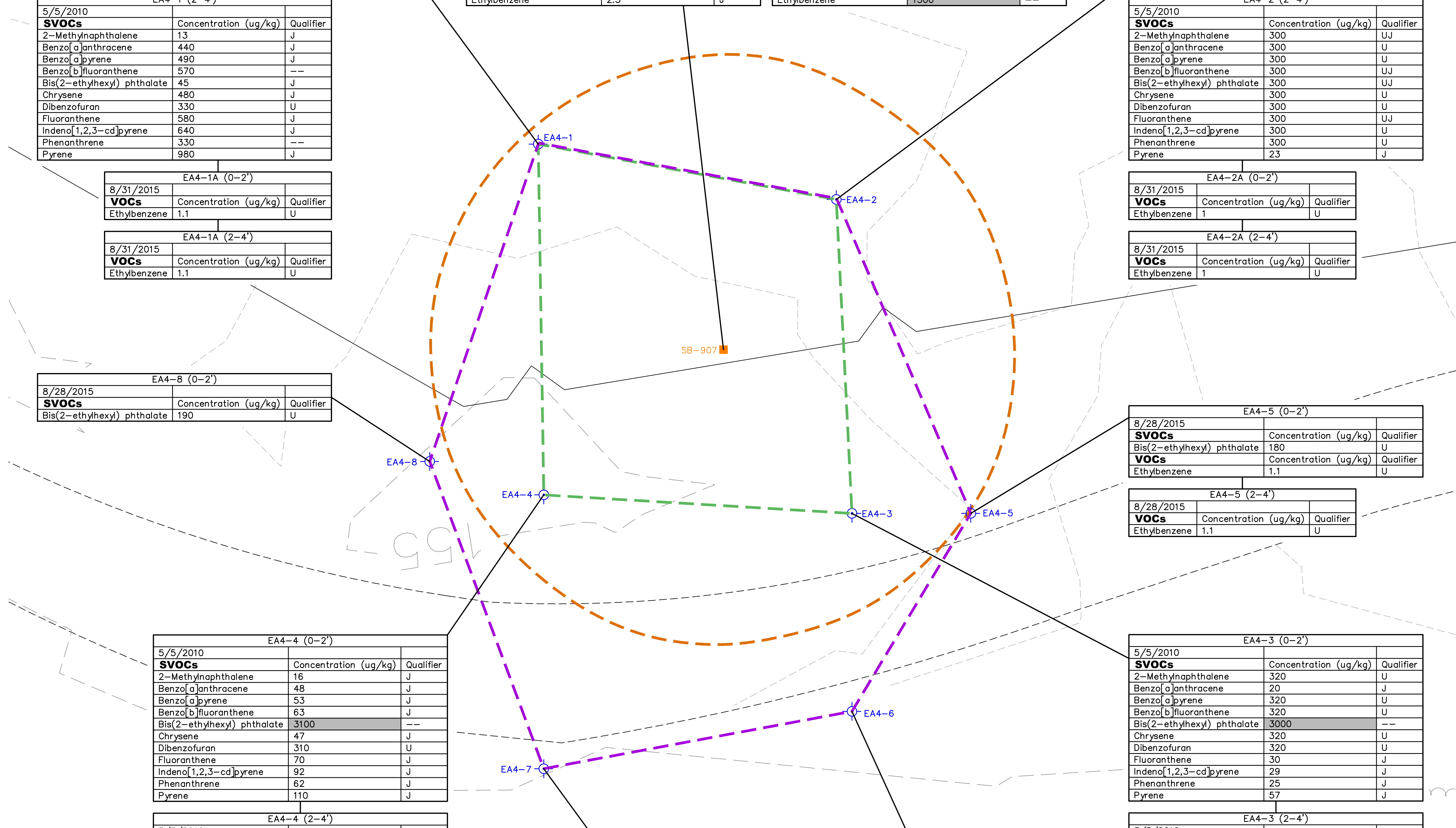
EA4-2 (0-2')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	300	U
Benzo[a]anthracene	300	U
Benzo[a]pyrene	25	J
Benzo[b]fluoranthene	31	J
Bis(2-ethylhexyl) phthalate	160	J
Chrysene	300	U
Dibenzofuran	300	U
Fluoranthene	37	J
Indeno[1,2,3-cd]pyrene	36	J
Phenanthrene	17	J
Pyrene	48	J

EA4-2 (2-4')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	300	UJ
Benzo[a]anthracene	300	U
Benzo[a]pyrene	300	U
Benzo[b]fluoranthene	300	UJ
Bis(2-ethylhexyl) phthalate	300	UJ
Chrysene	300	U
Dibenzofuran	300	U
Fluoranthene	300	UJ
Indeno[1,2,3-cd]pyrene	300	U
Phenanthrene	300	U
Pyrene	23	J

EA4-2A (0-2')		
8/31/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1	U

EA4-2A (2-4')		
8/31/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1	U

EA4-8 (0-2')		
8/28/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	190	U



EA4-5 (0-2')		
8/28/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	180	U
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.1	U

EA4-5 (2-4')		
8/28/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.1	U

EA4-4 (0-2')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	16	J
Benzo[a]anthracene	48	J
Benzo[a]pyrene	53	J
Benzo[b]fluoranthene	63	J
Bis(2-ethylhexyl) phthalate	3100	--
Chrysene	47	J
Dibenzofuran	310	U
Fluoranthene	70	J
Indeno[1,2,3-cd]pyrene	92	J
Phenanthrene	62	J
Pyrene	110	J

EA4-4 (2-4')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	300	U
Benzo[a]anthracene	300	U
Benzo[a]pyrene	300	U
Benzo[b]fluoranthene	300	U
Bis(2-ethylhexyl) phthalate	300	U
Chrysene	300	U
Dibenzofuran	300	U
Fluoranthene	300	U
Indeno[1,2,3-cd]pyrene	300	U
Phenanthrene	300	U
Pyrene	300	U

EA4-7 (0-2')		
8/28/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	72	J
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.1	U

EA4-7 (2-4')		
8/28/2015		
VOCs	Concentration (ug/kg)	Qualifier
Ethylbenzene	1.2	U

EA4-6 (0-2')		
8/28/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	180	U

EA4-3 (0-2')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	320	U
Benzo[a]anthracene	20	J
Benzo[a]pyrene	320	U
Benzo[b]fluoranthene	320	U
Bis(2-ethylhexyl) phthalate	3000	--
Chrysene	320	U
Dibenzofuran	320	U
Fluoranthene	30	J
Indeno[1,2,3-cd]pyrene	29	J
Phenanthrene	25	J
Pyrene	57	J

EA4-3 (2-4')		
5/5/2010		
SVOCs	Concentration (ug/kg)	Qualifier
2-Methylnaphthalene	320	U
Benzo[a]anthracene	320	U
Benzo[a]pyrene	13	J
Benzo[b]fluoranthene	320	U
Bis(2-ethylhexyl) phthalate	400	--
Chrysene	320	U
Dibenzofuran	320	U
Fluoranthene	19	J
Indeno[1,2,3-cd]pyrene	320	U
Phenanthrene	320	U
Pyrene	32	J

LEGEND:

- 150 CONTOUR INDEX
- SHEET PILE CONTAINMENT WALL
- ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION
- TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION)
- TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (4 FBG EXCAVATION)

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SOIL SAMPLE LOCATION
- DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = EXCEEDANCE OF PMC
3. = EXCEEDANCE OF RDEC AND PMC
4. B = ANALYTE WAS FOUND IN AN ASSOCIATED BLANK, AS WELL AS IN THE SAMPLE
5. E = ANALYTE EXCEEDED CALIBRATION RANGE
6. J = ANALYTE RESULT IS ESTIMATED
7. PMC = POLLUTANT MOBILITY CRITERIA
8. RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA
9. SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS
10. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
11. ug/kg = MICROGRAMS PER KILOGRAM
12. VOCs = VOLATILE ORGANIC COMPOUNDS
13. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 5' 10'
GRAPHIC SCALE

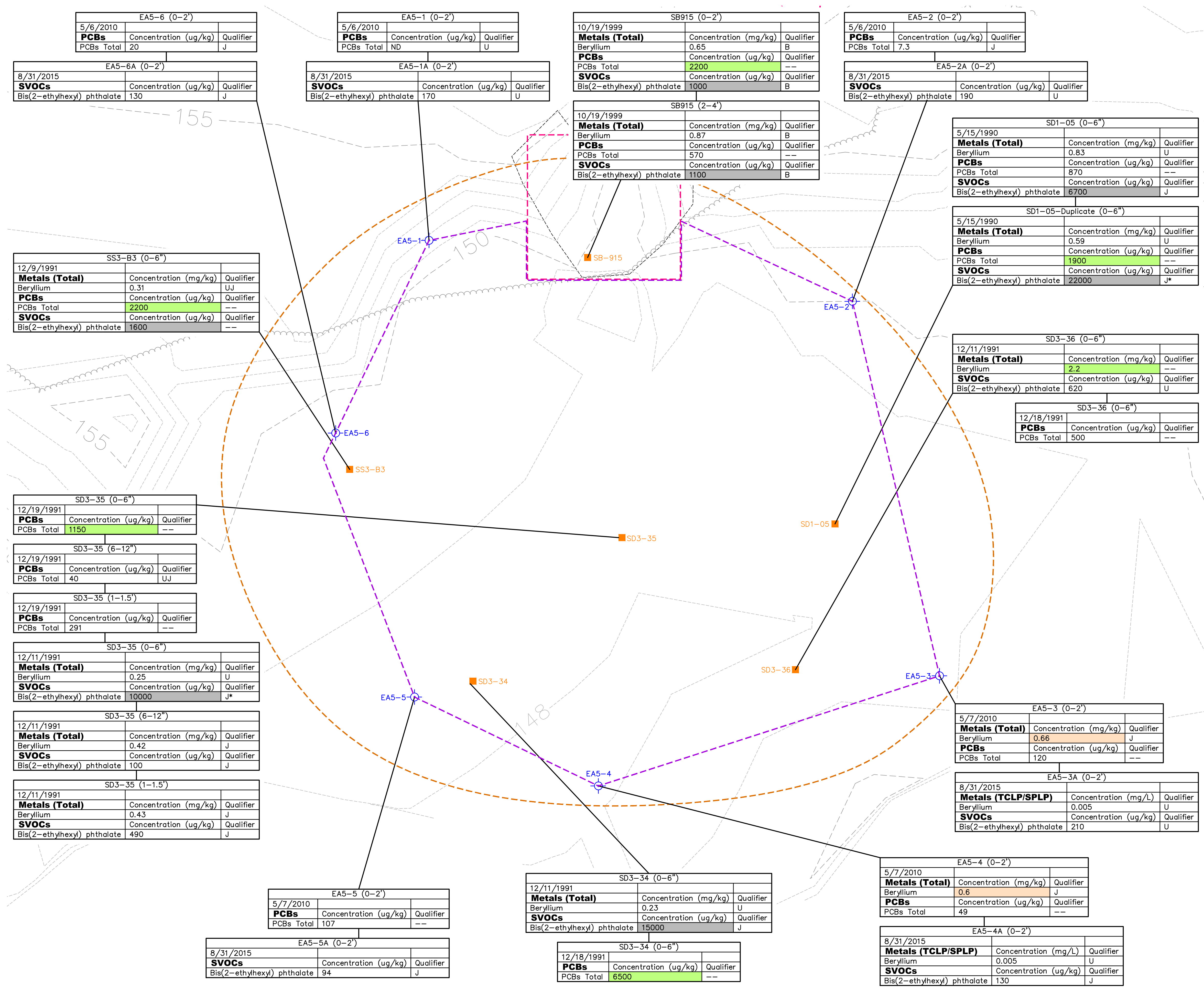
SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA 4

ARCADIS Design & Consultancy for natural and built assets

FIGURE 5

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B.DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF* TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\00010\B0054634C05.dwg LAYOUT: 5 SAVED: 2/29/2016 2:09 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 3/2/2016 11:28 AM BY: SMALL, BRIAN



EA5-6 (0-2')

5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	20	J

EA5-6A (0-2')

8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	130	J

EA5-1 (0-2')

5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	ND	U

EA5-1A (0-2')

8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	170	U

SB915 (0-2')

10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.65	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1000	B

SB915 (2-4')

10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.87	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	570	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1100	B

EA5-2 (0-2')

5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	7.3	J

EA5-2A (0-2')

8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	190	U

SD1-05 (0-6")

5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.83	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	870	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	6700	J

SD1-05-Duplicate (0-6")

5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.59	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1900	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	22000	J*

SS3-B3 (0-6")

12/9/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.31	UJ
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1600	--

SD3-36 (0-6")

12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	2.2	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	620	U

SD3-36 (0-6")

12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	500	--

SD3-35 (0-6")

12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1150	--

SD3-35 (6-12")

12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	40	UJ

SD3-35 (1-1.5')

12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	291	--

SD3-35 (0-6")

12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.25	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	10000	J*

SD3-35 (6-12")

12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.42	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	100	J

SD3-35 (1-1.5')

12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.43	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	490	J

EA5-3 (0-2')

5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.66	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	120	--

EA5-3A (0-2')

8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	210	U

EA5-5 (0-2')

5/7/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	107	--

EA5-5A (0-2')

8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	94	J

SD3-34 (0-6")

12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.23	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	15000	J

SD3-34 (0-6")

12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	6500	--

EA5-4 (0-2')

5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.6	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	49	--

EA5-4A (0-2')

8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	130	J

LEGEND:

- 150 CONTOUR INDEX
- ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION
- TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION)
- APPROXIMATE LOCATION OF PRIOR SOIL REMOVAL DURING OUTFALL CONSTRUCTION (NOTE 5)

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SOIL SAMPLE LOCATION
- DELINEATION SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = TOTAL METALS RESULT (IN mg/kg) EXCEES 20 TIMES THE GA PMC (IN mg/L), WHICH SUGGESTS THE POTENTIAL FOR TCLP/SPLP RESULT TO EXCEED GA PMC.
3. = EXCEEDANCE OF PMC
4. = EXCEEDANCE OF RDEC
5. SOILS ADJACENT TO THE NEW OUTFALL WERE REMOVED AS PART OF THE PRE-ISTR SITE PREPARATION ACTIVITIES WHEN THE NEW OUTFALL LOCATION WAS CONSTRUCTED. THE SOILS WERE CONSOLIDATED IN THE THERMAL TREATMENT AREA. THE EXCAVATION WAS RESTORED WITH GEOTEXTILE FABRIC AND RIPRAP. ADDITIONAL EXCAVATION IN AREA 5 WILL ABUT THE PRIOR REMOVAL AREA.
6. B = ANALYTE WAS FOUND IN AN ASSOCIATED BLANK, AS WELL AS IN THE SAMPLE
7. J = ANALYTE RESULT IS ESTIMATED
8. mg/kg = MILLIGRAMS PER KILOGRAM
9. mg/L = MILLIGRAMS PER LITER
10. PCBS = POLYCHLORINATED BIPHENYLS
11. PMC = POLLUTANT MOBILITY CRITERIA
12. RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA
13. SPLP = SYNTHETIC PRECIPITATION LEACHING PROCEDURE
14. SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS
15. TCLP = TOXICITY CHARACTERISTIC LEACHING PROCEDURE
16. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
17. ug/kg = MICROGRAMS PER KILOGRAM
18. * = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS
19. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 10' 20'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CIANCI EXCAVATION AREA 5

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6

APPENDIX D

EA-5 Supplemental Investigation Work Plan and Summary Report

DRAFT

MEMO

ARCADIS Design & Consultancy for natural and built assets

To:
Bruce Thompson
Jessie McCusker
de maximis, inc.

Copies:
Project File

Arcadis U.S., Inc.
160 Chapel Road
Suite 201
Manchester
Connecticut 06042-1625
Tel 860 645 1084
Fax 860 645 1090

From:
Jeffrey S. Holden, P.E., LEP

Date:
April 25, 2016

Arcadis Project No.:
B0054634.0001

Subject:
Additional Delineation for Cianci Property Excavation Area 5
Solvents Recovery Service of New England, Inc. Superfund Site
Southington, Connecticut

This memorandum summarizes the scope of proposed additional soil sampling at the Cianci Excavation Area 5 (EA-5) for the purpose of delineating the extent of removal required to meet the applicable soil cleanup levels specified in the SOW. Removal in this area is planned to address six historical soil sample locations near the culvert discharge that exceeded cleanup levels for one or more constituents, and to address additional soils impacted by dioxin. Initial horizontal delineation of EA-5 was performed in accordance with the approach proposed in the Soil Investigation Plan (SIP, Attachment G to the Remedial Design/Remedial Action [RD/RA] Work Plan). Selected interior and perimeter locations (based on the SIP-based delineation) were then analyzed to assess the presence and extent of potential dioxin impacts in this area. The dioxin investigation resulted in a slight eastward expansion of the removal area that had already been targeted based on non-dioxin constituents. The resulting horizontal removal limits (for both the SIP-based and dioxin-based removal areas) are shown on Figure 1.

The objectives of the additional sampling proposed herein are:

1. **To confirm the vertical extent of removal needed to achieve soil cleanup levels.** Of the six original sample locations triggering the need for soil remediation in EA-5, one was collected from a depth of 0-2’, and five were collected from a depth of 0-0.5’. The originally planned removal depth throughout the entire area was 2 feet. The sampling proposed herein is intended to confirm that 2 feet of excavation is sufficient around the prior 0-2’ sample location (SB-915), and to assess whether shallower excavation (to a depth of 1 foot) may be sufficient throughout the remainder of the area where initial samples were collected from 0-0.5’.

2. **To provide sufficient bottom and sidewall samples to meet the target minima (for non-dioxin constituents) as specified in the Post-Excavation Confirmatory Sampling Plan.[1]** The Post-Excavation Confirmatory Sampling Plan was prepared prior to the development of a dioxin-based cleanup level, and described the planned approach for confirmation soil sampling in Cianci Property excavation areas. In overview, it calls for one bottom confirmation sample per 1000 square feet of excavation area, and one sidewall sample per 50 linear feet of excavation perimeter, with samples being analyzed for the specific constituents that triggered removal in that area. It also allowed for delineation or other pre-existing sample locations to serve as confirmation of removal boundaries, where appropriate.

   The target removal limits for EA-5 based on the SIP delineation (i.e., for non-dioxin constituents) include an area of 10,274 square feet and a perimeter of 408 linear feet. Based on the Post-Excavation Confirmatory Sampling Plan, this calls for collection of 11 bottom samples and 9 perimeter sidewall samples, as shown on Table 1. As also shown on Table 1, there are currently no samples that would confirm the vertical extent of removal, and six samples that serve to delineate the perimeter. Accordingly, the sampling proposed herein includes 11 locations that would serve to confirm the vertical extent of removal, and 3 additional perimeter samples, thus meeting the Post-Excavation Confirmatory Sampling Plan objectives (assuming the samples all indicate concentrations below applicable cleanup levels).

   For the dioxin-based removal area (i.e., the eastward extension of the SIP-based removal limits), sufficient horizontal delineation exists, but no samples confirm the vertical extent. Accordingly, two bottom samples are proposed in this area to verify the vertical extent of removal.

   Providing pre-excavation delineation of the EA-5 removal limits is important because it will eliminate the need for post-excavation confirmatory samples in the area. This will allow prompt backfill, restoration, and stabilization of the area, which is important given its location within the floodplain of the Quinnipiac River. Eliminating the need for post-excavation confirmation samples reduces the time that excavation areas are exposed, prevents delays to other project components (e.g., cap construction, which cannot be completed until soils are consolidated beneath the cap area), and eliminates project delays potentially associated with laboratory analysis (which can take three weeks for dioxin samples), additional excavation, and additional resampling.

3. **To provide sufficient data to confirm that the vertical extent of excavation in EA-5 will meet the dioxin-based cleanup level.** Selected sample locations within the planned removal limits will be analyzed for dioxin to confirm that the planned vertical removal limits (i.e., 2 feet in the western area and 1 foot in the eastern area) will be sufficient to achieve the dioxin cleanup level.

SAMPLE COLLECTION AND ANALYSIS

Based on the objectives specified above, the proposed confirmation sample requirements described in the Post-Excavation Confirmatory Sampling Plan, and consistent with the dioxin-based delineation approach used in other areas of the site, Table 2 summarizes proposed sampling plan. This includes a description of

[1] Provided as Attachment G to the Remedial Design/Remedial Action Work Plan (Arcadis 2010).

the proposed sample locations, depth, analytical parameters, and rationale. The specific sample locations are also shown on Figure 1.

If each of the proposed sample locations indicates concentrations below applicable soil cleanup goals, sufficient pre-excavation delineation will have been achieved to confirm the proposed excavation depths and eliminate the need for post-excavation confirmatory sampling. If one or more bottom or sidewall samples exceeds soil cleanup levels, additional samples may be collected to pre-delineate the removal limits (as time allows), else the excavation limits will be expanded where needed, and post-excavation confirmation samples will be collected from those specific areas consistent with the Post-Excavation Confirmatory Sampling Plan.

TABLES

Table 1
EA-5 Excavation Confirmation Sampling Summary
SRSNE Superfund Site, Southington, CT

<table>
<tr><th rowspan="2">Excavation Area</th><th rowspan="2">Target Constiutents [1]</th><th rowspan="2">Perimeter (linear ft)</th><th rowspan="2">Area (ft^2)</th><th colspan="2">Required Number of Samples [2]</th><th colspan="2">Existing Number of Samples</th><th colspan="2">Additional Samples Required</th><th rowspan="2">Seasonal Low Water Table Depth (ft bgs) [3]</th><th rowspan="2">Bottom Samples Not Required Below: [3]</th></tr>
<tr><th>Sidewall</th><th>Bottom</th><th>Sidewall</th><th>Bottom</th><th>Sidewall Sample</th><th>Bottom Sample</th></tr>
<tr><td>EA-5 West</td><td>SVOCs (Bis(2-ethylhexyl) phthalate) and PCBs</td><td rowspan="2">408</td><td rowspan="2">10,274</td><td rowspan="2">9</td><td rowspan="2">11</td><td rowspan="2">6</td><td rowspan="2">0</td><td rowspan="2">3</td><td rowspan="2">11</td><td rowspan="2">~ 3</td><td rowspan="2">3 ft bgs (PMC) / 4 ft bgs (RDEC)</td></tr>
<tr><td>EA-5 East</td><td>SVOCs (Bis(2-ethylhexyl) phthalate), PCBs and metals (Be)</td></tr>
</table>

Notes:
ft bgs - feet below ground surface
Be - beryllium
PCBs - polychlorinated biphenyls
PMC - Pollutant Mobility Criteria
RDEC - Residential Direct Exposure Criteria

1 - Target constituents refer to the constituents that exceeded cleanup goals in initial characterization sampling and subsequent delineation sampling and therefore, are subject to analysis in post-excavation verification samples.

2 - Required number of samples based on target removal limits based on delineation sampling and the following:
-- sidewall samples: one per 50 linear feet of sidewall and minimum of 3 per excavation area
-- bottom samples: one per 1,000 square feet of excavated area (no minimum)

In the event that excavation limits are modified (i.e., as a result of confirmation sampling) the number of sidewall and bottom verification samples would be modified accordingly

3 - As described in the Performance Standards (Section 2.5.3 of the RDWP), PMC-based standards apply to the depth of the seasonal low water table and RDEC based standards apply to a depth of 4 feet (with the expectation that an Environmental Land Use Restriction will be applied). Based on these criteria, these columns indicate the depth below which bottom veriifciation samples will not be required becasuse the associated PMC- or RDEC-based criteria no longer apply.

Table 2
EA5 Confirmation Soil Sampling Program
SRSNE Superfund Site, Southington, CT

Excavation Area	Bottom / Sidewall	Delineation Sample Location	Sample Interval (ft bgs)	(Bis(2-ethylhexyl) phthalate	PCBs	Total and SPLP Be	Dioxin	Rationale
EA-5 West	Bottom samples	EA5-DEL-B1	2-3 ft bgs	x	x			confirm vertical extent of bis(2-eh)P and PCBs
		EA5-DEL-B2	2-3 ft bgs	x	x		x	confirm vertical extent of bis(2-eh)P and PCBs; confirm removal limit addresses dioxin
		EA5-DEL-B3	2-3 ft bgs	x	x			confirm vertical extent of bis(2-eh)P and PCBs
	Sidewall Samples	EA5-DEL-SW1	0-2 ft bgs	x	x			confirm horizontal extent of bis(2-eh)P and PCBs
EA-5 East	Bottom samples	EA5-DEL-B4	1-2 ft bgs	x	x		x	confirm vertical extent of bis(2-eh)P and PCBs; confirm removal limit addresses dioxin
		EA5-DEL-B5	1-2 ft bgs	x	x			confirm vertical extent of bis(2-eh)P and PCBs
		EA5-DEL-B6	1-2 ft bgs	x	x	x	x	confirm vertical extent of bis(2-eh)P, PCBs and Be; confirm removal limit addresses dioxin
		EA5-DEL-B7	1-2 ft bgs	x	x			confirm vertical extent of bis(2-eh)P and PCBs
		EA5-DEL-B8	1-2 ft bgs	x	x	x	x	confirm vertical extent of bis(2-eh)P, PCBs, and Be; confirm removal limit addresses dioxin
		EA5-DEL-B9	1-2 ft bgs	x	x			confirm vertical extent of bis(2-eh)P, and PCBs
		EA5-DEL-B10	1-2 ft bgs	x	x	x		confirm vertical extent of bis(2-eh)P, PCBs, and Be
		EA5-DEL-B11	1-2 ft bgs	x	x	x		confirm vertical extent of bis(2-eh)P, PCBs, and Be
	Sidewall Samples	EA5-DEL-SW2	0-2 ft bgs	x	x			confirm horizontal extent of bis(2-eh)P and PCB removal limit
		EA5-DEL-SW3	0-2 ft bgs	x	x	x		confirm horizontal extent of bis(2-eh)P, PCB, and Be removal limit
Dioxin Area	Bottom samples	EA5-DEL-B12	1-2 ft bgs				x	assess whether 1 fbg removal meets dioxin cleanup standard
		EA5-DEL-B13	1-2 ft bgs				x	assess whether 1 fbg removal meets dioxin cleanup standard

Notes:
ft bgs - feet below ground surface
PCBs - polychlorinated biphenyls
Be - beryllium

FIGURES

EA5–6 (0–2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	20	J

EA5–6A (0–2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	130	J

EA5–1 (0–2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	ND	U

EA5–1A (0–2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	170	U

SB915 (0–2')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.65	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	1000	B

SB915 (2–4')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.87	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	570	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	1100	B

EA5–2 (0–2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	7.3	J

EA5–2A (0–2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	190	U

SD1–05 (0–6")		
5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.83	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	870	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	6700	J

SD1–05–Duplicate (0–6")		
5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.59	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1900	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	22000	J*

SS3–B3 (0–6")		
12/9/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.31	UJ
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	1600	––

SD3–36 (0–6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	2.2	––
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	620	U

SD3–36 (0–6")		
12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	500	––

SD3–35 (0–6")		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1150	––

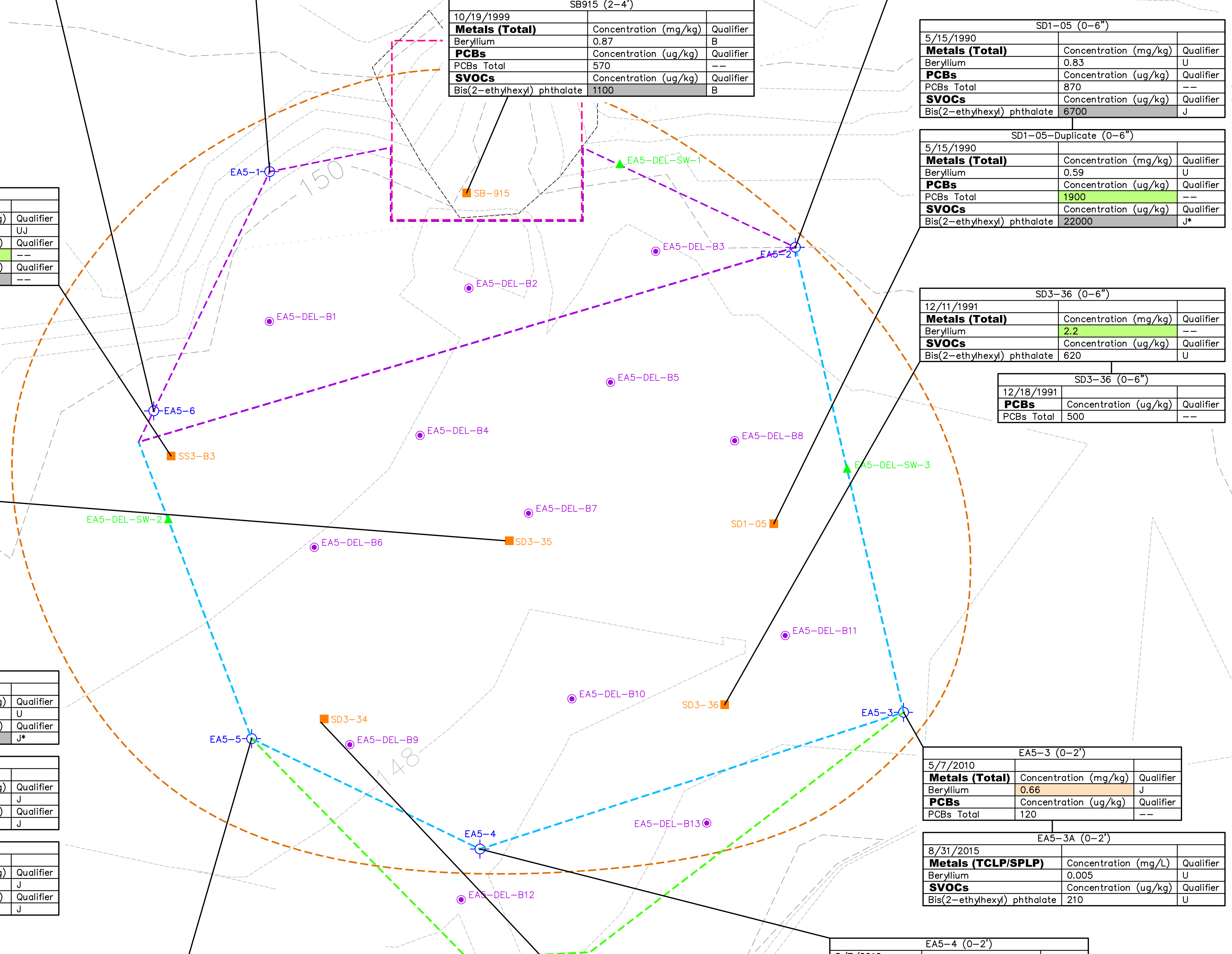
SD3–35 (6–12")		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	40	UJ

SD3–35 (1–1.5')		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	291	––

SD3–35 (0–6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.25	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	10000	J*

SD3–35 (6–12")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.42	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	100	J

SD3–35 (1–1.5')		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.43	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	490	J



EA5–3 (0–2')		
5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.66	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	120	––

EA5–3A (0–2')		
8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	210	U

EA5–5 (0–2')		
5/7/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	107	––

EA5–5A (0–2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	94	J

SD3–34 (0–6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.23	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	15000	J

SD3–34 (0–6")		
12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	6500	––

EA5–4 (0–2')		
5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.6	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	49	––

EA5–4A (0–2')		
8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2–ethylhexyl) phthalate	130	J

LEGEND:

150 CONTOUR INDEX

ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION

TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION)

TARGET REMOVAL LIMITS BASED ON DELINEATION SAMPLING (1 FBG EXCAVATION)

TARGET REMOVAL LIMITS BASED ON DIOXIN DATA

APPROXIMATE LOCATION OF PRIOR SOIL REMOVAL DURING OUTFALL CONSTRUCTION (NOTE 5)

CIANCI EXCAVATION AREA SAMPLES

ORIGINAL SOIL SAMPLE LOCATION

DELINEATION SAMPLE LOCATION

PROPOSED DELINEATION BOTTOM SAMPLE LOCATION

PROPOSED DELINEATION SIDEWALL SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. = TOTAL METALS RESULT (IN mg/kg) EXCEES 20 TIMES THE GA PMC (IN mg/L), WHICH SUGGESTS THE POTENTIAL FOR TCLP/SPLP RESULT TO EXCEED GA PMC.
3. = EXCEEDANCE OF PMC
4. = EXCEEDANCE OF RDEC
5. SOILS ADJACENT TO THE NEW OUTFALL WERE REMOVED AS PART OF THE PRE–ISTR SITE PREPARATION ACTIVITIES WHEN THE NEW OUTFALL LOCATION WAS CONSTRUCTED. THE SOILS WERE CONSOLIDATED IN THE THERMAL TREATMENT AREA. THE EXCAVATION WAS RESTORED WITH GEOTEXTILE FABRIC AND RIPRAP. ADDITIONAL EXCAVATION IN AREA 5 WILL ABUT THE PRIOR REMOVAL AREA.
6. B = ANALYTE WAS FOUND IN AN ASSOCIATED BLANK, AS WELL AS IN THE SAMPLE
7. J = ANALYTE RESULT IS ESTIMATED
8. mg/kg = MILLIGRAMS PER KILOGRAM
9. mg/L = MILLIGRAMS PER LITER
10. PCBS = POLYCHLORINATED BIPHENYLS
11. PMC = POLLUTANT MOBILITY CRITERIA
12. RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA
13. SPLP = SYNTHETIC PRECIPITATION LEACHING PROCEDURE
14. SVOCs = SEMI–VOLATILE ORGANIC COMPOUNDS
15. TCLP = TOXICITY CHARACTERISTIC LEACHING PROCEDURE
16. U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT
17. ug/kg = MICROGRAMS PER KILOGRAM
18. * = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS
19. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.

0 10' 20'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIP DELINEATION SAMPLE LOCATION MAP - CIANCI EXCAVATION AREA 5

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF* ,TEXT PLOTTED: 4/22/2016 12:43 PM BY: SMALL, BRIAN
G:\ENVCAD\Manchester\ACT\B0054634\0001\00100\54634C01.dwg LAYOUT: 1 SAVED: 4/22/2016 12:42 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB

MEMO

To:
Bruce Thompson
Jessie McCusker
de maximis, inc.

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Project File

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From:
Jeffrey S. Holden, P.E., LEP

Date:
June 29, 2016

Arcadis Project No.:
B0054634.0001

Subject:
Summary of Supplemental "Pre-Delineation" Sampling for Cianci Property Excavation Area EA-5
Solvents Recovery Service of New England, Inc. Superfund Site
Southington, Connecticut

In a memorandum dated March 4, 2016, Arcadis summarized the results of delineation sampling performed for the five targeted Cianci property excavation areas. That sampling was performed in accordance with the approach described in the Soil Investigation Plan (SIP, Attachment G to the Remedial Design/Remedial Action [RD/RA] Work Plan). In addition, this area was investigated as part of evaluating the presence and extent of dioxin-impacted soils beyond the proposed RCRA cap limits, resulting in a slight eastward expansion of the SIP-based delineation to address dioxin-impacted soils above the planned cleanup goal.

In the course of subsequent remedial design, it was determined that additional sampling was warranted in the EA-5 area to facilitate timely and efficient remedy implementation. Such additional sampling could effectively "pre-delineate" the extent of removal, thus eliminating the need for post-excavation samples and minimizing the time to complete and backfill the area given its location within the floodplain. This was discussed with the USEPA and CT DEEP during a meeting on April 19, 2016, at which time it was agreed that additional sampling would be performed in support of the design. The scope of the additional sampling was described in a memorandum dated April 25, 2016, which also stated the following investigation objectives:

1. To confirm the vertical extent of removal needed to achieve soil cleanup levels;
2. To provide sufficient bottom and sidewall samples to meet the target minima (for non-dioxin constituents) as specified in the Post-Excavation Confirmatory Sampling Plan (Attachment G to the RD/RA Work Plan); and
3. To provide sufficient data to confirm that the vertical extent of excavation in EA-5 will meet the dioxin-based cleanup level.

Regarding the first objective, the preliminary EA-5 removal limits indicated in the March 4, 2016 SIP delineation memo called for a 2-foot removal depth throughout the entire area because one of the six original site characterization samples from this area was collected from that depth interval and exceeded the soil cleanup levels for PCBs and bis(2-ethylhexyl)phthalate. However, the remaining initial characterization samples from that area were collected from a depth of 0- to 6-inches. Accordingly, additional vertical delineation was intended to confirm whether excavation shallower than 2’ (e.g., 1’) would be sufficient in at least some portion of the area.

Regarding the second objective, the existing EA-5 dataset was compared to the confirmation sampling approach specified in the Post-Excavation Confirmatory Sampling Plan. From this comparison, it was determined that, based on the size of the EA-5 excavation area anticipated from the SIP delineation,11 bottom samples and 3 additional sidewall samples would be required to confirm the extent of removal consistent with the approach specified in the Post-Excavation Confirmatory Sampling Plan. In addition, for the additional eastward expansion to target the dioxin-impacted soils, two additional samples were warranted to confirm the vertical extent of removal in this area. Note that “sidewall” and “bottom” sample designations reflect the assumption that the soils would be excavated to the target limits, such that these samples would then be representative of the soils remaining at the bottom and sides of the excavation area.

Regarding the third objective, select bottom samples were identified for analysis of dioxin to confirm that the planned vertical extent of removal would be sufficient to achieve the target dioxin cleanup level (30 parts per trillion [ppt]).

Based on the above, and as specified in the April 25, 2016 work plan memorandum, the sampling plan included three sample locations to serve as sidewall verification samples around the perimeter of the anticipated soil excavation area, plus 13 samples intended to confirm the vertical extent of removal within the this area. It was also hypothesized that a 2-foot excavation would be required around historical sample location SB-915, but that 1-foot of removal may be sufficient for the remainder of the area. The proposed demarcation between the 1-foot and 2-foot removal areas was shown on Figure 1 of the April 25, 2016 memo. Further, based on the square footages of the proposed 2-foot excavation area, the proposed 1-foot excavation area, and the additional adjacent dioxin-based removal area (where 1-foot of removal was also proposed), three of the 13 interior samples were located within the proposed 2-foot excavation area, eight were located in the proposed 1-foot excavation area, and two were located in the dioxin removal area. This distribution would provide for bottom confirmation samples in each portion of the excavation area to meet the targets specified in the Post-Excavation Confirmatory Sampling Plan. The targeted sample locations, as well as an indication of the proposed 1-foot and 2-foot excavation areas, are shown on attached Figure 1. The analytical parameters and rationale are summarized on Table 1.

The 16 sample locations proposed in the April 25, 2016 memo were collected on April 28, 2016. The resulting analytical data are summarized in Table 2 and shown on Figure 2. Figure 2 also reflects the surveyed sample locations, which vary in some cases from the targeted locations based on field accessibility and placement. Evaluation of the resulting data results in the following conclusions:

1. All three of the sidewall samples indicated soil concentrations below the soils cleanup levels for the target constituents. Therefore, combined with pre-existing SIP samples that delineate the area, sufficient data are available to confirm the horizontal limits of the EA-5 excavation area to a depth of 2 feet below grade. (Note that, as described below, additional removal is proposed in certain areas to a depth of greater than 2 feet, triggering additional sidewall sampling in those areas.)
2. Of the 11 samples targeting vertical delineation of the SIP-defined excavation area, nine indicated concentrations below the cleanup levels for target constituents. This included two of the three samples collected from the proposed 2-foot excavation area around sample location SB915, and seven of the eight samples collected from the proposed 1-foot excavation area throughout the remainder of the SIP-defined area.

3. Each of the six bottom samples analyzed for dioxin indicated concentrations below the delineation objective, indicating that the proposed removal limits were sufficient to address dioxin in this area.
4. Four of the bottom samples and one sidewall sample were subject to analysis for beryllium. All five samples indicated total beryllium concentrations greater than 20 times the PMC, indicating the theoretical potential to exceed the PMC. Accordingly, the samples were analyzed for beryllium via the SPLP, and none indicated exceedances of the PMC. As a result, delineation for beryllium has been completed based on the existing data.
5. One of the two bottom samples that exceeded a soil cleanup level (EA5-DEL-B1) was collected from a depth of 2-3 feet below grade within the proposed 2-foot excavation area around prior sample location SB915 (Figure 2). The detected PCB concentration (1.45 ppm) exceeded the PCB cleanup level (1 ppm).
6. The second bottom sample that exceeded a soil cleanup level (EA5-DEL-B10) was collected from a depth of 1-2 feet below grade within the proposed 1-foot excavation area in the eastern portion of the EA-5 area (Figure 2). The detected PCB concentration (1.01 ppm) marginally exceeded the PCB cleanup level (1 ppm).

Based on the SIP and supplemental pre-delineation sampling summarized above, the vertical extent of removal has not been confirmed around two of the 13 samples intended to represent the bottom of the excavation under previously proposed removal limits. Accordingly, the excavation around those two locations will be extended vertically an additional foot, and additional bottom and sidewall samples will be collected as part of the remedy implementation. The additional excavation areas are shown on Figure 3. The areas surround the two samples that exceed the PCB soil cleanup level at the base of the proposed excavation, and extend laterally to adjacent samples (or the originally delineated excavation perimeter). The plan for post-excavation confirmation sampling in these areas is as follows:

Location	Area (ft^2)	Perimeter (linear feet)	Add’l Bottom Samples Req’d[1]	Add’l Sidewall Samples Req’d[1]
EA5-DEL-B1	1533	192	2	3[2]
EA5-DEL-B10	862	134	1	1[3]

1. Sample requirements based on one per 1000 ft^2 for bottom samples and 1 per 50 linear feet for sidewall samples, per the Post-Excavation Confirmatory Sampling Plan.
2. Existing sidewall sample location includes the sample collected EA5-DEL-B2
3. Existing sidewall sample locations include EA5-4, and EA5-DEL-B7

The target post-excavation confirmation sample locations are shown on Figure 3. These samples will be collected as soon as possible following excavation to the revised limits (shown on Figure 3) and submitted on a 24-hour laboratory turnaround time to minimize project delays.

TABLES

Table 1
EA-5 Excavation Confirmation Sampling Summary
SRSNE Superfund Site, Southington, CT

Excavation Area	Target Constituents [1]	Perimeter (linear ft)	Area (ft^2)	Req'd # of Samples [2]		Existing # of Samples		Add'l Samples Required		Seasonal Low Water Table Depth (ft bgs) [3]	Bottom Samples Not Required Below: [3]
				Sidewall	Bottom	Sidewall	Bottom	Sidewall	Bottom		
EA-5	**SVOCs** (Bis(2-ethylhexyl) phthalate), **PCBs**, and **metals** (Be)	408	10,274	9	11	6	0	3	11	~ 3	3 ft bgs (PMC) / 4 ft bgs (RDEC)

Notes:
ft bgs - feet below ground surface
Be - beryllium
PCBs - polychlorinated biphenyls
PMC - Pollutant Mobility Criteria
RDEC - Residential Direct Exposure Criteria

1 - Target constituents refer to the constituents that exceeded cleanup goals in initial characterization sampling and subsequent delineation sampling and therefore, are subject to analysis in post-excavation verification samples.

2 - Required number of samples based on target removal limits based on delineation sampling and the following:

-- sidewall samples: one per 50 linear feet of sidewall and minimum

-- bottom samples: one per 1,000 square feet of excavated area (no

In the event that excavation limits are modified (i.e., as a result of confirmation sampling) the number of sidewall and bottom verification samples would be modified accordingly.

3 - As described in the Performance Standards (Section 2.5.3 of the RDWP), PMC-based standards apply to the depth of the seasonal low water table and RDEC based standards apply to a depth of 4 feet (with the expectation that an Environmental Land Use Restriction will be applied). Based on these criteria, these columns indicate the depth below which bottom verification samples will not be required because the associated PMC- or RDEC-based criteria no longer apply.

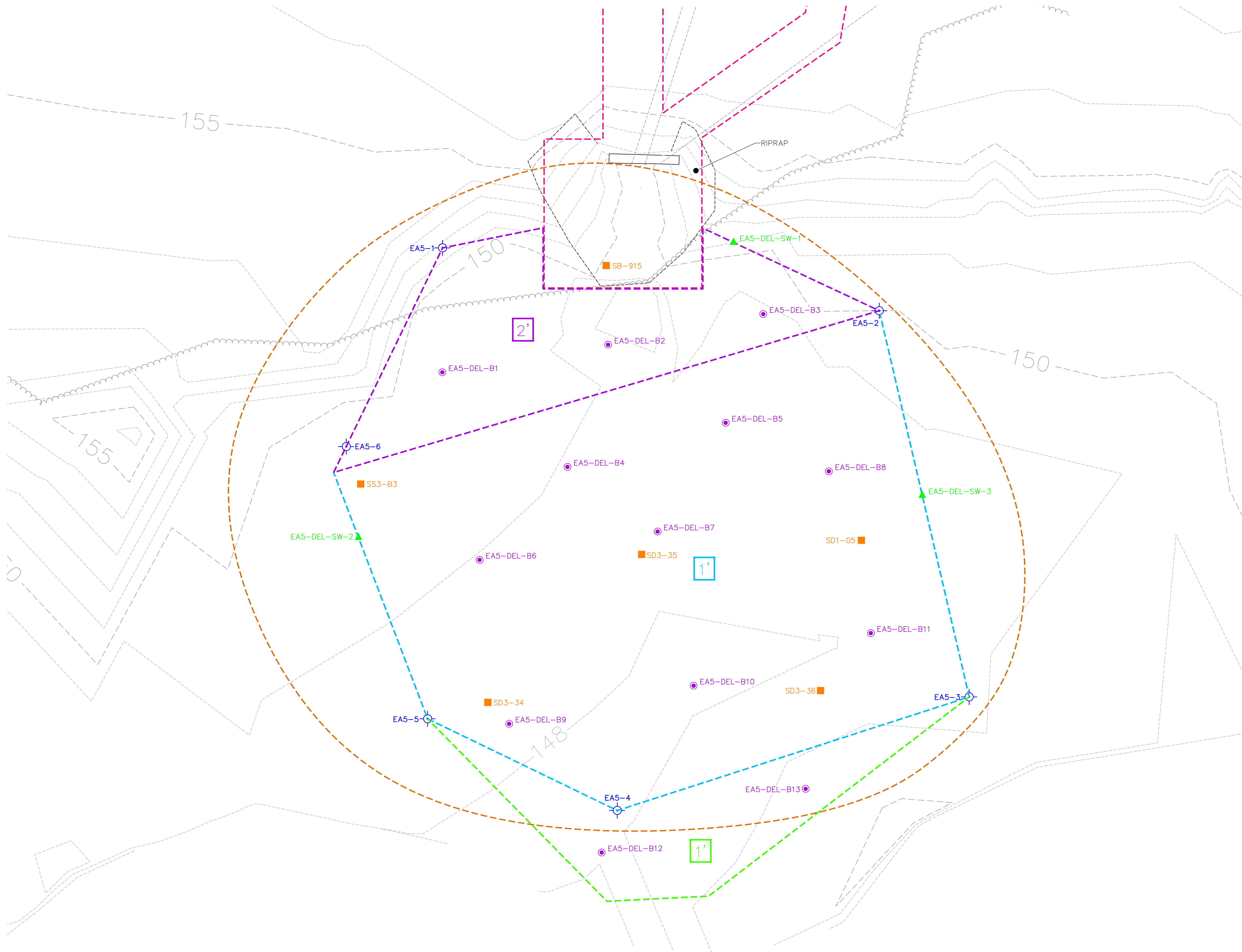
Table 2
EA-5 Excavation Confirmation Sampling Results
SRSNE Superfund Site, Southington, CT

			Sample ID	EA5-DEL-B1(2-3')		EA5-DEL-B2(2-3')		EA5-DEL-B3(2-3')		EA5-DEL-B4(1-2')		EA5-DEL-B5(1-2')		EA5-DEL-B6(1-2')		EA5-DEL-B7(1-2')		EA5-DEL-B8(1-2')	
			Sample Date	4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016	
			Top Sample Depth (ft)	2		2		2		1		1		1		1		1	
			Bottom Sample Depth (ft)	3		3		3		2		2		2		2		2	
Analyte	**Unit**	**GA PMC**	**RDEC**																
Metals (Total)																			
Beryllium	mg/kg	--	2	NA	--	NA	--	NA	--	NA	--	NA	--	0.314	--	NA	--	0.365	--
Metals (SPLP)																			
Beryllium	mg/l	0.004	--	NA	--	NA	--	NA	--	NA	--	NA	--	0.005	U	NA	--	0.005	U
PCBs																			
PCBs, Total	ug/kg	--	1000	1450	--	744	--	51.1	U	486	--	434	--	115	J	507	--	78.6	J
SVOCs																			
Bis(2-ethylhexyl) phthalate	ug/kg	1000	44000	250	J	260	U	260	U	260	U	300	J	240	U	320	J	260	U
Dioxin																			
TEQ: ND=DL/2	pg/g	--	--	NA	--	25.8	U	NA	--	NA	--	NA	--	11.1	U	NA	--	4.43	U

			Sample ID	EA5-DEL-B9(1-2')		EA5-DEL-B10(1-2')		EA5-DEL-B11(1-2')		EA5-DEL-B12(1-2')		EA5-DEL-B13(1-2')		EA5-DEL-SW-1 (0-2')		EA5-DEL-SW-2(0-2')		EA5-DEL-SW-3(0-2')	
			Sample Date	4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016		4/28/2016	
			Top Sample Depth (ft)	1		1		1		1		1		0		0		0	
			Bottom Sample Depth (ft)	2		2		2		2		2		2		2		2	
Analyte	**Unit**	**GA PMC**	**RDEC**																
Metals (Total)																			
Beryllium	mg/kg	--	2	NA	--	0.436	--	0.39	--	NA	--	NA	--	NA	--	NA	--	0.58	--
Metals (SPLP)																			
Beryllium	mg/l	0.004	--	NA	--	0.005	U	0.005	U	NA	--	NA	--	NA	--	NA	--	0.005	U
PCBs																			
PCBs, Total	ug/kg	--	1000	43.2	U	1010	--	56	--	NA	--	NA	--	43.8	U	130	J	311	--
SVOCs																			
Bis(2-ethylhexyl) phthalate	ug/kg	1000	44000	220	U	140	J	240	U	NA	--	NA	--	220	U	260	U	330	U
Dioxin																			
TEQ: ND=DL/2	pg/g	--	--	NA	--	NA	--	NA	--	13.5	U	17.3	U	NA	--	NA	--	NA	--

Notes:
U = Analyte not detected above the laboratory's Reporting Limit
J = Analyte result is estimated
Total metals result (in mg/kg) exceeds 20 times the GA PMC (in mg/L) which suggests the potential for SPLP to exceed GA PMC; SPLP analysis was run and did not exceed GA PMC.
Exceedance of the Residential Direct Exposure Criteria

FIGURES



LEGEND:

- CONTOUR INDEX
- ESTIMATED REMOVAL LIMITS PER FIGURE 7 OF THE RECORD OF DECISION (NOTE 3)
- 1' PROPOSED EXCAVATION DEPTH (NOTE 4)
- PROPOSED REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION) (NOTE 4)
- PROPOSED REMOVAL LIMITS BASED ON DELINEATION SAMPLING (1 FBG EXCAVATION) (NOTE 4)
- PROPOSED REMOVAL LIMITS BASED ON DIOXIN DATA
- APPROXIMATE LOCATION OF PRIOR SOIL REMOVAL DURING OUTFALL CONSTRUCTION (SEE NOTE 5)

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SITE CHARACTERIZATION SOIL SAMPLE LOCATION
- EXISTING DELINEATION SAMPLE LOCATION
- PROPOSED PRE-DELINEATION BOTTOM SAMPLE LOCATION
- PROPOSED PRE-DELINEATION SIDEWALL SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.
3. ROD-BASED REMOVAL LIMITS SUPERSEDED BY DELINEATION SAMPLING PERFORMED IN ACCORDANCE WITH THE SOIL INVESTIGATION PLAN (SIP)
4. PROPOSED REMOVAL LIMITS SHOWN ON THIS FIGURE ARE BASED ON SIP DELINEATION DATA COLLECTED PRIOR TO APRIL 2016 AND SUBJECT TO CHANGE BASED ON SUPPLEMENTAL PRE-EXCAVATION DELINEATION SAMPLING PROPOSED HEREIN.
5. SOILS ADJACENT TO THE NEW OUTFALL WERE REMOVED AS PART OF THE PRE-ISTR SITE PREPARATION ACTIVITIES WHEN THE NEW OUTFALL LOCATION WAS CONSTRUCTED. THE SOILS WERE CONSOLIDATED IN THE THERMAL TREATMENT AREA. THE EXCAVATION WAS RESTORED WITH GEOTEXTILE FABRIC AND RIPRAP. ADDITIONAL EXCAVATION IN AREA 5 WILL ABUT THE PRIOR REMOVAL AREA.

0 10' 20'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIP PROPOSED EA 5 "PRE-DELINEATION" SAMPLE LOCATION PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B.DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF [TEXT
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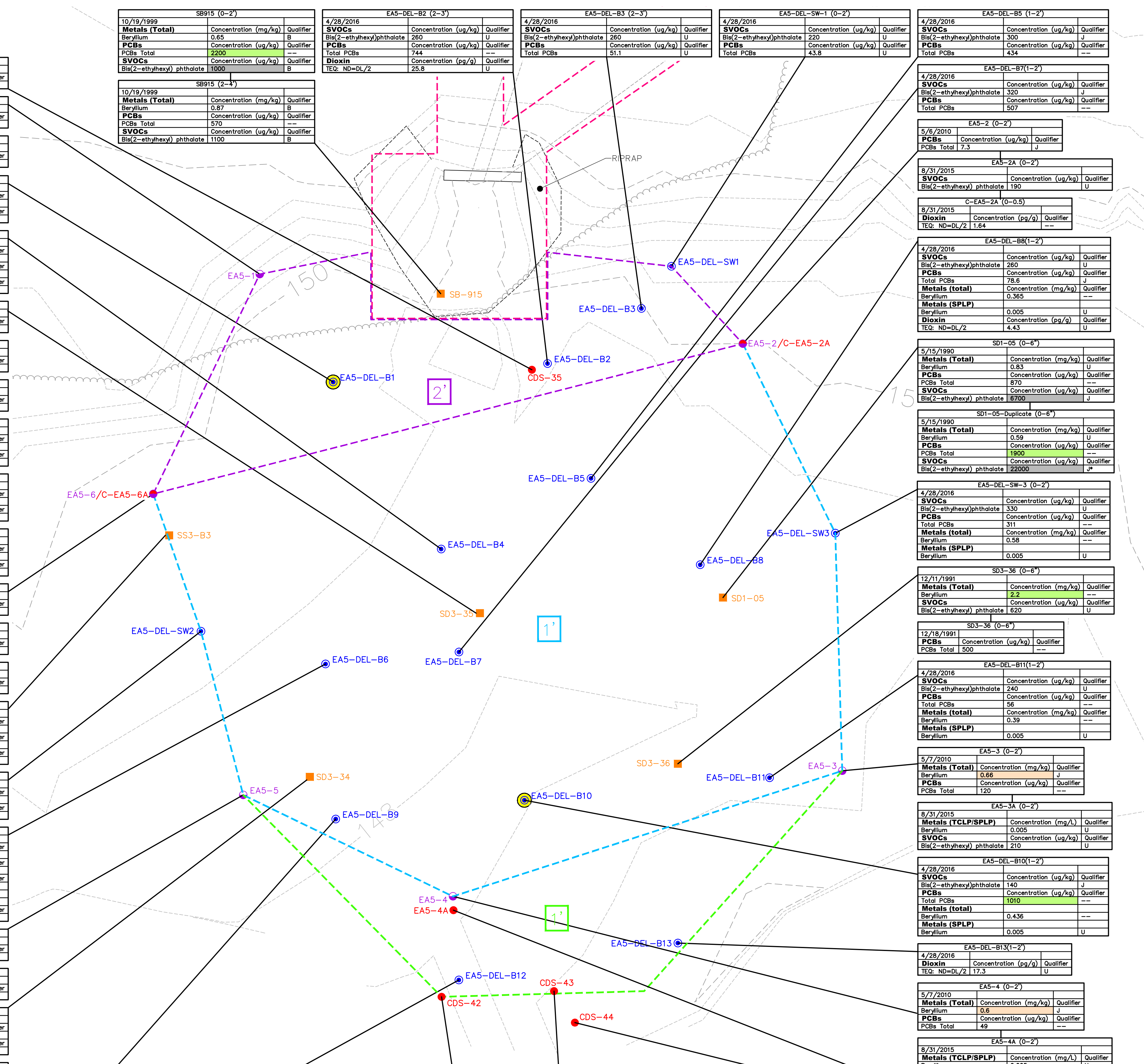


CDS-35 (0-0.5')		
8/31/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	25.1	--

EA5-1 (0-2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	ND	U

EA5-1A (0-2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	170	U

EA5-DEL-B1 (2-3')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	250	J
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	1450	--

EA5-DEL-B4 (1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	260	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	486	--
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	6.27	U

SD3-35 (0-6")		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1150	--

SD3-35 (6-12")		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	40	UJ

SD3-35 (1-1.5')		
12/19/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	291	--

SD3-35 (0-6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.25	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	10000	J*

SD3-35 (6-12")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.42	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	100	J

SD3-35 (1-1.5')		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.43	J
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	490	J

EA5-6 (0-2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	20	J

EA5-6A (0-2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	130	J

C-EA5-6A (0-0.5')		
8/31/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	5.22	--

SS3-B3 (0-6")		
12/9/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.31	UJ
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1600	--

EA5-DEL-SW-2 (0-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	260	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	130	J

EA5-DEL-B6(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	240	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	115	J
Metals (total)	Concentration (mg/kg)	Qualifier
Beryllium	0.314	--
Metals (SPLP)		
Beryllium	0.005	U
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	11.1	U

EA5-5 (0-2')		
5/7/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	107	--

EA5-5A (0-2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	94	J

SD3-34 (0-6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.23	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	15000	J

SD3-34 (0-6")		
12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	6500	--

SB915 (0-2')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.65	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	2200	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1000	B

SB915 (2-4')		
10/19/1999		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.87	B
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	570	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	1100	B

EA5-DEL-B2 (2-3')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	260	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	744	--
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	25.8	U

EA5-DEL-B3 (2-3')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	260	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	51.1	U

EA5-DEL-SW-1 (0-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	220	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	43.8	U

EA5-DEL-B5 (1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	300	J
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	434	--

EA5-DEL-B7(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	320	J
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	507	--

EA5-2 (0-2')		
5/6/2010		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	7.3	J

EA5-2A (0-2')		
8/31/2015		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	190	U

C-EA5-2A (0-0.5)		
8/31/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	1.64	--

EA5-DEL-B8(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	260	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	78.6	J
Metals (total)	Concentration (mg/kg)	Qualifier
Beryllium	0.365	--
Metals (SPLP)		
Beryllium	0.005	U
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	4.43	U

SD1-05 (0-6")		
5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.83	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	870	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	6700	J

SD1-05-Duplicate (0-6")		
5/15/1990		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.59	U
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	1900	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	22000	J*

EA5-DEL-SW-3 (0-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	330	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	311	--
Metals (total)	Concentration (mg/kg)	Qualifier
Beryllium	0.58	--
Metals (SPLP)		
Beryllium	0.005	U

SD3-36 (0-6")		
12/11/1991		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	2.2	--
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	620	U

SD3-36 (0-6")		
12/18/1991		
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	500	--

EA5-DEL-B11(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	240	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	56	--
Metals (total)	Concentration (mg/kg)	Qualifier
Beryllium	0.39	--
Metals (SPLP)		
Beryllium	0.005	U

EA5-3 (0-2')		
5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.66	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	120	--

EA5-3A (0-2')		
8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	210	U

EA5-DEL-B10(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	140	J
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	1010	--
Metals (total)		
Beryllium	0.436	--
Metals (SPLP)		
Beryllium	0.005	U

EA5-DEL-B13(1-2')		
4/28/2016		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	17.3	U

EA5-4 (0-2')		
5/7/2010		
Metals (Total)	Concentration (mg/kg)	Qualifier
Beryllium	0.6	J
PCBs	Concentration (ug/kg)	Qualifier
PCBs Total	49	--

EA5-4A (0-2')		
8/31/2015		
Metals (TCLP/SPLP)	Concentration (mg/L)	Qualifier
Beryllium	0.005	U
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl) phthalate	130	J

C-EA5-4A (0-0.5')		
10/14/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	51.3	--

EA5-DEL-B9(1-2')		
4/28/2016		
SVOCs	Concentration (ug/kg)	Qualifier
Bis(2-ethylhexyl)phthalate	220	U
PCBs	Concentration (ug/kg)	Qualifier
Total PCBs	43.2	U

EA5-DEL-B12(1-2')		
4/28/2016		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	13.5	U

CDS-42 (0-0.5')		
11/6/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	4.69	--

CDS-43 (0-0.5')		
11/6/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	12.9	--

CDS-44 (0-0.5')		
12/15/2015		
Dioxin	Concentration (pg/g)	Qualifier
TEQ: ND=DL/2	8.14	--
TEQ: ND=DL/2	8.06*	--

LEGEND:

150 CONTOUR INDEX

1' PROPOSED EXCAVATION DEPTH (NOTE 3)

PROPOSED REMOVAL LIMITS BASED ON DELINEATION SAMPLING (2 FBG EXCAVATION) (NOTE 3)

PROPOSED REMOVAL LIMITS BASED ON DELINEATION SAMPLING (1 FBG EXCAVATION) (NOTE 3)

PROPOSED REMOVAL LIMITS BASED ON DIOXIN DATA

APPROXIMATE LOCATION OF PRIOR SOIL REMOVAL DURING OUTFALL CONSTRUCTION (SEE NOTE 4)

SHADING INDICATES LOCATION EXCEEDS ONE OR MORE APPLICABLE SOIL CLEANUP LEVELS AT THE PROPOSED REMOVAL LIMITS

CIANCI EXCAVATION AREA SAMPLES

ORIGINAL SITE CHARACTERIZATION SOIL SAMPLE LOCATION

2010/2015 DELINEATION SAMPLE LOCATION

APRIL 2016 PRE-DELINEATION SAMPLE LOCATION (NOTE 5)

DIOXIN CHARACTERIZATION SOIL SAMPLE LOCATION

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.
3. PROPOSED REMOVAL LIMITS SHOWN ON THIS FIGURE ARE BASED ON SIP DELINEATION DATA COLLECTED PRIOR TO APRIL 2016 AND SUBJECT TO CHANGE BASED ON SUPPLEMENTAL PRE-EXCAVATION DELINEATION SAMPLING PROPOSED HEREIN.
4. SOILS ADJACENT TO THE NEW OUTFALL WERE REMOVED AS PART OF THE PRE-ISTR SITE PREPARATION ACTIVITIES WHEN THE NEW OUTFALL LOCATION WAS CONSTRUCTED. THE SOILS WERE CONSOLIDATED IN THE THERMAL TREATMENT AREA. THE EXCAVATION WAS RESTORED WITH GEOTEXTILE FABRIC AND RIPRAP. ADDITIONAL EXCAVATION IN AREA 5 WILL ABUT THE PRIOR REMOVAL AREA.
5. APRIL 2016 SAMPLE LOCATIONS BASED ON SURVEYED LOCATIONS AND MAY DIFFER FROM PROPOSED LOCATIONS BASED ON FIELD ACCESSIBILITY.
6. = TOTAL METALS RESULT (IN mg/kg) EXCEEDS 20 TIMES THE GA PMC (IN mg/L), WHICH SUGGESTS THE POTENTIAL FOR TCLP/SPLP RESULT TO EXCEED GA PMC.
7. = EXCEEDANCE OF PMC AT LOCATIONS/DEPTHS WHERE PMC APPLIES BASED ON GROUNDWATER DEPTH
8. = EXCEEDANCE OF RDEC

B = ANALYTE WAS FOUND IN AN ASSOCIATED BLANK, AS WELL AS IN THE SAMPLE

J = ANALYTE RESULT IS ESTIMATED

mg/kg = MILLIGRAMS PER KILOGRAM

mg/L = MILLIGRAMS PER LITER

pg/g = PICOGRAMS PER GRAM

PCBS = POLYCHLORINATED BIPHENYLS

PMC = POLLUTANT MOBILITY CRITERIA

RDEC = RESIDENTIAL DIRECT EXPOSURE CRITERIA

SPLP = SYNTHETIC PRECIPITATION LEACHING PROCEDURE

SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS

TCLP = TOXICITY CHARACTERISTIC LEACHING PROCEDURE

U = ANALYTE NOT DETECTED ABOVE THE LABORATORY'S REPORTING LIMIT

ug/kg = MICROGRAMS PER KILOGRAM

* = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS

0 10' 20'

GRAPHIC SCALE

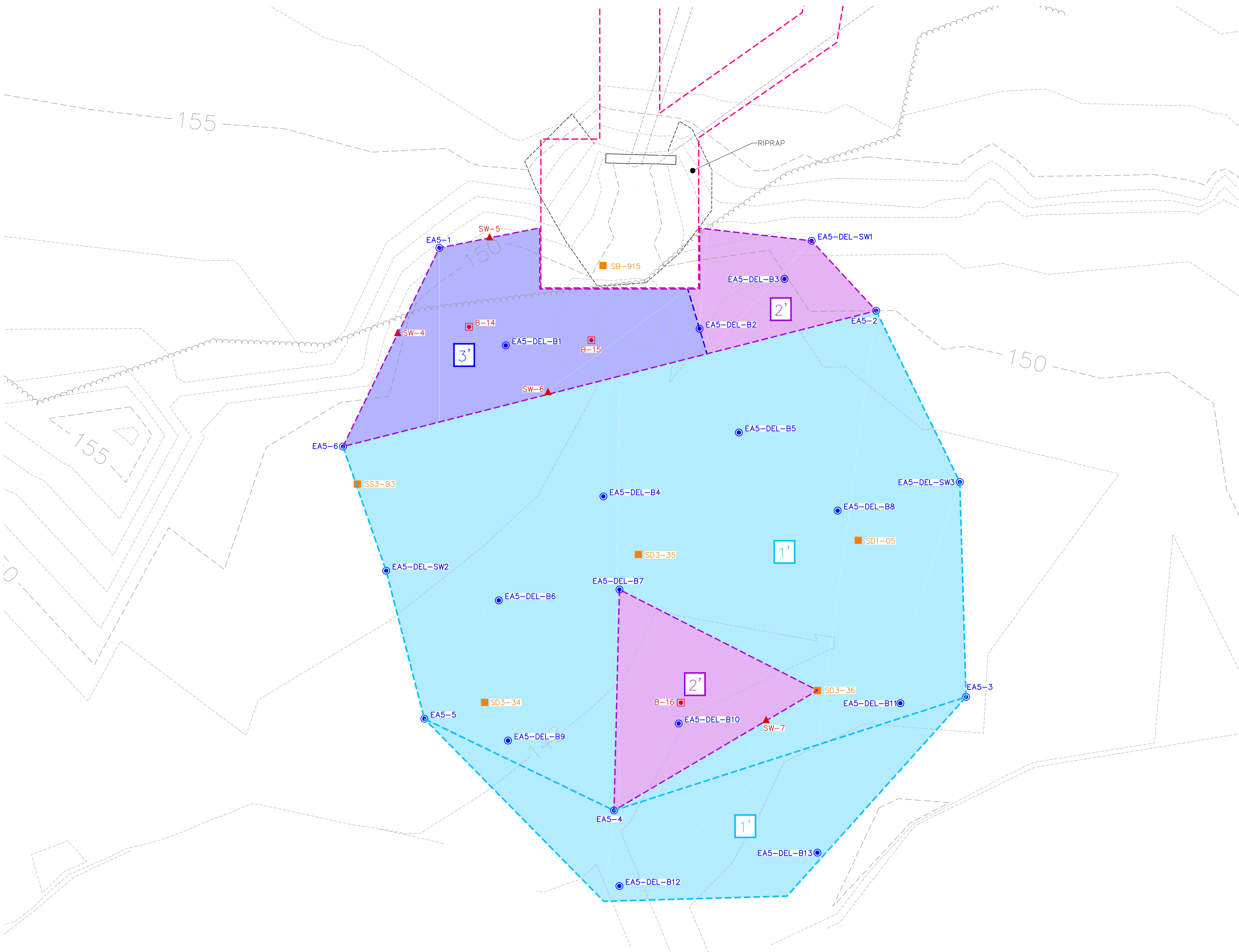
SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

EA5 SOIL DATA SUMMARY

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B DECLERCQ LD: B DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF. |TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\01800\2016\54634C02.dwg LAYOUT: 2 SAVED: 6/21/2016 3:33 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 6/21/2016 3:34 PM BY: SMALL, BRIAN



LEGEND:

- CONTOUR INDEX
- 1' PROPOSED EXCAVATION DEPTH (NOTE 3)
- TARGET 1' REMOVAL AREA
- TARGET 2' REMOVAL AREA
- TARGET 3' REMOVAL AREA
- APPROXIMATE LOCATION OF PRIOR SOIL REMOVAL DURING OUTFALL CONSTRUCTION (NOTE 4)

CIANCI EXCAVATION AREA SAMPLES

- ORIGINAL SITE CHARACTERIZATION SOIL SAMPLE LOCATION
- EXISTING DELINEATION SAMPLE LOCATION
- PROPOSED BOTTOM CONFIRMATION SAMPLE (NOTE 5)
- PROPOSED SIDEWALL CONFIRMATION SAMPLE (NOTE 5)

NOTES:

1. BASE MAP REFERENCED FROM "TOPOGRAPHIC SURVEY" BY: PEREIRA ENGINEERING, DATED: JULY 11, 2014, SCALE: 1"=50'.
2. FILE COORDINATE SYSTEM: CT STATE PLANE, NAD27, FEET.
3. PROPOSED REMOVAL LIMITS SHOWN ON THIS FIGURE ARE BASED ON SIP DELINEATION DATA COLLECTED THROUGH APRIL 2016.
4. SOILS ADJACENT TO THE NEW OUTFALL WERE REMOVED AS PART OF THE PRE-ISTR SITE PREPARATION ACTIVITIES WHEN THE NEW OUTFALL LOCATION WAS CONSTRUCTED. THE SOILS WERE CONSOLIDATED IN THE THERMAL TREATMENT AREA. THE EXCAVATION WAS RESTORED WITH GEOTEXTILE FABRIC AND RIPRAP. ADDITIONAL EXCAVATION IN AREA 5 WILL ABUT THE PRIOR REMOVAL AREA.
5. BOTTOM AND SIDEWALL SAMPLES ARE PROPOSED FOR THOSE AREAS WHERE EXISTING DATA ARE NOT SUFFICIENT TO CONFIRM THE PROPOSED HORIZONTAL AND VERTICAL EXTENTS OF REMOVAL (IE, AROUND APRIL 2016 SAMPLE LOCATIONS EA5-DEL-B1 AND EA5-DEL-B10).

PROPOSED CONFIRMATION SAMPLE LOCATIONS AND DEPTHS

LOCATION	TYPE	DEPTH (FEET BELOW EXISTING GRADE)
SW-4	SIDEWALL	2-3
SW-5	SIDEWALL	2-3
SW-6	SIDEWALL	2-3
SW-7	SIDEWALL	1-2
B-14	BOTTOM	3-4
B-15	BOTTOM	3-4
B-16	BOTTOM	2-3

* SAMPLES TO BE ANALYZED FOR PCBs ONLY BASED ON EXISTING DELINEATION DATA.

0 10' 20'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

EA5 - PROPOSED REMOVAL LIMITS AND CONFIRMATION SAMPLE LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B.DECLERCQ LD: B.DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF* TEXT
G:\ENVCAD\Manchester\ACT\B0054634\0001\01800\2016\54634C03.dwg LAYOUT: 3 SAVED: 6/21/2016 2:38 PM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 6/21/2016 2:42 PM BY: SMALL, BRIAN

APPENDIX E

Technical Specifications

Table of Contents

SECTION 01 30 00

ADMINISRATIVE REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Section includes:
   1. Equivalent Procedures/Products;
   2. Operations Plan;
   3. Project Schedule;
   4. Project Meetings;
   5. Provisions for Extra Work/Change Orders;
   6. Office Trailer and Support Services;
   7. Work Hours/Work Restrictions;
   8. Working Limits;
   9. Existing Conditions;
   10. Protection of Existing Monitoring Wells;
   11. Protection of the Environment;
   12. Survey Control;
   13. Contractor Equipment and Materials Cleaning;
   14. Coordination with Others;
   15. Permits; and
   16. Transportation and Off-Site Treatment/Disposal.

B. Related Sections:
   1. Section 01 33 00, Submittal Procedures;
   2. Section 01 35 29, Contractor's Health and Safety Plan;
   3. Section 01 77 19. Project Closeout Requirements; and
   4. Section 01 78 39, Project Record Documents.

1.2 EQUIVALENT PRODUCTS/PROCEDURES

Unless directed otherwise, the Contractor may propose the use of products and materials other than those specified in the RCRA Cap Design Drawings and Specifications. The CONTRACTOR may also submit procedures for performing operations other than those described. All proposed substitute products, materials and procedures must be effectively equivalent to the materials and procedures specified in the RCRA Cap Design Drawings and Specifications. In submitting "equivalent" products or procedures, the CONTRACTOR recognizes that it is responsible for all costs associated with furnishing, installing, or performing the "equivalent" product or procedure. This will include all costs for the ENGINEER to review, modify, or redesign the removal plans to accommodate the "equivalent" product or procedure.

The submittal or use of an "equivalent" product or procedure will in no way impact the overall implementation schedule. Potential time delays associated with the ENGINEER to review the proposed substitute should be considered by the CONTRACTOR in submitting an "equivalent" product or procedure.

The CONTRACTOR may base his cost proposal on the use of "equivalent" products or procedures in lieu of those specified within this Contract. However, the CONTRACTOR recognizes that this will be done at risk, as the "equivalent" product or procedure may be deemed by the ENGINEER as unacceptable. No additional costs will be incurred by the SRSNE Site Group for the replacement of "equivalent" products or procedures with those originally specified.

The ENGINEER will be the sole judge of acceptability, and no substitute will be ordered or installed without the ENGINEER's prior written acceptance. The ENGINEER may require the CONTRACTOR to furnish, at the CONTRACTOR's expense, a special performance guarantee or other surety with respect to any substitute.

1.3 OPERATIONS PLAN

The Contractor shall prepare an Operations Plan in accordance with the requirements of the Contract Documents and the SRSNE Site Group. This plan will be prepared in consultation with the Construction Manager and Engineer and will include, but not be limited to, the following items:

- Work sequence description;
- List of equipment to be used on site;
- Material Handling and Staging Plan;
- Project Schedule;
- Erosion and Sediment Control Plan;
- Dust Control Measures; and
- Contractor Equipment Cleaning Procedures.

The purpose of the Operations Plan will be to summarize the materials, procedures, controls, and equipment that the Contractor will utilize during implementation of the work. The Operations Plan should address all appropriate issues described in the RCRA Cap Design and should be of sufficient detail for potential review by the regulatory agencies.

For the purposes of developing a bid, the Contractor should assume that a draft and final version of the Operations Plan will be developed and submitted, and that at least one conference call will be held among the Construction Manager, the Contractor, and the Engineer to discuss the draft plan prior to finalization. Field activities shall not be initiated until the Operations Plan has been submitted to and approved by the Engineer.

1.4 PROJECT SCHEDULE

As part of the Operations Plan (Section 1.02), the CONTRACTOR must submit a proposed draft Project Schedule to the CONSTRUCTION MANAGER and ENGINEER for review and approval. The draft Project Schedule should include all elements of the work included under this Contract. This schedule must be a neatly prepared and labeled horizontal bar chart that identifies the first work day of each week, has separate lines for each section of work, and indicates all anticipated start and completion dates. Additional requirements are provided as follows.

At a minimum, the following work items should be included:

- Mobilization;
- Site Preparation;
- Excavation of Delineated Areas;

- Cap Subgrade Grading;
- Installation of Geosynthetics;
- Drainage;
- Cap Final Grading;
- NTCRA 1 Area Grade Modifications;
- Rails to Trails Construction;
- Site Restoration; and
- Demobilization.

Show complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities including work by subcontractors. Indicate the early and late start, early and late finish, float dates, and duration.

Revise and resubmit a construction progress schedule on a weekly basis.

Failure to comply with these requirements may result in a work stoppage, at the CONTRACTOR's expense, until such time that the requirements of this condition are met.

1.5 PROJECT MEETINGS

A Pre-Construction Meeting will be scheduled by the CONSTRUCTION MANAGER after the award of Contract and prior to the Contractor's mobilization to the Site. The purpose of the Pre-Construction Meeting is to review Contract requirements, review/modify the Contractor's Project Schedule (Section 1.4), discuss the development of the Contractor's Operations Plan (Section 1.3), introduce various project team members representing the Contractor, the Construction Manager, and the Engineer and resolve any questions raised by said parties.

In the preparation of a cost proposal, the CONTRACTOR should assume participation in continuous coordination efforts with all parties involved. Informal meetings will be held at the Site. These meetings will be attended by on-site representatives of the Contractor and the Construction Manager, to discuss day-to-day operations, schedule, health and safety items, outstanding issues, and the general status of the project. Approximate weekly meetings will be held on-site among representatives of the Contractor, the Construction Manager, and/or the Engineer. These meetings will be held to discuss issues including, but not limited to, project status, schedule, scope of work, and overall project implementation issues.

1.6 PROVISIONS FOR EXTRA WORK/CHANGE ORDERS

During the course of performing this Contract, modifications may be identified that impact the amount of manpower, equipment, materials, or other subcontract services required. In this event, the CONSTRUCTION MANAGER will prepare a Change Order. The Change Order will inform the CONTRACTOR of Contract modifications and request a cost adjustment in reference to the original Contract cost proposal. If the cost adjustment is acceptable to and approved by the CONSTRUCTION MANAGER, the CONTRACTOR will be authorized to proceed with implementing the Change Order. If the cost adjustment is not acceptable to the Construction Manager, then the Construction Manager, the Contractor, and Engineer will further discuss and revise the scope of work and costs until acceptable to all parties.

1.7 OFFICE TRAILER AND SUPPORT SERVICES

For the purpose of preparing a bid, the CONTRACTOR shall assume that one mobile office trailer shall be provided (by the Contractor) on site. A portable sanitary facility shall also be provided for the duration of the project. The CONTRACTOR shall coordinate the installation of utility services for the office trailer. The specific location to be utilized for the field trailer will be discussed between the Construction Manager and the selected Contractor following the award of Contract. If, for any reason, the Contractor feels that an office trailer will not be required to support his operations, he may so indicate to the Construction Manager with his bid, and the bid price should reflect the lack of a field trailer. However, the CONSTRUCTION MANAGER reserves the right to require that the Contractor provide an office trailer.

Regardless of whether an office trailer is provided, the Contractor shall provide both a phone (cellular or traditional) and sanitary facilities at the work site for the duration of site activities. The phone shall be accessible to key site personnel so that they can be contacted as required. Sanitary facilities shall be maintained and serviced for the duration of site activities.

1.8 WORK HOURS/WORK RESTRICTIONS

It is anticipated that on-site work activities can be conducted between the hours of 7:00 a.m. and 6:00 p.m., five days per week (Monday through Friday), except in cases of emergency, or unless prior approval has been obtained from the CONSTRUCTION MANAGER.

Smoking in work areas is prohibited at all times. A designated smoking area may be established by the Construction Manager outside of the work areas.

1.9 WORKING LIMITS

The CONTRACTOR must restrict all work activities, including, but not limited to, storage of materials and equipment to be incorporated in the project, as well as parking of vehicles, heavy equipment, project trailers, etc., to those areas approved by the SRSNE Site Group. The Contractor may use off-site storage of materials and equipment at his discretion provided the location is approved by the CONSTRUCTION MANAGER and consistent with the approved work plan. In addition, its use will be at no additional cost to the SRSNE Site Group and shall not impede the progress of work.

1.10 EXISTING CONDITIONS

It is the CONTRACTOR’s responsibility to understand and verify the exact nature, character, quality, and quantity of all conditions to be encountered. Any reliance upon the information made available by the SRSNE Site Group will be at the CONTRACTOR’s risk. The CONTRACTOR agrees that it will neither have nor assert against the SRSNE Site Group any claim for damages for extra work or otherwise for relief from any obligation of this contract based upon the accuracy of the drawings or information furnished. The Contractor may be entitled to an adjustment in the Contract Price only under the circumstances and to the extent provided by the Contract.

In addition to the information shown on the Design Drawings and in the Specifications, the SRSNE Site Group may possess additional information and data. Bidders are instructed to make a written request to the CONSTRUCTION MANAGER if they desire to review any such information. Neither the SRSNE Site Group nor its Representative will be responsible for any deduction, interpretation, or conclusion drawn by any prospective Contractor from any information or data provided or available to prospective Contractors.

Bidders shall satisfy themselves by personal inspection and examination of the Site and surroundings. Bidders shall obtain the necessary information as to risks, contingencies, and other circumstances which may influence or affect their bids, including, but not limited to, Laws and Regulations; the nature and the location of the work activities; the general and local conditions (particularly those bearing upon transportation); storage of materials; availability of labor, water, electric power, and roads; uncertainties of weather or physical conditions at the Site; the location and condition of existing utilities and structures both above and below ground; the conformation and conditions of the ground; the character of equipment and facilities needed prior to and during the work activities; and all other matters which can in any way affect the progress, performance, or furnishing of the work activities or the cost thereof under the Contract. Bidders shall not claim at any time after submission of bids that there was any misunderstanding of the terms and conditions of the Contract related to the site conditions, including, without limitation, any of the matters described in this paragraph.

1.11 PROTECTION OF EXISTING MONITORING WELLS

Numerous existing groundwater monitoring wells are present within or adjacent to work areas at the Site (Design Drawing 2). To ensure that these wells are accessible and intact for future groundwater monitoring, the CONTRACTOR shall protect the wells as part of site preparation activities. Specifically, prior to subgrade preparation, the existing well casings will be clearly marked and flagged by the Contractor to minimize the potential for inadvertent damage by construction equipment. This will include the placement of stakes and fencing around the wells so that they are clearly visible.

1.12 PROTECTION OF THE ENVIRONMENT

The CONTRACTOR shall take all necessary precautions to protect the environment when performing the work of this Contract. In doing so, the CONTRACTOR must protect all water courses, surface waters, groundwater, soils, and air from degradation or damage in accordance with all federal, state, and local laws and regulations.

To minimize erosion of areas subject to restoration activities and minimize sedimentation in site drainage pathways, the CONTRACTOR must utilize appropriate soil erosion and control measures. This will include the placement and maintenance of staked straw bales, silt fences, surface water diversion methods, and other site controls at locations identified on the Design Drawings, as directed by the CONSTRUCTION MANAGER or at any other locations determined to be appropriate by the Contractor during the performance of the work. All erosion and control measures must be inspected on a daily basis and after any rainfall to assure that they are performing as intended. Following inspection, and as necessary, the erosion and control measures should be modified, cleaned, reinforced, replaced, and/or otherwise maintained.

The CONTRACTOR must take adequate measures for keeping noise levels, as produced by construction equipment, to safe and tolerable limits as set forth by OSHA, the USEPA, Connecticut codes or ordinances, and/or any local requirements. All construction equipment presenting a potential noise nuisance must be provided with noise muffling devices.

1.13 SURVEY CONTROL

The CONTRACTOR will be responsible for performing all survey activities, using a Connecticut-licensed land surveyor, during the performance of activities. The SRSNE Site Group will provide the selected Contractor with one or more location and elevation benchmarks suitable for the establishment of survey control. The Contractor shall establish a grid -- with grid spacing not to exceed 25 feet -- to be used during survey control activities. These activities include recording elevations at each of the grid intersections following subgrade preparation and following backfill and topsoil placement for the surface cover.

Based on the contents of this Administrative Requirements section, the Contractor should anticipate and schedule site work to accommodate the performance of survey activities. No Contractor claims for additional payment due to work interruption caused by the performance of survey activities will be considered by the SRSNE Site Group.

1.14 CONTRACTOR EQUIPMENT AND MATERIALS CLEANING

All reusable equipment and materials utilized by the Contractor in the performance of this Contract must be cleaned prior to re-location within the Site, after handling impacted materials, prior to handling "clean" materials, and prior to departure from the Site.

At a minimum, the following procedures must be executed by the CONTRACTOR:

A. For equipment and materials that are being transferred from the areas of the site subject to excavation and/or cap construction, a visual inspection must be performed. Any visible soils or other debris must be promptly removed.

B. Equipment and materials that are used to handle "clean" materials after having handled impacted soils subject to excavation or soils within the RCRA cap construction area shall be cleaned and visually inspected prior to handling the clean materials. The equipment cleaning area must be constructed within the project limits and must consist of a low-permeability barrier (e.g., polyethylene sheeting) which must be sloped to a collection sump. Precautions must be taken to limit contact between the equipment, personnel performing the cleaning activities, and any cleaning liquids that may accumulate in the cleaning area. The CONTRACTOR shall be responsible for constructing and maintaining the cleaning area to accommodate all loads, equipment, and contamination transport scenarios. At the completion of the work, the CONTRACTOR shall dismantle all materials associated with cleaning area, load them into appropriate containers for appropriate disposal, and restore the area to its original conditions.

C. The extent and method of cleaning shall be at the discretion of the CONTRACTOR; however, each piece of equipment or material must be inspected by the CONTRACTOR and CONSTRUCTION MANAGER prior to its departure from the site. The CONSTRUCTION MANAGER, at his or her sole discretion, may also perform wipe sampling of the CONTRACTOR's equipment upon mobilization to the site, before the equipment is used to handle clean materials, and/or prior to demobilizing the equipment from the site. The samples will be analyzed for any site-related constituents deemed appropriate by the CONSTRUCTION MANAGER. The CONTRACTOR shall anticipate and accommodate a delay of three working days for sampling and analysis of such equipment prior to its use in handling clean materials or departure from the site. If sampling indicates unacceptable results, the CONTRACTOR must re-clean the equipment or materials at no additional expense to the SRSNE Site Group.

D. The CONTRACTOR shall also clean all hand tools and small equipment (e.g., shovels) that have contacted potentially impacted materials. The method of cleaning shall be at the discretion of the CONTRACTOR and shall be specified in the Operations Plan, as indicated below.

   The CONTRACTOR shall anticipate the need for wipe sampling and shall plan on a minimum duration of three work days between the time of sampling and the time analytical results are received. No claims shall be made by the CONTRACTOR for delays associated with the collection and analysis of wipe samples according to this schedule.

The CONTRACTOR must submit a detailed description of the proposed equipment cleaning procedures as part of the Operations Plan (Section 1.3).

1.15 COORDINATION WITH OTHERS

The effective and timely performance of remedial activities at the Site will require coordination between the CONTRACTOR (and his subcontractors), the CONSTRUCTION MANAGER, the ENGINEER, and representatives of various utility companies. The CONTRACTOR shall recognize and accommodate the work of other parties to facilitate timely implementation of the overall project. Several conditions have been included in this Contract to facilitate coordination efforts. These include Project Meetings (Section 1.5), Project Schedule (Section 1.4), and the identification of the sequence of work activities (in the Operations Plan, Section 1.3).

The CONTRACTOR shall not view any portion of the time expended waiting for further direction, or coordination time with various contractors, as an interruption to work, and shall not submit a claim for payment due to work interruptions caused thereby.

1.16 PERMITS

The Work is being performed under a CERCLA Consent Decree. CERCLA response actions are exempted by law from the requirement to obtain Federal, State, or local permits related to any activities conducted completely on-site. This includes “the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action” [Section 300.400 (e) (1) of the National Contingency Plan]. This does not remove the requirement to meet (or waive) the substantive provisions of permitting regulations that are applicable and/or relevant and appropriate requirements (ARARs). Accordingly, the CONTRACTOR shall comply with the substantive requirements of all otherwise-applicable permits, but need not apply for or obtain Federal, State, or local permits for activities conducted on-site, in very close proximity to the site, and necessary for implementation of the Work.

1.17 TRANSPORTATION AND OFFSITE TREATMENT/DISPOSAL

The CONTRACTOR shall be responsible for the transportation of any excess waste material (e.g., soil, water, debris, etc.) generated during excavation activities and not used or consolidated on site to an appropriate offsite treatment/disposal facility(ies), as determined by the CONSTRUCTION MANAGER and consistent with the approved work plan.

The CONTRACTOR shall load excavated soil/debris (into lined roll-off containers and/or lined dump trucks for transportation to an approved offsite facility for treatment/disposal. The loading activities shall be conducted in accordance with the Operations Plan and the RCRA Cap Design. Based on the results of the waste characterization activities conducted by the CONSTRUCTION MANAGER, the excavated soil/debris (deemed suitable for offsite treatment/disposal) will be treated/disposed in a manner consistent with the results of characterization sampling.

The CONTRACTOR shall be responsible for properly containerizing, stockpiling, characterizing, and preparing waste material for offsite treatment/disposal. Each waste medium (e.g., soil, water, waste debris, PPE, etc.) shall be properly containerized via USDOT approved 55-gallon drums, temporary tanks, lined and covered roll-off containers, tanker trucks, or lined and covered dump trailers and properly labeled and stored with like materials. The cover for dump trailers/trucks shall consist of a solid tarp that can be secured on all sides below the top of the box.

The CONTRACTOR shall coordinate the transportation and offsite treatment/disposal of materials (e.g., soil, water, debris, etc.) generated during excavation activities and, at a minimum, shall be responsible for the following:

A. Provision/preparation of a Uniform Hazardous Waste Manifest or Bill of Lading, to be signed by the Owner and the truck driver.

B. Preparation and submittal of a daily summary sheet that indicates, at a minimum, the following information regarding each truck load:
   1. Load number (sequential);
   2. Uniform Hazardous Waste Manifest Number or Bill of Lading Number;
   3. Truck ID number (license plate number of the truck and/or trailer used);
   4. Estimated gross weight;
   5. Estimated tar weight;
   6. Estimated net load weight;
   7. Material type (nonhazardous, hazardous, debris, water, etc.); and
   8. Destination.

   All waste streams shall be hauled directly from the Site to the final disposal facility. Transportation of all waste streams shall be in accordance with all federal, state, and local laws, rules, and regulations. The CONTRACTOR shall be required to have all appropriate local, state, and federal transport permits, licenses, and approvals.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Work under this section includes submittals due from the Contractor as specified herein, in Contract Documents, and in the Request for Proposal (RFP). Items covered include: Submittal Procedures, Engineer's Review of Submittals, Work Plans, Survey/Layout Data, Engineering Data, Progress Reports, Construction Drawings, Final Record Drawings, and Submittal Register.
   2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of materials and equipment and to implement procedures following ENGINEER's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
   3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site; quantities; information pertaining solely to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
   4. CONTRACTOR's signature of submittal's stamp and letter of transmittal shall be CONTRACTOR's representation that CONTRACTOR has complied with his obligations under the Contract Documents relative to that submittal. ENGINEER and OWNER shall be entitled to rely on such representations by CONTRACTOR.

1.2 TYPES OF SUBMITTALS

A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specifications Sections; when type of submittal is not designated in the associated Specification Section, submittal will be classified as follows:
   1. Action Submittals include:
      a. Shop Drawings.
      b. Product data.
      c. Samples.
   2. Informational Submittals include:
      a. Certificates.
      b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
      c. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
      d. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
      e. Field or Site quality control submittals (other than testing plans, procedures,

and testing limitations), including results of operating and acceptability tests at the Site.

f. Supplier reports.
g. Qualifications statements.
h. Administrative submittals including:
   1) Construction Schedule – Section 01 71 13.
   2) Operations Plan – Section 01 30 00.
   3) Contractor's Health and Safety Plan – Section 01 35 29.
   4) Dust Prevention and Control Plan – Section 01 57 05.
   5) Survey Layout Data- Part 1.5 below.
   6) Field engineering reports and similar information.

3. Closeout Submittals include:
   a. Maintenance contracts.
   b. Operations and maintenance data.
   c. Warranty documentation.
   d. Record documentation.
4. When type of submittal is not specified and is not included in the list above, request an interpretation from ENGINEER and ENGINEER will determine the type of submittal.

B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
   1. Requests for interpretations of the Contract Documents.
   2. Change Orders, Work Change Directives, and Field Orders.
   3. Applications for Payment
   4. Reports, documentation, and permit applications required to be furnished by CONTRACTOR to authorities having jurisdiction.

1.3 PROCEDURE FOR SUBMITTALS

A. All Submittals regardless of origin shall be submitted to the ENGINEER in accordance with this Section. The appropriate address and receiver of submittals will be designated at the preconstruction conference to be held following the Notice to Proceed.

B. Electronic submittals shall be in Microsoft Office compatible format. A transmittal letter shall accompany all submittals. The transmittal letter shall indicate:
   - Description and purpose of submittal, date, and submittal number;
   - Section and paragraph of the Specification with which the item complies;
   - Type of submittal (Manufacturer's Data, Shop Drawing, Sample, Record Drawing, etc.);
   - Desired return date of submittal;
   - Name and telephone number of the person to whom any questions can be directed; and
   - Any deviations from the Contract Documents.

C. All submittals regardless of origin shall be stamped with the approval of CONTRACTOR and identified with the Project name and number, CONTRACTOR'S name, and references to applicable Contract Specifications, Contract Documents, and the CONTRACTOR submittal number. When catalog pages are submitted, applicable items shall be clearly identified in a way that is reproducible using a copier or scanner. The current revision, issue number, and date shall be indicated on all Drawings and any other necessary descriptive data.

D. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades. The submittal number should appear within or next to the CONTRACTOR stamp. Resubmittals shall bear the number of the first submittal followed by a letter (e.g., A, B,) to indicate the sequence of the resubmittal.

E. Multiple submittals shall be sufficiently separated and bundled such that the end of one submittal and the start of another is clearly discernable. Staples, rubber bands, paper clips, or tab dividers are acceptable.

F. One PDF and one editable electronic copy (if applicable) of each submittal and necessary data shall be submitted to the ENGINEER. Submittal Drawings shall use AutoCAD 2010 or later by Autodesk, Inc. The ENGINEER will not accept submittals from anyone but the CONTRACTOR.

G. The CONTRACTOR's stamp of approval is representation to the ENGINEER that CONTRACTOR accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that he has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

H. All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in the Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the Contractor (including modifications to other facilities that may be a result of the deviation).

I. The CONTRACTOR shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted by the Engineer have been taken into account.

J. When the Drawings and data are returned marked **"REVIEWED"** or **"REVIEWED AND NOTED,"** no additional copies need be furnished.

K. When the Drawings and data are returned marked **"REVISE AND RESUBMIT,"** the corrections shall be made as noted thereon and as instructed by the ENGINEER and a revised electronic copy shall be submitted.

L. When the Drawings and data are returned marked **"REJECTED,"** it indicates that the submittal is unacceptable and a revised version must be submitted.

M. When corrected copies are resubmitted, the CONTRACTOR shall work in track changes in order to direct specific attention to all revisions and shall list separately any revisions made other than those called for by the ENGINEER on previous submissions.

N. Resubmittals shall be made within 5 days of the date of the letter returning the material to be modified or corrected, unless within 2 days CONTRACTOR submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

O. The CONTRACTOR's letter of transmittal for resubmissions shall list the date of the original submittal letter, the date of the ENGINEER's letter returning the submittal, and the dates of submission and return of any previous resubmittals.

1.4 ENGINEER'S REVIEW

A. Except as specified otherwise, for submittals required to be submitted to the ENGINEER for review before mobilization, allow 14 days excluding delivery time to and from the CONTRACTOR. Schedule submittals to expedite the Contract and in accordance with specified scheduling. Coordinate submission of related items. For submittals with samples or other products requiring lab analysis (e.g., fill sources), allow for an additional 7 days for review by the ENGINEER for a total of 21 days excluding delivery time to and from the CONTRACTOR.

B. For each submittal submitted for review by the ENGINEER after mobilization allow 7 days excluding delivery time to and from the CONTRACTOR.

C. The CONTRACTOR shall incorporate expected lead times of materials and equipment, and anticipated submittal review time into the Contractor's construction schedule. The CONTRACTOR shall anticipate the possibility of delays in lead times and submittal approvals and plan to get submittals in and approved well in advance of order deadlines. The CONTRACTOR will demonstrate advance planning by showing float time for submittal approvals where ever possible in the baseline Submittal/Construction Project Schedule.

D. Closeout Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.

E. Maintenance Material Submittals, Results of ENGINEER's Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as "accepted" will be recorded in ENGINEER's submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

1.5 SURVEY/LAYOUT DATA

A. When required by the Contract Documents, CONTRACTOR shall submit survey/layout data in accordance with submittal procedures. Whenever possible, CONTRACTOR's survey/layout data will be overlain on design layout or baseline drawings for comparison. Survey/layout data shall be submitted in the same format as Construction Drawings.

B. All field books, notes, quantity take-offs, and other data developed by CONTRACTOR in performing surveys required as part of the Work shall be available to the CONSTRUCTION MANAGER for examination throughout the construction period. All such data shall be submitted to the CONSTRUCTION MANAGER with the other documentation required for final acceptance of the Work.

1.6 ENGINEERING DATA

A. Engineering data covering all equipment and fabricated materials which shall become a permanent part of the Work under this Contract shall be submitted to the ENGINEER for review. CONTRACTOR shall be responsible for timely submittal of required engineering data to allow for the ENGINEER's review. These data shall include Drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

1.7 CONSTRUCTION DRAWINGS

A. Submit sets of complete detailed Construction Drawings, including five hard copy sets, a complete PDF and CADD file in AutoCAD 2010 (or newer) for acceptance of all materials, equipment, accessories, and appurtenances specified herein or shown on the Design Drawings prior to the fabrication, installation, or incorporation of the specified materials, equipment, or accessories into the Work. Submit all in accordance with the requirements of the Contract Documents and Specifications.

B. Construction drawings are generally defined as all Drawings, diagrams, illustrations, brochures, schedules, and other data that are prepared by the CONTRACTOR, a subcontractor, manufacturer, fabricator, supplier, or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

C. All Construction Drawings shall be in conformity with the Drawings and Specifications. All Construction Drawings shall be made to scale, shall be accurate and distinct, and shall give all dimensions required for the fabrication, installation, and incorporation of the specified items in the Work. Whenever the location of any of the materials, equipment, accessories, and appurtenances is not shown on the Drawings, Contractor shall furnish prints of construction drawings for the purpose of giving the exact location in plan and in elevation of the said materials, equipment, accessories, and appurtenances. Construction Drawings of mechanical equipment shall also show outline and section views, complete details, the kind of materials to be used, electrical diagrams, the kind of machine work and finish to be applied, and indicated conformity to specified requirements.

1.8 RECORD DRAWINGS

A. Final Record drawings shall prepared in accordance with Section 01 78 39 – Project Record Documents.

1.9 SUBMITTAL REGISTER

A. A submittal register has been provided for the Contractor's use.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

Submittal Register
Solvents Recovery Service of New England, Inc., Southington, Connecticut 10/6/2016

Item No.	Section	Title	Submittal Description	Required Submittal Timeline	Date Received	Status/Date (see Note 1)	Notes
1	01 30 00	Administrative Requirements	Contractor's Operations Plan	14 days prior to mobilization			
	01 30 00	Administrative Requirements	Equipment List	Part of Contractor's Operations Plan			
	01 30 00	Administrative Requirements	Project Approach & Work Sequence	Part of Contractor's Operations Plan			
	01 30 00 & 01 71 13	Administrative; Mobilization	Project Schedule	30 days after notice of award; Also part of Contractor's Operations Plan			
	01 30 00	Administrative Requirements	Equipment Cleaning Procedures	Part of Contractor's Operations Plan			
	01 30 00	Administrative Requirements	Waste Management / Disposal Plan	Part of Contractor's Operations Plan			
	31 23 05	Excavation and Fill	Excavation Plan; Compaction Procedures	Part of Contractor's Operations Plan			
	01 30 00 & 01 57 05	Administrative; Temporary Controls	Erosion and Sediment Control Plan	At least 1 week prior to commencement of construction; Also part of Contractor's Operations Plan			
	01 30 00 & 01 57 05	Administrative; Temporary Controls	Dust Prevention and Control Plan, including product data for dust control products	At least 1 week prior to commencement of construction; Also part of Contractor's Operations Plan			
2	01 35 29	Contractor's Health and Safety Plan	Health and Safety Plan	14 days prior to mobilization			
3	01 57 05	Temporary Controls	silt fence	At least 2 weeks prior to use			
		Temporary Controls	filter socks	At least 2 weeks prior to use			
4	26 05 43.13	Underground Ductbanks for Electrical Systems	Shop Drawings - layouts and profile of proposed routing of ductbank showing locations of manholes, and handholes (if required) and pipe/utility crossings.	At least 2 weeks prior to use			
			Installation procedures	At least 2 weeks prior to use			
			Field test reports	Within 2 days of test completion			
			Record drawings	Part of Final Closeout Submittal			
5	31 05 19	Geotextiles for Earthwork	Manufacturer's data, specifications, installation instructions and dimensions	At least 2 weeks prior to use			
			Certifications & manufacturer's affidavit	At least 2 weeks prior to use			
6	31 05 19 16	Geomembranes for Earthwork	Corporate background and information.	At least 2 weeks prior to use			
			Written certification that the minimum specification limits are guaranteed by the Manufacturer.	At least 2 weeks prior to use			
			QC procedures for manufacturing, list of material properties including certified test results.	At least 2 weeks prior to use			
			Origin (resin supplier's name and resin production plant) and identification (brand name and number) of the resin.	At least 2 weeks prior to use			
			Copies of dated QC certificates issued by the resin supplier.	At least 2 weeks prior to use			
			Shop drawings showing panel layout	At least 1 week prior to commencement of construction			
			QC program manuals covering all phases of manufacturing and installation	At least 2 weeks prior to use			
			Copy of the Installer's letter of approval or license by the Manufacturer.	At least 2 weeks prior to use			
			Instructions for storage, handling, installation, seaming, inspection plan and fail criteria for liner inspections, and QA/QC testing procedures	At least 2 weeks prior to use			
			Contractor's written certification (provided prior to the installation of the FML) that the field-delivered FML has not been damaged due to improper transportation, handling, or storage.	At least 1 week prior to commencement of construction			
7	31 05 19 19	Geogrids for Earthwork	Manufacturer's/distributor's product data sheets.	At least 2 weeks prior to use			
			Manufacturer's Quality Control Plan with QC procedures for manufacturing and ISO 9001 certification.	At least 2 weeks prior to use			
			Manufacturers Mill Certificate signed by the manufacturer.	At least 2 weeks prior to use			
			Manufacturer's geogrid test reports for properties listed in specification.	At least 2 weeks prior to use			
			Instructions for storage, handling, and installation.	At least 2 weeks prior to use			
			Manufacturer's warranty.	At least 2 weeks prior to use			

Submittal Register
Solvents Recovery Service of New England, Inc., Southington, Connecticut 10/6/2016

Item No.	Section	Title	Submittal Description	Required Submittal Timeline	Date Received	Status/Date (see Note 1)	Notes
8	31 05 19 23	Geosynthetic Clay Liner	List of GCL installation crew personnel and resumes of the Supervisor and QC Manager	At least 2 weeks prior to use			
			Copy of the Manufacturer's Manufacturing Quality Assurance/Manufacturing Quality Control (MQA/MQC) Plan for testing GCL	At least 2 weeks prior to use			
			Statement of the GCL Manufacturer's experience in manufacturing GCL, including the manufacturing and supplying company's name, address, and employee contact	At least 2 weeks prior to use			
			Certification from the GCL Manufacturer attesting that the proposed GCL meets the physical, mechanical, and manufacturing requirements.	At least 2 weeks prior to use			
			MQC certificates for the material to be delivered to the site.	At least 2 weeks prior to use			
			Summary report including results of MQC testing required for GCL material	At least 2 weeks prior to use			
			QC program manuals covering all phases of manufacturing and installation	At least 2 weeks prior to use			
			Proposed method of GCL panel seaming including overlap distance at sides and end of panels and use of additional material to complete the seal (if any).	At least 2 weeks prior to use			
			Internal and interface shear strength test results	At least 2 weeks prior to use			
			Schedule of operations including means and methods of installation.	At least 2 weeks prior to use			
			Proposed method of deploying material and placement of panels.	At least 2 weeks prior to use			
			Method or process by which adjacent panels will be joined to provide a continuous hydraulic barrier.	At least 2 weeks prior to use			
			Installer certification that the final surface on which the GCL is to be installed is acceptable.	At least 2 weeks prior to use			
			Shop drawings including details and panel layout diagrams of all overlapping attachments and anchoring.	At least 2 weeks prior to use			
			Proposed method of protecting installed GCL panels from rain, ponding water, or other elements that could over hydrate or damage the GCL.	At least 2 weeks prior to use			
			Record Panel Layout Diagram.	At least 2 weeks prior to use			
			Summary and log of all field quality control work completed by the Contractor.	2 weeks following completion of installation			
			Certification that GCL installation is complete and in accordance with these specifications.	2 weeks following completion of installation			
			Statement of material and installation warranties	2 weeks following completion of installation			
9	31 05 19 26	Geocomposites	Manufacturer's data for the geocomposite including physical properties	At least 2 weeks prior to use			
			The origin (supplier's name and production plant) and identification (brand name and number) of the geotextile and geonet used to fabricate the geocomposite	At least 2 weeks prior to use			
			Material sample of geocomposite.	At least 2 weeks prior to use			
			Manufacturer's installation procedures and specifications.	At least 2 weeks prior to use			
			Manufacturer's Quality Assurance (QA)/Quality Control (QC) program.	At least 2 weeks prior to use			
			Written certification that the minimum test values provided are guaranteed by the Manufacturer.	At least 2 weeks prior to use			
			Contractor's proposed transportation, handling, and storage techniques for the geocomposite.	At least 2 weeks prior to use			
			Contractor's written certification (provided prior to the installation of the geocomposite) that the surface on which the geocomposite is to be installed is acceptable	At least 2 weeks prior to use			
			Shop drawings depicting installation details, a panel layout diagram, and a description of proposed installation techniques for the geocomposite.	At least 2 weeks prior to use			
			QC certificates	At least 2 weeks prior to use			
			Contractor's written certification that the field-delivered material meets the Manufacturer's specifications	At least 2 weeks prior to use			

Item No.	Section	Title	Submittal Description	Required Submittal Timeline	Date Received	Status/Date (see Note 1)	Notes
10	31 11 00	Clearing and Grubbing	Tree Removal Plan, Limits of Clearing Plan	14 days prior to commencement of site clearing			
			Arborist qualifications				
11	31 23 05	Excavation and Fill	Name and location of the source of each proposed fill material.	At least 2 weeks prior to placement on site			
			General Fill - results of moisture/density	At least 2 weeks prior to placement on site			
			Select Fill - results of moisture/density	At least 2 weeks prior to placement on site			
			Processed Aggregate Base - results of moisture/density	Within 2 days of test completion			
			Excavated On-site Soils to be used as Fill - results of moisture/density	At least 2 weeks prior to placement on site			
			General Fill - Atterberg Limits	At least 2 weeks prior to placement on site			
			General Fill - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			Select Fill - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			Filter Stone - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			Stone Screenings - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			Processed Aggregate Base - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			NTCRA 1 General Fill - grain size/sieve testing reports	At least 2 weeks prior to placement on site			Average of 6 samples min
			NTCRA 1 Trench Backfill Material - grain size/sieve testing reports	At least 2 weeks prior to placement on site			Average of 10 samples min
			Surfacing Stone (Solar panels) - grain size/sieve testing reports	At least 2 weeks prior to placement on site			
			General Fill - samples for chemical analysis	At least 4 weeks prior to delivery			
			Select Fill - samples for chemical analysis	At least 4 weeks prior to delivery			
			Processed Aggregate Base - samples for chemical analysis	At least 4 weeks prior to delivery			
			Filter Stone - samples for chemical analysis	At least 4 weeks prior to delivery			
			Stone Screenings - samples for chemical analysis	At least 4 weeks prior to delivery			
			NTCRA 1 General Fill - samples for chemical analysis	At least 4 weeks prior to delivery			
			NTCRA 1 Trench Backfill Material - samples for chemical analysis	At least 4 weeks prior to delivery			
			Surfacing Stone (Solar panels) - samples for chemical analysis	At least 4 weeks prior to delivery			
			General Fill - moisture content	At least 2 weeks prior to placement on site			
			Select Fill - moisture content	At least 2 weeks prior to placement on site			
			Processed Aggregate Base - moisture content	At least 2 weeks prior to placement on site			
			Excavated On-site Soils to be used as Fill - moisture content	At least 2 weeks prior to placement on site			
12	31 37 00	Riprap	Name and location of the source of riprap	At least 2 weeks prior to use			
			Samples and test reports	At least 2 weeks prior to use			
			Supplier's DOT certification	At least 2 weeks prior to use			
13	32 31 00	Fences	Shop drawings	At least 2 weeks prior to use			
			Layout drawings	At least 2 weeks prior to use			
			Product data	At least 2 weeks prior to use			
			Manufacturer's certification	At least 2 weeks prior to use			
			Design data (if required)	At least 2 weeks prior to use			
			Manufacturer's installation instructions	At least 2 weeks prior to use			
			Qualifications statement - erector	At least 2 weeks prior to use			
14	32 12 00	Flexible Paving	Shop drawings - asphalt mix designs and aggregate gradations.	At least 2 weeks prior to use			
			Product data	At least 2 weeks prior to use			
			Quality Assurance Test Data and Source Quality Control Submittals	At least 2 weeks prior to use			
			Delivery tickets	Within 2 days of paving completion			
			Results of required field quality control testing	Within 2 days of paving completion			
15	32 92 00	Turf and Grasses	Shop Drawings	At least 2 weeks prior to use			
			Product data	At least 2 weeks prior to use			
			Seed Certificate and certificates of inspection	At least 2 weeks prior to use			
			Test reports for topsoil	At least 2 weeks prior to use			
			Qualifications data for landscaper and testing agency	At least 2 weeks prior to use			
			Written statement with source information	At least 2 weeks prior to use			
			Closeout submittals including operations and maintenance data and warranty documentation	Part of Final Closeout Submittal			
16	32 93 00	Plants	Shop Drawings	At least 2 weeks prior to use			
			Product data	At least 2 weeks prior to use			
			Material certificates of compliance	At least 2 weeks prior to use			
			Qualifications data for landscaper and testing agency	At least 2 weeks prior to use			

Submittal Register
Solvents Recovery Service of New England, Inc., Southington, Connecticut 10/6/2016

Item No.	Section	Title	Submittal Description	Required Submittal Timeline	Date Received	Status/Date (see Note 1)	Notes
17	33 05 05	Buried Pipe Installation	Shop Drawings	At least 2 weeks prior to use			
			Product data	At least 2 weeks prior to use			
			Manufacturer's certification	At least 2 weeks prior to use			
18	33 05 13	Manholes	Shop Drawings	At least 2 weeks prior to use			
19	01 33 00 & 01 77 19	Submittal Procedures Closeout Requirements	Construction Drawings (in AutoCAD 2010)	Interim: 14 days prior to fabrication or installation into the Work Final: within 7 days of Final Acceptance Certificate			
20	01 77 19	Closeout Requirements	Final Closeout Submittal	Prior to submitting an application for substantial completion			
			Closeout Documentation of Work (various documentation pertaining to all components of work)	Part of Final Closeout Submittal			
			Maintenance manuals, tools, spare parts, keys, etc.	Upon receipt of final acceptance			
			Record Drawings	Part of Final Closeout Submittal			

Notes:

1. Submittal status nomenclature is as follows:
   - R - Reviewed
   - N - Reviewed and Noted
   - S - Revise and Resubmit
   - J - Rejected
   - I - For Information Only
2. All submittals must be stamped with approval of the Contractor and accompanied by a transmittal letter, indicating: (1) Description and purpose, date and submittal number, (2) Section & paragraph of the specification with which it complies, (3) Type of submittal, (4) Desired return date, (5) Name and phone number to whom questions can be directed, and (6) Any deviations from Contract Drawings.
3. Submittal timelines do not include time for delivery from and to the Contractor.
4. See Specifications for additional submittal requirements.

SECTION 01 35 29

CONTRACTOR'S HEALTH AND SAFETY PLAN

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall prepare and maintain a written, Site-specific, health and safety plan (HASP), and conduct all construction activities in safe manner that avoids:
      a. injuries to employees, Subcontractors, and other persons with an interest at or near the Site;
      b. employee exposures to health hazards above occupational limits established by Laws or Regulations, American Conference of Governmental Industrial Hygienists (ACGIH), and Nuclear Regulatory Commission (NRC), as applicable;
      c. exposure of the public and OWNER's employees to air contaminants above levels established for public exposure by the USEPA, NRC, and by other authorities having jurisdiction at the Site;
      d. significant increases in concentrations of contaminants in soil, water, or sediment near the Site; or
      e. violations of OSHA Regulations, or other Laws or Regulations.

B. Related Sections:
   1. Section 01 33 00, Submittal Procedures.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Preparer of HASP:
      a. Engage a Certified Industrial Hygienist (CIH), accredited by the American Board of Industrial Hygiene, or Certified Safety Professional certified by the Board of Certified Safety Professionals, to prepare or supervise preparation of HASP.
      b. HASP preparer shall be thoroughly familiar with: (i) Laws and Regulations and industry standards of safety and protection relating to health and safety pertaining to the Work; (ii) the requirements of the Contract Documents relative to health, safety, and protection; (iii) health and safety hazards associated with the Work and appropriate protections therefor; and (iv) CONTRACTOR's and OWNER's safety programs.
      c. HASP preparer shall have previously prepared site-specific health and safety plans for not less than five construction projects similar in nature, scope, and complexity to the Work.
      d. Submit preparer's qualifications with HASP.

B. Regulatory Requirements: Laws and Regulations applying to the Work under this Section include, but are not limited to:
   1. 29 CFR 1904 (OSHA), Recording and Reporting Occupational Injuries and Illnesses;
   2. 29 CFR 1910 (OSHA), Occupational Safety and Health Standards;
   3. 29 CFR 1926 (OSHA), Safety and Health Regulations for Construction;
   4. 49 CFR 171.8, Transportation, Definitions and Abbreviations;

5. 40 CFR 261.3, 264, and 265, Resource Conservation and Recovery Act (RCRA); and
6. Department of Labor, Safety and Health Regulations, Occupational Safety and Health Act of 1970, Public Law 91-596 and Section 107 of the Construction Safety Act (CSA) (PL 91-54).

C. The CONTRACTOR's HASP shall also be consistent with the site-specific HASP included as Attachment D to the Remedial Design Project Operations Plan.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. CONTRACTOR's HASP, in accordance with this Section. Submit within times indicated in Article 1.4 of this Section.
   2. Qualifications Statements:
      a. Qualifications for HASP preparer, including copy of valid, applicable certifications.

1.4 HASP SUBMITTAL

A. Timing of Submittals:
   1. Submit HASP the sooner of: seven days prior to pre-construction conference, or 30 days prior to CONTRACTOR's scheduled mobilization at the Site.
   2. Do not perform Work at the Site until written HASP has been accepted by the CONSTRUCTION MANAGER.
   3. Delays in the Work Associated with Submittal or Review of HASP:
      a. Notwithstanding other provisions of the Contract Documents, changes in the Contract Price or Contract Times will not be authorized due to delay by CONTRACTOR in developing, submitting, revising, or obtaining acceptance of the HASP.

B. Limitations of Review of HASP:
   1. Review and acceptance of CONTRACTOR's HASP will be only to determine if the topics covered in HASP comply with the Contract Documents and specific requirements of safety documents referenced therein (such as OWNER's safety programs, if any).
   2. Review and acceptance will not extend to safety measures, means, methods, techniques, procedures of construction, or whether representations made in the HASP complies with Laws and Regulations, or standards of good practice.
   3. CONTRACTOR's responsibility for safety and protection at the Site shall be as indicated in the Contract Documents. Nothing associated with review or acceptance of HASP will create or imply any obligation by OWNER, CONSTRUCTION MANAGER, ENGINEER, or others to oversee or become, in any way, responsible for CONTRACTOR's safety obligations under the Contract Documents.

1.5 CONTRACTOR'S HEALTH AND SAFETY PROGRAM

A. General:
   1. The materials present in the work area contain constituents including, but not limited to, VOCs, SVOCs, dioxins, selected metals, and PCBs. The results of prior investigation activities related to this Contract will be available for review by the selected Contractor. It is the CONTRACTOR's responsibility to understand and incorporate the information obtained from these prior activities in the preparation of the cost proposal and in the development of a HASP.

2. For work required by the Contract involving the potential for personnel contact or exposure to constituents present in the soils and material, the CONTRACTOR must comply with 29 CFR 1910, 29 CFR 1926, 40 CFR 260-267, and related regulations which call for the development and implementation of a safety and health program for employees involved in hazardous waste operations. The CONTRACTOR will be required to comply with all requirements under these regulations for this project.
3. Prior to commencement of field activities, the CONTRACTOR must certify that personnel employed at the Site who are directly involved with removal activities, including employees and subcontractors, have completed a 40-hour hazardous waste site health and safety training course (and annual refresher training) in accordance with 29 CFR 1910.120 and 29 CFR 1926.65. The CONTRACTOR must also certify that any individuals who later became employed by the Contractor also receive such training prior to performing work at the Site.
4. The CONTRACTOR must certify that all personnel who will be employed by the Contractor to perform work at the Site, including direct employees as well as subcontractors, have received the initial and annual (if applicable) medical examinations and are enrolled in an on-going medical surveillance program as required by 29 CFR 1910 and 29 CFR 1926.
5. The CONTRACTOR must also comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).
6. The CONTRACTOR will be responsible for the safety of his employees, subcontractors, suppliers, and other parties at the work area as a result of the CONTRACTOR's direction.

B. Location:
1. Retain at the Site a copy of complete HASP and related information.
2. Retain copy of HASP and related information at CONTRACTOR's project office.
3. Throughout the Project, update as necessary all copies of HASP and related information.
4. Copies of HASP and other related information shall be made available to CONTRACTOR's employees, Subcontractors, Suppliers, OWNER, and ENGINEER immediately upon request.

C. HASP Content: The CONTRACTOR must prepare, submit, and implement a HASP in accordance with 40 CFR 1910.120, 29 CFR 1926.65. The HASP must address, but not be limited to, the following components:
1. Identification of Key Personnel - Identify, by name and by title, the on-site and off-site health and safety personnel responsible for the implementation of health and safety procedures. All on-site personnel involved in the activities must have OSHA 40-hour Hazardous Waste Training (29 CFR 1910.120 and 1926.65) and the corresponding 8-hour refresher course update.
2. Training - Describe and provide certification of all supervisory and on-site personnel having received appropriate health and safety training. Training requirements shall also include attending an initial site orientation prior to engaging in any on-site activities. Sign-off sheets acknowledging attendance shall be provided.
3. Medical Surveillance - Certify that all supervisory and on-site personnel have received appropriate medical examinations and are able to conduct the tasks required for this project including, but not limited to, working with chemicals, using respiratory protection, using personal protective equipment and conducting hazardous waste operations in accordance with 29 CFR 1910.120 and 1926.65.
4. Site Hazards - Identify and provide a means of mitigating all foreseeable biological, chemical, and physical hazards associated with the work, including, but not limited to, hazards associated with exposure to constituents of concern, heavy equipment operation, site conditions, weather, biological hazards, materials handling, and work around excavated areas.

5. Work Zones - Provide a site plan which depicts the designation of zones including: (1) Exclusion Zones (2) Decontamination Zones, and (3) Support Zones. The level of personal protection for each zone must be included.
6. Personal Safety Equipment and Protective Clothing - Identify personal safety equipment and protective clothing to be used and available on site. This shall include identification of expected levels of protection (A, B, C, D) for each task, and the action levels for personal protective equipment upgrades. A respiratory protection program that meets the requirements of 29 CFR 1910.134, and which establishes specific requirements for any respirator use shall be included.
7. Personal Air Monitoring - Identify protocols and criteria associated with personal air monitoring of on-site personnel.
8. Personnel and Equipment Decontamination - Describe methods and procedures to be used for personnel, vehicle, and equipment decontamination.
9. Confined Space Entry - Describe procedures for any confined space entry (if required) in accordance with OSHA's Confined Space Standard.
10. Material Safety Data Sheets - Provide Material Safety Data Sheets (MSDSs) for all materials to be brought on site, as well as constituents which are expected to be encountered in the course of implementation of the removal actions.
11. Construction Safety Procedures (OSHA 1926.1 - 1926.652, Subpart A-P) to address excavation and trenching safety procedures, as well as daily site safety inspection checklist to evaluate these items.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. General:
1. Should the CONTRACTOR identify any unforeseen or site-specific safety-related factor, hazard, or condition that becomes evident during the performance of work at the site, it will be the CONTRACTOR's responsibility to bring these safety-related issues to the attention of the project team both verbally and in writing as quickly as possible for resolution. In the interim, the CONTRACTOR should take prudent action to establish and maintain safe working conditions and to safeguard employees, the public, and the environment.
2. Should the CONTRACTOR seek relief from or substitution for any portion or provision of the HASP, such relief or substitution must be requested in writing to the ENGINEER, and if approved, be authorized in writing by the ENGINEER.
3. Any disregard for the provisions of these Health and Safety requirements will be deemed just and sufficient cause for termination of the Contract without compromise.

+ + END OF SECTION + +

SECTION 01 57 05

TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide and maintain methods, materials, equipment, and temporary construction as required for controlling environmental conditions at the Site and adjacent areas during construction.
   2. Maintain controls until no longer required. Provide temporary controls at all times when CONTRACTOR is working at the Site.
   3. Temporary controls include, but are not limited to, the following:
      a. Erosion and sediment controls; and
      b. Dust controls.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill; and
   2. Section 31 37 00, Riprap.

1.2 QUALITY CONTROL

A. The CONSTRUCTION MANAGER will be monitoring dust and particulate levels for conformance with the *RCRA Cap Construction Remedial Action Work Plan* during the performance of the Work. Immediate corrective action shall be taken by the Contractor, at no additional cost to the OWNER, to reduce dust and particulate emissions to acceptable levels if requested by the CONSTRUCTION MANAGER.

B. Contractor shall comply with the requirements of the Stormwater Pollution Prevention Plan section of the *RCRA Cap Construction Remedial Action Work Plan* during the performance of the Work.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Silt fencing materials; and
      b. Filter socks.

B. Informational Submittals: Submit the following:
   1. Procedural Submittals:
      a. At least one week prior to the start of construction, the Contractor shall submit to the CONSTRUCTION MANAGER for review a site specific Dust Prevention and Control Plan detailing methods to be used to prevent and control onsite dust generation and migration from the Site during construction activities.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. General:
   1. Materials utilized for temporary erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.

B. Silt Fencing:
   1. Filter Cloth:
      a. Products and Manufacturers: Provide one of the following:
         1) Contech “Silt Fence”;
         2) Hanes Geo Components “Silt Fence”;
         3) Atlantic Construction Fabrics (ACF) Environmental “Silt Fence”; or
         4) Approved equal.
      b. Height: Two feet, minimum.
      c. Securely fasten filter cloth to wire mesh using ties spaced at maximum intervals of two feet on centers at top and mid-height of wire mesh.
   2. Fence Support Posts:
      a. Length: Not less than three feet.
      b. Material: Metal or other acceptable material with "U", “T”, or "I" cross section, or hardwood measuring not less than 1.25-inch by 1.25-inch in cross-section.

C. Hay Bales.
   1. Bales shall be firmly-packed, unrotted straw bound firmly with baling wire. Cross-sectional area on the small end of each bale shall be approximately 12 inches by 12 inches or larger.
   2. Posts shall comply with requirements for silt fencing support posts, or may be suitable reinforcing steel rods.

D. Mulch Materials and Soil Stabilization.
   1. Mulch shall be unrotted straw or salt hay.
   2. Soil stabilization emulsions, when used, shall be an inert, eco-friendly chemical manufactured for the specific purpose of erosion control and soil stabilization, applied with mulch or stabilization fibers.
   3. Wood-fiber or paper-fiber, when used, shall be 100 percent natural and biodegradable.
   4. Erosion control mat or netting shall be biodegradable. Acceptable materials include jute, excelsior, straw or coconut fiber, and cotton.

E. Riprap for Stone Check Dams:
   1. Riprap shall be No. 3 Crushed Stone in accordance with Part M.01.01 of the State Of Connecticut Department Of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction.

F. Temporary Stone Construction Entrance:
   1. Stone: Tough, hard, durable stone complying with the following gradation requirements:

Sieve Size	Total Percent Passing
2.5inch	100
2-inch	90 to 100
1.5-inch	35 to 70
1.0-inch	Zero to 15

2. Geotextile Separation Fabric: As recommended by geotextile manufacturer for separating stone from subgrade, for the vehicle weight and traffic frequency required.

PART 3 – EXECUTION

3.1 DUST CONTROL

A. Implement and maintain dust and particulate control measures throughout the duration of construction and in accordance with the CONTRACTOR’s accepted Dust Prevention and Control Plan.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere. Use only potable water if a water misting system is to be used for dust and particulate control.

C. Do not use chemical means for dust and particulate control without CONSTRUCTION MANAGER's prior approval.

D. Use appropriate dust covers on trucks hauling fine or dusty material.

E. Prevent dust from becoming a nuisance to operations at the facility, or to adjacent property owners or occupants.

F. Ensure that open excavations and soil-covered backfilled areas are thoroughly wetted down at the end of each working day, unless precipitation is occurring, to prevent the generation of dust overnight. Additionally, apply mulch, wetting, or other method approved by the CONSTRUCTION MANAGER to open excavations and soil-covered backfilled areas before weekend Work stoppage, or any other time when a particular Work area will remain idle the following day.

G. Wet down haul routes as needed during Work activities, and as needed during non-working time periods, to minimize dust generation.

3.2 EROSION AND SEDIMENT CONTROLS

A. Installation and Maintenance of Erosion and Sediment Controls – General:
   1. General:
      a. Provide temporary erosion and sediment controls as shown and indicated on the Drawings and as indicated elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously-undisturbed areas.
      b. Installation of erosion and sediment controls shall be in accordance with the applicable requirements indicated in Article 1.2 of this Section, and as shown or indicated in the Contract Drawings.
      c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.
      d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.

e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provide measures for regulating drainage and controlling erosion and sedimentation, subject to the CONSTRUCTION MANAGER's approval.

f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.

2. Coordination:

a. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment controls.

3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.

4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any additional measures required to comply with the Storm Water Pollution Prevention Plan for the Project.

5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.

6. Access Roads and Parking Areas: When possible, access roads and temporary roads and parking shall be located and constructed to avoid adverse effects on the environment. Provide measures to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.

7. Earthwork and Temporary Controls:

a. Perform excavation, fill, and related operations in accordance with Section 31 23 05, Excavation and Fill.

b. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.

c. Hold to a minimum the areas of bare soil exposed at one time.

d. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.

e. In performing earthwork, eliminate depressions that could serve as mosquito breeding pools.

f. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.

8. Inspection and Maintenance:

a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; promptly implement corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established.

b. Inspect not less often than the frequency indicated in the Storm Water Pollution Prevention Plan section of the *RCRA Cap Construction Remedial Action Work Plan*.

c. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.

d. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.

9. Duration of Erosion and Sediment Controls:

a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.

   b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.
10. Work Stoppage:
   a. If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
11. Failure to Provide Adequate Controls:
   a. In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and sedimentation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control.
   b. Cost of such work by OWNER, plus engineering and inspection costs, will be deducted from amounts due CONTRACTOR, as set-offs in accordance with the Contract Documents.

B. Silt Fencing:
1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated in the Contract Documents and where required.
2. Locations of Silt Fencing/Hay Bales:
   a. Where possible, install silt fencing along contour lines so that each given run of silt fencing is at the same elevation.
   b. Provide silt fencing or hay bales around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.
   c. Do not install silt fencing at the following types of locations:
      1) Area of concentrated storm water flows such as ditches, swales, or channels;
      2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing; and
      3) Across upstream or discharge ends of storm water piping or culverts.
3. Silt Fence Installation:
   a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
   b. When two sections of filter cloth abut each other, fold over edges and overlap by not less than six inches and securely fasten to wire mesh.
   c. Embed posts in the ground to the depth necessary for proper controls; embed posts to not less than 16 inches below ground.
   d. Filter cloth and wire mesh shall extend not less than eight inches below ground and not less than 16 inches above ground.
   e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.
4. Hay Bale Installation:
   a. Install straw bales in shallow excavation as wide as the bale and approximately four to six inches below surrounding grade.
   b. Ends of straw bales shall tightly abut ends of adjacent straw bales.
   c. Securely install straw bales using two support posts per straw bale, driven into the ground not less than 1.5 to two feet below bottom of straw bale. Top of post shall be flush with top of straw bale. Angle first post for each straw bale toward the previously-installed straw bale.
   d. Frequently inspect straw bales and repair or replace as required. Remove accumulated silt and debris from behind straw bales.
5. Maintenance:
   a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.

C. Mulching and Soil Stabilization:
   1. Use mulching to temporarily stabilize exposed soil and fill material.
      a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
      b. Application of mulching for soil stabilization shall be as follows.
         1) Unrotted Straw or Salt Hay: 1.5 to two tons per acre;
         2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers; and
         3) Wood-fiber or Paper-fiber Application: 1,500 lbs. per acre, installed by hydroseeding.
      c. Where mats or netting are used:
         1) Cover entire area to be stabilized with mats or netting.
         2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, four inches or more wide, at top and bottom of slope. Tamp trench full of soil. Four inches from trench, secure mat or netting with appropriate staples spaced at intervals of 10 inches.
         3) Overlap adjacent strips of mat or netting by not less than four inches.

D. Protection of Storm Water Drainage Inlets and Catch Basins:
   1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
   2. Install filter socks around the perimeter of drainage inlet or catch basin in accordance with manufacturer's instructions.
   3. Remove silt and sediment from behind filter socks as required.

E. Temporary Stone Construction Entrance:
   1. Where shown on the Drawings, and where construction vehicles will regularly transit to paved surfaces from unstabilized surfaces, provide temporary stone construction entrance. CONTRACTOR vehicles shall use temporary stone construction entrances.
   2. Provide temporary stone construction entrances of the width, length, and thickness shown or indicated on the Drawings.
   3. Installation:
      a. Ensure that subgrade under each temporary stone construction entrance is suitably dense for the intended purpose. Suitably prepare subgrade as required for temporary stone construction entrance.
      b. Provide on subgrade a layer of geotextile separation fabric, installed in accordance with geotextile separation fabric manufacturer's recommendations for separation.
      c. Provide stone on installed geotextile separation fabric. Grade the stone for passage of vehicles.
   4. Maintenance:
      a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.
      b. When upper layer of temporary stone construction entrance becomes contaminated with soil, remove the contaminated material and replace with clean stone.
      c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is unacceptable.

3.7 INSPECTIONS

A. The Contractor shall have a qualified professional perform all site assessments and inspections of the site erosion control measures in accordance with the requirements of Connecticut Permit for Stormwater and Dewatering Wastewaters from Construction Activities.

3.8 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:
   1. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.
   2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

+ + END OF SECTION + +

SECTION 01 71 13

MOBILIZATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. The Work covered by this Section includes furnishing all materials and equipment and performing all labor necessary to assemble and set-up for the Project. This shall include the initial movement of personnel and equipment to the Site, and establishment of the field offices, shops, storage areas, sanitary, and other facilities necessary and required by the Contractor in the execution of the Work.
   2. This Work further includes the demobilization of all equipment, material, and labor established during mobilization and construction activities upon completion of the Work.

1.2 SUBMITTALS

A. The Contractor shall provide a construction schedule identifying the time line for conducting the project from Mobilization through Demobilization of equipment and personnel. The schedule shall be prepared using Microsoft Project compatible software. Construction schedule shall be provided to the CONSTRUCTION MANAGER 30 days after Notice of Award.

1.3 DEFINITIONS

A. Mobilization includes locating and transporting all necessary equipment, materials, and labor to the Site to complete all work as specified in the Contract Documents.

B. Demobilization includes the movement and removal of all equipment, materials and labor established during mobilization and construction activities from the Site following completion of the Work.

1.4 RELATED SECTIONS

A. Section 01 30 00, Administrative Requirements – Part 1.14 Contractor Equipment and Materials Cleaning.

B. Section 01 33 00, Submittal Procedures.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 GENERAL

A. Scope:
   1. Section includes:
      a. Substantial Completion; and
      b. Final inspection.

1.2 SUBSTANTIAL COMPLETION

A. Substantial Completion – General:
   1. Prior to requesting Substantial Completion, perform the following for the substantially completed Work:
      a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic and manual modes.
      b. Complete field quality control Work, including testing at the Site, indicated in Specifications Sections for individual materials and equipment items. Submit results of, and obtain ENGINEER's acceptance of, field quality control tests required by the Contract Documents.
      c. Complete other tasks that the Contract require be completed prior to Substantial Completion.
   2. Complete final cleaning, and remove temporary facilities and tools prior to requesting inspection of the Work for certification of substantial completion. The CONSTRUCTION MANAGER and the ENGINEER will perform the substantial completion inspection.

1.3 FINAL INSPECTION

A. Final Inspection – General:
   1. Prior to requesting final inspection, verify that all of the Work is fully complete and ready for inspection.
   2. Upon receipt of CONTRACTOR's request, the CONSTRUCTION MANAGER will either proceed with initial inspection or advise the CONTRACTOR of substantial completion tasks not fulfilled. Following initial inspection, the CONSTRUCTION MANAGER will either prepare the certificate of substantial completion, or advise the CONTRACTOR of work which must be performed prior to issuance of the certificate of substantial completion. The CONSTRUCTION MANAGER will repeat the inspection when requested and assure that the Work has been substantially completed. Results of the completed initial inspection will form the initial "punch-list" for subsequent inspections and for final acceptance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 FINAL CLEANING

A. At the time of project close out, clean and restore the Work area to its original condition. Complete the following operations before requesting the CONSTRUCTION MANAGER's and ENGINEER's inspection for certification of substantial completion:
   1. Remove non-permanent protection and labels;
   2. Remove trash and debris; and
   3. Inspect yards and grounds.

+ + END OF SECTION + +

SECTION 26 05 43.13

UNDERGROUND DUCTBANKS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install underground ductbanks.

B. Coordination:
   1. Ductbank routing on the Drawings is diagrammatic. Coordinate installation with piping and other Underground Facilities and locate ductbanks clear of interferences.
   2. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before underground ductbank Work.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Layouts showing proposed routing of ductbank and locations of manholes, and handholes, if required.
      b. Profiles of ductbanks showing crossings with piping and other Underground Facilities.

B. Informational Submittals: Submit the following:
   1. Special Procedure Submittals:
      a. Installation procedures.
   2. Field Quality Control Submittals:
      a. Field test report.

C. Closeout Submittals: Submit the following:
   1. Record Drawings:
      a. Include actual routing of underground ductbank runs on record documents in accordance with Section 01 77 19, Closeout Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Duct: Provide conduit and fittings as shown on the Design Drawings. Conduit types shall be as follows:
   1. Schedule 40 or 80 PVC conduits for power circuits.

B. Backfill: Provide backfill, including select backfill, in accordance with Section 31 23 05, Excavation and Fill.

C. Conduit Spacers: Conduit spacers shall be nonmetallic, interlocking type to maintain spacing between conduits. Provide spacers suitable for all conduit types used in multiple sizes.

D. Duct Sealing Compound:
   1. Products and Manufacturers: Provide one of the following:
      a. 0-Z/Gedney, Type DUX.
      b. Or equal.

E. Detectable Underground Warning Tape:
   1. Products and Manufacturers: Provide one of the following:
      a. Indentoline by Brady.
      b. Or equal.
   2. Material: Polyethylene or polyester with detectable metal core and polyester underlaminate.
   3. Width: Two inches.
   4. Color and Labeling: Yellow or red with permanently imprinted black letters: "CAUTION – Buried Electric Line", repeated continuously over full length of tape.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify CONSTRUCTION MANAGER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Excavation and Backfilling:
   1. Provide excavation and backfilling for ductbank installation in accordance with Section 31 23 05, Excavation and Fill.
   2. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables, or prevent adequate compaction of backfill.

B. Conduit Layout:
   1. Slope ductbank runs for drainage toward manholes and away from buildings with slope of approximately three inches vertical per 100 feet of run.
   2. Make bends with sweeps of not less than four-foot radius or five-degree angle couplings.

C. Conduit Transitions:
   1. Conduit installations shall be watertight throughout entire length of ductbank.
   2. Transition from non-metallic to galvanized rigid steel conduit where ductbanks enter structure walls and slabs.
   3. Terminate conduits in insulated grounding bushings.
   4. Continue conduits inside as indicated in the Design Drawings.
   5. If ducts are not concrete-encased, provide expansion and deflection fittings.
   6. Plug and seal empty spare conduits entering structures. Conduits in use entering structures shall be sealed watertight with duct sealing compound.

D. Connections to Structures:
   1. Ductbank penetrations through structure walls shall be watertight.

E. Detectable Underground Warning Tape:
   1. Provide detectable underground warning tapes, complying with Part 2.1.E above, over the full length of each underground ductbank.
   2. Install warning tapes approximately 12 inches below grade.
   3. Provide multiple tapes across the width of each ductbank. Locate center of a warning tape above each edge of ductbank, and at intervals across top width of ductbank so that clear space between tapes does not exceed six inches.

+ + END OF SECTION + +

SECTION 31 05 19

GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and services required to provide and place geosynthetics as shown and specified.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill; and
   2. Section 31 37 00, Riprap.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM D 1117 - Test Methods for Non-Woven Fabrics;
      b. ASTM D 3776 - Test Methods for Mass per Unit Area (Weight) of Woven Fabric;
      c. ASTM D 5034 - Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test);
      d. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity;
      e. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles;
      f. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles (Grab Method);
      g. ASTM D 4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile;
      h. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products;
      i. ASTM D 5101 - Standard Test Method for Measuring the Soil-Geotextile System Clogging Potential by the Gradient Ratio;
      j. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles; and
      k. ASTM D 5567 - Standard Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems.
   2. American Association of State Highway and Transportation Officials (AASHTO).
      a. AASHTO M 288-06 - Standard Specification for Geotextile Specification for Highway Applications.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Geotextile manufacturer shall be a specialist in the manufacture of geotextile cushion fabric, and have produced and successfully installed a minimum of five million square feet.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Submit geotextile manufacturer's data, specifications, installation instructions and dimensions.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit an affidavit certifying that the geotextile fabric furnished complies with all requirements specified herein.
      b. No fabric shall be shipped until the affidavit is submitted to the ENGINEER.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Each roll of geotextile delivered to the Site shall be labeled by the manufacturer identifying the manufacturer's name, product identification, lot number, roll number and roll dimensions.

B. All rolls and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER if any loss or damage exists to geotextile fabric. Replace loss and repair damage to new condition, in accordance with manufacturer’s instructions.

C. Geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings.

PART 2 - PRODUCTS

2.1 NON-WOVEN GEOTEXTILE FABRIC

A. Material shall be needle-punched geotextile, manufactured for subsurface drainage and roadway separation applications and comprised of polypropylene fibers, with elongation greater than 50 percent. Non-woven geotextile material shall comply with AASHTO M 288-06 and the properties specified below:

Property	Method	Minimum Value (MARV*)
Mass per Unit Area	ASTM D5261	8 oz/sq yd min.
Grab Strength	ASTM D4632	205 lbs min.
Trapezoidal Tear Strength	ASTM D4533	70 lbs min.
Puncture Strength	ASTM D4833	400 lbs min.
Apparent Opening Size (AOS)	ASTM D4751	0.180 mm max.
Permittivity	ASTM D4491	1.3 sec^{-1} min.
Survivability	AASHTO M288-06	Class 2

*Minimum average roll value - all properties except AOS.

B. Product and Manufacturer: Provide one of the following:
   1. Mirafi 160N as manufactured by TenCate Corporation; or
   2. Approved equal.

2.2 WOVEN GEOTEXTILE FABRIC

A. Material shall be manufactured for separation applications and comprised of high-tenacity polypropylene yarns with elongation less than 20 percent. Woven geotextile shall comply with AASHTO M 288-06 and the properties specified below:

Property	Method	Minimum Value (MARV*)
Grab Strength	ASTM D4632	250 lbs min.
Trapezoidal Tear Strength	ASTM D4533	90 lbs min.
Puncture Strength	ASTM D4833	700 lbs min.
Apparent Opening Size (AOS)	ASTM D4751	0.425 mm max.
Permittivity	ASTM D4491	0.1 sec^{-1} min.
Ultraviolet Stability	ASTM D4355	70% min. (after 500 hours of exposure)
Survivability	AASHTO M288-06	Class 2

*Minimum average roll value - all properties except AOS.

B. Product and Manufacturer: Provide one of the following:
   1. Mirafi 830X as manufactured by TenCate Corporation; or
   2. Approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

A. All geotextiles shall be weighted with sandbags or the equivalent when required. Such sandbags shall be installed during placement and shall remain until replaced with cover material or geomembrane.

B. Placement of the geotextile shall not be conducted during adverse weather conditions. The geotextile shall be kept dry during storage and up to the time of deployment. Removal of the sandbags or equal shall only occur upon placement of an overlying soil layer. Geotextiles shall not be placed during excessively windy periods that preclude the proper placement of the geotextiles.

C. CONTRACTOR shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

D. During placement of geotextiles, care shall be taken not to entrap in the geotextile stone, excessive dust, or moisture that could damage the geomembrane, generate clogging, or hamper subsequent seaming.

E. Proper cutting tools shall be used to cut and size the geotextile materials. Care shall be exercised while cutting geotextiles.

F. Geotextiles shall not be exposed to precipitation prior to being installed, and shall not be exposed to direct sunlight for more than 15 days.

G. Geotextiles shall be overlapped 12-inches.

H. In all cases, seams on slopes shall be parallel to the line of slope. Horizontal seams shall be avoided on slopes.

3.3 GEOTEXTILE REPAIR

A. Any holes or tears in the fabric shall be repaired as follows:
   1. On slopes: A fabric patch shall be sewn into place using a double sewn lock stitch (1/4-inch to 3/4-inch apart and no closer than 1-inch from any edge). Should any tear exceed ten percent of the width of the roll, that roll shall be removed from the slope and replaced.
   2. Non-slopes: A fabric patch shall be spot-seamed in place with a minimum of 24-inches of overlap in all directions.

3.4 PLACEMENT OF COVER MATERIALS

A. CONTRACTOR shall place all cover materials in such a manner to ensure the geotextile is not damaged; minimal slippage of the geotextile on underlying layers; and no excess tensile stresses in the geotextile.

B. Geotextile shall be covered within the time period recommended by the Manufacturer, and in no case later than two weeks after its placement.

+ + END OF SECTION + +

SECTION 31 05 19.16

GEOMEMBRANES FOR EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and services required to furnish and install 60-mil thick, textured low linear density polyethylene (LLDPE) Flexible Membrane Liner (FML) material as shown on the Contract Drawings and as specified herein.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill
   2. Section 31 05 19.13 Geotextiles for Earthwork
   3. Section 31 05 19.23 Geosynthetic Clay Liners
   4. Section 31 05 19.26 Geocomposites

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics;
      b. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Gravity) of Plastics by Displacement;
      c. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting;
      d. ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique;
      e. ASTM D 1603 - Standard Test Method for Carbon Black Content in Olefin Plastics;
      f. ASTM D 4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique;
      g. ASTM D 4437 - Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes;
      h. ASTM D 4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products;
      i. ASTM D 5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test;
      j. ASTM D 5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics;
      k. ASTM D 5617 - Test Method for Multi-Axial Tension Test for Geosynthetics;
      l. ASTM D 5994 - Standard Test Method for Measuring Core Thickness of Textured Geomembrane;
      m. ASTM D6392 - Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods;
      n. ASTM D 6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes; and
      o. ASTM D 7466 - Standard Test Method for Measuring the Asperity Height of Textured Geomembrane.

B. Geosynthetic Research Institute (GRI):
   1. GRI Test Method GM 17 (GRI GM17): Test Properties, Testing Frequencies, and Recommended Warranty for LLDPE Smooth and Textured Geomembranes.

C. Where reference is made to one of the above codes, standards, specifications, or publications, the revisions in effect at the time of bid shall apply.

1.3 SUBMITTALS

A. The Contractor shall submit the following information regarding the FML Manufacturer:
   1. Corporate background and information.
   2. Manufacturing capabilities including:
      a. QC procedures for manufacturing; and
      b. List of material properties including certified test results, to which FML samples are attached.
   3. Origin (resin supplier's name and resin production plant) and identification (brand name and number) of the resin.
   4. Copies of dated QC certificates issued by the resin supplier.
   5. Written certification that the minimum specification limits provided in Part 2.02 of this section are guaranteed by the Manufacturer.

B. A copy of the Installer's letter of approval or license by the Manufacturer.

C. Record drawings (prepared by the Installer and provided upon completion of installation) illustrating the following information:
   1. Dimensions of all FML field panels.
   2. Panel locations referenced to the Technical Drawings, which depict the identification number assigned to each FML panel.
   3. All field seams and panels with the appropriate number or code.
   4. Location of all patches, repairs, and destructive testing samples.

D. Shop drawings (provided at least one week prior to installation) that include the layout plan for all FML field panels.

E. QC program manuals covering all phases of manufacturing and installation.

F. Complete and detailed written instructions for the storage, handling, installation, seaming, inspection plan fail criteria for liner inspections, and QA/QC testing procedures of the liner in compliance with this section and the condition of its warranty.

G. Manufacturer's standard warranty provided for the FML.

H. Installer's written certification (provided prior to the installation of the FML) that the final surface on which the FML is to be installed is acceptable to both CONSTRUCTION MANAGER and the CONTRACTOR. The certification is subject to the review and approval or rejection by CONSTRUCTION MANAGER.

I. Contractor's written certification (provided prior to the installation of the FML) that the field-delivered FML has not been damaged due to improper transportation, handling, or storage.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Each roll of FML delivered to the Site shall be labeled by the manufacturer identifying the manufacturer's name, product identification, lot number, roll number, thickness of the material, and roll dimensions.

B. All rolls and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify CONSTRUCTION MANAGER if any loss or damage exists to FML. Replace loss and repair damage to new condition, in accordance with manufacturer's instructions. The CONTRACTOR shall be liable for all damages to the materials incurred prior to and during transportation to the site.

PART 2 - PRODUCTS

2.1 LLDPE GEOMEMBRANE

A. FML Material Specifications:

1. FML material shall be LLDPE geomembrane textured on both sides and meet the following specification values listed below and as listed in GRI GM17.

Property	Test Method	Specification Limit
		60 mil Textured
Density (max.)	ASTM D1505/D792	0.940 g/cc
Carbon Black Content	ASTM D1603 (3) /D4218	2.0 – 3.0%
Carbon Black Dispersion	ASTM D5596	9 of 10 views in category 1 or 2 1 of 10 views in category 3
Thickness (nominal) Thickness (min. avg.) lowest individual 8 of 10 values lowest individual of 10 values	ASTM D5994	60 mil 57 mil 54 mil 51 mil
Tensile Strength at Break (min. avg.)	ASTM D6693 Type IV	90 lb/in
Elongation at Break (min. avg.)		250%
Tear Resistance (min. avg.)	ASTM D1004	33 lbs
Asperity Height (min. avg.)	ASTM D7466	16 mil
Puncture Resistance (min. avg.)	ASTM D4833	66 lbs
Break Resistance Strain (min.)	ASTM D5617	30 minutes

B. Welding Material:
1. The resin used in the welding material must be identical to the liner material.
2. All welding materials shall be of a type recommended and supplied by the Manufacturer and shall be delivered in the original sealed containers, each with an indelible label bearing the brand name, Manufacturer's mark number, and complete directions as to proper storage.

2.2 QUALTY CONTROL

A. Provide QC certificates for all materials delivered to the Site. QC certificates shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or

Technical Services Manager. The QC certificates shall include lot and roll identification numbers, testing procedures, and results of QC tests. At a minimum, QC test results shall be provided for the properties listed below:

1. Density (ASTM D1505);
2. Carbon black content (ASTM D1603);
3. Carbon black dispersion (ASTM D5596);
4. Thickness (ASTM D5994);
5. Tensile properties (ASTM D6693);
6. Asperity Height (GM 12);
7. Tear Resistance (ASTM D1004);
8. Puncture Resistance (ASTM D4833); and
9. Stress Crack Resistance (D5397).

B. The above QC tests shall be performed at the minimum frequencies listed in Tables 2a/2b of GRI GM17.

C. Field delivered material shall be subjected to the following conformance tests performed at the Contractor's expense:

1. Density (ASTM D1505);
2. Carbon black content (ASTM D1603);
3. Carbon black dispersion (ASTM D5596);
4. Thickness (ASTM D5994); and
5. Tensile properties (ASTM D6693).

Conformance tests shall be performed on the first and last rolls of each delivered lot.

D. All conformance test results will be reviewed by the ENGINEER for conformance with the project specifications, prior to the deployment of the FML.

E. If a test result is not in conformance with a required value, all material from the lot represented by the failing test shall be considered out of Specification and rejected. Alternatively, at the option of the Engineer, one of the two following procedures may be performed, in response to a failing conformance test result:

1. If the Contractor has reason to believe that the failing test may be the result of the CQA Laboratory incorrectly conducting the tests, the Contractor may request that the sample in question be retested by the CQA Laboratory with a technical representative of the manufacturer present during the testing. This re-testing shall be done at no additional cost to Project. Alternatively, the Contractor may have the sample retested at two different approved (i.e., by the Engineer) CQA Laboratories at no additional cost to Project. If both laboratories produce passing results, the material may be accepted. If both laboratories do not produce passing results, then the original CQA Laboratory's failing test results will be considered accurate and the material will be rejected.
2. Additional conformance test samples may be taken to "bracket" the portion of the lot not meeting Specification (note that this procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line). To isolate the out-of-Specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both of the additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number) will be rejected. If one or both of the additional tests fail, then the entire lot will be rejected or the procedure may be repeated (again, at no additional cost to the Project) with two additional tests that bracket a greater number of rolls within the lot.

F. The CONTRACTOR shall obtain and submit to the CONSTRUCTION MANAGER a copy of the Manufacturer's Warranty for the FML.

G. The FML installer shall guarantee the FML installation against defects in the installation and workmanship for a minimum of 1 year commencing with the date of final acceptance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Related Earthwork:
   1. The Contractor shall ensure that all related earthwork requirements under this section are complied with:
      a. The FML installations shall be performed on geotextile-covered surfaces free from stones or protruding objects.
      b. No FML shall be placed onto an area that has become softened by precipitation. Appropriate methods of moisture control are the responsibility of the Contractor.
      c. No FML shall be placed on frozen soil material. Such material shall be removed and replaced with new soil fill as specified in Materials and Performance (M&P) – Section 02222 (Fill Materials).
      d. All surfaces on which the FML is to be installed shall be acceptable to CONSTRUCTION MANAGER prior to FML installation.
      e. Free edges of FML shall be secured so as to prevent uplift by wind or the intrusion of water under the liner. Edge protection shall include sandbags, polyethylene sheeting, or other methods as deemed necessary by the Contractor and approved by CONSTRUCTION MANAGER.
      f. The FML shall be anchored within an anchor trench constructed to the dimensions shown on the Technical Drawings. Care shall be taken while backfilling the trenches to prevent damage to the FML.

B. FML Deployment:
   1. FML shall be deployed according to the following procedures:
      a. Placement of the FML panels shall be according to the approved location and position plan provided by the Installer. Placement shall follow all instructions on the boxes or wrapping containing the FML materials that describe the proper methods of unrolling panels.
      b. FML deployment shall not be undertaken if weather conditions will preclude material seaming following deployment.
      c. The method of placement must ensure that:
         1) Deployed FML must be visually inspected for uniformity, tears, punctures, blisters, or other damage or imperfections. Any such imperfections shall be immediately repaired and reinspected.
         2) No equipment used shall damage the FML by handling, trafficking, leakage of hydrocarbons, or other means.
         3) No personnel working on the FML shall smoke, wear damaging shoes, or engage in other activities that could damage the FML.
         4) The prepared surface underlying the FML must not be allowed to deteriorate after acceptance, and must remain acceptable up to the time of FML placement and until completion of the project.

5) Adequate temporary loading and/or anchoring (e.g., sand bags), not likely to damage the FML, shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).
6) Direct contact with the FML shall be minimized (i.e., the FML in excessively high-traffic areas shall be protected by geotextiles, extra FML, or other suitable materials).
7) Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's are acceptable if wheel contact is less than 5 psi.
8) The method used to unroll or adjust the panels does not cause excessive scratches or crimps in the FML and does not damage the supporting soil or underlying geotextile (where applicable).
9) The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels).

d. Any damage to the FML panels or portions of the panels as a result of placement must be replaced or repaired at no cost to CONSTRUCTION MANAGER. The decision to replace or repair any panel or portions of panels shall be made by CONSTRUCTION MANAGER.
e. The Installer shall assign an "identification number" to each FML panel placed. The number system used shall be simple, logical, and shall identify the relative location in the field.

C. All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests.

D. Seaming:

1. The seaming procedures below shall be implemented, where applicable, during installation of the FML. The seaming procedures are as follows:
   a. Generally, all seams whether field or factory, shall be oriented parallel to the line of slope, not across slope. At liner penetrations and corners, the number of seams shall be minimized.
   b. The area of the FML to be seamed shall be cleaned and prepared according to the procedures specified by the Manufacturer. Any abrading of the FML shall not extend more than one-half inch on either side of the weld. Care shall be taken to eliminate or minimize the number of wrinkles and "fishmouths" resulting from seam orientation.
   c. Field seaming is prohibited when either the air or sheet temperature is below 32ºF, when the sheet temperature exceeds 122ºF, or when the air temperature is above 104ºF. At air or sheet temperatures between 32ºF and 40ºF, seaming shall be conducted directly behind a preheating device. In addition, seaming shall not be conducted when FML material is wet from precipitation, dew, fog, etc., or when winds are in excess of 20 miles per hour.
   d. Seaming shall not be performed on frozen or excessively wet underlying soil surfaces.
   e. Seams shall have an overlap beyond the weld large enough to perform destructive peel tests, but shall not exceed 5 inches.
   f. The Contractor shall perform trial seams on excess FML material. A 1-foot by 3-foot seamed liner sample shall be fabricated with the seam running down the 3-foot length in the center of the sample. Such trial seaming shall be conducted prior to the start of each seaming session for each seaming crew, every 4 hours, after any significant change in weather conditions or FML temperature, or after any change in seaming equipment. From each trial seam, four field test specimens shall be taken. The test specimens shall be 1-inch by 12-inch strips cut perpendicular to the trial seam. Two of these specimens shall be shear tested and two shall be peel tested using a field tensiometer, and recorded as pass (failure of liner material) or fail (failure of seam). Upon initial failure, a second trial seam shall be made; if both trial seams fail, then the seaming device and its operator shall not perform any seaming operations until the deficiencies are corrected and

two successive passing trial seams are produced. Completed trial seam samples cannot be used as portions of a second sample and must be discarded.

g. Where fishmouths occur, the material shall be cut, overlapped, and an overlap weld shall be applied. Where necessary, patching using the same liner material shall be welded to the FML sheet.

h. Acceptable seaming methods for FML are:
   1) Extrusion welding using extrudate with identical physical, chemical, and environmental properties; and
   2) Hot wedge welding using a proven fusion welder and master seamer.

i. Seaming device shall not have any sharp edges that might damage the FML. Where self-propelled seaming devices are used, it shall be necessary to prevent "bulldozing" of the device into the underlying soil.

E. Seam Testing:
1. The Contractor shall perform non-destructive seam testing on 100 percent of field seams. The following test method and procedures may be used:
   a. Air pressure testing may be used if double-track hot-wedge welding has been used to seam the HDPE FML. Using approved pressure testing equipment, the following procedures will be followed:
      1) Seal both ends of the air channel separating the double-track hot-wedge welds.
      2) Insert pressure needle into air channel and pressurize the air channel to 27 psi.
      3) Monitor pressure gauge for 3 minutes and determine whether pressure is maintained without a loss of more than 2 psi.
      4) If the pressure test fails, then localize the leak and mark the area for repair.
         a) Air pressure testing will be conducted under the direct observation of CONSTRUCTION MANAGER.
         b) Vacuum testing will be used on all seams not tested using air pressure testing. Using an approved vacuum box, the following procedures will be followed:
            i. Apply a soapy water mixture over the seam.
            ii. Place vacuum box over soapy seam and form a tight seal.
            iii. Create a vacuum by reducing the vacuum box pressure to 5 psi for 10 seconds.
            iv. Observe through the vacuum box window any bubbles.
            v. Where bubbles are observed, mark seam for repair.
            vi. Move vacuum box further down seam overlapping tested seam by 3 inches.
            vii. Where hot-wedge seaming has been performed, the overlap must be cut back to the weld.
         c) All vacuum testing will be conducted under the direct observation of CONSTRUCTION MANAGER.
2. In addition to non-destructive seam testing, the Contractor will perform destructive testing. The destructive testing procedures are as follows:
   a. Test samples will be prepared by the Installer every 500 feet of seam length, a minimum of one test for each seaming machine per day, or more frequently at the discretion of CONSTRUCTION MANAGER. Sample location and size will be selected by CONSTRUCTION MANAGER. The sample size (12 x 56 inches) will be large enough to produce three sets of test specimens for the following tests:
      1) Seam Shear Strength (ASTM D6392); and
      2) Peel Adhesion (ASTM D6392).
   b. Ten specimens will compose a set. Five of these will be tested for peel and the other five for shear strength. Each specimen will be 1-inch wide and 12-inches long with the field seam at the

center of the specimen. The 56-inch sample length will first be cut at the ends to produce two field peel test specimens. The remaining 54 inches will be divided up into thirds and one-third submitted to the Contractor, one-third to the independent testing laboratory, and one-third to CONSTRUCTION MANAGER for storage and future reference.

c. Test specimens will be considered passing if the minimum values below are met or exceeded for four of the five test specimens tested by the independent laboratory. All acceptable seams will lie between two locations where samples have passed.
d. The cost of destructive testing will be borne by the Contractor.
e. Seams will meet the following minimum criteria:

Field Seam Properties	Test Method	Specification Limit
Shear Strength	ASTM D6392	90 ppi
Peel Adhesion – Fusion	ASTM D6392	75 ppi and Film tear bond
Peel Adhesion – Extrusion	ASTM D6392	66 ppi and Film tear bond

3. If a sample fails destructive testing, the Contractor shall ensure that: the seam is reconstructed in each direction between the location of the sample that failed and the location of the next acceptable sample; or the welding path is retraced to an intermediate location at least 10 feet in each direction from the location of the sample that failed the test, and a second sample is taken for an additional field test. If this second test sample passes, the seam must be then reconstructed between the location of the second test and the original sampled location. If the second sample fails, the process must be repeated.
   a. All costs for work performed to achieve passing tests along with costs for retesting will be borne by the Contractor.
4. If double-track hot-wedge welding is used, CONSTRUCTION MANAGER and the Installer must agree on the track weld that will be used in the destructive testing. The weld chosen inside or outside must be consistently tested, and must pass according to the criteria above.
5. All holes created by cutting out destructive samples will be patched by the Contractor immediately with an oval patch of the same material welded to the membrane using extrusion welding. The patch seams will be tested using a vacuum box and using the procedures described above. Work will not proceed with materials covering the FML until passing results of destructive testing have been achieved.
6. At the ends of each field seam, two field test specimens will be taken and field tested with a field tensiometer. Both specimens must pass prior to placing the membrane in the anchor trench or continuing with additional seams. Failure of these specimens will require correcting the seaming device and repair of the preceding seam according to the failure testing and procedures described above.

F. Liner Repair:
1. All imperfections, flaws, construction damage, and destructive and nondestructive seam failures shall be repaired by the Installer of the FML. The appropriate methods of repair are listed below:
   a. Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter;
   b. Grinding and rewelding, used to repair small sections of extruded seams;
   c. Spot welding or seaming, used to repair pinholes or other minor, localized flaws;
   d. Capping, used to repair large lengths of failed seams;
   e. Topping, used to repair areas of inadequate seams which have an exposed edge; and
   f. Removing bad seams and replacing with a strip of new material welded into place.

G. Construction Material Placement and Penetrations:

1. Wrinkles that develop from normal placement procedures must be controlled such that the underlying FML does not fold over. Small wrinkles, defined as having their height less than or equal to one-half their base width, may be trapped and pushed down by the overlying soil. Any wrinkle that becomes too large and uncontrollable or that folds the FML over must be brought to the attention of CONSTRUCTION MANAGER. If necessary, the FML shall be uncovered, cut, laid flat, seamed by extrusion welding, and non-destructively tested.

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+ + END OF SECTION + +

SECTION 31 05 19.19

GEOGRIDS FOR EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and services required to furnish and install bi-axial geogrid material as shown on the Contract Drawings and as specified herein.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM D 4759 - Standard Practice for Determining the Specification Conformance of Geosynthetics.
      b. ASTM D 6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
      c. ASTM D7748 - Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products (using samples of geogrid with 2 longitudinal ribs and side ribs cut flush to the junctions with the longitudinal ribs).
      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 5818 - Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics.
      f. ASTM D1603 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
      g. ASTM D6637 Method A - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
      h. ASTM D7737 - Standard Test Method for Individual Geogrid Junction (performed at 10% per minute strain rate).
      i. ASTM D7864 - Standard Test Method for Determining the Aperture Stability Modulus of Geogrids (calculated at a torque of 22.1lb-in).
      j. EPA 9090A - Compatibility Test for Wastes and Membrane Liners.

B. Where reference is made to one of the above codes, standards, specifications, or publications, the revisions in effect at the time of bid shall apply.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's/distributor's product data sheets (product data sheets must originate from the company/organization that will be certifying that the product delivered meets the specification).

B. Manufacturer's Quality Control Plan including:
   1. QC procedures for manufacturing; and
   2. Certification that manufacturing meets ISO 9001 quality standards.

C. Submit the Manufacturers Mill Certificate signed by the manufacturer clearly indicating:
   1. Manufacturer's name.
   2. Manufacturing plant address and contact information.
   3. Date of manufacture.

D. Manufacturer's geogrid test reports properties/tests listed under Sections 2.1 and 2.2 of this specification including, at minimum:
   1. Description of geogrids tested including lot numbers, Mill Certificates and all pertinent quality control data from lots tested sufficient to relate results to products being supplied to this project.
   2. Date, location and results of testing presented as required by the standard test procedures listed.

E. Manufacturer's printed transportation, storage and installation instructions. Include methods for maintaining installed products.

F. Submit manufacturer's warranty.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in manufacturer's original, unbroken rolls and packaging, with labels clearly identifying product name, style lot number and manufacturer.

B. Store materials in accordance with manufacturer's instructions.

C. Protect materials during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 BI-AXIAL GEOGRID

A. Bi-axial Geogrid Material Specifications:
   1. Geogrid material shall consist of a polypropylene grid formed by punching and orienting a single sheet of film to form a stable, regular grid network of square apertures and shall meet the specification values listed below.

Property	Test Method	Specification Limit	
		XD[1]	XMD[1]
Aperture Dimensions	-	1.0 in	1.3 in.
Minimum Rib Thickness	-	0.03 in.	0.03 in.
Tensile Strength @ 2% Strain	ASTM D6637-10 Method A	280 lb/ft	450 lb/ft
Tensile Strength@ 5% Strain	ASTM D6637-10 Method A	580 lb/ft	920 lb/ft

Property	Test Method	Specification Limit	
		XD[1]	XMD[1]
Ultimate Tensile Strength	ASTM D6637-10 Method A	850 lb/ft	1300 lb/ft
Carbon Black Content (min.)	ASTM D1603	2.0%	
Junction Efficiency (min.)	ASTM D7737-11	93%	
Flexural Stiffness (min.)	ASTM D7748-12	250,000 mg-cm	
Aperture Stability (min)	ASTM D5617	0.32 m-N/deg	
UV Light Degradation Resistance (min.)	ASTM D4355-05	100%	
Long Term Degradation Resistance(min.)	EPA 9090A	100%	
Installation Damage Resistance (min.)	ASTM D5818	90%	

Notes:
1. XD and XMD values shown are minimum average roll values determined in accordance with ASTM D4759.

2.2 QUALITY CONTROL

A. Provide QC certificates for all materials delivered to the Site. QC certificates shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. The QC certificates shall include lot and roll identification numbers, testing procedures, and results of QC tests. At a minimum, QC test results shall be provided for the properties listed below:
   1. Tensile Strength @ 2% Strain (ASTM D6637);
   2. Tensile Strength @ 5% Strain (ASTM D6637);
   3. Ultimate Tensile Strength (ASTM D6637);
   4. Carbon Black Content (ASTM D1603);
   5. Junction Efficiency (ASTM D7737);
   6. Asperity Stability (ASTM D5617);
   7. UV Degradation Resistance (ASTM D4355);
   8. Long-Term Degradation Resistance (ETA 9090A); and
   9. Installation Damage Resistance (D5818).

B. Acceptable Manufacturers:
   1. Tensar International, Inc.
   2. TenCate
   3. Approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Related Earthwork:
   1. The Contractor shall ensure that all related earthwork requirements under this section are complied with:

a. Before beginning installation, verify site conditions are as indicated on the drawings. Notify the CONSTRUCTION MANAGER if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.
b. Select fill material shall be free of any foreign material and shall be free-flowing and not frozen when placed.

B. Geogrid Installation:

1. Install the geogrid in accordance with the manufacturer's instructions.

2. Geogrid shall be installed directly on prepared subgrade.

3. Geogrid shall be overlapped at all edges and seems such that panels do not separate during placement of fill over them. Minimum required overlap shall be per the manufacturer’s recommendations. Electrical ties may be used to mechanically join adjacent panels if required to maintain continuity.

4. Geogrid shall be temporarily secured in place before, during fill placement using sand bags, pins, or backfill as required by the aggregate fill properties, fill placement procedures and weather conditions.

5. Fill placement shall proceed in such a manner that it minimized development of wrinkles in and/or movement of the geogrid.

6. A minimum loose lift thickness of six inches is required before operating tracked vehicles over the geogrid placement area. Under all circumstances, turning of tracked equipment shall be avoided while over the geogrid placement area.

+ + END OF SECTION + +

SECTION 31 05 19.23

GEOSYNTHETIC CLAY LINERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and services required to complete the installation of geosynthetic clay liner (GCL) where shown on the Contract Drawings.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill;
   2. Section 31 05 19.13 Geotextiles for Earthwork;
   3. Section 31 05 19.16 Geomembranes for Earthwork; and
   4. Section 31 05 19.26 Geocomposites.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM D 4354 Standard Practice for Sampling of Geosynthetics for Testing;
      b. ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
      c. ASTM D 4873 Standard Guide for Identification, Storage and Handling of Geosynthetic Rolls and Samples;
      d. ASTM D 5887 Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter;
      e. ASTM D 5888 Standard Guide for Storage and Handling of Geosynthetic Clay Liners;
      f. ASTM D 5889 Standard Practice for Quality Control of Geosynthetic Clay Liners;
      g. ASTM D 4643 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method;
      h. ASTM D 5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles;
      i. ASTM D 5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners;
      j. ASTM D 5891 Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners;
      k. ASTM D 5993 Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners; and
      l. ASTM D 6495 Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners.

B. Where reference is made to one of the above codes, standards, specifications, or publications, the revisions in effect at the time of bid shall apply.

1.3 SUBMITTALS

A. The Contractor shall submit to CONSTRUCTION MANAGER the following items:

1. Prior to Delivery to the Site:
    a. A list of all GCL installation crew personnel and resumes of the Supervisor and QC Manager including prior experience installing GCL. This information shall be submitted at least 30 days prior to the commencement of GCL installation. If the exact crew who will be performing the installation is not known 30 days in advance of the start date, the Contractor shall submit a list of several potential crew members. This information shall be supplied in a timely manner for approvals in order to avoid delay of any construction activities. GCL crew staff will be subject to approval by CONSTRUCTION MANAGER.
    b. A copy of the Manufacturer's Manufacturing Quality Assurance/Manufacturing Quality Control (MQA/MQC) Plan for testing GCL.
    c. A statement of the GCL Manufacturer's experience in manufacturing GCL, including the manufacturing and supplying company's name, address, and employee contact.
    d. A certification from the GCL Manufacturer attesting that the proposed GCL meets the physical, mechanical, and manufacturing requirements specified in Part 2 of this Section.
    e. Copies of the MQC certificates for the material to be delivered to the site. The reports shall include the quality control test results of samples obtained during the manufacturing of material to be delivered to the site. The GCL will be rejected if it does not meet the specified requirements of Part 2 of this Section, or if it is found to have defects, rips, holes, flaws, deterioration, or other damage deemed unacceptable by the CONSTRUCTION MANAGER.
    f. Summary report including results of MQC testing required by this Section for GCL material to be delivered to the site. The report must clearly demonstrate that the GCL material to be delivered to the site meets requirements of Part 2 of this Section.
    g. Proposed method of GCL panel seaming including overlap distance at sides and end of panels and use of additional material to complete the seal (if any).
    h. Internal and interface shear strength test results as required in Section 2.
2. Prior to Installation:
    a. A schedule of operations including means and methods of installation.
    b. The proposed method of deploying material and placement of panels.
    c. Proposed method or process by which adjacent panels will be joined to provide a continuous hydraulic barrier.
    d. The Installer shall certify in writing that the final surface on which the GCL is to be installed is acceptable.
    e. Shop drawings including details and panel layout diagrams of all overlapping attachments and anchoring.
    f. Proposed method of protecting installed GCL panels from rain, ponding water, or other elements that could over hydrate or damage the GCL.
3. During Installation Submitted Daily:
    a. Daily construction progress reports clearly showing GCL panels and GCL roll numbers placed by date.
4. Upon Completion:
    a. Record Panel Layout Diagram.
    b. Summary and log of all field quality control work completed by the Contractor.
    c. Certification that GCL installation is complete and in accordance with these specifications.
    d. Statement of material and installation warranties.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for the protection of the GCL against damage during transportation to the site, during storage and installation at the site, and prior to placement of subsequent construction material.

B. GCL labeling, shipment, and storage shall follow ASTM D4873 and D5888, as modified according to this Section.

C. Product labels shall clearly show the manufacturer or supplier name, style name, roll number, and roll dimensions.

D. If any special handling is required, it shall be so marked on the outside surface of the wrapping (i.e., "Do not stack more than three rolls high").

E. The GCL shall be supplied dry (unhydrated, 30% or less moisture content) and be delivered to the site undamaged.

F. Each GCL roll shall be wrapped with material that will protect the bentonite from moisture and the GCL from damage due to shipment, water, sunlight, and contaminants.

G. The protective wrapping shall be maintained during periods of shipment and storage. If the wrapping is damaged prior to the installation, the packaging shall be immediately repaired and/or roll tarped to prevent potential additional hydration. The roll shall be set aside and marked for closer inspection upon deployment. Sections of the roll may be rejected if the moisture content of the bentonite has become excessively high as determined by the CONSTRUCTION MANAGER.

H. Storage area should be relatively flat and well drained. During storage, the GCL rolls shall be elevated off the ground utilizing a method which will not damage the GCL. Material that is damaged as a result of the method of storage or handling shall be rejected and replaced at no additional cost to the OWNER. The GCL rolls shall be adequately covered to protect them from the following:
   1. Site construction damage;
   2. Precipitation and ponded water;
   3. Chemicals that are strong acids or bases;
   4. Flames or sparks, temperatures in excess of 49°C (120°F); and
   5. Any environmental condition that might damage the GCL.

I. The contractor shall protect the work described in this Section before, during, and after installation. Only non-damaged, sufficiently dry material (as determined by the CONSTRUCTION MANAGER) shall be included within the construction.

J. Roll numbers on partially used rolls shall be maintained such that each GCL roll number can be readily identified just prior to GCL deployment.

K. If the CONSTRUCTION MANAGER determines that the GCL is damaged or excessively hydrated, the Contractor shall make all repairs and replacements in a timely manner to prevent delays in the progress of work. Any material damaged by the Contractor, or damaged by others due to improper delivery, installation, and/or storage, as determined by CONSTRUCTION MANAGER, shall be replaced by the Contractor at no cost to the OWNER.

PART 2 - PRODUCTS

2.1 GEOSYNTHETIC CLAY LINER - GENERAL

A. The GCL shall consist of a low permeability sodium bentonite encapsulated between two non-woven geotextiles. The bentonite and finished product requirements are described in the following Parts and include the minimum quality control testing.

B. The Contractor shall obtain a certificate from the GCL manufacturer for MQC testing described in this Part.

2.2 BENTONITE

A. The bentonite used for the production of the GCL shall be low permeability sodium bentonite.

B. The bentonite portion of the GCL shall be granular bentonite.

C. The supplier and/or source of the bentonite shall be included in the MQA results for the bentonite.

2.3 GCL

A. GCL material may be acceptable for use provided the selected product meets the above-described requirements and the following minimum test values:

GEOSYNTHETIC CLAY LINER		
Property	**Method**	**Value**
Hydraulic Conductivity	ASTM D5887	5×10^{-9} cm/sec max.
Mass Per Unit Area		
1. Bentonite Content	ASTM D5993	0.75 lb/ft^2 dry weight MARV*
2. Geotextile Upper Layer	ASTM D5261	6.0 oz/yd^2 MARV*
3. Geotextile Lower Layer	ASTM D5261	6.0 oz/yd^2 MARV*
Bentonite Moisture Content	ASTM D4643	30% max.
Index Flux [1]	ASTM D5887	1×10^{-8} m^3/m^2/sec max.
Tensile Strength[2]	ASTM D6768	45 lb/in MARV*

* Minimum Average Roll Value

1. Test according to manufacturer's recommendations and in compliance with the specified ASTM standard.
2. Tensile testing to be performed in the machine and cross directions.

C. Acceptable Manufacturers
1. CETCO (Bentomat® DN); or
2. Approved equal.

2.4 QUALTY CONTROL

A. The field-delivered material shall meet the specification values according to the Manufacturer's specification sheet and meet or exceed the requirements in this specification.

B. All conformance test results will be reviewed by the ENGINEER for conformance with the project specifications, prior to the deployment of the GCL.

C. Conformance testing shall be conducted in accordance with ASTM D6495 and at a minimum shall determine the following characteristics on the GCL:
   1. Hydraulic Conductivity (ASTM D5887);
   2. Mass per Unit Area of Bentonite (ASTM D5993)
   3. Mass per Unit Area Upper and Lower Layer Geotextile (ASTM D5261);
   4. Bentonite Moisture Content (ASTM D4643);
   5. Index Flux of GCL (ASTM D5887); and
   6. Tensile Strength of GCL (ASTM D6768).

D. GCL samples will be taken across the entire width of the roll. Unless otherwise specified or permitted by the CONSTRUCTION MANAGER, samples shall be three feet long by the roll width.

E. Unless otherwise specified, samples shall be taken at a frequency of one per 25,000 square feet of material delivered to the site.

F. If a test result is not in conformance with a required value, all material from the lot represented by the failing test shall be considered out of Specification and rejected. Alternatively, at the option of the Engineer, one of the two following procedures may be performed, in response to a failing conformance test result:
   1. If the Contractor has reason to believe that the failing test may be the result of the CQA Laboratory incorrectly conducting the tests, the Contractor may request that the sample in question be retested by the CQA Laboratory with a technical representative of the manufacturer present during the testing. This re-testing shall be done at no additional cost to Project. Alternatively, the Contractor may have the sample retested at two different approved (i.e., by the Engineer) CQA Laboratories at no additional cost to Project. If both laboratories produce passing results, the material may be accepted. If both laboratories do not produce passing results, then the original CQA Laboratory's failing test results will be considered accurate and the material will be rejected.
   2. Additional conformance test samples may be taken to "bracket" the portion of the lot not meeting Specification (note that this procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line). To isolate the out-of-Specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both of the additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number) will be rejected. If one or both of the additional tests fail, then the entire lot will be rejected or the procedure may be repeated (again, at no additional cost to the Project) with two additional tests that bracket a greater number of rolls within the lot.

G. The Manufacturer shall have developed and shall adhere to its own QA program in the manufacture of the geosynthetic clay liner.

PART 3 - EXECUTION

3.1 PREPARATION

A. The surface to be covered by the GCL shall be cleared of sharp objects, boulders, sticks, or any materials that may puncture, shear, or tear the GCL. The GCL subgrade shall have a smooth, finished surface, free from pockets, holes, ruts and depressions that could cause bridging and overstress the material in the opinion of the CONSTRUCTION MANAGER.

B. The Contractor shall inspect the subgrade for unsuitable areas or soft spots before the GCL is placed. Additional surface preparation will be required to eliminate any unsuitable areas as determined by the CONSTRUCTION MANAGER.

C. The subgrade/geosynthetic surface below the GCL shall:
   1. Be prepared in accordance with the Technical Drawings and Specifications.
   2. For GCL deployment over soil surfaces, the prepared soil surface shall have no stones or other protrusions that may be damaging to the GCL as determined by the CONSTRUCTION MANAGER.
   3. Be approved, accepted and certified by the CONSTRUCTION MANAGER and Contractor's quality assurance inspector.

3.2 INSTALLATION

A. GCL shall not be deployed during periods of excessive rain or winds, which would prevent an acceptable installation as determined by the CONSTRUCTION MANAGER.

B. All GCL materials shall be installed according to the grades and locations presented in the Technical Drawings and in accordance with manufacturer's recommendations.

C. The Contractor shall furnish the roll number and panel number to CONSTRUCTION MANAGER prior to the installation of each panel.

D. The Contractor shall maintain the GCL in an "as received" condition up to and including the time that the overlying layer of the engineered barrier is documented by the CONSTRUCTION MANAGER. While the GCL will begin to hydrate immediately upon deployment, it is essential that the GCL not become excessively hydrated prior to loading, as placement of material over hydrated bentonite may destabilize a given area. The GCL must have a minimum of 1 foot of general fill in place prior to full hydration. Additional restrictions and guidance with regard to hydrated or wet GCL are as follows:
   1. GCL shall not be placed on wet subgrade, as determined by the CONSTRUCTION MANAGER.
   2. GCL becoming partially hydrated prior to covering with general fill shall be evaluated by the CONSTRUCTION MANAGER to ascertain the condition of the material and to determine if removal and replacement is necessary.
   3. In the event that excessive hydration occurs prior to the placement of the overlying materials described above, the GCL material shall be evaluated by the CONSTRUCTION MANAGER to ascertain the condition of the material and to determine if removal is necessary.

E. The Contractor is required to place cover materials as quickly as possible after deployment of GCL. The GCL and overlying geomembrane shall be deployed on the same day to avoid exposure of the GCL to precipitation.

F. Contractor personnel shall not be allowed to wear shoes that can damage the GCL during deployment or placement of subsequent geosynthetic materials.

G. GCL panels shall be deployed in a direction from the highest elevation to the lowest elevation within the area to be lined. Whenever possible, GCL panels shall be staggered such that cross seams between panels are not continuous throughout the lined area. GCL panels shall be installed free of tension.

H. GCL seams shall be overlapped a minimum of 6 in. on edge seams and minimum of 24 in. on end seams after shrinkage and before placing cover.

I. The GCL rolls shall be handled in a manner that minimizes loss of bentonite along edges during deployment.

J. The Contractor shall be responsible for protection of the GCL during installation. Unless otherwise approved by the CONSTRUCTION MANAGER, no rubber tire ATV's, tracked vehicles, or other equipment which may pose a risk of puncturing, tearing, or otherwise damaging the GCL shall be permitted for use directly over the GCL.

K. The GCL shall not be covered until inspected and approved by the CONSTRUCTION MANAGER.

3.3 REPAIRS

A. Repairs are to be made as soon as possible following deployment of GCL panels.

B. Damage to the GCL shall be repaired in the following manner, unless alternate procedures are proposed by the Contractor and approved by the CONSTRUCTION MANAGER:
   1. The damaged area shall be cleared of dirt and debris.
   2. A patch of GCL shall be cut to extend a minimum of 12 in. beyond the damaged area in all directions.
   3. Granular bentonite shall be placed around the perimeter of the damaged area at a rate of 0.25 pounds per linear foot.
   4. The patch shall be placed over the damaged area and may be secured with an adhesive to keep the patch in position during backfilling or other activities over the GCL. The adhesive shall be approved by the Manufacturer and the CONSTRUCTION MANAGER.

C. Damage to GCL during installation shall be repaired according to this Section. If CONSTRUCTION MANAGER determines that the damage is considered un-repairable, the damaged material will be replaced at no additional cost to the OWNER.

+ + END OF SECTION + +

SECTION 31 05 19.26

GEOCOMPOSITES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and services required to furnish and install geocomposite where shown on the Design Drawings and as specified herein.

B. Related Sections:
   1. Section 31 23 05, Excavation and Fill;
   2. Section 31 05 19.13 Geotextiles for Earthwork;
   3. Section 31 05 19.16 Geomembranes for Earthwork; and
   4. Section 31 05 19.23 Geosynthetic Clay Liners.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM D 1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer;
      b. ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique;
      c. ASTM D 1603 - Standard Test Method for Carbon Black Content in Olefin Plastics;
      d. ASTM D 1777 - Standard Test Method for Thickness of Textile Materials;
      e. ASTM D 3776 - Standard Test Methods for Mass per Unit Area (Weight) of Fabric;
      f. ASTM D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity;
      g. ASTM D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles;
      h. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
      i. ASTM D 4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head;
      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 D 5199 - Standard Test Method for Measuring Thickness of Geotextiles and Geomembranes;
      m. ASTM D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles;
      n. ASTM D 7005 - Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites; and
      o. ASTM F 904 - Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials.

B. Geosynthetic Research Institute (GRI):
   1. GRI Test Method GC 7 (GRI GC7): Determination of Adhesion and Bond Strength of Geocomposites.

C. Where reference is made to one of the above codes, standards, specifications, or publications, the revisions in effect at the time of bid shall apply.

1.3 SUBMITTALS

A. Manufacturer’s data for the geocomposite including physical properties and roll size.

B. The origin (supplier’s name and production plant) and identification (brand name and number) of the geotextile and geonet used to fabricate the geocomposite.

C. Material sample of geocomposite.

D. Manufacturer’s installation procedures and specifications.

E. Manufacturer's Quality Assurance (QA)/Quality Control (QC) program.

F. Written certification that the minimum test values provided under Part 2.02 of this section are guaranteed by the Manufacturer.

G. Contractor's proposed transportation, handling, and storage techniques for the geocomposite.

H. Contractor’s written certification (provided prior to the installation of the geocomposite) that the field-delivered geocomposite has not been damaged due to improper transportation, handling, or storage.

I. Contractor’s written certification (provided prior to the installation of the geocomposite) that the surface on which the geocomposite is to be installed is acceptable to both the CONSTRUCTION MANAGER and the Contractor. The certification is subject to the review and approval or rejection by CONSTRUCTION MANAGER.

J. All personnel performing installation shall be qualified by previous experience.

K. Shop drawings depicting installation details, a panel layout diagram, and a description of proposed installation techniques for the geocomposite.

L. QC certificates (signed by a responsible party employed by the Manufacturer) for the geocomposite, which identify the sections of field-delivered material they represent. The QC certificates shall include lot and roll identification numbers, testing procedures, and results of QC tests. At a minimum, results shall be given in accordance with the Design Drawings and Specifications for:
   1. Unit Weight (geotextile component) (ASTM D5261);
   2. Thickness (ASTM D1777);
   3. Geotextile-Geonet Ply Adhesion (ASTM D7005/F904/GRI GC7); and
   4. Transmissivity (ASTM D4716).

      QC tests for the above-listed properties shall be performed in accordance with the Manufacturer’s QA/QC program.

M. Contractor’s written certification that the field-delivered material meets the Manufacturer’s specifications. The Contractor shall also provide the lot and roll identification numbers for the field-delivered material.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The geocomposite shall be packaged and shipped by appropriate means so as to prevent damage. Geocomposite rolls will be wrapped in relatively opaque and water tight plastic to prevent damage during shipping and storage. Geocomposite rolls that have been delivered to the job site will be unloaded and stored in their original, unopened wrappers in a secure, dry area, and protected from weathering. Materials shall be delivered only after the required submittals have been received and approved by CONSTRUCTION MANAGER.

B. The geocomposite shall be furnished in rolls marked or tagged with the following information:
   1. Manufacturer's Name;
   2. Product Identification;
   3. Lot/Batch Number;
   4. Roll Number; and
   5. Roll Dimensions.

C. The geocomposite shall be stored in an area approved by CONSTRUCTION MANAGER that prevents damage to the product or packaging.

D. The geocomposite shall be kept clean and free from dirt, dust, mud, and any other debris.

E. Any geocomposite found to be damaged shall be replaced with new material at the Contractor's expense.

PART 2 - PRODUCTS

2.1 GEOCOMPOSITE

A. The geocomposite shall be comprised of a high-density polyethylene (HDPE) drainage net composited with two, 8 oz/yd^2 non-woven geotextiles. The geotextiles shall be heat bonded to both sides of the drainage net.
   1. The drainage net to be used in the composite shall be a profiled mesh made by extruding two sets of high density strands together to form a diamond shaped, three-dimensional net to provide planar fluid flow. The drainage net shall be made of HDPE containing carbon black, anti-oxidants, and heat stabilizers that shall be manufactured from resin provided from one resin supplier.
   2. The geotextile shall be a non-woven, needle punched polymeric material

B. Geocomposite material may be acceptable for use provided the selected product meets the above-described requirements and the following minimum test values:
   1. Drainage Net:

Property	Test Method	Unit of Measure	Minimum Test Value
Specific Gravity	ASTM D1505	g/cm^3	0.94
Melt Flow Index	ASTM D1238 – Condition E	g/10 min.	0.3 maximum
Carbon Black Content	ASTM D1603	%	2.0 – 3.0

2. Geotextile:

Property	Test Method	Unit of Measure	Minimum Test Value
Grab Tensile	ASTM D4632	lbs	158
Grab Elongation	ASTM D4632	%	50
Puncture	ASTM D4833	lbs	56
Trapezoidal Tear	ASTM D4533	lbs	56
Burst Strength	ASTM D3786	lbs	189
Permittivity	ASTM D4491	sec^{-1}	1.3
Apparent Opening Size	ASTM D4751	mm	< 0.25

3. Composited Materials:

Property	Test Method	Unit of Measure	Minimum Test Value
Transmissivity	ASTM D4716*	m^2/s	6.06×10^{-3}
Ply Adhesion	ASTM D7005/F904 GRI GC7	lb/in width	0.5

* Test method to be performed with the following modifications:

Substrate Material:	60-mil textured LLDPE or HDPE geomembrane on top of steel plate and overlain by a steel plate
Superstrate Material:	Neoprene or 6 inches of representative soil
Applied Normal Compressive Load:	2,300 lbs/ft^2
Seating Time:	100 hours (minimum)
Hydraulic Gradient:	0.1

C. Acceptable Manufacturers:
1. GSE Lining Technology, Inc.;
2. TENAX;
3. SKAPS Industries; and
4. Approved equal.

2.2 QUALITY CONTROL

A. The field-delivered material shall meet the specification values according to the Manufacturer's specification sheet and meet or exceed the requirements in this specification.

B. All conformance test results will be reviewed by the ENGINEER for conformance with the project specifications, prior to the deployment of the geocomposite.

C. If a test result is not in conformance with a required value, all material from the lot represented by the failing test shall be considered out of Specification and rejected. Alternatively, at the option of the Engineer, one of the two following procedures may be performed, in response to a failing conformance test result:
1. If the Contractor has reason to believe that the failing test may be the result of the CQA Laboratory incorrectly conducting the tests, the Contractor may request that the sample in question be retested by the CQA Laboratory with a technical representative of the manufacturer present during the testing.

This re-testing shall be done at no additional cost to Project. Alternatively, the Contractor may have the sample retested at two different approved (i.e., by the Engineer) CQA Laboratories at no additional cost to Project. If both laboratories produce passing results, the material may be accepted. If both laboratories do not produce passing results, then the original CQA Laboratory's failing test results will be considered accurate and the material will be rejected.

2. Additional conformance test samples may be taken to "bracket" the portion of the lot not meeting Specification (note that this procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line). To isolate the out-of-Specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If both of the additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number) will be rejected. If one or both of the additional tests fail, then the entire lot will be rejected or the procedure may be repeated (again, at no additional cost to the Project) with two additional tests that bracket a greater number of rolls within the lot.

D. The Manufacturer shall have developed and shall adhere to its own QA program in the manufacture of the geocomposite.

PART 3 - EXECUTION

3.1 PREPARATION

A. The areas designated for placement of geocomposite shall be free from any deleterious material.

B. If the geocomposite is not clean before installation, it shall be washed by the Contractor until accepted by CONSTRUCTION MANAGER.

C. Prior to installation of any geocomposite, CONSTRUCTION MANAGER and the Contractor must both concur that the underlying Flexible Membrane Liner (FML) is acceptable. This will necessitate reviewing of all QA/QC testing of the FML by CONSTRUCTION MANAGER and the Contractor. The Contractor shall submit written verification that both CONSTRUCTION MANAGER and the Contractor agree that the underlying FML is acceptable (refer to Part1.04I of this section).

3.2 INSTALLATION

A. Geocomposite shall be installed at locations shown on the Design Drawings.

B. Adjacent rolls shall be installed so that the geonet component will have a minimum overlap of 4 inches.

C. The geonet shall be tied with plastic fasteners every 5 feet along the slope and every 6 inches on butt seams and in the anchor trenches.

D. The geotextiles shall be continuously sewn using a polymeric thread with chemical and ultraviolet resistance properties equal to or exceeding those of the geotextile.

E. The geocomposite shall be unrolled downslope, keeping the net in slight tension to minimize wrinkles and folds.

F. If a tri-planar material is used, it must be installed in the appropriate flow direction.

G. Adequate loading shall be placed to prevent uplift by wind.

H. Holes or tears in the geocomposite shall be repaired in accordance with the Manufacturer's recommendations.

I. Any portion of the geocomposite exhibiting a flaw shall be repaired. Prior to acceptance of the geocomposite, the Installer shall locate and repair all damaged areas as directed by CONSTRUCTION MANAGER.

+ + END OF SECTION + +

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
   2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
   3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
   4. Limits of Clearing and Grubbing Work: Clear and grub all areas within the Work areas unless otherwise shown or indicated in the Contract Documents.

B. Related Sections:
   1. Section 01 57 05, Temporary Controls.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Laws and Regulations applying to the Work under this Section include, but are not necessarily limited to, the following:
      a. 40 CFR 262 and 263, Resource Conservation and Recovery Act (RCRA); and
      b. Section 22a-449(c)-100, Connecticut Standard Remediation Regulations.

1.3 SUBMITTALS

A. Action Submittals: Submit the following
   1. Shop Drawings:
      a. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
      b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.
   2. Qualification Statements:
      a. Arborist.

1.4 WARRANTY

A. CONTRACTOR shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from CONTRACTOR’s operations becomes evident during the correction period, CONTRACTOR shall replace damaged items and property at no additional cost to OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:
   1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by CONTRACTOR to original condition or replace in kind, to satisfaction of CONSTRUCTION MANAGER, at no additional cost to OWNER.
   2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by CONSTRUCTION MANAGER. Correct at CONTRACTOR's expense damage caused by CONTRACTOR outside the limits of clearing Work.
   3. Do not remove trees without approval of CONSTRUCTION MANAGER, unless shown or indicated for removal.
   4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:
   1. Delineation of Clearing and Grubbing Limits:
      a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits.
      b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with CONSTRUCTION MANAGER before commencing removal of trees, vegetation, and other materials to be removed.
      c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and CONSTRUCTION MANAGER allows removal of flagging.
   2. Erosion and Sediment Controls:
      a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
      b. Comply with erosion and sediment control requirements of Section 31 25 14, Stabilization Measures for Erosion and Sedimentation Control.
      c. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

A. Remove and dispose of all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.

B. Remove and dispose of existing wooden railroad ties located in the Rails to Trails area between the south side of the RCRA cap and Curtiss Street.

C. Trees and Shrubs Improperly Destroyed or Damaged:
   1. For each tree or shrub to remain that is destroyed or damaged beyond repair by CONTRACTOR, provide two replacements of the same species at locations to be designated by ENGINEER.

D. Trees and shrubs to remain that have been damaged or require trimming shall be treated and repaired under the direction of a qualified arborist, or other professional with qualifications acceptable to ENGINEER. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by CONTRACTOR at no additional cost to OWNER.

E. Disposal of Cleared and Grubbed Materials:
   1. Stage above-ground portion of tree trunks greater than 6” in diameter at designated location(s) approved by the CONSTRUCTION MANAGER.
   2. Chip branches, stems and trunks that are less than 6” in diameter onsite for stockpiling at location(s) designated by the CONSTRUCTION MANAGER.
   3. Root balls or other materials cleared at or below grade will be disposed of offsite at a commercial facility in accordance with applicable regulations.
   4. Dispose of rubbish, railroad ties, debris, and other cleared and grubbed material at appropriate off-Site location in accordance with Laws and Regulations unless otherwise shown or indicated in the Contract Documents.
   5. Do not burn clearing debris at the Site.

+ + END OF SECTION + +

SECTION 31 23 05

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of structures, underground facilities, roads, and other facilities required to complete the Work.
   2. Preparation of subgrade for asphalt pavement is included under this Section.
   3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof, except rock requiring drilling, blasting or special equipment for removal.

B. Related Sections:
   1. Section 31 05 19, Geosynthetics for Earthwork.

C. General:
   1. Earth materials from on-site excavations and excess materials from Rails to Trails excavation shall be consolidated under the RCRA cap, unless otherwise specified.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM D422, Test Method for Particle-Size Analysis of Soils;
   2. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method;
   3. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3));
   4. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass;
   5. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils;
   6. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); and
   7. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. "Subgrade" is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR’s Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
      b. Do not employ the same laboratory hired by OWNER for field quality control testing under the field quality control Article of this Section.
      c. Testing laboratory shall be experienced in the types of testing required.
      d. Selection of testing laboratory is subject to CONSTRUCTION MANAGER's acceptance.

B. Quality Assurance Testing:
   1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by CONSTRUCTION MANAGER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR’s expense.
   3. CONTRACTOR’s Testing Laboratory Scope:
      a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.
      b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
      c. Submit to CONSTRUCTION MANAGER and CONTRACTOR written report results of each test.
   4. Required Quality Assurance Material Testing by CONTRACTOR’s Testing Laboratory:
      a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each of the following types of material incorporated into the Work: select fill, general fill, filter stone, and processed aggregate base.
      b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill.
      c. Moisture/density relations in accordance with ASTM D1557. Perform one test for every 5,000 cubic yards of the following types of materials incorporated into the Work: select fill, general fill, excavated materials from on-site and processed aggregate base material.
      d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of the following types of material incorporated into the Work: select fill, general fill, excavated materials from on-site and processed aggregate base material.
      e. NTCRA 1 Fill Material:
         1) Gradation in accordance with ASTM D422 - 10 samples minimum.
      f. NTCRA 1 Trench Backfill Material:
         1) Gradation in accordance with ASTM D422 - 6 samples minimum.

C. Regulatory Requirements:
   1. Perform excavation work in compliance with the requirements of authorities having jurisdiction and Laws and Regulations, including:
      a. Clean Water Act (CWA) -Discharge to Waters of the United States, Section 404.
   2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

3. An existing underground AT&T fiber optic line is located along the west side of the RCRA cap area and on the east side of the Rails to Trails between the RCRA cap and Curtiss Street as shown on the Design Drawings. The CONTRACTOR shall coordinate with AT&T for all work conducted within 10 feet of fiber optic line.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
  1. Samples:
     a. At least four weeks prior to delivery of any aggregate and soil material required under this Section or topsoil material to the Site, the Contractor shall submit samples to the Construction Manager to conduct at least one set of chemistry analyses for each aggregate type and borrow source. Samples from each fill source shall be tested for the presence of PCBs, pesticides, VOC, SVOC, Herbicides dioxin, and TAL Metals. A joint inspection of the aggregate or borrow source will be conducted by the Contractor and Construction Manager. All sampling at source material shall be done in the presence of both the Contractor and Construction Manager.
     b. If sample results from 1.5.A.2.a show that the proposed material does not meet the Soil Cleanup Levels for the site, the Contractor must identify a new source for the material and provide the required data report for the new source of material prior to the use of such material onsite.

B. Informational Submittals: Submit the following:
  1. Procedure Submittals:
     a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
        1) Name of CONTRACTOR’s “competent person” in responsible charge of excavation and fill Work;
        2) Excavation method(s), excavation protection system(s), and additional items to be included in the Work;
        3) Copies of “manufacturer's data” or other tabulated data if protective system(s) are designed on the basis of such data; and
        4) Plan for coordination with the utility company (AT&T) when conducting any excavation, fill, or other intrusive work within 10 feet of the fiber optic line.
     b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
  2. The name and location of the source of each proposed fill material.
  3. The name and location of contingent off-site water treatment facility for disposal of dewatering liquids if on-site treatment is not available.
  4. Quality Assurance Test Results Submittals:
     a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
        1) Tests on borrow fill material; and
        2) Optimum moisture - maximum dry density curve for each type of fill material.

5. Field Quality Control Submittals:
   a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
      1) Field density testing.
6. Qualifications Statements:
   a. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory's personnel that will perform quality assurance testing required in this Section.
   b. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory's personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

A. Subsurface Information: Supplemental information provided with the request for proposal includes information available relative to subsurface conditions at the Site. Such information and data is not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by CONTRACTOR. OWNER will not be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

B. Existing Structures:
   1. The Contract Documents show or indicate certain structures and underground facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. CONTRACTOR shall explore ahead of the excavation to determine the exact location of all existing structures and underground facilities. Existing structures and underground facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and underground facilities damaged by CONTRACTOR without additional cost to OWNER.
   2. Movement or operation of construction equipment over underground facilities shall be at CONTRACTOR's sole risk and only after CONTRACTOR has prepared and submitted to CONSTRUCTION MANAGER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR's analysis of the loads to be imparted and CONTRACTOR's proposed measures to protect structures and underground facilities during the Project.
   3. Coordinate with utility owners for shut-off of services in active piping and conduits. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
   4. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by CONSTRUCTION MANAGER after acceptable temporary utility services are provided by CONTRACTOR for the affected structure or property.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Select Fill:
1. Material shall be well-graded, crushed stone aggregate, free of organic material, complying with the following:

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1.5-inch	100
¼-inch	25-60
No. 4	15-45
No. 10	5-25
No. 100	0-10
No. 200	0-5

2. Material shall meet the requirements of Section M.02.02 of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

B. General Fill:
1. Material shall be free of: rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
2. Fill shall be classified as ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, and/or SM.

C. Stone Screenings:
1. Material shall be natural or artificially graded mixture of crushed stone, broken stone or natural or crushed sand complying with the gradation requirements below.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
3/8-inch	100
No. 8	60-100

2. Material shall meet the requirements of Section M.01.01 of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

D. Processed Aggregate Base
1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand, complying with the gradation requirements below. Crushed slag is unacceptable.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
2.5-inch	100
2-inch	95-100
¾-inch	50-75
¼-inch	25-45

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
No. 40	5-20
No. 100	2-12

2. Material shall meet the requirements of Section M.05.01 of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

E. Filter Stone:
1. Material shall be well-graded, clean, durable broken stone or screened gravel complying with the gradation requirements below.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1/2-inch	100
3/8-inch	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

F. NTCRA 1 General Fill Material: [Withdrawn. Refer to Part 2.1.B.]

G. NTCRA 1 Trench Backfill Material:
1. Materials used as trench backfill in the NTCRA 1 area will consist of washed pea gravel with and average d_{17} value between 2 mm and 10 mm, where d_{17} is the size for which 17 percent of the sample by weight passes (i.e., 17% of sample finer). The contractor will verify and document that this specification is met by performing the quality assurance testing outlined in Part 1 of this specification.

H. Solar Panel Area Surfacing Stone:
1. Materials used for the surface of the cap area below the solar panel installation will consist of a natural or artificially graded mixture of crushed stone, broken stone or natural or crushed sand complying with the gradation requirements below.

Sieve Sizes (Square Openings)	Percentage by Weight Passing Sieve
1-inch	100
¾-inch	90-100
½-inch	20-55
3/8-inch	0-15
No. 4	0-5

2. Material shall meet the requirements of Section M.01.01 of the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

2.2 SOURCE QUALITY CONTROL

A. Perform quality assurance testing, and submit results to CONSTRUCTION MANAGER, in accordance with the 'Quality Assurance" Article in Part 1 of this Section.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide CONSTRUCTION MANAGER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. CONSTRUCTION MANAGER will advise CONTRACTOR in writing when CONSTRUCTION MANAGER is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:
   1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

B. Payment for Test Pits:
   1. All payment for test pits shown or indicated in the Contract Documents will be part of the lump sum Contract Price.
   2. Separate payment will not be made for test pits made by CONTRACTOR for CONTRACTOR's own use.

3.3 PREPARATION

A. Dust/Vapor/Odor Control:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to CONSTRUCTION MANAGER's acceptance and approval of authorities having jurisdiction.
   2. The CONTRACTOR shall supply an adequate supply of BioSolve® (or approved equivalent), sprayers, vapor-suppressant foam, and a foaming unit for the duration of the Project. These items will be used accordingly to suppress dust/vapors/odors in accordance with this RCRA Cap Design.

B. Maintenance and Protection of Traffic:
1. Keep all streets and traffic ways open for passage of traffic and pedestrians during the Project, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable.
2. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, and other acceptable temporary expedients to accommodate traffic. Closings of street or traffic way shall be for shortest time practical, and passage shall be restored immediately after completion of fill and temporary paving or bridging.
3. Give required advance notice to fire department, police department, and other emergency services as applicable of proposed construction operations.
4. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than 2 days prior to construction that will affect the property.
5. Hydrants, valves, fire alarm boxes, postal boxes and delivery service boxes, and other facilities that may require access during construction shall be kept accessible for use.
6. Provide temporary signage, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect traffic and warn of hazards. Such Work shall comply with requirements of owner of right-of-way and authorities having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.

3.4 DEWATERING

A. Dewatering - General:
1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to CONSTRUCTION MANAGER and backfilling operations are completed and acceptable to CONSTRUCTION MANAGER.
2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
5. Remove water from excavations as fast as water collects.

B. Disposal of Water Removed by Dewatering Operation:
1. CONTRACTOR’s dewatering operation shall collect groundwater in a manner that minimizes the entrainment of silts and shall discharge to the on-site groundwater treatment facility. The maximum transfer rate to the treatment facility shall not exceed 5 gallons per minute. All water treatment shall be coordinated with the CONSTRUCTION MANAGER and treatment system's operator. Prior to transfer for treatment, all water shall be allowed to settle for a minimum of 12 hours to remove entrained silts.

2. If the volume of dewatering liquid to be disposed of by the CONTRACTOR exceeds the capacity of the on-site treatment system, the dewatering liquids shall be disposed of at an off-site treatment facility approved by the CONSTRUCTION MANAGER.
3. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
4. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
5. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits.

B. Excavation Protection:
   1. Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced as required by the soil conditions.

C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.

D. When excavations are made below required grades without written order of CONSTRUCTION MANAGER, fill such excavations with compacted select fill material, as directed by CONSTRUCTION MANAGER, at CONTRACTOR’s expense.

E. Subgrades - General:
   1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with select fill. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
   2. If, in CONSTRUCTION MANAGER’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select Fill material at CONTRACTOR’s expense.

F. Proofrolling Subgrades:
   1. Prior to placing fill or constructing pavements or slabs, proofroll the subgrade surface with sufficient proofrolling apparatus. Before starting proofrolling, submit to and obtain acceptance from CONSTRUCTION MANAGER of proofrolling apparatus and procedure to be used.
   2. Proofrolling operations shall be made in the presence of CONSTRUCTION MANAGER. Notify CONSTRUCTION MANAGER at least 24 hours in advance of start of proofrolling operations.
   3. Subgrades displaying pronounced elasticity or deformation, deflection, cracking, or rutting shall be stabilized as directed by CONSTRUCTION MANAGER. Unsuitable materials shall be undercut to the depth directed by CONSTRUCTION MANAGER and replaced with select fill material. Other suitable stabilization methods may be directed by CONSTRUCTION MANAGER.

G. Pipe Trench Preparation:
   1. Not more than 150 feet of trench may be opened in advance of installing pipe in trench.
   2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
      a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
      b. Enlargement of trench width at pipe joints may be made when required and approved by CONSTRUCTION MANAGER.
      c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
      d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
      e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
   3. Depth of trench shall be as shown or indicated. If required and approved by CONSTRUCTION MANAGER in writing, depths may be revised.
   4. Where CONSTRUCTION MANAGER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

H. Excavated Materials to be Consolidated under Cap:
   1. Stockpile excavated materials in designated areas as indicated on the Drawings.
   2. As excavation proceeds, keep stockpiles of excavated materials separate from waste materials.
   3. Place, grade, and shape stockpiles for proper drainage.
   4. Locate and retain soil materials away from edge of excavations.
   5. Dispose of excess soil material and waste materials as specified in this Section.
   6. Stockpiled excavated soils for use as select fill or general fill shall be tested and classified by laboratory as on-Site select fill or on-Site general fill. Perform required quality assurance testing for material verification on stockpiled materials as soon as possible to demonstrate compliance of excavated materials with the Contract Documents.

3.6 UNAUTHORIZED EXCAVATION

A. All excavations outside lines and grades shown or indicated and that are not approved by CONSTRUCTION MANAGER, together with removing and disposing of the associated material, shall be at CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR’s expense.

3.7 EROSION AND SEDIMENT CONTROLS

A. Provide temporary erosion and sediment controls in accordance with Section 01 57 05, Temporary Controls.

3.8 FILL AND COMPACTION - GENERAL PROVISIONS

A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.

B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
   1. CONSTRUCTION MANAGER’s authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work;
   2. Inspection, testing, approval, and recording of locations of Underground facilities;

3. Removal of concrete formwork;
4. Removal of shoring and bracing, and filling of voids with satisfactory materials;
5. Removal of trash and debris; and
6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.

C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.

D. Fill materials placed within 6 inches of the bottom and top of the RCRA cap geosynthetics shall have a maximum stone particle size of ½-inch.

E. Placement - General:
1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground facilities.
2. Place fill materials at moisture content and density as specified in Table 31 23 05-A of this Section and this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
3. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents.
4. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor or tracked equipment. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
5. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
7. Repair, at CONTRACTOR's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by CONSTRUCTION MANAGER.

F. Fill in Pipe Trenches:
1. Place pipe bedding material in pipe trenches in horizontal layers, and thoroughly compact each layer before the next layer is placed.

2. Piping Installed in Fills Above Pre-construction Grade:
   a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.
3. Pipe Bedding: Pipe bedding material shall be as follows:
   a. Unless otherwise shown, install piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.
4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
   a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
   b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.
   c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
   d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.

G. Fill Placement over Geosynthetics:
   1. No equipment shall be operated directly on the top surface of geosynthetics without permission from the CONSTRUCTION MANAGER. General fill shall be pushed out over geosynthetics in an upward tumbling motion so that wrinkles in geosynthetics do not fold over. Soil shall not be dropped directly onto geosynthetics from a height greater than 3 feet. On slopes, fill shall be placed from the bottom of the slope upward.
   2. The first lift of soil placed over geosynthetics shall be a minimum of 12 inches in loose thickness. Equipment with ground pressures less than 5 psi shall be used to place and compact the first lift of general fill. Compaction shall consist of a minimum of 2 passes over all areas.
   3. The loose lift thickness of each subsequent lift shall be no greater than 12 inches.

H. Subbase Placement:
   1. Provide subbase material where shown to the limits shown or indicated.
   2. Place subbase material in compacted lifts not exceeding depth of six inches each.

I. Drainage Stone Placement:
   1. Provide drainage stone material where shown to the limits shown or indicated.
   2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage stone using suitable compaction equipment.

J. Compaction Density Requirements:
1. Compaction required for all types of fills shall be in accordance with Table 31 23 05-A of this Section. Moisten material or aerate the material as necessary to provide the moisture content that will facilitate obtaining the required compaction.

TABLE 31 23 05-A
REQUIRED MINIMUM DENSITY

Material	Percent Compaction (ASTM D1557)	Uncompacted Lift (inches)
Subgrade - Existing Soils	Not Applicable	Proof-rolling
On-site Excavated Materials Consolidated Below RCRA Cap	90	12
General Fill - RCRA Cap	Lightly compacted with tracked equipment	12
General Fill - NTCRA 1 Area	90	12
Select Fill		
Access roads and driveways	95	6
Pipe backfill	95	6
Subbase Material (Processed Aggregate Base)	95	6
Pipe Bedding Material	95	6
Drainage Stone and NTCRA 1 Trench Backfill Material	Not Applicable	6

2. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent.
3. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated in Table 31 23 05-A of this Section.
4. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the "Field Quality Control" Article in Part 3 of this Section.
5. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to OWNER until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by CONSTRUCTION MANAGER) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

K. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with Table 31 23 05-A and the associated "Compaction Density Requirements" in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.9 GRADING

A. General:
   1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.10 PAVEMENT SUBBASE COURSE

A. General:
   1. Place subbase material (processed aggregate base), in layers of specified thickness, over ground surface to support pavement courses.
   2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by CONSTRUCTION MANAGER.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:
   1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
   2. Provide geotextile separation fabric over the prepared subgrade in accordance with Section 31 05 19, “Geosynthetics for Earthwork.”
   3. Compaction and Grade Control: Comply with compaction requirements for excavation and fill in this Section, and the following requirements:
      a. Compaction with roller shall begin at the sides of the area to be paved and continue toward the center. Continue compaction until there is no movement of the course ahead of the roller.
      b. After rolling, check for grade with a line not less than 40 feet in length; depression over 1/2-inch deep shall be filled to satisfaction of CONSTRUCTION MANAGER.
   4. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
   5. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
   6. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.11 FIELD QUALITY CONTROL

A. Site Tests: CONTRACTOR will employ a testing laboratory to perform field quality control testing.
   1. Required Material Tests:
      a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.

2. Authority and Duties of Testing Laboratory:
   a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to CONSTRUCTION MANAGER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of CONSTRUCTION MANAGER and CONTRACTOR to such failure.
   b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate CONSTRUCTION MANAGER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
3. Responsibilities and Duties of CONTRACTOR:
   a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
   b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
   c. It shall be CONTRACTOR's responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.
   d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade:
      1) 200 linear feet of trench fill;
      2) 10 cubic yards of select fill;
      3) 100 cubic yards of consolidation material;
      4) 100 cubic yards of general fill; and
      5) 50 cubic yards of subbase material.
4. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
   a. Trenches for Underground facilities: One location every 200 linear feet;
   b. For General Fill (NTCRA 1 Area): One per 1,000 square feet on every compacted lift; and
   c. Subbase Material: One per 1,000 square feet on every compacted lift.
5. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR's expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

3.12 VERIFICATION AND FINAL ACCEPTANCE

A. RCRA Cap and NTCRA 1 Area Final Grades
   1. Soil fill materials shall be constructed to the lines and grades shown on the Contract Drawings unless otherwise requested by the CONSTRUCTION MANAGER. Acceptance of final grades will be based on site observations by the CONSTRUCTION MANAGER and review of a final as-built survey information. Any settlements that occur prior to final acceptance of the Contract work shall be restored to design and/or intended grades by the CONTRACTOR at no additional cost to the OWNER.

2. CONTRACTOR shall conduct surveys as needed for excavation, placement of backfill and monitoring progress of the Work. CONTRACTOR shall notify the ENGINEER when final grading is complete, and the CONSTRUCTION MANAGER will have a state licensed surveyor conduct a verification survey. CONTRACTOR shall be responsible for cost of failed verification surveys.

+ + END OF SECTION + +

SECTION 31 37 00

RIPRAP

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install riprap at locations shown or indicated in the Contract Documents.

B. Coordination:
   1. Review procedures under this and other Sections and coordinate the Work that must be performed with or before placing riprap.

C. Related Sections:
   1. Section 31 05 19.13, Geotextiles for Earthwork;
   2. Section 31 11 00, Clearing and Grubbing; and
   3. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. American Society for Testing and Materials, (ASTM):
      a. ASTM C127, Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
   2. State of Connecticut Department of Transportation:
      a. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Riprap Supplier:
      a. Supplier of riprap and other materials furnished under this Section shall be certified by the State of Connecticut Department of Transportation for furnishing such materials for highways.

B. Regulatory Requirements:
   1. Reference Specifications and Details:
      a. Comply with applicable requirements of State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

1.4 SUBMITTALS

A. Action Submittals: Submit the following.
   1. Product Data:
      a. Source or quarry name, gradation, and other information required by CONSTRUCTION MANAGER. Submit for each source of material proposed.

b. Samples and test reports of type materials. Test reports shall include, but not be limited to, gradation, soundness test, and chemical test reports for aggregate source characterization.

B. Informational Submittals: Submit the following.
   1. Certificates:
      a. Where material is specified according to reference specification item number, submit copy of Supplier's valid certification from entity issuing the reference specification, and associated certification of material conformance with the reference specifications.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Riprap: Material shall be Intermediate Riprap in accordance with Section M.12.02 of the reference specifications indicated in Article 1.3 of this Section.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clear ground surface of brush, trees, stumps, and other objectionable material, and dress to a smooth surface. Clearing and grubbing, where required, shall comply with Section 33 11 00, Clearing and Grubbing.

B. Remove all soft or spongy material to depth shown or indicated on the Drawings or as directed by ENGINEER, and replace with acceptable material. Excavation, removal of unsuitable material if any, and backfilling shall comply with Section 31 23 05, Excavation and Fill.

C. Placing of geotextiles, where required, shall comply with Section 31 05 19.13, Geotextiles for Earthwork.

3.2 INSTALLATION

A. Riprap Placing:
   1. Minimum total thickness of riprap shall be as shown on the Drawings.
   2. Place riprap stones so that weight of stone is carried by underlying material and not by adjacent stones. Carefully place the stones on geosynthetics, where required, to produce an even distribution of pieces, with minimum of voids and without damaging the geosynthetic. Place the full-course thickness in one operation while preventing segregation and avoiding displacing of underlying material. Do not place stones in layers, by dumping into chutes, or by other methods that cause segregation or damage to geosynthetic, if any. When necessary, rearrange individual stones for uniform distribution.
   3. Riprap may be placed using equipment, and placing shall produce an installation of firm and solid riprap. Level the top surface of riprap to required alignment and slope by hand-placing stones to fill large voids and to make surface even.
   4. On slopes, place the largest stones at the bottom. Riprap shall be properly sized to form compact, solid blanket to protect the slope or channel, as applicable. On slopes steeper than one foot vertical to 1.5 feet horizontal, do not use rounded boulders or cobbles without grouting stones in place.
   5. Grouting: Where grouting of riprap is required, comply with the following:

   a. When stones are in place, completely fill spaces between stones with "grout fill" material in accordance with Section 03 60 00, Grouting.
   b. ENGINEER may direct that occasional spaces be left ungrouted for relief of hydrostatic pressure. Chink ungrouted spaces with spalls of suitable size.
   c. Do not grout riprap in freezing weather.
   d. Clean exposed surface of stones to remove accumulation of grout.
   e. Keep grouted riprap moist for seven days after grouting. Suitable grout curing compound may be employed when approved by ENGINEER.
6. When existing riprap is in proximity to riprap provided under this Section, place riprap to conform as closely as practicable in size and character to existing riprap.
7. Unless otherwise indicated, existing riprap removed to facilitate other Work shall be reinstalled or replaced at no additional cost to OWNER.

+ + END OF SECTION + +

SECTION 32 12 00

FLEXIBLE PAVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install flexible, hot-mix, hot-laid, asphalt concrete pavement.
   2. The Work includes:
      a. Preparation such as sawcutting, milling where shown or indicated, cleaning, and other preparation for installing flexible pavements;
      b. Providing asphalt concrete paving materials;
      c. Providing tack coat material;
      d. Providing pavement markings where shown or indicated; and
      e. Providing quality controls and testing.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. State of Connecticut Department of Transportation:
      a. Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.
   2. American Society for Testing and Materials, (ASTM):
      a. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3[600 kN-m/m3]); and
      b. D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Asphalt Concrete Production Facility:
      a. Production facility for asphalt concrete, tack coat materials, and other bitumastic materials shall be certified by the State of Connecticut Department of Transportation for furnishing such materials for highways.
   2. CONTRACTOR's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials provided under this Section.
      b. Do not employ the same laboratory hired by OWNER for field quality control testing under the "Field Quality Control" Article of this Section.

c. Testing laboratory shall be experienced in the types of testing required.
d. Selection of testing laboratory is subject to CONSTRUCTON MANAGER's acceptance.

B. Regulatory Requirements:
1. Reference Specifications and Details:
a. Comply with applicable requirements of State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

1.4 SUBMITTALS

A. Action Submittals: Submit the following.
1. Shop Drawings:
a. Submit the proposed asphalt concrete mix design for each asphalt concrete material, and other bituminous materials, required under this Section, providing complete data on materials, including location in the Work, source, material content and percentages, temperatures and all other pertinent data. Indicate proportion of bituminous material from reclaimed asphalt pavement.
b. Proposed gradation for each aggregate to be used in flexible paving. Submit gradation test results for the same material furnished on a previous project. Indicate the proportion of reclaimed asphalt pavement.
2. Product Data:
a. Manufacturer’s complete product data on all pavement marking materials proposed for use, including product literature, specifications, and recommended application techniques and other installation data.

B. Informational Submittals: Submit the following:
1. Quality Assurance Test Data Submittals and Source Quality Control Submittals:
a. Submit for quality assurance tests and source quality control tests required.
2. Delivery Tickets:
a. Submit copy of delivery ticket for each load of asphalt concrete, tack coat materials, and other materials obtained from asphalt concrete production facility, signed by CONTRACTOR.
3. Field Quality Control Submittals:
a. Submit results of required field quality control testing.

1.5 SITE CONDITIONS

A. Weather Limitations:
1. Temperature:
a. For surface course paving or other pavement courses in lifts less than two inches thick, temperature of surface on which pavement is to be placed shall be 50 degrees F or greater.
2. Prohibitions:
a. Do not place flexible paving materials when weather is foggy or during precipitation.
b. Do not place flexible paving materials when the base on which the material will be placed contains moisture in excess of optimum.
c. Place flexible paving materials only when CONSTRUCTON MANAGER concurs that weather conditions are suitable.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:
   1. Provide subbase course of the thickness shown or indicated, in accordance with Section 31 23 05, Excavation and Fill.
   2. Flexible Pavement Courses:
      a. Provide the flexible pavement courses indicated below.
      b. Rails to Trails and Parking Lot Pavement:
         1) Binder Course: 1.5 inches compacted thickness; and
         2) Surface Course (Wearing Course or Top Course): 1.5 inches compacted thickness.

2.2 ASPHALT CONCRETE MIXES

A. Asphalt Concrete Mixtures: Provide the following materials designed and manufactured in accordance with reference specifications indicated in Article 1.3 of this Section.
   1. Binder Course: HMA S0.375 superpave mix complying with Section M.4.02.2 of State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.
   2. Surface Course (Wearing Course, Top Course): HMA S0.375 superpave mix complying with Section M.4.02.2 of State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, 2016.

2.3 BITUMINOUS MATERIALS

A. Bituminous Materials for Asphalt Concrete:
   1. Bituminous materials for asphalt concrete shall comply with the reference specifications indicated in Article 1.3 of this Section, for the asphalt concrete mixes specified.

B. Tack Coat:
   1. Tack coat shall be emulsified asphalt.
   2. Provide tack coat complying with ASTM D977, Type RS-1 or RSH-1.

2.4 AGGREGATES IN FLEXIBLE PAVEMENTS

A. Aggregates for Asphalt Concrete – General:
   1. Aggregate materials used in flexible pavement shall be in accordance with the reference specifications indicated in Article 1.3 of this Section, for the asphalt concrete mix designs indicated.

B. Reclaimed Asphalt Pavement (RAP):
   1. Processed material obtained by milling or full depth removal of existing asphalt concrete pavement may be used as aggregate in asphalt concrete base course and binder course.
   2. Maximum proportion of RAP in the asphalt concrete provided shall comply with requirements of the reference specifications indicated in Article 1.3 of this Section.

2.5 PAVEMENT MARKING MATERIALS

A. Material:
   1. Pavement marking paint shall have chlorinated rubber base.
   2. Factory-mixed, quick-drying and non-bleeding, complying with FS TT-P-115, Type III.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the subbase and base on which flexible paving will be installed. Notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Do not place materials on subgrades, or subbase that is muddy or has water thereon.

3.2 PREPARATION

A. Preparation: Before starting installation of flexible paving, perform the following:
   1 Grade Control: Establish and maintain throughout flexible paving installation the required lines and grades, including crown and cross-slope for each asphalt concrete course during construction operations.
   2. Prepare subgrade and provide subbase for flexible pavement in accordance with Section 31 23 05, Excavation and Fill. Before installing flexible pavement, obtain CONSTRUCTION MANAGER's concurrence that subgrade and subbase are suitable for installing flexible pavement.
   3. Provide appropriate maintenance and protection of traffic measures during placement of pavement.
   4. Provide tack coat as indicated in Article 3.3 of this Section.

3.3 INSTALLATION OF FLEXIBLE PAVING

A. General:
   1. Provide final pavement surfaces of uniform texture, at required grades and cross-sections.
   2. Construct roadways to the lines, grades, and typical sections shown or indicated.

B. Installation of Asphalt Concrete:
   1. Asphalt concrete mixture shall be transported to the site of paving and placed as soon as possible after mixing.
   2. Placement of each asphalt concrete course shall be completed over the full width of the section under construction during each day's paving operations.
   3. Spread and finish asphalt concrete courses by means of self-propelled mechanical spreading and finishing equipment. Compacted thickness of layers placed shall not exceed 150 percent of specified thickness unless approved in writing by ENGINEER.
   4. Compaction:
      a. Rollers:
         1) Use sufficient rolling equipment to satisfactorily compact and finish the quantity of asphalt concrete placed. There shall be not less than two rollers on the Project at all times. When acceptable to ENGINEER, one of the rollers may be a pneumatic-tire roller.

2) During rolling operations, roller speed shall not exceed three miles per hour. When sufficient number of rollers is not available, reduce the quantity of asphalt concrete placed to accommodate the available rollers' speed.
3) Required rollers shall be at the Site, in acceptable operating condition, prior to placing of asphalt concrete.
4) Use of vibratory rollers in lieu of steel-wheeled rollers is acceptable, however when thickness of asphalt concrete is one-inch or less, rolling shall be in the static mode.

b. Rolling of initially-placed asphalt concrete material, or breakdown rolling, shall begin as soon as the asphalt concrete mixture will bear the roller without undue displacement.
c. Rolling shall be longitudinal, overlapping on successive trips by not less than one-half roller rear wheel width, and not more than three-quarters of roller rear wheel width. Alternate trips of the roller shall be of slightly different lengths.
d. At all times, roller motion shall be slow enough to avoid displacing the asphalt concrete.
e. Operate rollers continuously from breakdown of laid asphalt concrete through finish rolling.
f. Perform finish rolling using a steel-wheeled roller or a vibratory steel-wheel roller operating in the static mode.
g. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
h. At each location not accessible to roller, thoroughly compact asphalt concrete with tampers and finish, where necessary, with a hot smoothing iron to provide uniform, smooth layer over the entire area so compacted.

5. Each compacted asphalt concrete course shall be within plus or minus 1/4-inch of the indicated thickness.

C. Construction Joints:
1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction, and bond throughout.
2. Provide a transverse joint extending over the full width of the strip being laid and at right angles to its centerline at end of each workday and at other times when the placement of hot-mix asphalt concrete will be suspended for a period of time that will allow asphalt concrete mixture to chill.
3. Thoroughly compact by rolling the forward end of a freshly laid strip of asphalt concrete before the asphalt concrete mixture becomes chilled. When the Work is resumed, the end shall be cut vertically for the full depth of the layer.

D. Joining of Pavements:
1. When pavement is to join existing or previously-laid pavement, the existing or previously-laid pavement shall be neatly and carefully edged to allow for overlapping and feathering of the subsequent course of asphalt concrete material.
2. Where new pavement is to meet existing pavement, the existing pavement shall be sawcut and notched.
3. Where new pavement will meet existing asphalt pavement, remove existing pavement 12 inches onto undisturbed existing pavement course at edges where new pavement will meet existing pavement.
4. Tack Coat:
   a. Provide tack coat material at the following locations:
      1) At edges where new pavement will connect to existing or previously-installed pavement.
      2) On surface of existing or previously-installed pavement course over which new pavement will be installed, prior to placement of the subsequent pavement course. Tack coat may be deleted when a succeeding layer of asphalt pavement is being applied over a freshly-placed asphalt pavement course that has been subjected to very little or no traffic, with approval of CONSTRUCTION MANAGER.

3) Where new pavement will abut curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.

b. Tack Coat Installation: Install tack coat immediately prior to installing pavement. Place pavement while tack coat is wet. Apply tack coat in accordance with reference specification indicated in Article 1.3 of this Section.

E. Curing:
1. Do not allow traffic onto pavement until directed by CONSTRUCTION MANAGER. Traffic will not be allowed on new asphalt concrete pavement until surface temperature is less than 140 degrees F.

F. Defective Pavement Work:
1. When directed by ENGINEER, remove and replace defective flexible paving Work. Cut out such areas of defective pavement and fill with fresh asphalt concrete materials, compacted to required density.

3.4 FIELD QUALITY CONTROL

A. Asphalt Concrete Mix Temperature: Measure temperature at time of placement, record, and submit to CONSTRUCTION MANAGER.

B. Surface Smoothness:
1. Test finished surface of each flexible paving course for smoothness, using a ten-foot straightedge applied parallel to and at right angles to centerline of paved areas.
2. Check surfaced areas at intervals as directed by CONSTRUCTION MANAGER.
3. Surfaces will be acceptable relative to smoothness when measurements are equal to or less than the following:
   a) Base Course: 3/8-inch vertical in ten feet horizontal;
   b) Binder Course: 3/8-inch vertical in ten feet horizontal;
   c) Surface Course (Wearing Course): 1/4-inch vertical in ten feet horizontal; and
   d) Surfaces will be acceptable when variance is equal to or less than 1/4-inch from the template.
4. Elevation: Finished surface of pavement shall be within plus or minus 1/2-inch of elevations shown or indicated.

C. Density:
1. Test Method: ASTM D2950 nuclear method; test one sample every 1,000 square yards of pavement. Test for each asphalt concrete course installed.
2. In addition, compare density of in-place flexible paving materials against laboratory specimen or certificates on same asphalt pavement mixture, using nuclear density device.
3. Criteria for Acceptance: Density of in-place asphalt pavement material shall be not less than 90 percent of the recorded laboratory specimen or certificate density. Density shall be not greater than 98 percent.

3.5 ADJUSTING

A. Pavement Adjustment:
1. Repair or replace in manner acceptable to CONSTRUCTION MANAGER areas of pavement that are observed to pond or collect water.

3.6 CLEANING

A. Cleaning: After completing the paving operations, clean surfaces of excess or spilled bituminous materials, excess asphalt concrete, and foreign matter.

3.7 PROTECTION

A. Protect finished pavement until pavement has become properly hardened and cool.

B. Cover openings of drainage structures, manholes, valve boxes, and similar items in the paved area until permanent coverings are provided.

3.8 PAVEMENT MARKINGS

A. Pavement Markings: Provide pavement markings where shown or indicated.
   1. Preparation:
      a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
      b. Do not begin marking bituminous concrete pavement until approved by ENGINEER.
      c. When reflective glass beads are required, mix with paint prior to paint application.
   2. Application:
      a. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's recommendations.

+ + END OF SECTION + +

SECTION 32 31 00

FENCES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install fencing.
   2. Extent of fencing is shown or indicated.
   3. Types of materials required under this Section include:
      a. Aluminum-coated, steel chain link fabric; and
      b. Wood post and rail pedestrian fence.
   4. Substitutions: Structural shapes of satisfactory sections and equal strengths may be substituted upon ENGINEER's approval of CONTRACTOR's substitution request.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless;
   2. ASTM A90/A90M - Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings;
   3. ASTM A123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products;
   4. ASTM A153/A153M -Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware;
   5. ASTM A428/A428M - Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles;
   6. ASTM A491 - Specification for Aluminum-Coated Steel Chain-Link Fence Fabric;
   7. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings;
   8. ASTM B6 - Specification for Zinc;
   9. ASTM C94 - Standard Specification for Ready-Mixed Concrete;
   10. ASTM F537 - Standard Specification for Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials;
   11. ASTM F552 - Terminology Relating to Chain Link Fencing;
   12. ASTM F567 - Standard Practice for Installation of Chain-Link Fence;
   13. ASTM F626 - Specification for Fence Fittings;
   14. ASTM F669 - Standard Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence;
   15. ASTM F1043 - Specification for Strength and Protective Coatings of Steel Industrial Chain Link Fence Framework;
   16. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; and
   17. ASTM A1011/A1011M - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

B. Chain Link Fence Manufacturers Institute (CLFMI):
   1. CLFMI CLF 2445, Product Manual; and
   2. CLFMI, Step-by-Step Installation Guide.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning.
   1. "Knuckling" describes the type of selvage obtained by interlocking adjacent pairs of wire ends and then bending the wire ends back into a closed loop.
   2. "Fencing" describes an assembly of metal components, including wire chain-link fabric fastened to top, bottom and intermediate horizontal rails and to vertical line posts, corner posts and terminal posts. This assembly includes all auxiliary components, gates, fittings, fasteners, and other accessories, all with specified protective coatings.

B. Terminology used in this Section and not defined in this Article will be construed in accordance with the terminology used in CLF 2445 and ASTM F552.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Erector/Installer:
      a. Engage a single erector that is skilled and trained, and possesses successful and documented experience installing fencing, and employs only workers with specific skill and successful experience in the type of Work required.
      b. Erector shall be acceptable to fencing manufacturer.
      c. Submit name and qualifications of erector with the following information for a minimum of three successful projects:
         1) Names and telephone numbers of owner and architect or engineer responsible for project;
         2) Approximate fencing contract amount; and
         3) Quantity of fencing installed.

B. Component Supply and Compatibility:
   1. Provide fencing as complete system with all gates, hardware, appurtenances and other components produced by a single manufacturer, including custom erection accessories, fittings, clamps, and fastenings as required for complete system.

1.5 SUBMITTALS

A. Action Submittals: Submit the following.
   1. Shop Drawings:
      a. Drawings at scale of 1/4-inch equal to one foot of typical fence assembly, identifying all materials, dimensions, sizes, weights, and finishes of rails, posts, braces, supports and other fencing components. Show fence heights, and locations of gates. Show gate swing, or other operation, hardware, and accessories. Include plans, elevations, and sections, with required installation and operating clearances, and details of post anchorage, attachments, and bracing.
      b. Large-scale details drawn at scale of three inches equal to one foot for all connections and gate details.

2. Product Data:
   a. Copies of manufacturer's technical product information, and specifications for all fencing components.
   b. Data substantiating that materials proposed comply with the following:
      1) Weight of aluminum coating on wire fabrications, in compliance with ASTM A428; and
      2) Weight of zinc coating on pipe fabrications, in compliance with ASTM A90.

B. Informational Submittals: Submit the following.
   1. Certifications:
      a. Submit shipping list for materials used, endorsed with manufacturer's voucher, signed by authorized employee of manufacturer, certifying that material used in fencing complies with the Contract Documents and with the approved submittals.
   2. Design Data: Submit with the Shop Drawings:
      a. When proposing fencing framework or other structural components that varies from the Contract Documents, submit fabricator's structural calculations for design of proposed fencing. Structural analysis shall verify that all system components including supports, gates, fasteners, fittings, and connections comply with the Contract Documents and requirements of authorities having jurisdiction at the Site.
   3. Manufacturer's Instructions:
      a. Manufacturer's installation instructions.
   4. Qualifications Statements:
      a. Erector.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
   1. Packaging and Marking: Comply with CLFMI CLF 2445.
   2. Deliver materials in manufacturer's original, unopened packaging with all factory-applied tags, labels and other identifying information intact, legible and accurately representing material on approved submittals.

B. Storage of Materials:
   1. Store all materials under weatherproof cover, off the ground and away from other construction activities.
   2. Do not store material in a manner that would create a humidity chamber. Provide for free movement of air under protective cover and between components of the fencing.

C. Handling of Materials:
   1. Handle material in manner that is in compliance with manufacturer's recommendations and that avoids damaging coatings.

1.7 PROJECT CONDITIONS

A. Obtain measurements at the Site to verify layout information and dimensions for fencing and gates in relation to reference points indicated in the Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Considerations:
   1. Modifications may be made only as necessary to meet Site conditions to ensure proper fitting and support of the Work and only upon submittal of Shop Drawings and receipt of approval by the CONSTRUCTION MANAGER.

2.2 MATERIALS

A. General:
   1. Tube sizes specified are nominal outside dimension.
   2. Roll-formed section sizes are nominal outside dimensions.
   3. Wire gages shall conform to American Steel and Wire Company gage.
   4. Heat-form arcs and chords before applying protective coatings to metal.
   5. Sizes specified are given for uncoated metal. Protective coatings are in addition to specified metal dimensions, gages, and sizes.
   6. Provide weights of zinc and aluminum coatings on wire and pipe fabrications in accordance with CLFMI CLF 2445.

B. Chain-Link Fence Fabric:
   1. One-piece fabric widths, for fencing 12 feet and less in height, complying with CLFMI CLF 2445.
   2. Wire mesh shall be woven throughout in form of approximately-uniform square mesh with parallel sides and horizontal and vertical diagonals of approximately-uniform dimensions, of size and gage specified and in compliance with ASTM A817, Type 1, cold-drawn carbon steel wire with minimum breaking strength of 2,170 pounds and coated with aluminized finish, as specified. Fabric shall be as recommended by CLFMI for heavy industrial usage.
   3. Provide fence fabric imprinted with manufacturer's trade name, country of origin, core wire gage, and finished outside diameter gage.
   4. Provide fabric knuckled to eliminate exposure of sharp edges.
   5. Fabric Gage: Provide the following.
      a. No. 9-gage wires.
   6. Mesh Size: Provide the following.
      a. Two-inch mesh.

2.3 FRAMEWORK

A. General: The following table presents actual OD and equivalent nominal NPS size and trade size of round members.

Actual OD (inches)	NPS Size (inches)	Trade Size (inches)
1.315	1.0	1-3/8
1.660	1.25	1-5/8
1.900	1.5	2
2.375	2.0	2.5
2.875	2.5	3
3.500	3.0	3.5

Actual OD (inches)	NPS Size (inches)	Trade Size (inches)
4.000	3.5	4
6.625	6.0	6-5/8
8.625	8.0	8-5/8

B. Pipe shall be commercial grade, plain-end steel pipe with standard-weight walls. Steel strip used for manufacture of pipe shall comply with ASTM F1083, Schedule 40 pipe with minimum yield strength of 25,000 psi and protected with zinc, as specified.

C. Fittings: Comply with ASTM F626.

D. End, Corner, and Pull Posts: Provide end, corner, and pull posts of following minimum sizes:
   1. Over six feet fabric height and less than eight feet fabric height:
      a. 2.875 inches OD pipe weighing 5.79 pounds per linear foot.

E. Line Posts: Provide line posts of following minimum sizes and weights:
   1. Over six feet fabric height and less than eight feet fabric height:
      a. 2.375 inches OD pipe weighing 3.65 pounds per linear foot.

F. Top Rail: Provide top rails, unless otherwise shown or indicated, conforming to the following:
   1. 1.660 inch OD pipe weighing 2.27 pounds per linear foot.
   2. Provide in manufacturer's longest lengths, with expansion-type coupling 0.051-inch thick rail sleeves, approximately seven inches long, for each joint.
   3. Provide means for attaching top rail securely to each gate, corner, pull, and end post.

G. Roll-Formed Steel: Provide rolled steel shapes produced from structural-quality steel conforming to ASTM A1011, Grade 45, with minimum yield strength of 45,000 pounds psi. Protective coating system shall conform to ASTM F1043, as specified.

2.4 AUXILIARY FENCING MATERIALS AND ACCESSORIES

A. Wire Ties:
   1. For tying fabric to line posts, use nine-gage, aluminum alloy 1100-H4, PVC-coated wire ties to match fence fabric, spaced 12 inches on centers.
   2. For tying fabric to rails and braces, use nine-gage, aluminum alloy 1100-H4, PVC-coated wire ties to match fence fabric, spaced two feet on centers.
   3. For tying fabric to tension wire, use 11-gage, aluminum alloy 1100-H4, PVC-coated wire hog ring ties to match fence fabric, spaced two feet on centers.

B. Tension Wire: Provide tension wire consisting of aluminized, seven-gage, coiled spring steel wire coated with 0.40-ounces of aluminum per square foot of wire surface, minimum, in compliance with ASTM F1664.
   1. Locate at bottom of fabric only.

C. Post Caps: Pressed steel, wrought iron, or cast aluminum alloy, designed as weather-tight closure cap, for tubular posts. Provide one cap for each post unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
   1. Provide caps with openings to allow through-passage of top rail.
   2. Provide cone-type caps for terminal posts and loop-type caps for line posts.

D. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16-inch by 3/4-inch. Provide one stretcher bar for each gate and end-post, and two for each corner- and pull-post, except where fabric is integrally woven into the post.

E. Stretcher Bar Bands: Pressed steel, galvanized, 0.078-inch to 0.108-inch thick depending on post diameter, spaced not greater than 15 inches on centers to secure stretcher bars to end-, corner-, pull-, and gate-posts.
   1. Bands may also be used with special fittings for securing rails to end-, corner-, pull-, and gate-posts.

F. Truss Rods: Steel rods, 3/8-inch diameter, merchant quality with turnbuckle.

G. Concrete: Concrete for footings shall be minimum 3,000 pounds per square inch (psi) (at 28 days) mix.

2.5 FINISHING

A. Chain-Link Fence Fabric:
   1. Aluminized finish with not less than 0.40 ounces aluminum per square foot, complying with ASTM A491, Class II.

B. Framework and Appurtenances: Provide the following finishes for steel framework, auxiliary system components, and miscellaneous accessories:
   1. Galvanizing: Zinc for galvanizing shall be of High Grade or Special High Grade conforming to ASTM B6 with maximum aluminum content of 0.01 percent. Galvanize metal using hot-dip process in accordance with the following:
      a. Structural Iron and Steel Shapes: ASTM A123;
      b. Rolled-Form Sheet Steel: ASTM A653;
      c. Hardware and Accessories: ASTM A153;
      d. Fittings: ASTM F626; and
      e. Pipe: ASTM A53.
   2. Provide minimum weights of zinc as follows:
      a. Pipe: 1.8-ounces of zinc per square foot. Apply Type A coating both inside and outside according to ASTM F1043, as determined by ASTM A90.
      b. Rolled-Form Sheet Steel: 4.0-ounces of zinc per square foot of surface area.
      c. Hardware and Accessories: Zinc weights in compliance with Table 1 of ASTM A153.

C. Welded Joints:
   1. Repair zinc coatings at welded joints by applying zinc-rich paint, as specified in ASTM A780.

2.6 WOOD FENCES

A. Timber:
   1. All timber materials for new fencing shall be No. 1 grade cedar.

B. Fence Posts:
   1. Wood posts shall conform to the details and dimensions indicated on the Design Drawings. Wood posts shall be straight, sound, and seasoned with ends sawed off square or as indicated. All knots shall be trimmed flush with the surface.

2. All dimension timber and lumber required for fences shall be sound, straight, and free from knots, splits, and shakes. It shall be of the species and grades indicated on the Design Drawings.

2.7 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
   1. Fabric, posts, rails, and other supports shall be straight or uniformly curved to provide the profiles shown, to dimensional tolerance of 1/16-inch in 10 feet without warp or rack in the finished Work.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be erected and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

A. Comply with CLFMI Step-by-Step Installation Guide and ASTM F567. Do not begin installation and erection of fencing until final grading is completed.

B. Excavation: Outside of the cap area, drill holes of diameters specified, for post footings in firm, undisturbed or compacted soil. For posts installed in the cap area, machine or hand excavate holes to dimensions of footing indicated on the Design Drawings in the compacted cap fill.
   1. Soil from footing excavations outside the cap area shall be consolidated under the RCRA cap or as directed by CONSTRUCTION MANAGER.

C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.
   1. Center and align posts in holes 3-inches above bottom of excavation.
   2. Posts shall be set in concrete footings, except as otherwise shown or specified. Place concrete around posts in continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
   3. Extend concrete to two inches above ground surface, or to two inches below ground surface if cover of sod, bituminous asphalt paving, or other material is shown or indicated to conceal concrete. Crown to shed water away from posts.
   4. Extend footings for gate posts to underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.
   5. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing materials, or other acceptable curing method.

D. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven days after placement, before installing rails, tension wires, barbed wire, or chain-link fabric.
   1. Do not stretch and tension fabric and wires, and do not hang gates, until concrete has attained its full design strength.

E. Posts and Rails:
   1. Line Posts: Set posts in cast-in-place concrete footings as specified, spaced not more than ten feet on centers. Provide caps on top of each post to exclude moisture and to receive top rail, unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
   2. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer to form continuous rail between terminal posts.
   3. Brace Assemblies: Install braces so posts are plumb when diagonal rods are under proper tension. Install brace assemblies at end-posts and at both sides of corner- and pull-post panels. Panels adjacent to gates shall have intermediate horizontal rails and diagonal bracing. Diagonal bracing shall run from center of first line-post to bottom of terminal-post.

F. Chain-Link Fabric:
   1. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released. Fasten to terminal posts and gate posts with tension bars threaded through mesh and secured with tension bands at maximum intervals of 14 inches.
   2. Tie to line-posts, gate frames and top and bottom rails with tie wires spaced at maximum 12 inches on posts and two feet on rails.
   3. Connect tension bars to posts and frames by means of adjustable bolts and bands spaced not more than 14 inches apart.
   4. Leave approximately two inches between finish ground surface and bottom selvage, except where bottom of fabric extends into concrete.
   5. Join roll of chain-link fabric by weaving a single picket into the ends of roll to form continuous mesh.

G. Stretcher Bars: Thread through or clamp to fabric four inches on centers, and secure to posts with metal bands spaced 15 inches on centers.

H. Tie Wires: Use U-shaped wires conforming to diameter of pipe. Clasp pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons and clothing.

I. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.3 REMOVE AND RESET EXISTING FENCE

A. General:
   1. Materials shall be the components salvaged from the existing chain link fence which are designated to be removed and reset.
   2. Contractor shall furnish all such additional new material for the replacement of existing materials which are damaged or otherwise unsatisfactory, in the opinion of the Construction Manager for incorporation in the reset fence.
   3. Fence relocation and new fence installation shall be sequenced such that adequate perimeter security exists at all times during non-work periods.

B. Fence Removal:
   1. Where a portion of the remaining fence is to remain, the remaining end section shall be modified to adequately secure the fencing. The modified section shall include all hardware necessary to

secure the fencing in a manner similar to the existing end section or as directed by the CONSTRUCTION MANAGER.

2. The Contractor shall carefully dismantle and remove the existing fence (including gates) and salvage all materials determined satisfactory for incorporation in the reset fence.
3. The Contractor shall provide for safe storage of all fence materials salvaged until such time as they are reset.
4. Any concrete post footings shall be broken up and removed and the post carefully cleaned and stored.
5. All post holes shall be filled to meet existing grade.
6. All work shall be done in a workmanlike manner with care taken not to disturb the surrounding area and existing fence to remain.
7. Any damage done to the area or existing fence to remain, caused by the Contractor's operations, shall be repaired to the original condition at no expense.

C. Reset Fence:
1. The Contractor shall clean and assemble the salvaged fence components, incorporate all required new materials and reset the fence plumb and true to the lines, grades, and limits established.
2. The Contractor shall furnish and install concrete footings for the relocated fence when the existing fence in original position was of this type of construction.
3. Concrete footings shall have minimum dimensions as specified on the Design Drawings.

3.4 ADJUSTMENT AND CLEANING

A. Repair coatings damaged in the shop or at the Site by recoating with manufacturer's recommended repair compound, applied in accordance with manufacturer's directions. Repair hot-dip galvanized coatings in accordance with ASTM A780.

B. Gate: Adjust gate that are reset to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, and malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

C. Repair and replace broken or bent components.

+ + END OF SECTION + +

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all turf and grasses for RCRA cap construction and restoration of upland and wetland areas.
   2. Extent of RCRA cap and site restoration is shown on the Design Drawings.
   3. Types of products required include the following.
      a. Topsoil;
      b. Wetland seed mixture;
      c. Upland seed mixture;
      d. Upland erosion control seed mixture;
      e. Inorganic soil amendments;
      f. Organic soil amendments;
      g. Fertilizers;
      h. Mulches;
      i. Erosion-control materials; and
      j. Accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, turf and grasses.

C. Related Sections:
   1. Section 33 11 00, Clearing and Grubbing;
   2. Section 32 31 00, Fences; and
   3. Section 32 93 00, Plants.

1.2 REFERENCES

A. Standards referenced in this Section are listed below.
   1. Association of Official Analytic Chemists, (AOAC):
      a. Official Methods of Analysis of AOAC International.
   2. Association of Official Seed Analysts, (AOSA):
      a. Journal of Seed Technology; Rules for Testing Seeds.
   3. American Society of Agronomy, (ASA):
      a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
   4. American Society for Testing and Materials, (ASTM):
      a. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes;
      b. ASTM C 602, Specification for Agricultural Liming Materials;
      c. ASTM D 75, Practice for Sampling Aggregates;
      d. ASTM D 422, Test Method for Particle Size Analysis of Soil;

e. ASTM D 977, Specification for Emulsified Asphalt;
f. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System);
g. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes;
h. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction; and
i. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.

1.3 DEFINITIONS

A. The term "final grade" shall be used to describe the finished surface elevation of planting soil.

B. The term "manufactured topsoil" shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.

C. The term "loam" shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.

D. The term "percentage pure live seed" shall be defined as the percent (%) purity multiplied by percent (%) germination divided by 100 to equal the percent pure live seed (PLS) and shall be calculated for all seed lots using each seed lots own unique purity and germination test results. A PLS pound shall be defined as the bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

E. The term "subgrade" shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of turf and grasses and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
   a. Names and telephone numbers of owner, architects or engineers responsible for projects;
   b. Approximate contract cost of the turf and grasses; and
   c. Amount of area installed.
2. Installer's Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, turf and grasses. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.
4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer's instructions provided on each product label.

B. Soil-Testing Laboratory Qualifications:
   1. An independent laboratory, recognized by governing authorities having jurisdiction at the Site, with the experience and capability to conduct testing indicated and that specializes in types of soil tests to be performed.
   2. To qualify for approval, an independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work, in accordance with ASTM E 329 and as documented according to ASTM E 548.

C. Soil Analysis: Furnish report of soil analysis to ENGINEER, prepared by a qualified soil-testing laboratory, stating percentages of organic matter; mechanical gradation of sand, silt, and clay content in compliance with ASTM D 422; cation exchange capacity; sodium absorption ratio; deleterious materials content; pH; and mineral and plant-nutrient content of soil. In addition to the soil chemical tests required in Part 1.5.A.1 of Section 31 23 05, Excavation and Fill, chemical analysis shall include tests for percentages of nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, iron, manganese, copper, zinc, extractable aluminum, and total soluble salts.
   1. Existing On-Site Soil:
      a. Existing on-site soil shall not be used for topsoil.
   2. Manufactured Imported Topsoil:
      a. Test each 1000 cubic yards of manufactured topsoil at the proposed source. In addition, after ENGINEER'S approval of manufactured topsoil based on results and recommendations of soil testing reports, test each 1000 cubic yards of manufactured topsoil that is delivered to the Site for conformance to results and recommended modifications of approved soil test reports. Manufactured topsoil that differs from proposed source material, after modification according to recommendations of soil test reports, shall be rejected for use in the Work.
      b. Obtain a one cubic foot representative sample for each 1000 cubic yards of manufactured topsoil proposed for turf and grass Work, in compliance with ASTM D 75 and Appendixes, for securing samples from stockpiles.
      c. Place samples taken from each stockpile into separate clean, new and previously unused, containers and mix thoroughly. Maintain separation and legible labeling of each sample, taken from each stockpile, throughout the process of mixing, drying and delivering to soil analysis laboratory. Label samples on outside of container.
      d. Take one cup of topsoil from each container and allow to dry at room temperature. Once dry, place each one-cup sample in a separate, accurately labeled, new and previously unused one-cup sized plastic container, seal tightly and deliver to soil testing laboratory.
      e. Report suitability of manufactured topsoil as a component for grass plant growth. State recommended quantities of nitrogen, phosphorus, secondary and micronutrients, potash and soil amendments to be added to produce satisfactory manufactured topsoil. Include calculations, types of fertilizer and recommendations for application rates in either gallons or pounds per cubic foot of manufactured topsoil.
      f. Organic component of manufactured topsoil shall be obtained from compost and peat moss amendments specified, for such material to be used as loam.

D. Source Quality Control:
   1. Analysis and Standards: Package all products with manufacturer's certified analysis performed in accordance with methods established by AOAC, wherever applicable, or as specified.
   2. Provide manufactured imported topsoil from a commercial processing facility specializing in the manufacture of topsoil.

3. Seed that has been stored at temperatures, or under conditions not recommended by the seed supplier, or has become wet, moldy, or otherwise damaged, shall not be acceptable. The PLS for each seed lot shall be 75 percent, minimum.
4. Certify that all seed has been stored under conditions recommended by the seed supplier and has not been subjected to conditions damaging to PLS percentages.
5. Seed may be mixed by an approved method on-Site or at the seed supplier’s facilities. If the seed is mixed on-Site, each variety shall be delivered in the original containers and shall bear the supplier’s certified analysis. Where seed is mixed by the seed supplier, provide CONSTRUCTION MANAGER with the seed supplier’s certified statement as to the composition of the mixture.

1.5 SUBMITTALS

A. Action Submittals: Submit the following.
   1. Shop Drawings:
      a. Schedule for turf and grass-planting showing anticipated planting dates for each type of Work.
   2. Product Data:
      a. Manufacturer's product data, specifications and installation instructions for all required materials.
      b. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.
      c. Proportions of each component contained in hydro seed mixture. Identify number of pounds of each component required for each 100 gallons of water. Include the number of square feet of wetland, upland, upland erosion mixture that can be installed with each full tank of hydro seed mixture.
      d. PLS for each type of seed and each seed lot. Include bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

B. Informational Submittals: Submit the following.
   1. Certificates:
      a. Certification of Seed: For each grass-seed monostand and seed mixture, furnish seed supplier’s certification stating the botanical and common name, and percentage by weight of each species and variety, and percentage of purity, germination and weed seed. Include the year of production and date of packaging. Certify that seed has been stored in compliance with all recommendations of the seed supplier.
      b. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
   2. Test Reports: Submit the following:
      a. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
   3. Qualifications Data: Submit qualifications data for the following:
      a. Landscape installer;
      b. Landscape supervisor; and
      c. Testing agency.

4. Source Quality Control Submittals:
   a. Written statement providing the location from which manufactured topsoil is to be obtained and the names and addresses of the suppliers.

C. Closeout Submittals: Submit the following.
   1. Operations and Maintenance Data:
      a. Submit recommended procedures to be established for the maintenance of turf and grasses for one full year. Submit prior to expiration of required maintenance period.
   2. Warranty Documentation:
      a. Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Do not deliver seed until Site conditions are ready for installation.
   2. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
   3. Deliver seed in undamaged, original containers, sealed by the supplier and indicating compliance with approved Shop Drawings.
   4. Inspect turf and grass materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.

B. Storage of Materials:
   1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks from the Site.
   2. Seed that becomes wet, moldy or damaged during the time of storage on-Site or that has been damaged during transit is not acceptable.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Proceed with and complete turf and grass planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn, grass and wildflower planting required.
   2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of turf and grasses.
      a. Do not spread seed when wind velocity exceeds five miles per hour.
      b. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.
   3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:
   1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Plant during one of the following periods:
      a. Spring Planting: March 15 to June 1; and
      b. Fall Planting: September 1 to October 30.
   2. Coordinate provision of adequate and acceptable water supply with Project Schedule.

C. Pre-installation Conference:
   1. Prior to commencement of turf and grass planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around turf and grass areas that follows the turf and grass Work, including fencing Work

specified in Section 32 31 00, Fences; and CONSTRUCTION MANAGER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the turf and grass Work, including the following:

a. Review Project requirements and the Contract Documents.
b. Review required submittals, both completed and yet to be completed.
c. Review availability of water and methods of delivery.
d. Review status of below-grade work and required access during turf and grass planting and establishment.
e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
g. Review procedures required for protection of turf and grasses during the remainder of the construction period.
h. Review required inspection, testing, and certifying procedures.

2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. All soil accepted as topsoil shall comply with specified topsoil analysis.
2. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 1-inch in diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D 5268. Provide topsoil with the following analysis:
   a. 3/4-inch mesh: 100 percent passing;
   b. No. 4-sieve: 90 to 100 percent passing;
   c. No. 200-sieve: 0 to 10 percent passing;
   d. Clay content of material passing No. 200-sieve not greater than 60 percent, as determined by hydrometer tests;
   e. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to pH 7.0 at time of installation of lawns, grass and meadow areas, unless particular species of grass or wildflower stand requires a different pH to meet its growing needs;
   f. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum;
   g. Cation Exchange Capacity: 5, minimum;
   h. Organic content not less than five percent for lawn areas and not less than 10% for wetland and upland areas, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours); and
   i. Free of pests and pest larvae.

B. Seed:
   1. Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, specified.
   2. Seed Mixtures: Seeds of grass species as specified in the Design Drawings, with not less than 95 percent germination, not less than 80 percent pure seed, and not more than 0.25 percent weed seed by weight.

C. Fertilizers:
   1. Fertilizer or other topsoil amendments must be authorized by the ENGINEER prior to use. If authorized, the fertilizer shall be applied to the surface uniformly at the rate recommended by the agricultural laboratory.

D. Mulches:
   1. Straw Mulch: Provide air-dry, clean, mildew- and certified seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
   2. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

E. Erosion-Control Materials:
   1. Temporary Erosion-Control Blankets: 100 percent biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended 6-inches long steel wire staples.
   2. Permanent Erosion-Control Blankets: a machine-produced mat of 100% UV stable polypropylene fiber. The matting shall be of consistent thickness with the synthetic fibers evenly distributed over the entire area of the mat. The matting shall be covered on the top side with black heavyweight UV-stabilized polypropylene netting.

F. Water: Acceptable for turf and grass application and containing no material harmful to plant growth and establishment.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the areas and conditions under which turf and grass Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.

3.3 FINE GRADING

A. Immediately prior to dumping and spreading loam, clean subgrade of all stones greater than 2-inches and all other extraneous matter. Remove all such material from Site. Notify CONSTRUCTION MANAGER that subgrade has been cleaned, and obtain approval prior to spreading loam.

B. Do not attempt to spread excessively wet, muddy or frozen loam. Do not spread loam more than five days before seeding or planting.

C. Spread loam to a depth of 6 inches, or to the depth as indicated on the Design Drawings, but not less than required to meet final grades shown on the Design Drawings.
   1. Spread approximately one-half the thickness of required loam depth. After spreading loam, rototill, disk or harrow loam and subgrade to bring top 2-inches of subgrade upward into loam layer, so that there is a transitional layer between loam and subgrade.
   2. Spread remainder of loam to required final grades.
   3. Compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through loam. After compaction spread loam should offer firm, even resistance when a soil sampling tube is inserted.
   4. Phase the placement of the final lift so that wheeled vehicles do not have to travel over areas where final lifts are already in-place.
   5. Spread and compact to a smooth, uniform surface plane, to within plus or minus 1/2-inch of finish elevations. Roll and rake and remove all ridges, and fill depressions, as required. Remove all stones larger than 1-inch in any dimension and all sticks, roots, trash and other extraneous matter.
   6. Perform percolation tests as for subgrades, except limit depth of holes to 2/3 the depth of loam layer.

D. Spread ground limestone or acidulant and fertilizer, if authorized. Mix ground limestone with dry loam before spreading fertilizer and work lightly into the top 4-inches of loam by harrowing or tilling at least three days before applying commercial fertilizers.

E. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet final grades.

F. Moisten prepared areas before seeding, sodding, sprigging or plugging. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.

G. Prior to seeding or planting, restore loam to specified condition, if eroded or otherwise disturbed.

3.4 CONVENTIONAL SEEDING

A. General: Maintain grade stakes until removal is mutually agreed upon by all parties concerned.

B. Rake or harrow all seedbeds immediately prior to seeding to produce a rough, grooved surface, no deeper than 1-inch. Seed only when seedbed is in a friable condition and not muddy or hard.

C. Sow seed using a spreader or seeding machine.

D. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.

E. Sow lawn grass seed mixture at the rate as shown in the Design Drawings.

F. Cultipacker, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultipacker:
   1. Rake the seed lightly into top 1/8-inch of loam, roll in two directions with a water ballast roller, weighing not less than 100 pounds per linear foot.
   2. Take care during raking that seed is not raked from one spot to another.
   3. Protect seeded areas against erosion by spreading specified mulch after completion of seeding operations.
      a. Protect seeded areas against hot, dry weather or drying winds by applying peat moss mulch not more than 24 hours after completion of seeding operations. Presoak and scatter evenly to a depth of from 1/8-inch to 3/16-inches thick and roll to a smooth surface. Do not mound.
      b. Spread straw mulch to form a continuous loose blanket not less than 1-1/2-inch deep over seeded areas at the approximately rate of two tons-per acre.
      c. Protect seeded areas, with slopes exceeding one on six, by providing temporary or permanent erosion-control blankets as shown on the Design Drawings. Install erosion-control materials according to manufacturer’s written instructions and as follows:
         1) Vertically down slope without stretching fabric.
         2) Install hold down staples three per square yard minimum in center of fabric or as required to hold and shape the fabric to the contours of the slope. Install hold down staples along edges and overlaps of fabric at 9 inches on centers minimum, or as required to hold and shape the fabric to the contours of the slope.
         3) Lap fabric 4-inches minimum and turn edges of fabric into 8-inch deep by 16-inch wide earth trench and fill trench with earth.

G. Using a uniform fine spray, thoroughly and evenly water seeded areas. Provide adequate water to moisten seedbed to a depth of 2-inches.
   1. Repeat this process when peat mulch color lightens. Maintain all seedbeds in a uniformly moist condition, conducive to seed germination and plant establishment, as specified.

H. Reseed areas that remain without mulch for longer than three days.

I. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

J. Prevent foot or vehicular traffic, or the movement of equipment, over the mulched areas. Reseed areas damaged as a result of such activity.

3.5 MAINTENANCE

A. Maintain planted areas until accepted by the CONSTRUCTION MANAGER. Maintenance responsibilities begin immediately after planting and continue through at least two full growing seasons following the year of planting.

B. The Contractor shall maintain the vegetation such that 90% coverage and 90% tree/shrub survival are achieved by the end of the first full growing season. Maintenance activities for undesirable plant control include mowing, physical removal, and restricted hand application use of herbicides. Herbicide use shall be performed subject to the appropriate limitations of local and state regulation.

C. Notify CONSTRUCTION MANAGER prior to and following the performance of any maintenance activity.

D. All erosion rills or gullies within the topsoil layer shall be filled with additional approved topsoil, graded smooth, and re-seeded and mulched.

E. The Contractor shall also be responsible for repairs to all erosion of the seeded areas until all new grass is firmly established and reaches a height of not less than 4 inches. All bare or poorly vegetated areas must be re-seeded and mulched.

F. In the event that erosion control matting is used, such matting shall be composed of 100% non-synthetic, biodegradable material (such as jute mesh or approved equal). Erosion control matting shall be secured in place with biodegradable stakes.

+ + END OF SECTION + +

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install plants.
   2. Extent of plants is shown on the Design Drawings.
   3. Types of products required include the following:
      a. Shade and flowering trees.
      b. Deciduous shrubs.
      c. Accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the plants.

C. Related Sections:
   1. Section 33 11 00, Clearing and Grubbing.
   2. Section 32 31 00, Fences.
   3. Section 32 92 00, Turf and Grasses.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI):
      a. ANSI Z60.1, American Standard for Nursery Stock.
   2. Association of Official Analytic Chemists, (AOAC):
      a. Official Methods of Analysis of AOAC International.
   3. American Society of Agronomy, (ASA):
      a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
   4. American Society for Testing and Materials, (ASTM):
      a. ASTM A 36, Specification for Carbon Structural Steel.
      b. ASTM A 641, Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
      c. ASTM D 75, Practice for Sampling Aggregates.
      d. ASTM D 422, Test Method for Particle Size Analysis of Soil.
      e. ASTM D 977, Specification for Emulsified Asphalt.
      f. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
      g. ASTM D 4397, Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications.
      h. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.

i. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
j. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.
5. Hortus III, Liberty Hyde Bailey Hortorium.
6. United States Department of Agriculture, (USDA):
   a. Description of the Eco-regions of the United States.
   b. Plant Hardiness Zone Maps.

1.3 DEFINITIONS

A. The term “container-grown stock” describes healthy, vigorous, well-rooted plants, grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of plant required.

B. The term “finish grade” describes elevation of finished surface of planting soil mix.

C. The term “manufactured topsoil” describes soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil for planting soil mix.

D. The term “planting soil mix” describes native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with topsoil amendments.

E. The term “subgrade” describes surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil mix.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of plants and in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to CONSTRUCTION MANAGER along with the following information on a minimum of three successful projects:
      a. Names and telephone numbers of owner, architects or engineers responsible for projects.
      b. Approximate contract cost of the plants.
      c. Amount and kinds of plants installed.
   2. Installer’s Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of plants. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
   3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.
   4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer’s instructions provided on each product label.

B. Source Quality Control:
   1. General:

a. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements of ANSI Z60.1.
b. Ship plants with certificates of inspection as required by governing authorities having jurisdiction at the Site.

2. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the AOAC, wherever applicable or specified.
3. Provide plants grown in a recognized nursery in accordance with good horticultural practice, with healthy root systems developed by transplanting or root pruning. Provide healthy, vigorous plants grown for at least two years under climatic conditions similar to conditions in the locality of the Project and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions or disfigurement.
   a. Provide plants of the sizes shown. Plants of larger size may be used if acceptable to ENGINEER, and if sizes of roots or balls are increased proportionately.
   b. Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6-inches above ground for trees up to 4-inch caliper size, and 12-inches above ground for larger sizes.
   c. Measure main body of tree or shrub for height and spread; do not measure branches, or roots, tip-to-tip.
4. Inspection: ENGINEER may inspect plants either at place of growth or at Site, before planting, for compliance with requirements for genus, species, variety, size, and quality. ENGINEER retains right to inspect plants further for size and condition of ball and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of Work. Immediately remove rejected plants from Site.
   a. Notify ENGINEER of sources of planting materials, minimum of 1 week in advance of delivery to Site.
5. Do not prune plants before delivery, except as approved by ENGINEER, in writing. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape.
6. Requirements for Container Grown Plants:
   a. Where shown as acceptable, provide healthy, vigorous, well-rooted plants established in the container in which they are sold. Provide balled and burlapped stock, when required plants exceed maximum size recommended by ANSI Z60.1 for container grown plants.
   b. Containers: Use rigid containers that will hold ball shape and protect root mass during shipping. Provide plants established in containers of not less than the minimum sizes recommended by ANSI Z60.1 for the kind, type and size of plant required.

F. Pre-installation Conference:
1. Prior to commencement of planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other work in and around planting areas that follows the planting Work, including fencing Work specified in Section 32 31 00, Fences, and CONSTRUCTION MANAGER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the planting Work, including the following:

a. Review Project requirements and the Contract Documents.
b. Review required submittals, both completed and yet to be completed.
c. Review availability of water and methods of delivery.
d. Review status of below-grade work and required access during planting and extended service periods.
e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
g. Review procedures needed for protection of plantings during the remainder of the construction period.
h. Review required inspection, testing, and certifying procedures.

2. Record the discussions of the conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. Planting schedule showing scheduled start and finish dates for each type of planting in each area of Site.
2. Product Data:
   a. Manufacturer's specifications and installation instructions for all materials required.
   b. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.

B. Informational Submittals: Submit the following:
1. Certificates:
   a. Submit data certifying that materials comply with specified requirements.
2. Qualifications Data:
   a. Landscape installer.
   b. Landscape supervisor.
   c. Testing agency.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
1. Deliver each type of plant as the Work progresses, after preparations for planting that specific type of plant is completed, and when plants will be planted immediately upon arrival at the Site. Do not stockpile plants on-Site.
2. Deliver packaged materials in original, unopened containers, legibly showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery. Provide protective covering.

3. Do not drop plants during delivery.
4. Immediately remove unacceptable material from Site.

B. Storage of Materials:
   1. If planting is delayed more than six hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist.
   2. Set balled stock on ground and cover ball with soil, moistened peat moss or other acceptable material.
   3. Heel-in bare root plants in a bed containing adequate peat moss to keep roots in a moist condition. Soak roots in water for two hours before planting.
   4. Store and cover materials to prevent deterioration. Remove packaged materials that have become wet, or show deterioration or water marks, from Site.

C. Handling of Materials:
   1. Do not remove container-grown plants from containers until planting time.
   2. Do not lift or drag plants by stems or trunks. Handle plants by lifting container.
   3. Water as necessary to maintain plant root systems in a moist condition.

1.7 PROJECT CONDITIONS

A. Existing Conditions:
   1. Obstructions Below Ground and Utilities: Exercise extreme caution in all planting operations, as there are underground electric and telephone cables, sewer lines and water lines throughout the entire Site. Study and be familiar with the location of these obstructions and underground utilities. Place plantings, where shown in the proximity of these obstructions and underground utilities, clear of any interference. Repair all damages to obstructions and underground utilities caused by the Work of this Section.

B. Environmental Requirements:
   1. Proceed with and complete the Work as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of plant shown.
   2. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

C. Scheduling:
   1. Coordinate planting with specified extended service periods to provide required service from date of acceptable completion of each type of planting. Plant during one of the following periods:
      a. Spring Planting: March 15 to June 15.
      b. Fall Planting: September 1 to October 30.
   2. Do not begin planting until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project schedule.
   3. Do not proceed with installation of plants until all subgrade utility services have been installed, are operating successfully and have been approved by ENGINEER.
   4. Plant only after final grades are established and prior to planting of lawns and meadows, unless otherwise acceptable to ENGINEER. If planting occurs after lawn and meadow Work, protect lawn and meadow areas and promptly repair damage to lawns and meadows resulting from planting operations.
   5. Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage to protect during digging, handling, and transportation.

a. One week before evergreen trees and deciduous trees and shrubs in full leaf are to be dug, spray with anti-desiccant at nursery before moving and again two weeks after planting.
b. Apply anti-desiccant to evergreens, again, immediately after the first frost.

1.8 WARRANTY

A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranty: Warrant the following plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate care and maintenance, or abuse by OWNER, or incidents that are beyond CONTRACTOR'S control.
1. Warranty Period for Trees and Shrubs: One year from date of acceptance.
2. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
3. A limit of one replacement of each plant will be required, except where losses or replacement failures are due to CONTRACTOR’S failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General Landscape Design Criteria:
1. Provide plant materials true to name and variety, established in Hortus III.
2. Provide nursery-grown plants complying with ANSI Z60.1, typical of their species or variety and with a normal habit of growth for type of plant required, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous plants free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
3. Label at least one tree and one shrub and one bundle or flat of plants of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
1. Provide container-grown trees as shown on the Design Drawings.

B. Small Upright or Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.
1. Provide container grown trees as shown on the Design Drawings

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
   1. Provide container-grown deciduous shrubs as shown on the Contract Drawings.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Fabric: Polypropylene or polyester fabric, 3-ounces per square yard, minimum.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8-ounces per square yard, minimum.

2.5 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, hardwood or softwood obtained from certified sustainable managed forests, free of knots, holes, cross grain, and other defects, 2-inches by 2-inches by length indicated, pointed at one end.

B. Guy and Tie Wire: ASTM A 641, Class 1, galvanized-steel wire, 2-strand, twisted, 0.08-inch in diameter.

C. Guy Cable: Five-strand, 3/16-inch diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3-inches long, with two 3/8-inch galvanized eyebolts.

D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2-inch in diameter, black, cut to lengths required to protect tree trunks from damage.

E. Flags: Standard surveyor's plastic flagging tape, white, 6-inches long.

2.6 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch wide minimum, with stretch factor of 33 percent.

2.7 PLANTING SOIL MIXES

A. Topsoil shall be as specified in Section 32 92 00, Turf and Grasses.

B. Preparation of Planting Soil Mix:
   1. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
   2. Mix specified soil amendments and fertilizers with topsoil at the rates required to produce the pH needed for that particular planting and as specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

3. Provide planting soil mix proportions as follows:

Percent by Volume	Material
40 percent	Screened topsoil
25 percent	Peat Humus
25 percent	Compost
10 percent	Coarse Sand

4. Add five pounds 5-10-5 commercial fertilizer and three pounds of bonemeal per cubic yard of planting soil mix.
5. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at the Site.
6. Mix lime with dry soil prior to mixing of fertilizer. Prevent lime from contacting roots of acid-loving plants.
7. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil mix and tilling.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the subgrade, verify the elevations, observe the conditions under which planting Work is to be performed, and notify ENGINEER, in writing, of unsatisfactory conditions. Do no proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the CONSTRUCTION MANAGER.

B. Inspect plants for injury, insect infestation, and improper pruning.

C. Do not begin planting or wrapping of trees until deficiencies are corrected, or plants, replaced.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out plants at locations directed by ENGINEER. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 TREE AND SHRUB EXCAVATION

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation. Dispose of subsoil removed from pits and trenches in a legal manner, off-Site.
   1. Excavate approximately three times as wide as ball diameter for container-grown stock.

B. Obstructions: Notify CONSTRUCTION MANAGER if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

C. Drainage: Notify CONSTRUCTION MANAGER if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

D. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.4 TREE AND SHRUB PLANTING

A. Carefully remove root ball from container without damaging root ball or plant.
   1. After removal of plant from container, or sides from box, tease out feeder roots to assure positive contact and embedment into planting soil.

B. Organic Mulching: Apply 2-inch average thickness of organic mulch extending 12-inches beyond edge of planting pit or trench. Do not place mulch within 3-inches of trunks or stems.

C. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping.

D. Perform complete sequence of planting steps for each plant within the same day.

E. Dish top of backfill to allow for mulching. Provide dish four feet in diameter approximately 4-inches deep around each tree, with planting soil berm around edge of excavations to form shallow saucer to collect water.

F. After watering, any settlement within basins shall be refilled to required grade with planting soil mix.

3.5 TREE AND SHRUB PRUNING

A. Prune, thin out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the CONSTRUCTION MANAGER, do not cut tree leaders. Remove only injured or dead branches from ornamental flowering trees, if any. Prune to retain natural character and accomplish their use in the landscape design. Required tree sizes are the size after pruning.
   1. Remove all dead wood and suckers, and all broken and badly bruised branches.

B. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

C. Paint cuts over 1/2-inch in size with standard tree wound compound, covering exposed, living tissue.

D. All pruning wounds shall show vigorous bark on all edges at the time of harvest.

3.6 GUYING AND STAKING

A. Guy and stake trees immediately after planting.

B. Upright Staking and Tying: Stake trees of 2-inches through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of two stakes of length required to penetrate at least 18-inches below bottom of backfilled excavation and to extend at least 72-inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:
   1. Use two stakes for trees up to 12 feet high and 2-1/2-inches or less in caliper.
   2. Use three stakes for trees greater than 12 feet, but less than 14 feet high, and up to 4-inches in caliper. Space stakes equally around trees.
   3. Attach flags to each guy wire, 30-inches above finish grade.
   4. Paint turnbuckles with luminescent white paint.

3.7 MAINTENANCE

A. Maintain planted areas until accepted by the CONSTRUCTION MANAGER. Maintenance responsibilities begin immediately after planting and continue through at least two full growing seasons following the year of planting.

3.8 ACCEPTANCE CRITERIA FOR PLANTS

A. Planting Work will be considered acceptable when:
   1. Shade and Flowering Trees: When firmly planted, properly located and vertically upright with all securement devices and accessories, mulches, and saucers formed and in-place; with plant showing no signs of environmental stress, disease, insect infestations, mechanical damage or disfigurements such as suckers or watersprouts. Twigs and branches shall have a full bud set for their full length including terminal buds. Buds shall be swelling or provide other indications of becoming vigorous, healthy growth.
   2. Deciduous Shrubs: When firmly planted, properly located and vertically upright, with all mulches and saucers formed and in-place; with plant showing no signs of environmental stress, disease, insect infestations, damage or other disfigurement. Twigs and branches shall have a full bud set for their full length including terminal buds. Buds shall be swelling or provide other indications of becoming vigorous, healthy growth.

3.9 CLEANUP AND PROTECTION

A. Protect plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and extended service periods. Treat, repair, or replace damaged planting.

B. Protection includes all temporary fences, barriers and signs and other Work incidental to proper maintenance.

3.10 INSPECTION AND ACCEPTANCE

A. Where plants do not comply with specified acceptance criteria, replace plants and continue maintenance until plants comply with criteria for acceptance.

+ + END OF SECTION + +

SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
      c. Work on or affecting existing buried piping.
      d. Installation of all jointing and gasket materials, flexible couplings, sleeves, and other Work required for a complete, buried piping installation.
      e. Field quality control, including testing.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. American Water Works Association (AWWA):
   1. AWWA M41 - Ductile-Iron Pipe and Fittings.

B. American Society of Civil Engineers (ASCE):
   1. ASCE 37, Design and Construction of Sanitary and Storm Sewers.

1.3 SUBMITTALS

A. Action Submittals: Submit the following.
   1. Shop Drawings.
   2. Product Data:
      a. Manufacturer’s literature and specifications, as applicable, for products specified in this Section.

B. Informational Submittals: Submit the following
   1. Certificates:
      a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.

C. Closeout Submittals: Submit the following.
   1. Record Documentation:
      a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
      b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
   2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.

B. Storage:
   1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.

C. Handling:
   1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
   2. Avoid unnecessary handling of pipe.
   3. Keep pipe interiors free from dirt and foreign matter.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials for the piping, joints, sleeves and fittings shall be as shown on the Design Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
   2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from the CONSTRUCTION MANAGER before proceeding.
   3. Earthwork is specified in Section 31 23 05, Excavation and Fill.
   4. Excavation in excess of that required or shown, and that is not authorized by the CONSTRUCTION MANAGER shall be filled at CONTRACTOR's expense with granular material furnished, placed, and compacted in accordance with Section 31 23 05, Excavation and Fill.

B. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.
   1. Trench excavation and backfill, and bedding materials shall conform to Section 31 23 05, Excavation and Fill, as applicable.
   2. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
   3. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
   4. Do not lay pipe until CONSTRUCTION MANAGER approves bedding condition.
   5. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

C. Laying Pipe:
   1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
      a. Ductile Iron Pipe: AWWA M41; and
      b. Sanitary and Storm Sewers: ASCE 37.
   2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by the CONSTRUCTION MANAGER. Remove and reinstall pipes that are not installed correctly.
   3. Slope piping uniformly between elevations shown.
   4. Keep groundwater level in trench at least 6 inch below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
   5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by the CONSTRUCTION MANAGER.
   6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by the CONSTRUCTION MANAGER.
   7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
   8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the CONSTRUCTION MANAGER.
   9. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
   10. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
   11. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
   12. Do not place blocking under pipe, unless specifically approved by the CONSTRUCTION MANAGER for special conditions.
   13. Touch up protective coatings in manner satisfactory to the CONSTRUCTION MANAGER prior to backfilling.
   14. Notify CONSTRUCTION MANAGER in advance of backfilling operations.
   15. Exercise care to avoid flotation when installing pipe in locations with high groundwater.

D. Jointing Pipe:
   1. HDPE Pipe Joints:
      a. Bell and Spigot Joints:
         1) Remove all burrs and provide reference mark at correct distance from pipe end. Place mark such that no more than 1/2-inch of machined spigot surface will be visible outside of bell after pipe has been joined.
         2) Clean spigot end and bell thoroughly with soap and water before positioning gasket.
         3) Lubricate spigot groove with manufacturer's recommended lubricant. Thoroughly clean gasket and place in spigot groove starting at bottom, ensuring that gasket fins face backwards toward pipe.
         4) Thoroughly lubricate gasket with pipe manufacturer's recommended lubricant and equalize stretch in gasket by running screwdriver under gasket around its entire circumference three times. Reposition gasket in groove after stretching.
         5) Thoroughly clean and lubricate receiving bell. Align pipe as straight as possible and insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.
         6) If mechanical means are used to insert spigot end, protect with wood the end of pipe being pushed, to ensure even distribution of pressure.

E. Backfilling:
   1. Conform to applicable requirements of Section 31 23 05, Excavation and Fill.
   2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

F. Transitions from One Type of Pipe to Another:
   1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

3.2 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:
   1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
   2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.

3.3 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Each section of pipe shall be inspected before final acceptance by the CONSTRUCTION MANAGER. The inspection shall be by observation with illumination.
   2. The inspection shall determine the pipeline to be true to line and grade, to show no leaks, to have no obstruction to flow, to have no projections or protruding of connecting pipes or joint materials, shall be free from cracks, and shall contain no deposits of sand, dirt, or other materials.
   3. All deficiencies noted during the inspection shall be corrected to the ENGINEER's and/or CONSTRUCTION MANAGER's satisfaction at the expense of the CONTRACTOR.

+ + END OF SECTION + +

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all precast, cast-in-place and masonry manholes and structures.

B. General:
1. Manholes and structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as directed by ENGINEER.
2. Cast-iron frames, grates and covers shall be the standard frame and grate or cover unless otherwise shown.
3. All manholes and structures shall be precast construction, unless otherwise shown.

C. Related Sections:
1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
1. American Society for Testing and Materials, (ASTM):
    a. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
    a. Submit drawings showing design and construction details of all precast concrete manholes and structures, including details of joints between the manhole bases and riser sections and stubs or openings for the connections.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES AND STRUCTURES

A. Precast manholes and structures shall conform to the details shown. Provide cast-in-place concrete bases where shown.

B. Except where otherwise specified precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478, except as modified herein.

C. Precast, reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.

D. Joints between manhole components shall be the tongue and groove type employing a single, continuous rubber O-ring gasket and shall conform to AWWA C302. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections and top slabs of manholes 72-inches in diameter and less shall be rubber and concrete joints.

E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall not be less than 5-inches. Concrete top slabs shall not be less than 8-inches thick.

F. Lifting holes, if used in manhole components, shall be tapered, and no more than two shall be cast in each section. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs driven from the outside face of the section only.

G. The point of intersection (P.I.) of the sewer pipe centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in the floor of each manhole base and protruding approximately 1-inch above the finished floor of the base.

H. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

I. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

J. A precast or cast-in-place slab or precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover.

2.3 MISCELLANEOUS METALS

A. Metal frames and covers and similar required items shall be provided as shown on the Design Drawings.

PART 3 - EXECUTION

3.1 MANHOLE BASES

A. Precast bases shall be set on a crushed stone or crushed gravel foundation as shown. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.2 PRECAST MANHOLE SECTIONS

A. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

B. Install sections, joints and gaskets in accordance with manufacturer's recommendations.

C. Lifting holes shall be sealed tight with a solid rubber plug driven into the hole from the outside of the barrel and the remaining void filled with 1 to 2 cement-sand mortar.

3.3 GRADING RINGS

A. Grading rings or brick stacks shall be used for all precast manholes and structures, where required. Stacks or grade rings shall be a maximum of 12-inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack or grade rings shall be such as required to bring the manhole frame to the proper grade.

B. Each grade ring shall be laid in a full bed of mortar and shall be thoroughly bonded.

3.4 GRADING AT MANHOLES AND STRUCTURES

A. All manholes and structures in unpaved areas shall be built, as shown or directed by the ENGINEER, to an elevation higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown or directed by the ENGINEER. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth of grass is obtained.

B. CONTRACTOR shall be solely responsible for the proper height of all manholes and structures necessary to reach the final grade at all locations. CONTRACTOR is cautioned that ENGINEER'S review of Shop Drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.5 FIELD QUALITY CONTROL

A. Pre-cast reinforced concrete structures shall be subject to rejection on account of failure to conform to Specification requirements. In addition, individual sections may be rejected for any of the following reasons.
   1. Fractures or cracks passing through shell, except for single end crack not exceeding depth of joint;
   2. Defects indicating imperfect proportioning, mixing, and molding;
   3. The presence of surface defects indicating honeycombed or open texture;
   4. Damaged ends where such damage prevents making satisfactory joint;
   5. Internal diameter of section varies more than 1 percent from nominal diameter;
   6. Continuous crack having surface width of 0.01 inch or more and extending for length of 12 inches or more, regardless of position; and
   7. Non-conformance with approved Shop Drawings.

+ + END OF SECTION + +

APPENDIX F

Engineering Calculations

APPENDIX F

RCRA Cap Drainage Layer Calculations

Imagine the result

Calculation Sheet

Client: SRSNE Site Group

Project Location: Southington, CT

Project: SRSNE RCRA Cap Design **Project No.: B0054634.0001**

Subject: RCRA Cap Geocomposite Transmissivity Calculation

Prepared By: NWF **Date: September 2016**

Reviewed By: NWF **Date: September 2016**

Checked By: JSH **Date: September 2016**

OBJECTIVE:

Determine the minimum required transmissivity for the geocomposite in the RCRA Cap. Estimate the maximum anticipated applied loading on the geocomposite under installed conditions.

REFERENCES:

1. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 5 titled "Cap Subgrade Grading Plan," ARCADIS, June 2016.
2. "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers Comprising Two Different Slopes," Giroud, J.P., Zornberg, J.G., and Beech, J.F., technical paper presented in Geosynthetics International - Special Issue on Liquid Collection Systems, 2000.
3. "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers," Giroud, J.P., Zornberg, J.G., and A. Zhao., technical paper presented in Geosynthetics International - Special Issue on Liquid Collection Systems, 2000. (Portion Attached).
4. "Geosynthetic Landfill Cover Design Methodology and Construction Experience in the Pacific Northwest", Thiel, R.S.and Stewart, M. G., proceedings for Geosynthetics '93 held in Vancouver, B. C., 1993.
5. USEPA (Choi) comments regarding the draft 100% Design Report, dated August 31, 2016.

ASSUMPTIONS:

1. The Slope is a composite slope consisting of approximately 164 feet at 4.25% and approximately 69 feet at 16.67% (Reference 1).
2. As shown on Reference 1, the geocomposite will drain to a swale with a collection pipe installed at the base of the slope. Flow within the final cover collection pipe will drain to the low point along the pipe length where it will outlet into an existing catch basin.
3. The minimum required transmissivity for the slope is based on the Unit Gradient Method (presented in Reference 4) where the impingement rate, q_h, is defined as equal to the cover soil permeability. It is assumed that soils overlying the GDC will have a permeability of $1x10^{-4}$ cm/s, as suggested by USEPA for this application (Reference 5).

Calculation Sheet

4. To account for a reduction in geocomposite flow capacity over time (due to geotextile intrusion, core creep, and biological/chemical clogging) , the following reduction factors are assumed (Reference 3):

   - RF_{IN} = 1.1 (Reduction factor accounting for geotextile intrusion; recommended 1.0 to 1.2)
   - RF_{CR}= 1.3 (Reduction factor accounting for creep reduction in geonet core thickness; recommended 1.1 to 1.4)
   - RF_{CC} = 1.1 (Reduction factor accounting for chemical clogging; recommended 1.0 to 1.2)
   - RF_{BC} = 1.3 (Reduction factor accounting for biological clogging; recommended 1.2 to 1.5)

5. A factor of safety (FS_d) of 2.5 is used to account for uncertainties in assumptions, when calculating hydraulic properties of the GDC.

<u>CALCULATIONS:</u>

1. Minimum Required Transmissivity

The transmissivity for the two slopes is based on the Unit Gradient Method and method for determining the maximum liquid thickness when considering different slopes outlined in Reference 2:

$$\Theta_{up} = \frac{TSFq_h L_{up}}{\sin \beta_{up}}$$

$$\Theta_{down} = \frac{TSFq_h (L_{up} + L_{down})}{\sin \beta_{down}}$$

where,

Θ_{up} = ultimate transmissivity for the upstream slope
Θ_{down} = ultimate transmissivity for the downstream slope
TSF = total serviceability factor (a combination of reduction and overall design safety factors) = RF_{in} x RF_{cr} x RF_{cc} x RF_{bc} x FS_d (see Assumptions 4 and 5 for values)
q_h = impingement rate (rate at which water infiltrates through the cover soils into the geocomposite) = $1x10^{-4}$ cm/s
L_{up} = maximum drainage length for the upstream slope
L_{down} = maximum drainage length for the downstream slope
β_{up} = slope angle of drainage layer for the upstream slope
β_{down} = slope angle of drainage layer for the downstream slope

The required transmissivity for the upstream 4.25% slope segment is based on the following parameters:

TSF = 5.11
q_h = 1.0×10^{-4} cm/s
L = 164 feet= 50.3 m
β_{up} = 2.43^{o} (4.25%)

Calculation Sheet

$\therefore \Theta = 6.06 \times 10^{-3}$ m^2/s = 60.6 cm^2/s = Minimum Required Transmissivity for the 4.25% component of the Slope.

The required transmissivity for the downstream 16.67% slope segment is based on the following parameters:

TSF = 5.11
q_h = 1.0×10^{-4} cm/s
L_{up} = 164 feet = 50.3 m
L_{down} = 69 feet = 21.0 m
β_{down} = 9.46 (16.67%)

$\therefore \Theta = 2.22 \times 10^{-4}$ m^2/s = 22.2 cm^2/s = Minimum Required Transmissivity for the 16.67% component of the Slope.

2. Maximum Applied Load on the Geocomposite

Since the in-place transmissivity of the geocomposite is partly a function of the applied loading, it is necessary to estimate the maximum load that will be applied to the geocomposite. Due to its location within the final cover (3.5 feet below the top of the topsoil layer), the final cover geocomposite will experience about 420 psf due to soil weight (3.5 feet x 120 pcf = 420 psf). The operation of small construction equipment over the geocomposite during final cover construction is expected to result in another 720 psf (based on the use of low ground pressure equipment exerting about 5 psi). Combining these two loadings and multiplying by a factor of safety of 2.0 yields a design loading of about 2,300 psf.

SUMMARY:

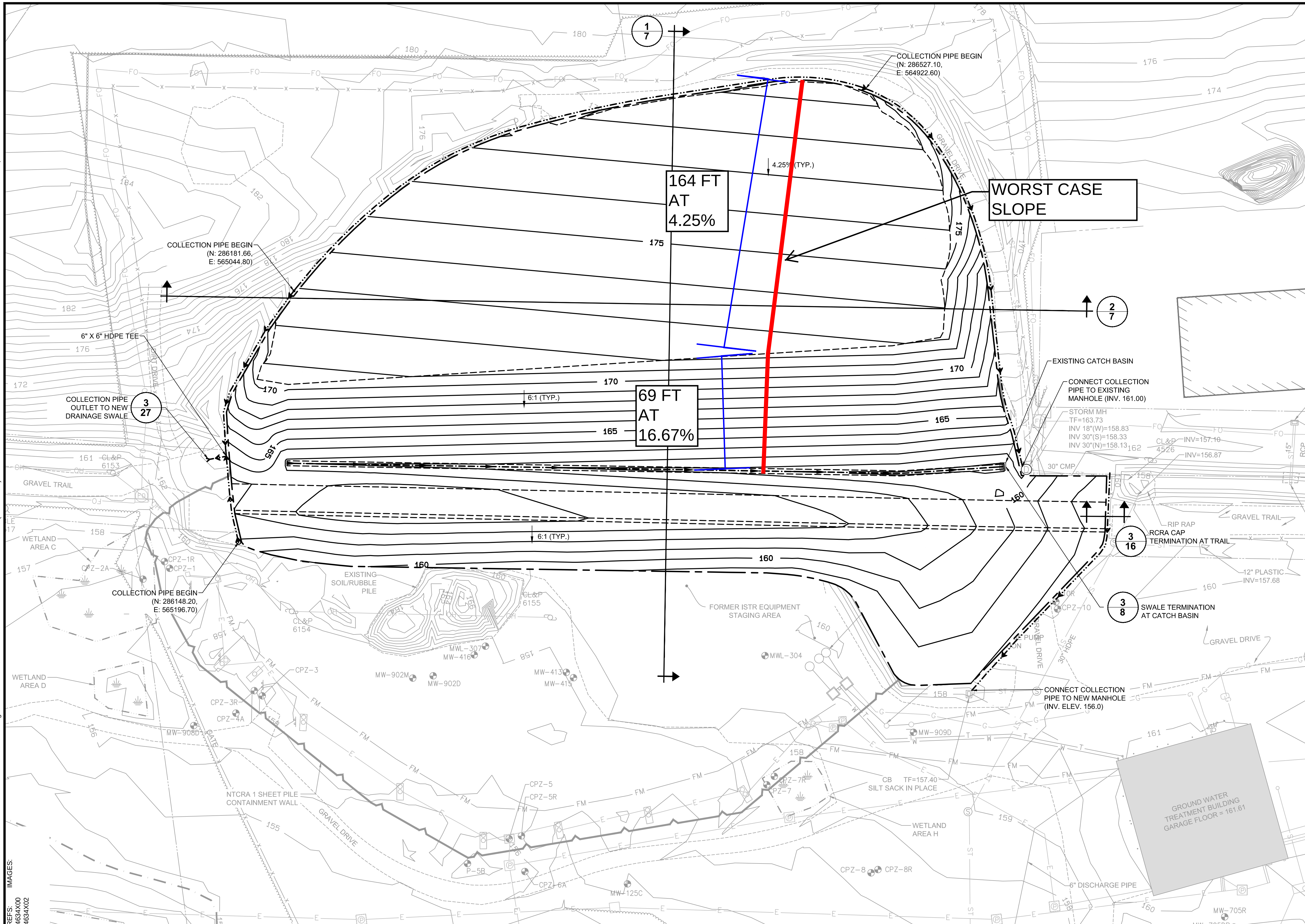
The minimum transmissivity value was determined for each slope and the geocomposite installed in the final cover must provide the following minimum transmissivities:

Θ = 60.6 cm^2/s with a hydraulic gradient = 0.0425 (approximately representative of a 4.25% slope)
Θ = 22.2 cm^2/s with a hydraulic gradient = 0.1667 (representative of a 16.67% slope)

The selected geocomposite for use within the RCRA cap shall have a minimum transmissivity of 60.6 cm^2/s. All final cover geocomposite materials must provide the required transmissivities under an applied loading of 2,300 psf and will be laboratory-tested using field-representative boundary conditions and site soils as a substrate.

Attachment 1

Slope Length Figure



LEGEND:

- 150 — PROPOSED SUBGRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF CAP AND SUBGRADE GRADING
- PROPOSED ANCHOR TRENCH
- PROPOSED DRAINAGE ANCHOR TRENCH AND FLOW DIRECTION
- PROPOSED COLLECTION PIPE AND FLOW DIRECTION
- X / XX — DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED GRADES/ELEVATIONS SHOWN REPRESENT TOP OF SUBGRADE (I.E., BOTTOM OF GEOSYNTHETICS) AFTER CONSOLIDATION OF TARGET EXCAVATION AREAS AND GRADING.

NOT FOR CONSTRUCTION

30' 0 30' 60'
1"=30'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

THIS DRAWING IS THE PROPERTY OF THE ARCADIS ENTITY IDENTIFIED IN THE TITLE BLOCK AND MAY NOT BE REUSED OR ALTERED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN PERMISSION OF SAME.

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

DRAFT

ARCADIS Design & Consultancy for natural and built assets

ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

CAP SUBGRADE GRADING PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date JUNE 2016

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APPENDIX F

RCRA Cap Cover System Collection Pipe Design

Imagine the result

Calculation Sheet

Client: SRSNE Site Group

Project Location: Southington, CT

Project: RCRA Cap Design **Project No.: B0054634.0001**

Subject: RCRA Cap Swale Collection Pipe Design

Prepared By: NWF **Date: September 2016**

Reviewed By: NWF **Date: September 2016**

Checked By: JEM **Date: September 2016**

OBJECTIVE:

Determine the required diameter of the perforated collection pipe located in the RCRA Cap system swale and drainage anchor trenches.

REFERENCES:

1. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 5 titled "Subgrade Grading Plan," ARCADIS, June 2016.

2. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 8 titled "Cap Details," ARCADIS, June 2016.

ASSUMPTIONS:

1. The hydraulic capacity of the RCRA Cap system collection pipes must equal or exceed the design outflow rate from the geocomposite that conveys water to the drainage feature or anchor trench. The design outflow from the geocomposite is based on Unit Gradient Method that was used to calculate the geocomposite transmissivity (see Reference 3) along with the slope of the RCRA Cap perpendicular to the pipe, and the length of the geocomposite that drains to the pipe (i.e., the length measured parallel to the RCRA Cap swale collection pipe).

2. The RCRA Cap swale collection pipe will have a minimum invert slope of 0.7% (Reference 2).

3. Three collection pipes are proposed to manage drainage from different portions of the RCRA Cap system (i.e., drainage swale and anchor trench collection pipes). Each collection pipe discharges to the either a manhole/catch basin or ground surface independently (References 1 and 2). Therefore, each collection pipe functions independently from the other. The sizing of the RCRA Cap system collection pipe is based on the worst case condition with the longest run (i.e., maximum volume of collected drainage), which is the one within the RCRA cap swale collection pipe (Reference 1).

4. All RCRA Cap system collection pipes will be perforated corrugated smooth-bore HDPE pipe (Reference 2). The Manning "n" for this pipe material is assumed to be 0.012 (see www.hancor.com/daids/hdpematerialcomp.asp).

Calculation Sheet

CALCULATIONS:

1. Maximum Flowrate to the RCRA Cap Swale Collection Pipe

The maximum outflow rate from the geocomposite is determined using Darcy's law, the definition of transmissivity, and the Unit Gradient Method. The peak flow is determined using the calculation indicated below:

Darcy's Law:

$Q = kiA$
$k = \Phi/t_d$ (from definition of transmissivity)
$A = L_c \times t_d$

Unit Gradient Method:

$\Phi = k_{veg} \times L_{slope} / \sin\beta = k_{veg} \times L_{slope} / i$

$\therefore Q = k_{veg} \times L_{slope} \times L_c$

where,

Q = required flow rate capacity (cfs).
t_d = thickness of the flow area (e.g., effective geocomposite thickness, length units cancel out)
i = drainage slope (dimensionless)
k_{veg} = permeability of the vegetative supporting soil = 0.0001 cm/sec = 0.00000328 ft/sec.
L_{slope} = length of the two slopes perpendicular to the collection pipe = 233 feet
L_c = length of the geocomposite draining to the collection pipe = 432 feet (note: counts only drainage from the west since area draining from the east is much smaller and west drainage length is based on maximum contributing length whereas most of the east drainage area is much less than the maximum)

Thus,
Q = (0.00000328 ft/s)(233 ft)(432 ft)
= 0.33 cfs

2. Required Pipe Diameter

The required pipe diameter is determined using the Manning equation and the maximum outflow rate from the geocomposite that drains to the RCRA Cap swale collection pipe.

The Manning equation is:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where,
Q = maximum outflow rate from the geocomposite = 0.33 cfs (from prior step)
A = cross sectional area of pipe flowing full = $\pi D^2/4$

Calculation Sheet

n = Manning "n" for corrugated polyethylene plastic pipe = 0.012 (Assumption 4)
R = hydraulic radius = A/P
P = wetted perimeter of pipe flowing full = πD
S = minimum longitudinal slope of pipe = 0.007

Solving for required D,

D_{req} = 0.43 ft = 5.16 in

A pipe size of 8 inches is selected for the central swale and will provide a flow area larger than that of the required pipe diameter by over 75%, providing additional capacity and factor of safety in the event of sediment accumulation. Pipe diameters of 6 inches will be used or the perimeter anchor trench pipes because their contributing drainage area is much smaller than the worst case design condition.

SUMMARY:

It was determined that the minimum collection pipe size for the RCRA Cap system would be 6-inch diameter. An 8-inch diameter perforated corrugated smooth-bore HDPE pipe was selected for use in the RCRA Cap collection system to provide additional capacity and a factor of safety.

APPENDIX F

RCRA Cap Geomembrane Stress Calculations

ARCADIS Design & Consultancy for natural and built assets

Imagine the result

Calculation Sheet

Client: SRSNE Site Group

Project Location: Southington, Connecticut

Project: RCRA Cap Design **Project No.: B0054634.0001**

Subject: Geomembrane Stress Evaluation

Prepared By: JEM **Date: September 2016**

Reviewed By: JEM **Date: September 2016**

Checked By: NWF **Date: September 2016**

OBJECTIVE:

Calculate the maximum overburden stress for loading on the flexible geomembrane liner during and following construction of the RCRA cap and compare to the maximum allowable stress for the flexible geomembrane liner to determine a factor of safety against puncture.

REFERENCES:

1. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 5 titled "Cap Subgrade Grading Plan," ARCADIS, June 2016.

2. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 6 titled "Cap Final Grading and Drainage Plan", ARCADIS, June 2016.

3. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 8 titled "Cap Details", ARCADIS, June 2016.

4. GSE Lining Technology, Inc., GSE Geomembrane Protection Design Manual. First Edition.

5. Goodyear Tire Engineering Data Book, Radial Medium Truck Tires, 2010 (portion attached).

6. Geosynthetic Institute, GRI White Paper # 14, Modification to the "GRI-Method" for the RF_{CR}-Factor Used in the Design of Geotextiles for Puncture Protection of Geomembranes, Robert M. Koerner, November 24, 2008.

ASSUMPTIONS:

1. The vegetative cover system includes a 60 mil LLDPE geomembrane, which is underlain by a geosynthetic clay layer and overlain with a double-sided geocomposite, 36 inches of general fill, and 6 inches of topsoil (Reference 3). The Rails to Trails pavement cover system will consist of a 60 mil LLDPE geomembrane, underlain by a geosynthetic clay layer and overlain with a double-sided geocomposite, 33 inches of general fill, and 9 inches of subbase and asphalt pavement.

2. The cover system will be installed over consolidated on-site material that will have a maximum particle size of 1 inch at the bottom of the cover system. This is a conservative assumption, as the specifications call for a maximum particle size of 0.5 inches in the uppermost 6 inches of soil below the geosynthetic materials.

Calculation Sheet

3. The puncture potential of the cover system geomembrane due to installation over the existing aggregate is determined using the procedures in Reference 4 and Reference 6 and by comparing the anticipated worst-case normal load on the geosynthetics to the maximum allowable normal load based on the thickness of the geomembrane, the maximum particle size in the underlying aggregate, and other factors.

4. In addition to the normal load due to burial beneath the cover soil, the geomembrane will experience an increased normal load during placement of the cover soil due to construction equipment. Once the geosynthetics are installed, construction equipment on the cover system will be limited to low-ground pressure tracked equipment exerting no more than approximately 5 psi on the ground surface after placement of the initial 1-foot of cover material and will also be subjected to heavy equipment loads during paving operations at the pavement subgrade elevation.

<u>CALCULATIONS</u>:

As discussed in Assumption 3, the factor of safety for puncture potential of the cover system geomembrane due to installation over existing fill soils can be assessed by comparing the estimated increase in normal load at the depth of the geosynthetics and the maximum allowable normal load for the geomembrane.

1. Maximum Allowable Normal Loading

Reference 4 is used to evaluate the puncture potential of the geomembrane as follows:

$$\sigma_{allow} = \left[450 \frac{M}{H'^2} - 1.3x10^5 (1.5 - t) H'^{-2.4} \right] \left[\frac{1}{MF_{PS} x FS_{CR} x FS_{CBD}} \right]$$

Where:

σ_{allow} = allowable normal pressure on geomembrane (kPa)
M = mass per unit area of nonwoven cushion geotextile (g/m^2) = 16 oz/yd^2 = 543 g/m^2
H = protrusion height (mm) = 0.5 x max particle size = 0.5 in = 12.5 mm
MF_{PD} = modification factor for packing density = 0.5 for packed stones
H' = effective protrusion height (mm) = H x MF_{PD} = 6.25 mm
MF_{PS} = modification factor for protrusion shape = 1.0 for angular stones
FS_{CR} = factor of safety for creep of geotextile and geomembrane = 1.3
FS_{CBD} = factor of safety for chemical and biological degradation = 1.0 for burial in clean soil
t = geomembrane thickness (mm) = 60 mil = 1.52 mm

Thus:

σ_{allow} = 4,811 kPa = 698 psi

Reference 6 (GRI Method) is used to evaluate the puncture potential of the geomembrane as follows:

Calculation Sheet

$$\sigma_{allow} = \left[50 + 0.00045\frac{M}{H^2}\right]\left[\frac{1}{MF_{PS} \times MF_{PD} \times MF_A}\right]\left[\frac{1}{RF_{CBD} \times RF_{CR}}\right]$$

Where:

σ_{allow} = allowable normal pressure on geomembrane (kPa)
M = mass per unit area of nonwoven cushion geotextile (g/m^2) = 16 oz/yd^2 = 543 g/m^2
H = protrusion height (m) = 0.5 x max particle size = 0.5 in = 0.0127m
MF_{PD} = modification factor for packing density = 0.5 for densely packed, 12 mm protrusion
MF_{PS} = modification factor for protrusion shape = 1.0 for angular stones
MF_A = modification factor for arching in solids = 0.5 for moderate geostatic conditions
RF_{CR} = reduction factor for long-term creep = 1.3 for 12 mm protrusion and mass/unit area = 550 gm/m^2
RF_{CBD} = reduction factor for chemical and biological degradation = 1.1 for mild leachate in clean soil

Thus:

σ_{allow} = 4,377 kPa = 635 psi

2. Factor of Safety for Equipment Loading During Initial Placement of Fill

Although the at-depth pressure increase on the geomembrane due to construction equipment operation will be less than the ground contact pressure beneath the construction equipment, this pressure dissipation is not considered herein because of the relatively shallow burial depth of the geomembrane (1 foot based on the general fill being installed in a 1-foot-thick lift). Thus, the at-depth pressure increase due to operation of construction equipment over the geomembrane is equal to 5 psi (Assumption 4).

The pressure due to burial beneath 1 foot of soil is approximately 0.8 psi (1.0 feet x 110 pounds per cubic foot). Thus, the total normal load experienced by the geomembrane is approximately 5.8 psi or 40.0 kPa. Because the expected at-depth increase in normal load is estimated to be 40.0 kPa, a factors of safety of approximately 120.3 and 109.5 is expected when compared to the results from Reference 4 and Reference 6, respectively.

3. Factor of Safety for Equipment Loading During Paving Operations

During paving operations, the minimum depth of cover over the geomembrane liner will be 33 inches during subbase placement and the maximum equipment loading will result from a fully loaded 10-wheel tandem axle dump truck with a maximum operating capacity of 53,800 lb. Reference 4 is used to determine the resulting loading on the liner as follows:

a) Calculate Gross Tire Contact Area at Geomembrane

Calculation Sheet

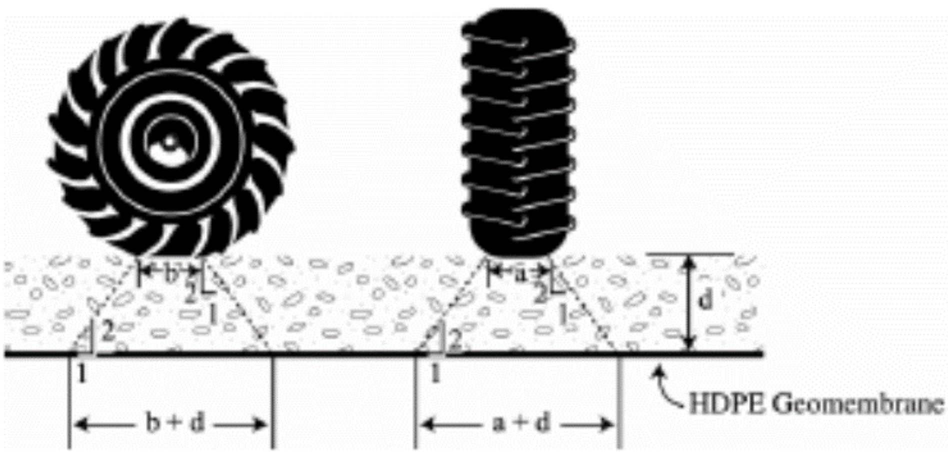


Figure 2.5 Stress Over Liner from Rubber Tire Vehicles.

For a Goodyear 295/75R22.5 tire for a Mack 10-wheel Dump Truck (Reference 5), a = 11.1 inches and b = 38.4 inches (static loaded radius = 19.2 inches) and the gross contact area A_g is calculated as follows:

$A_g = [a+d] \times [b+d]$ = 3149 in^2

b) Calculate Loading on Geomembrane

$$\sigma_{overburden} = \frac{m \times W \times I_{OL} \times I_{IF}}{2 \times A_g} + [\gamma_{soil} \times d_{soil}]$$

m =	0.67	
W=	53,800	lb
A_g=	3149.00	in^2
d_{soil} =	33	in
γ_{soil} =	0.069	lb/in^3 (120 lb/ft^3)
I_{if} =	1.3	

Calculation Sheet

I_{ol} = 1.3

Where,

m = Load distribution factor (assumed based on Reference 4),
W = Operating weight (lbs),
Ag = Area of tire (in^2) at geomembrane surface,
d = Depth of soil layer over the geomembrane (inches),
γ = Unit weight of soil or cover material overlying the geomembrane (lbs/in^3),
I_{if} = Impact factor (assumed based on Reference 4), and
I_{ol}= Overload factor (assumed based on Reference 4).

Thus:

$\sigma_{overburden}$ = 12 psi = 83 kPa

Based on the above, the expected at-depth loading for placement of subbase materials for paving operations is estimated to be 83 kPa. When compared to the allowable stresses of 4,811 kPa and 4,311 kPa calculated above, the expected factors of safety is approximately 58.0 and 52.0, respectively.

SUMMARY:

An evaluation of the puncture potential for the cover system geomembrane indicates that a minimum factor of safety of 52.0 is achieved with the proposed cover system cross section and the estimated maximum particle size in the existing aggregate to be overlain by the cover system. This minimum factor of safety occurs when 10-wheel dump trucks are used to place subbase gravel material for the Rails to Trails cover system.

APPENDIX F

Cover Veneer Stability Equipment Loads at Access Ramp

Client: Solvents Recovery Service of New England, Inc. **Project:** B0054634.0001

Title: RCRA Cap Design

Prepared by: Mandy Giampaolo **Date:** September 2016

Reviewed By: John Morgan **Date:** September 2016

Subject: Access Road Veneer Cap Stability Evaluation

Objective:

Evaluate the veneer stability of the proposed cap configuration for the access road design grade shown on Design Drawings 6 to 8 for this Resource Conservation and Recovery Act (RCRA) cap design. This stability analysis addresses the veneer stability of the proposed cap at the access road, and evaluates the veneer stability of the liner system at its weakest interface. The evaluation includes loads from equipment that will be using the access road for construction of a future solar field on the upper slope of the cap.

References:

1. ARCADIS. 2016. 100% RCRA Cap Design, SRSNE Superfund Site, Southington, CT.
2. Holtz, Robert D. and Kovacs William D. *An Introduction to Geotechnical Engineering.* Prentice Hall Inc. Upper Saddle River, New Jersey. 1981.
3. Koerner, R.M. and Dhani Narejo. 2005. *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces.*
4. Koerner, Robert M. and T. Soong, "Analysis and Design of Veneer Cover Soils," *Sixth International Conference on Geosynthetics,* 2005.

Attachments:

A. Proposed Cap Geometry and Components
B. Veneer Stability with Equipment Loading

Assumptions:

1. Cap configuration and slopes along the access road obtained from Drawings 6 and 7 of Reference 1. The cap system, from top to bottom, consists of 42 inches (1.07 meters) of cohesionless cover soil (consisting of 6 inches of topsoil and 36 inches of general fill), a geocomposite drainage layer, a textured 60-mil LLDPE flexible membrane liner (FML), a Geosynthetic Clay Liner (GCL), over Consolidated Material. No adhesion is assumed between the soils and the geosynthetics.

2. The cap system is freely drained (i.e., adequate subsurface drainage is provided to avoid a buildup of seepage forces at the soil/geosynthetic surface).
3. The minimum acceptable factor of safety is 1.50 for veneer stability.
4. The maximum (worst-case) slope gradient used for establishing the minimum factor of safety is 12% (approximately 6.9 degrees).
5. The unit weight of cover soil material is 18.85 kN/m^3 (120 pcf; Cap Stability Calculations of Reference 1).
6. The critical (weakest) interface governs the veneer stability of the cap. Here, the weakest interface occurs between the LLDPE and non-woven geotextile. Consistent with the cap stability evaluation, a value of 14 degrees was assumed for the interface friction angle at this interface.
7. The worse-cast slope condition (i.e., steepest slope over the longest distance) is approximately 12% (surface slope) over a length of approximately 27.7 meters (91 feet; Drawing 6 of Reference 1). The minimum cover soil thickness of 42 inches (1.07 meters) was assumed for the ramp.
8. Equipment using the access road for construction of the solar field is assumed to be similar to a John Deere 410 with 12.5 80-18 tires with the following properties:
   - Operating Weight = 85 kN (19,061 lb)
   - Lift Capacity = 32 kN (7,200 lb)
   - Axle Lifting Load = 109 kN (24,422 lb)
   - Total Load per Tire = 54.5 kN (12,211 lb)
   - Gross Tire Contact Area = 0.09 sq. meters (145 sq. in.) (assumed circular)
   - Ground Contact Pressure = 579 kN/m^2 (84 psi)
   - Travel speed in second gear, reverse = 13.2 km/h (8.2 mph; 3.7 m/s)
9. For the purposes of this calculation, the minimum braking time required for equipment to come to a complete stop on the access ramp is assumed to be approximately 0.5 seconds.

Calculations and Results:

Calculations were performed as outlined in Reference 4 and shown in Attachment B. In general, this equipment loading analysis is performed using the same methodology as for a finite slope analysis. However, in addition to the forces considered in a finite slope analysis, construction equipment weight and the force from equipment deceleration on the cover are applied to the active wedge.

For an estimate of the equipment acceleration, the following equation was used.

$V = V_o + at$, where

V = final velocity = 0 m/s
V_o = initial velocity, 3.7 m/s (Assumption 8)
a = equipment acceleration = unknown
t = stopping time, 0.5 s (Assumption 9)

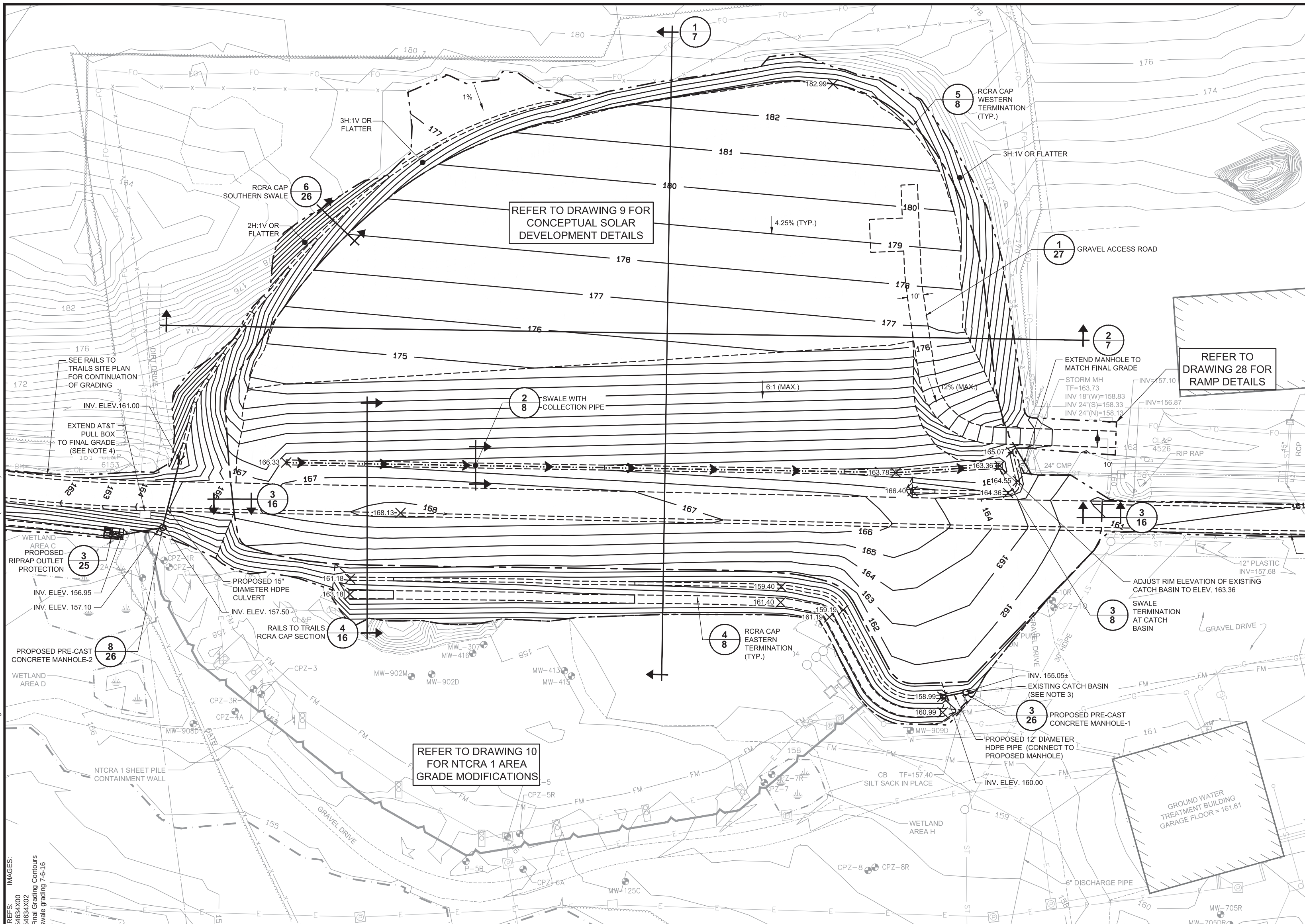
Therefore, equipment acceleration, $a = 7.4\ m/s^2$

The factor of safety against veneer sliding for the assumed equipment loading is 1.67. The estimated factor of safety satisfies the minimum factor of safety goals for the proposed access road and anticipated equipment usage during solar field construction. Therefore, so long as the equipment maintains speeds below approximately 8.2 mph when traveling downhill (which is consistent with published maximum backing speed for the anticipated equipment), and avoids any abrupt braking and/or acceleration while positioned on the slope, the potential for veneer sliding will be reduced.

Note that this calculation was completed before the USEPA requested the addition of geogrid stabilization beneath the access ramp and road leading up the cap to the solar area, so the calculation does not reflect the incorporation of geogrid. Because an acceptable factor of safety was determined without the geogrid, and the geogrid will provide further stabilization, a modified calculation is not needed to reflect the addition of geogrid.

ATTACHMENT A

Proposed Cap Geometry and Components



LEGEND:

- 150 — PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF FINAL GRADING
- LIMIT OF RCRA CAP
- PROPOSED SWALE AND FLOW DIRECTION (2/8)
- PROPOSED CULVERT
- PROPOSED PRE-CAST CONCRETE MANHOLE (3/26) (8/26)
- PROPOSED RIPRAP OUTLET PROTECTION (3/25)
- 161.15 X PROPOSED FINAL GRADE SPOT ELEVATION
- X/XX DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. REMOVE EXISTING CATCH BASIN AND INSTALL NEW MANHOLE.
4. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

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1"=30'

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Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

DRAFT

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RCRA CAP 100% DESIGN

CAP FINAL GRADING AND DRAINAGE PLAN

GENERAL

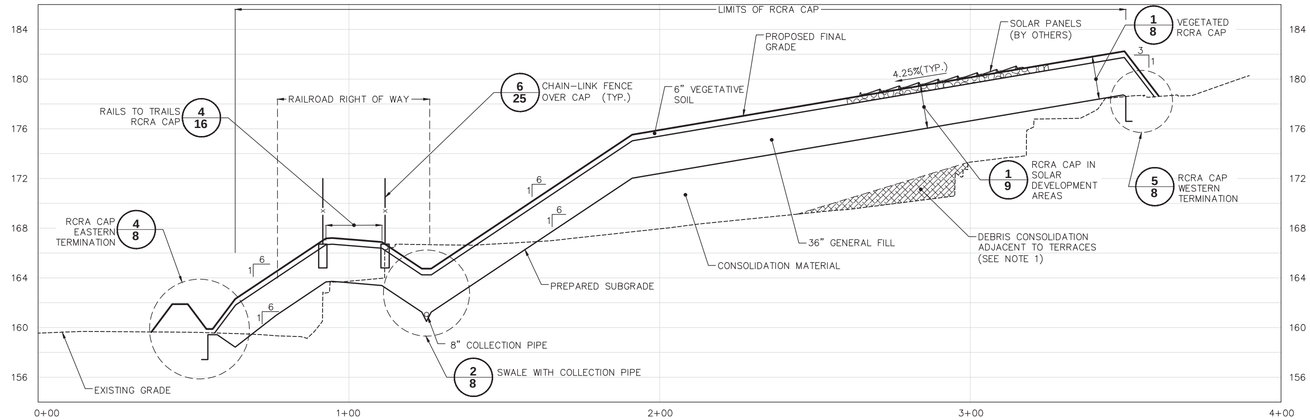
ARCADIS Project No. B0054634.0001.03900
Date JULY 2016

ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

6

NOTES:

1. CONSOLIDATE OVERSIZE MATERIAL (>3" IN LARGEST DIMENSION) FROM DEBRIS PILES AND EXCAVATION AREAS ADJACENT TO TERRACES.



CROSS SECTION 1

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'

CROSS SECTION 2

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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RCRA CAP 100% DESIGN

CAP CROSS SECTIONS

GENERAL

ARCADIS Project No. B0054634.0001.03900

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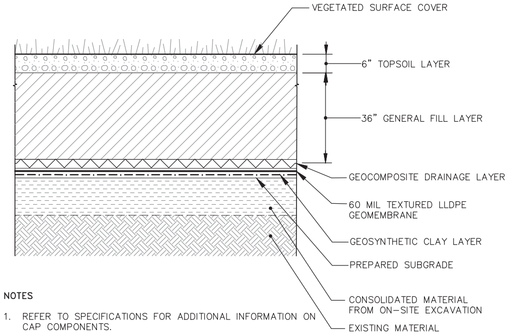
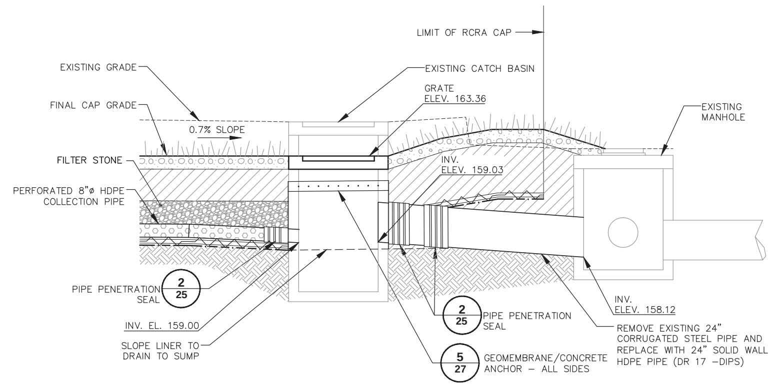


NOTES

1. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION ON CAP COMPONENTS.
2. THE TOTAL THICKNESS OF FILL MATERIALS ABOVE THE ENGINEERED BARRIER GEOSYNTHETICS SHALL BE A MINIMUM OF 42". THE CONTRACTOR SHALL DEMONSTRATE (THROUGH SURVEY AND TEST HOLE THICKNESS MEASUREMENTS) THE ACHIEVEMENT OF THIS MINIMUM THICKNESS IN ACCORDANCE WITH THE PROJECT REQUIREMENTS.

VEGETATED RCRA CAP (1)

NOT TO SCALE



SECTION A-A'

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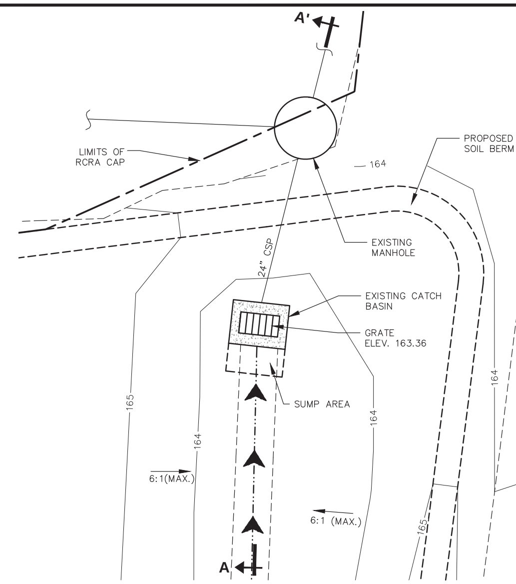
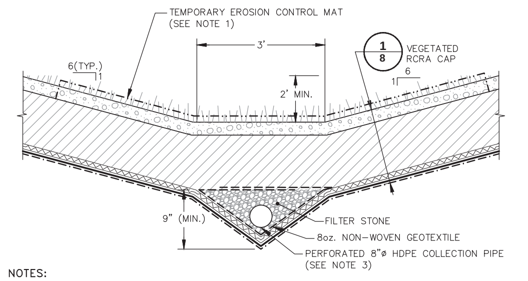


PLAN

SCALE: 1"=5'

SWALE TERMINATION AT CATCH BASIN (3)

NOT TO SCALE

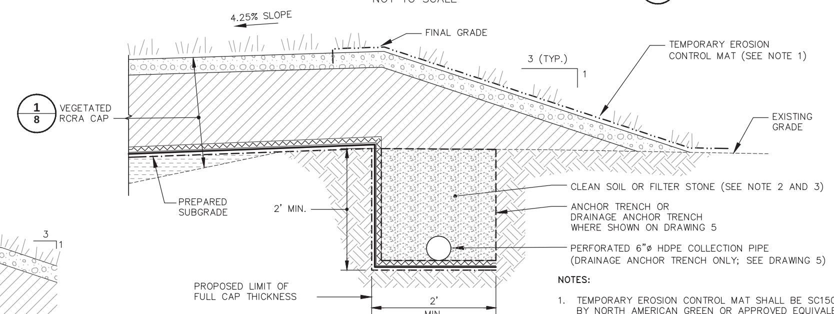


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. MINIMUM DITCH INVERT GRADIENT SHALL BE 0.7%.
3. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT.

SWALE WITH COLLECTION PIPE (2)

NOT TO SCALE

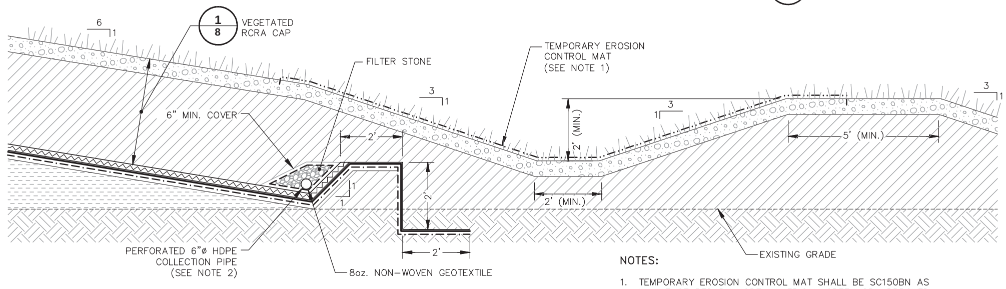


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.
2. ANCHOR TRENCH SHALL BE BACKFILLED WITH CLEAN SOIL FILL.
3. DRAINAGE ANCHOR TRENCH SHALL BE BACKFILLED WITH FILTER STONE WRAPPED IN NON-WOVEN FILTER GEOTEXTILE OVERLAPPED THE FULL WIDTH OF THE TRENCH.
4. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT. MINIMUM PIPE SLOPE SHALL BE 0.5%. COLLECTION PIPE FITTINGS, ELBOWS, AND CONNECTIONS SHALL BE MADE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RCRA CAP WESTERN TERMINATION (5)

NOT TO SCALE



RCRA CAP EASTERN TERMINATION (4)

NOT TO SCALE

NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT.

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JEFFREY HOLDEN		
Professional Engineer's No. 0023403		
State: CT	Date Signed	Project Mgr.: JH
Designed by: NWF	Drawn by: BS	Checked by: JEM

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ATTACHMENT B

Veneer Stability with Equipment Loading

PROJECT NUMBER/NAME: B0054634.0001/Solvents Recovery Service of New England, Inc.
SUBJECT: Access Road Equipment Veneer Stability - Acceleration

Veneer Cover Stability

(Reference: Koerner and Soong; 2003; Analysis and Design of Veneer Cover Soils; Geosynthetics International, 2005, 12, No. 1)

Veneer Stability with Construction Equipment Forces: Acceleration on Slope

$$F_e = W_e\left(\frac{a}{g}\right) \quad (17)$$

$$W_e = qwI \quad (16)$$

$$W_A = \gamma h^2\left(\frac{L}{h} - \frac{1}{\sin\beta} - \frac{\tan\beta}{2}\right) \quad (3)$$

$$N_A = W_A \cos\beta \quad (4)$$

$$C_a = c_a\left(L - \frac{h}{\sin\beta}\right) \quad (5)$$

$$W_P = \frac{\gamma h^2}{\sin 2\beta} \quad (8)$$

$$N_p = W_P + E_P \sin\beta \quad (9)$$

$$C = \frac{ch}{\sin\beta} \quad (10)$$

$$E_A = (W_A + W_e)\sin\beta + F_e - \frac{(N_e + N_A)\tan\delta + C_a}{FS} \quad (20)$$

$$E_P = \frac{C + W_P\tan\phi}{\cos\beta(FS) - \sin\beta\tan\phi} \quad (12)$$

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad (15)$$

$$a = [(W_A + W_e)\sin\beta + F_e]\cos\beta$$

$$b = -\{[(N_e + N_A)\tan\delta + C_a]\cos\beta + [(W_A + W_e)\sin\beta + F_e]\sin\beta\tan\phi + (C + W_P\tan\phi)\}$$

$$c = [(N_e + N_A)\tan\delta + C_a]\sin\beta\tan\phi \quad (22)$$

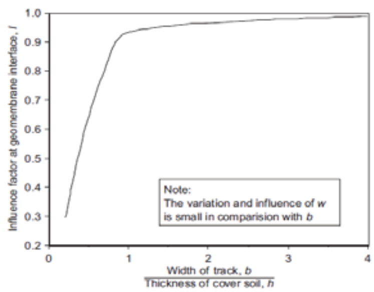
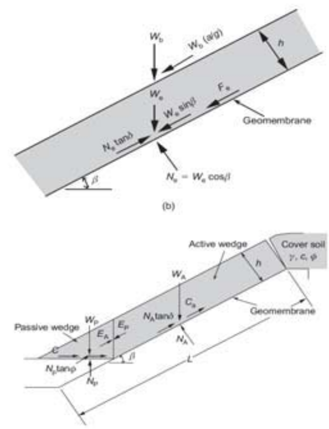


Figure 7. Values of influence factor *I* for use in Equation 16 to dissipate surface force through cover soil to geomembrane interface (after Poulos and Davis 1974)



where,

Wb = Total Load per Tire, kN		54.50	kN	
w = Length of loaded tire contact area, m (assume circular)		0.35	m	
b = Width of loaded tire contact area, m (assume circular)		0.35	m	
q = Equipment ground pressure, kN/m^2		581.65	kN/m^2	
I = Influence factor at geomembrane surface (Figure 7)		0.30		
We = Equivalent equipment force per unit width at the geomembrane interface, kN		60.27	kN	
a = Acceleration of Equipment, m/sec²		7.40	m/sec²	
Fe = Acceleration Force, kN		45.46	kN	
Ne = Effective equipment force normal to the active wedge failure plane		59.83787	kN	
L = length of slope, m	L =	27.70	m	
H = vertical height of slope measured from toe, m	H =	3.31	m	
β = subgrade slope angle, deg	β =	6.87	deg	0.1199 rad
ϕ = friction angle of cover soil, deg	ϕ =	30	deg	0.5236 rad
δ = interface friction angle between cover soil and subgrade, deg	δ =	14	deg	0.2443 rad
ca = adhesion between active wedge cover soil and subgrade, Pa(?)	ca =	0	Pa	
c = cohesion of cover soil, Pa(?)	c =	0	Pa	
γ = unit weight of cover soil, kN/m³	γ =	18.85	kN/m³	
h = minimum thickness of cover soil, m	h =	1.07	m	
Wa = total weight of active wedge, kN	Wa =	376.97	kN	
Na = effective force normal to failure plane of active wedge, kN	Na =	374.27	kN	
Ca = adhesion force along active wedge, kN	Ca =	0.00	kN	
Ea = interwedge force acting on the active wedge from the passive wedge, kN	Ea =	1421.41	kN	
Wp = total weight of passive wedge, kN	Wp =	90.86	kN	
C = cohesive force along the plane of the passive wedge, kN	C =	0.00	kN	
Ep = interwedge force acting on the passive wedge from the active wedge, kN	Ep =	32.99	kN	
Np = effective force normal to the failure plane of the passive wedge, kN	Np =	94.81	kN	
	a =	97.064		
	b =	-166.669		
	c =	7.421		
FSreqd = required factor of safety	FSreqd =	1.00		
FS = factor of safety against cover soil sliding on the subgrade	**FS =**	**1.67**		
β = slope angle	β =	8.30	H:1V	0.12 ft/ft

9/13/2016
C:\Users\mgiampaolo\Documents\ARCADIS Projects\SRSNE\Cap Design 2016\Veneer Stability\Cover Veneer Stability_Equipment Loads at Access Ramp_September 12.xls

APPENDIX F

RCRA Cap Stability Summary June 6 2016

CALCULATIONS

Client: Solvents Recovery Service of New England, Inc. **Project:** B0054634.0001

Title: RCRA Cap Design

Prepared by: Mandy Giampaolo **Date:** June 2016

Reviewed By: Kyle Warren **Date:** June 2016

Subject: Cap Stability Evaluation

Objective:

Evaluate the stability of the proposed cap configuration for the design grades shown on Design Drawings 6 to 8 for this Resource Conservation and Recovery Act (RCRA) cap design. This stability analysis addresses the sliding stability of the proposed cap, and evaluates the stability of the liner system at its weakest interface. The evaluation also considered the loadings from an access road for future construction of a solar field on the upper slope of the cap.

References:

1. ARCADIS. 2016. 100% RCRA Cap Design, SRSNE Superfund Site, Southington, CT.
2. Holtz, Robert D. and Kovacs William D. *An Introduction to Geotechnical Engineering.* Prentice Hall Inc. Upper Saddle River, New Jersey. 1981.
3. Koerner, R.M. and Dhani Narejo. 2005. *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces.*
4. Geo-Slope International Ltd, 2010. *Slope/W (2010)*.

Attachments:

A. Proposed Cap Geometry and Components
B. Slope/W Stability Output

Assumptions:

1. Cap configuration and slopes for the stability model cross-section obtained from Drawings 6 and 7 of Reference 1.
2. Soil classification and parameters used for stability evaluation were developed from a review of project specifications for the cap materials and placement.

3. The parameters used in the stability calculations are shown in Table 1. Soil parameters were assumed using Holtz and Kovacs typical values (Reference 2) for the various soil types and consistency. Parameters for the geosynthetics were estimated from the Koerner publication (Reference 3).

Table 1. Material Parameters

Material	Unit Weight (pcf)	Internal Friction Angle (degrees)
Consolidated Material	115	28 (1)
Subgrade Soils	115	26 (2)
General Fill	120	30 (3)
Geosynthetic Clay Liner (GCL) (Non-woven Geotextile to either Subgrade Soils or to Textured Geomembrane Interface)	58.6	14 (4)
LLDPE Geomembrane (Textured Geomembrane/ Non-woven Geotextile Interface)	58.6	14 (4)
Geocomposite Drainage Layer (Non-woven Geotextile to General Fill or to Textured Geomembrane Interface)	58.6	17 (5)
Riprap	140	38
Access Ramp	120	34

Notes:

1. Properties for Consolidated Material based on a boring information that indicates site soils consisting of fine sands and silts overlying sand and gravel. For the purposes of this evaluation, it was assumed that the excavation soils consist of fine sands and silts placed to a medium dense consistency.
2. Properties for Subgrade Soils are also based on available boring logs in the area of the proposed cap. Soil descriptions indicated near surface soils as fine sands and silt. For conservatism, the subgrade soils are assumed to be of a loose consistency.
3. Based on discussions with the project team and Reference 1, the General Fill is likely to be from an off-site source, and similar to soils imported for previous phases of work at the site. This granular soil is assumed to be a gravelly sand placed with minimal compaction (i.e., tracked in place) to a medium density.
4. Friction angle estimated from review of interface friction results from Reference 3 for textured LLDPE versus non-woven geotextile. Residual values used, and are reduced (from the reported 17 degrees) for conservatism since results for LLDPE vs GCL were not available.
5. Friction angle estimated from review of interface friction results from Reference 3 for textured LLDPE versus non-woven geotextile. Residual values used for conservatism.

4. Groundwater surface shown on stability model has been estimated from the available borings within the

consolidation area.

5. Minimum acceptable factor of safety value (FOS) is 1.50 for static and 1.0 for seismic.
6. A seismic peak ground acceleration of 0.114 g was assumed and used based on the 2009 NEHRP Recommended Seismic Provisions and the search tool to locate the parameter for the site.
7. The surcharge loading of 250 psf, applied on the access ramp, was selected to model loading from construction equipment operating on the surface of the cap for construction of a future solar field. The access ramp configuration included a 1V:3H slope from the swale up to the ramp grade of 12 percent (per Drawing 6 of Reference 1).

<u>Calculations and Results</u>:

The stability analyses were performed using the SLOPE/W® computer program by Geo-Slope International, Ltd. (Reference 4). The analyses were performed using the Spencer method, which satisfies both moment and force equilibrium. Sliding analyses with forced exit and entry locations were completed to evaluate the stability of the liner system at the weakest interface (i.e., the LLDPE geomembrane and geotextile fabric interface). Circular searches were performed to evaluate failure surfaces for the cap at its steepest slope section, with and without the access ramp. The limits for each search method were varied to estimate the critical failure surface and corresponding minimum factors of safety (FOS) under static and seismic conditions.

Results of the stability evaluation are summarized in the following table. Figures showing the critical failure surface for each analysis are included in Attachment B.

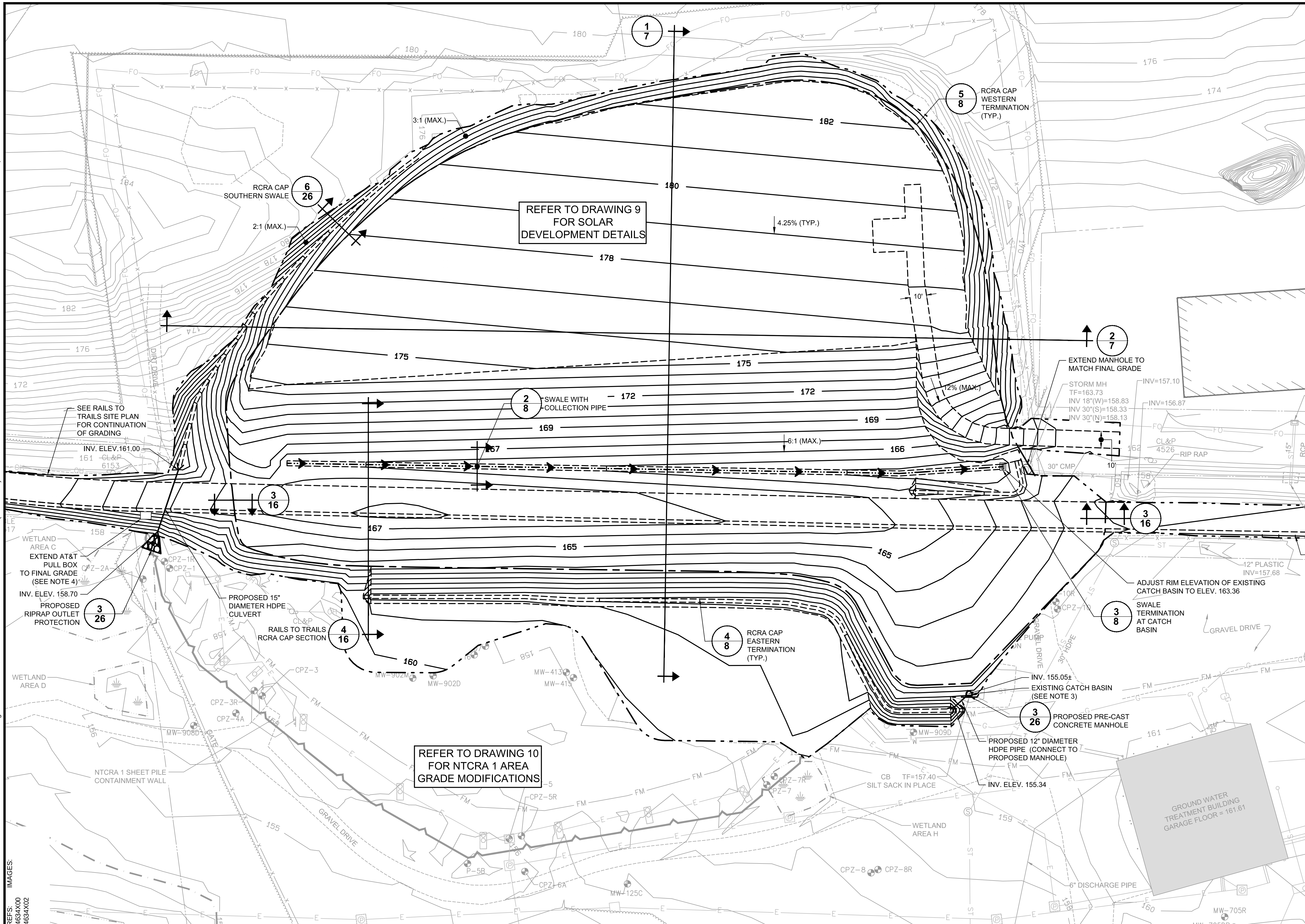
Table 2: Stability Factors of Safety

Scenario	**Factor of Safety Static Analysis**		**Factor of Safety Seismic Analysis**	
	Goal (Minimum)	**Result**	**Goal (Minimum)**	**Result**
Without Access Ramp				
Sliding, 4% Slope	1.50	6.02	1.0	1.41
Sliding, 1V:6H		1.91		1.14
Sliding, Toe		1.67		1.03
Circular, 1V:6H		3.10		1.59
With Access Ramp				
Sliding, 1V:6H	1.50	1.73	1.0	1.08
Circular, 1V:6H		2.01		1.37

As shown in Table 2, calculated FOS values satisfy the minimum FOS goals for the various slope scenarios evaluated for the loading conditions. Satisfactory FOS values were also attained for the seismic loading case for each scenario.

ATTACHMENT A

Proposed Cap Geometry and Components



LEGEND:

- 150 — PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF FINAL GRADING
- LIMIT OF CAP
- PROPOSED SWALE AND FLOW DIRECTION (2/8)
- PROPOSED CULVERT
- PROPOSED PRE-CAST CONCRETE MANHOLE (3/26)
- PROPOSED RIPRAP OUTLET PROTECTION (3/25)
- X/XX — DETAIL REFERENCE NUMBER / DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. REMOVE EXISTING CATCH BASIN AND INSTALL NEW MANHOLE.
4. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

NOT FOR CONSTRUCTION

30' 0 30' 60'
1"=30'

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

DRAFT

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RCRA CAP 100% DESIGN

CAP FINAL GRADING AND DRAINAGE PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900
Date JUNE 2016
ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

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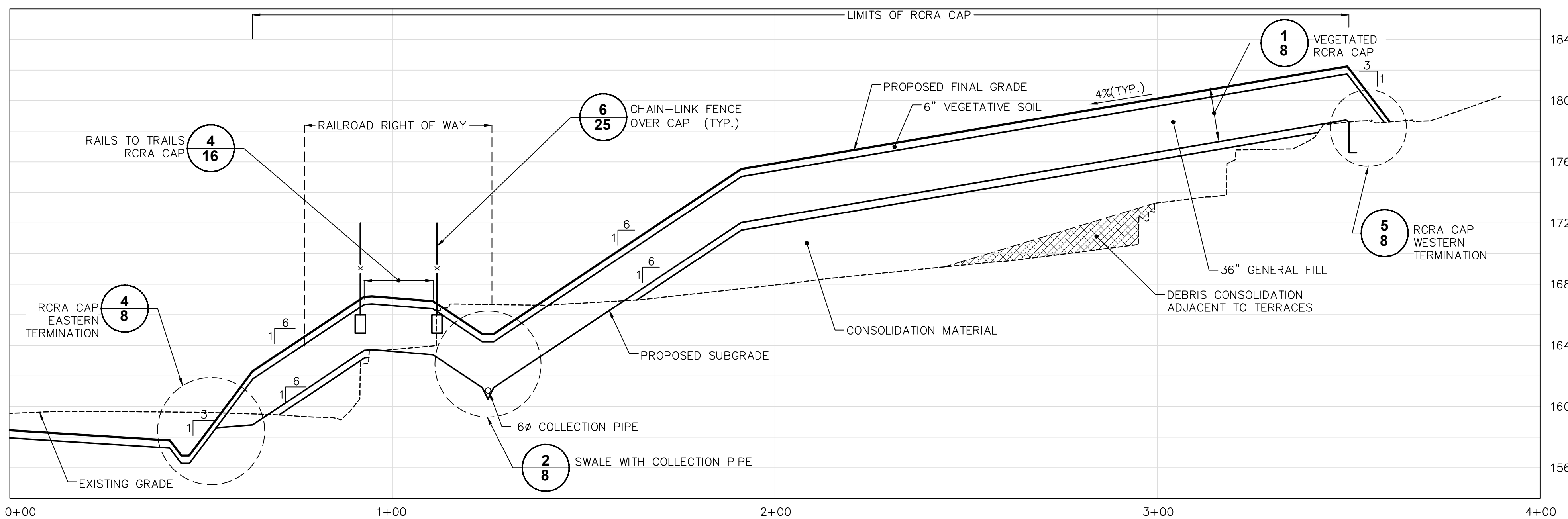
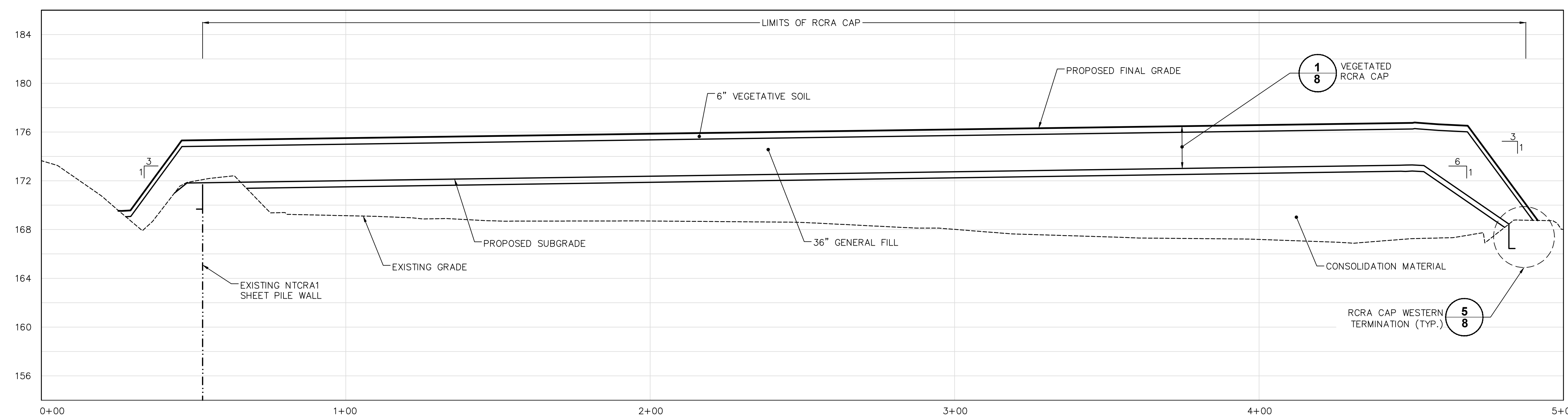


CROSS SECTION 1

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'



CROSS SECTION 2

HORIZONTAL SCALE: 1"=20'

VERTICAL SCALE: 1"=5'

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

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RCRA CAP 100% DESIGN

CAP CROSS SECTIONS

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date MAY 2016

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6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
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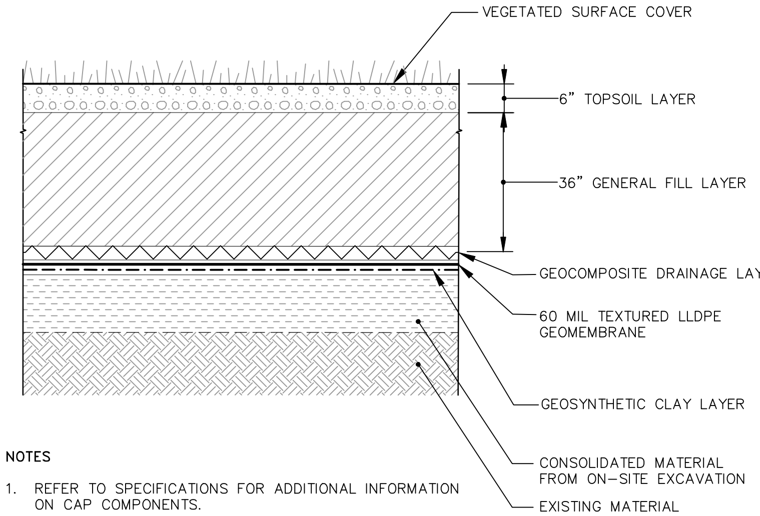
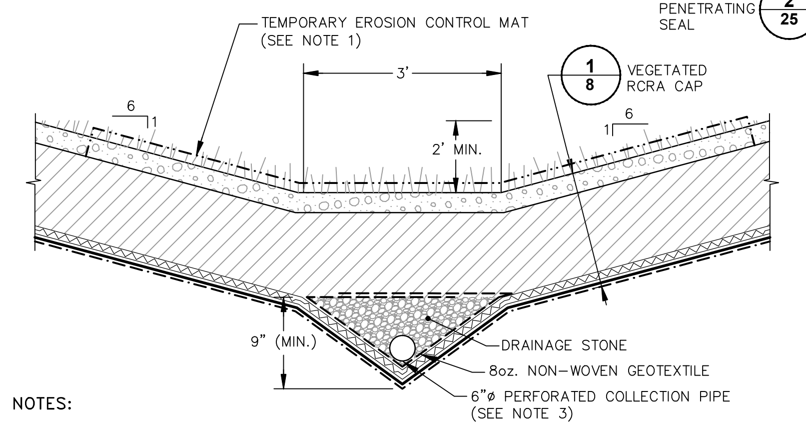


NOTES

1. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION ON CAP COMPONENTS.
2. THE TOTAL THICKNESS OF FILL MATERIALS ABOVE THE ENGINEERED BARRIER GEOSYNTHETICS SHALL BE A MINIMUM OF 42". THE CONTRACTOR SHALL DEMONSTRATE (THROUGH SURVEY) THE ACHIEVEMENT OF THIS MINIMUM THICKNESS IN ACCORDANCE WITH THE PROJECT REQUIREMENTS.

VEGETATED RCRA CAP (1)

NOT TO SCALE

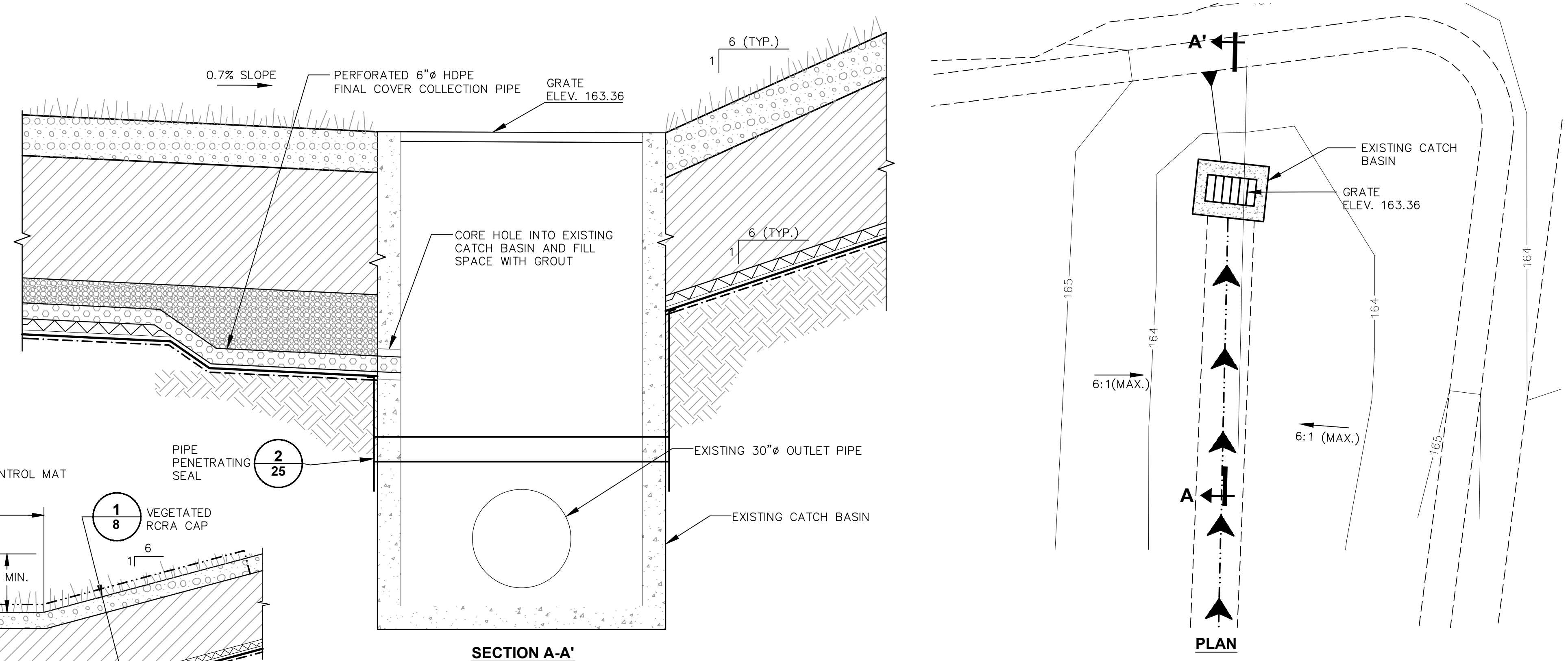


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT
2. MINIMUM DITCH INVERT GRADIENT SHALL BE 0.7%.
3. COLLECTION PIPE SHALL BE CORRUGATED SMOOTH-BORE N-12 (PERFORATED) AS MANUFACTURED BY ADS OR APPROVED EQUIVALENT. MINIMUM PIPE SLOPE SHALL BE 0.5%.

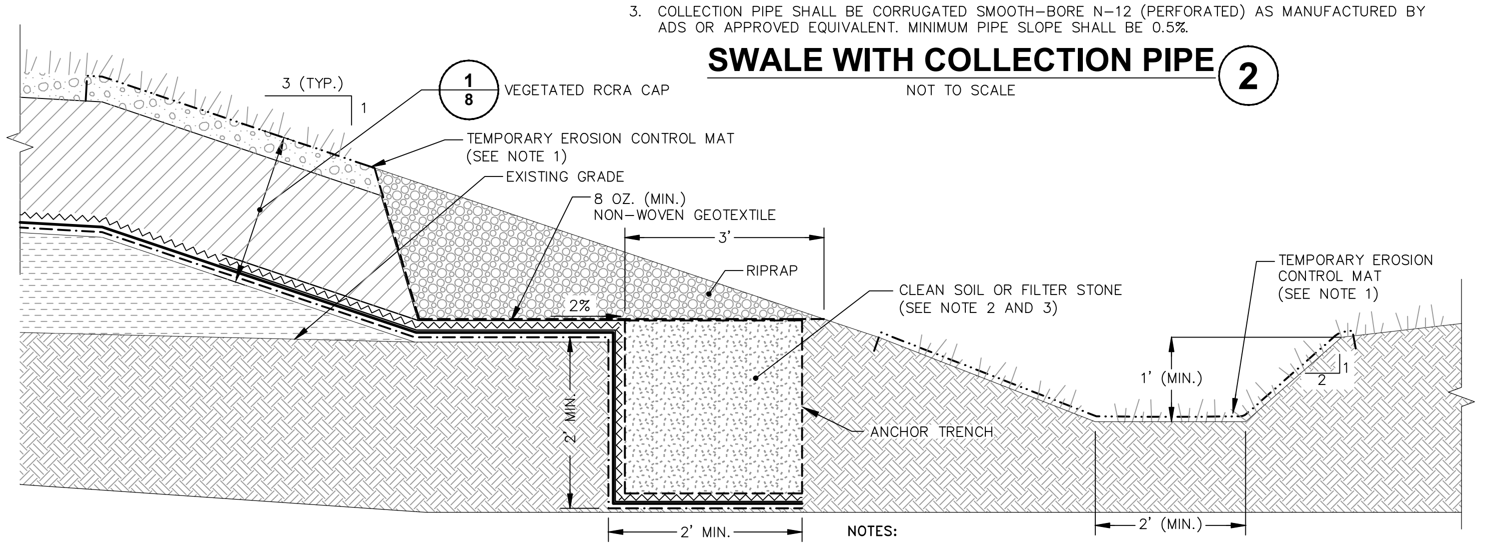
SWALE WITH COLLECTION PIPE (2)

NOT TO SCALE



SWALE TERMINATION AT CATCH BASIN (3)

NOT TO SCALE

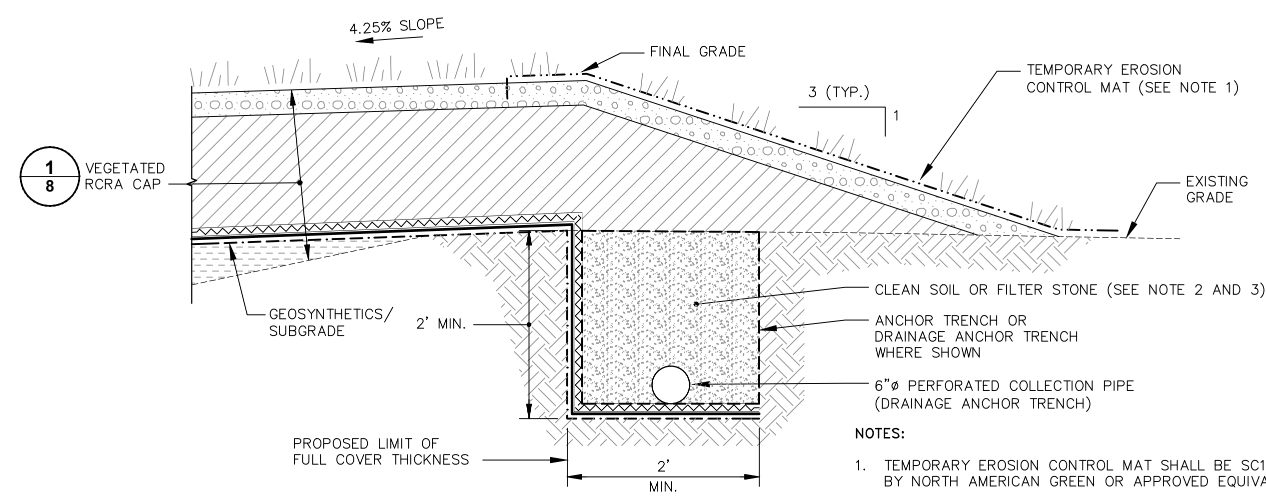


NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.
2. ANCHOR TRENCH SHALL BE BACKFILLED WITH CLEAN SOIL FILL.
3. DRAINAGE ANCHOR TRENCH SHALL BE BACKFILLED WITH FILTER STONE WRAPPED IN NON-WOVEN FILTER GEOTEXTILE OVERLAPPED THE FULL WIDTH OF THE TRENCH.

RCRA CAP EASTERN TERMINATION (4)

NOT TO SCALE



NOTES:

1. TEMPORARY EROSION CONTROL MAT SHALL BE SC150BN AS MANUFACTURED BY NORTH AMERICAN GREEN OR APPROVED EQUIVALENT.
2. ANCHOR TRENCH SHALL BE BACKFILLED WITH CLEAN SOIL FILL.
3. DRAINAGE ANCHOR TRENCH SHALL BE BACKFILLED WITH FILTER STONE WRAPPED IN NON-WOVEN FILTER GEOTEXTILE OVERLAPPED THE FULL WIDTH OF THE TRENCH.
4. COLLECTION PIPE SHALL BE PERFORATED SMOOTH INTERIOR CORRUGATED HDPE. COLLECTION PIPE FITTINGS, ELBOWS, AND CONNECTIONS SHALL BE MADE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RCRA CAP WESTERN TERMINATION (5)

NOT TO SCALE

NOT FOR CONSTRUCTION

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XREFS: 54634X00 IMAGES:

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
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Designed by	Drawn by	Checked by
NWF	BS	JEM

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RCRA CAP 100% DESIGN

CAP DETAILS

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date MAY 2016

ARCADIS OF NEW YORK
6723 TOWPATH RD.
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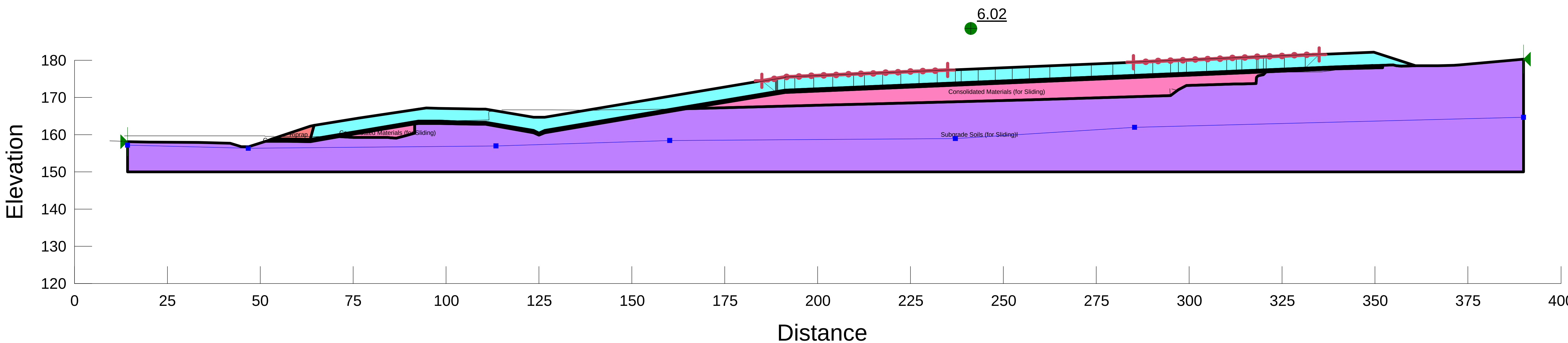
8

ATTACHMENT B

Slope/W Stability Output

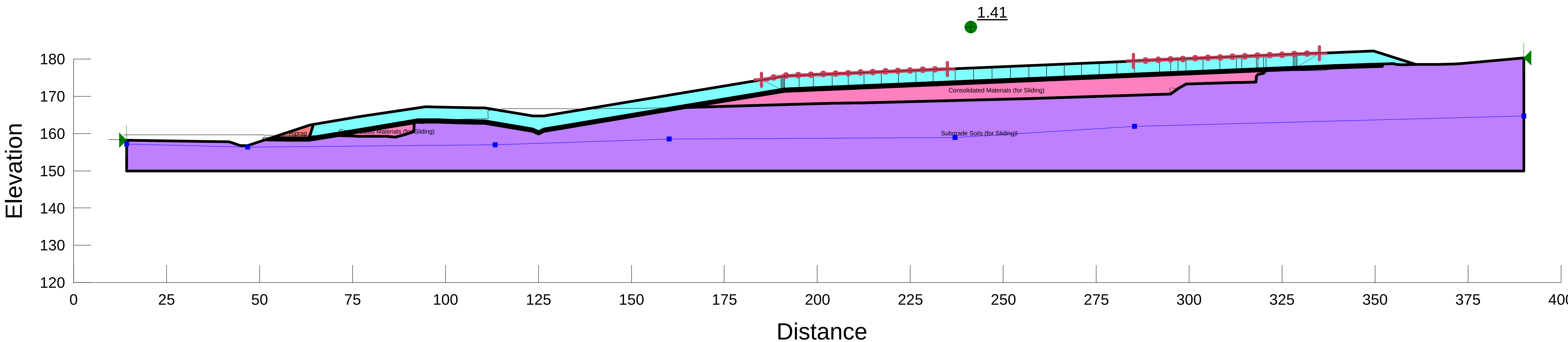


Static, Sliding, 4% Slope

MATERIALS:

Geosynthetic Clay Liner   Mohr-Coulomb   58.6 pcf   0 psf   14 °   1
LLDPE Geomembrane   Mohr-Coulomb   58.6 pcf   0 psf   14 °   1
Geocomposite Drainage Layer   Mohr-Coulomb   58.6 pcf   0 psf   17 °   1
General Fill   Mohr-Coulomb   120 pcf   0 psf   32 °   1
Subgrade Soils (for Sliding)l   Bedrock (Impenetrable)   1
Consolidated Materials (for Sliding)   Bedrock (Impenetrable)   1
Riprap   Mohr-Coulomb   140 pcf   0 psf   38 °   1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

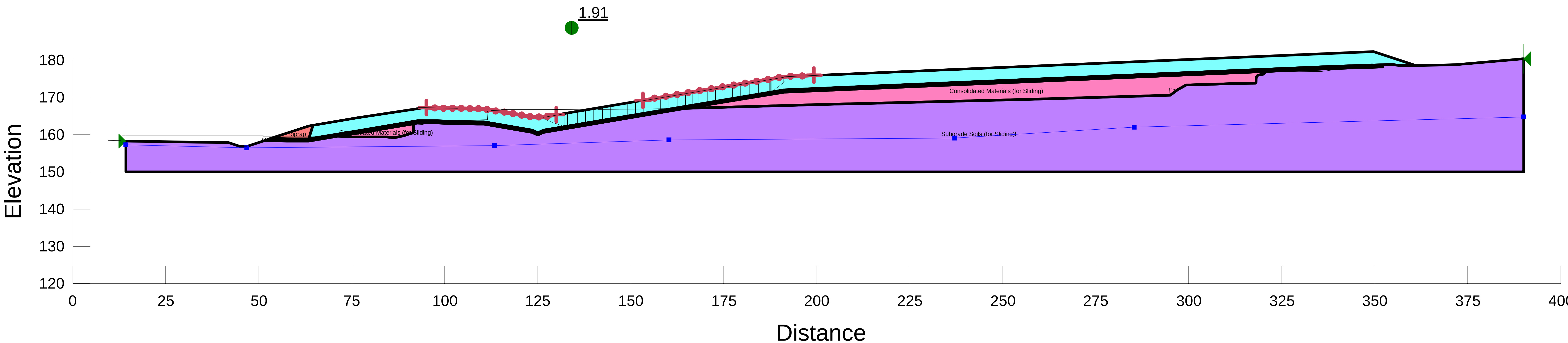


Seismic, Sliding, 4% Slope

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

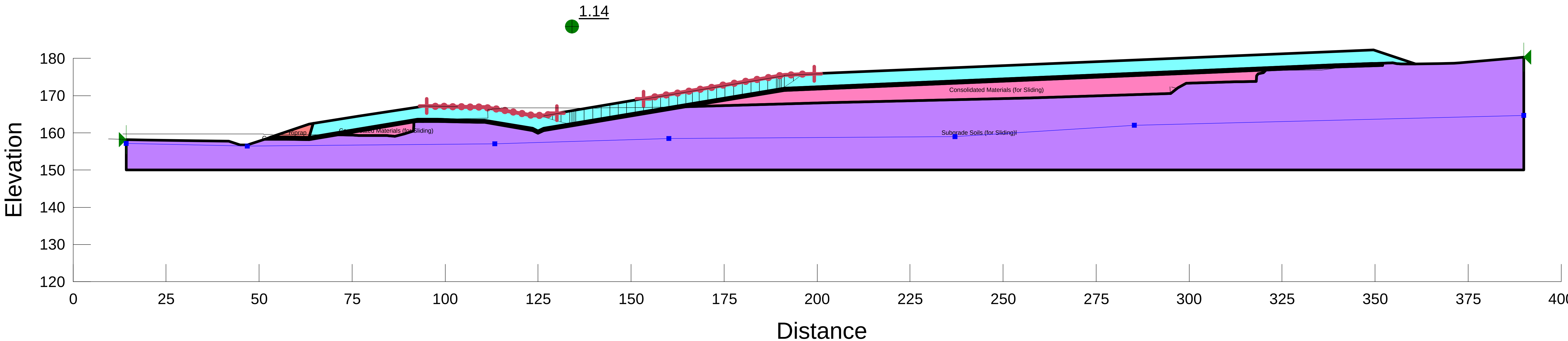


Static, Sliding, 1V:6H Slope

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

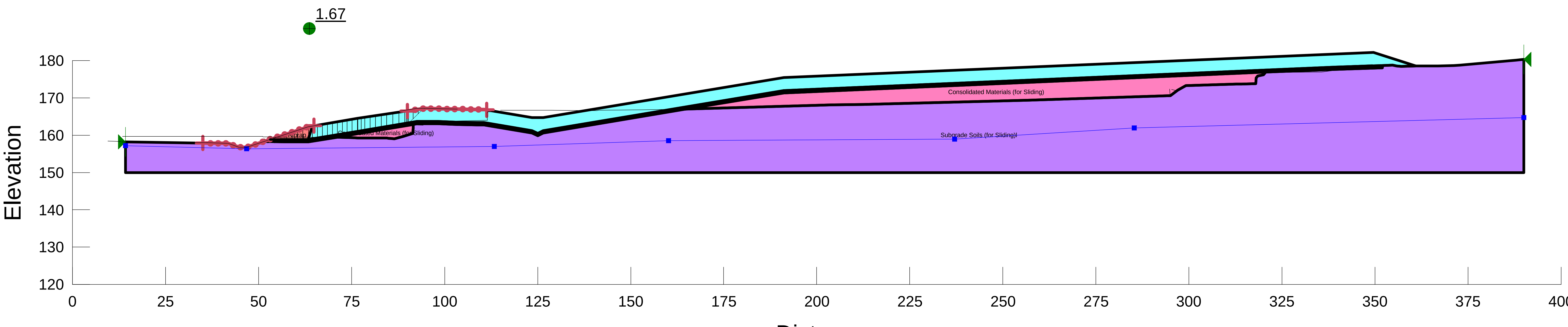


Seismic, Sliding, 1V:6H Slope

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

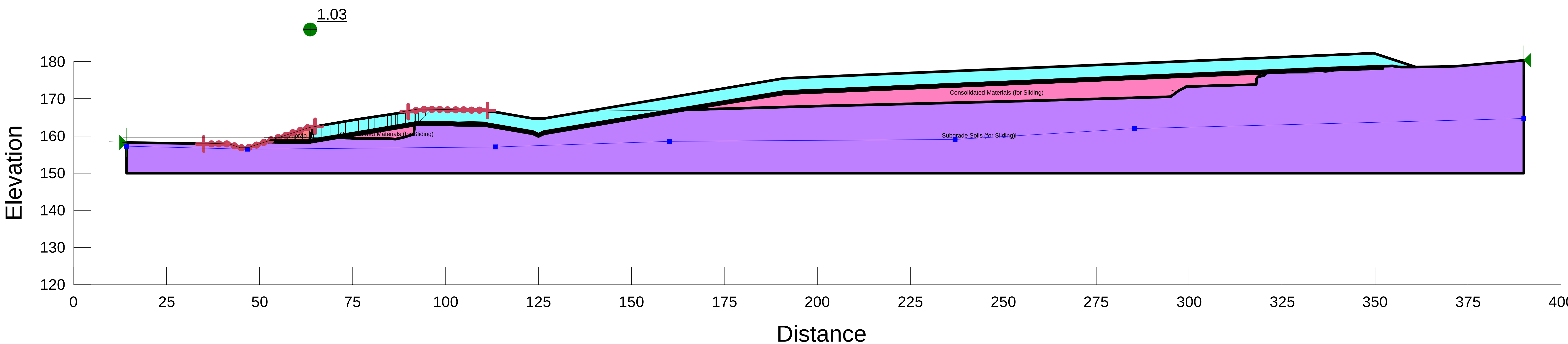


Static, Sliding, Toe

MATERIALS:

Geosynthetic Clay Liner   Mohr-Coulomb   58.6 pcf   0 psf   14 °   1
LLDPE Geomembrane   Mohr-Coulomb   58.6 pcf   0 psf   14 °   1
Geocomposite Drainage Layer   Mohr-Coulomb   58.6 pcf   0 psf   17 °   1
General Fill   Mohr-Coulomb   120 pcf   0 psf   32 °   1
Subgrade Soils (for Sliding)l   Bedrock (Impenetrable)   1
Consolidated Materials (for Sliding)   Bedrock (Impenetrable)   1
Riprap   Mohr-Coulomb   140 pcf   0 psf   38 °   1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

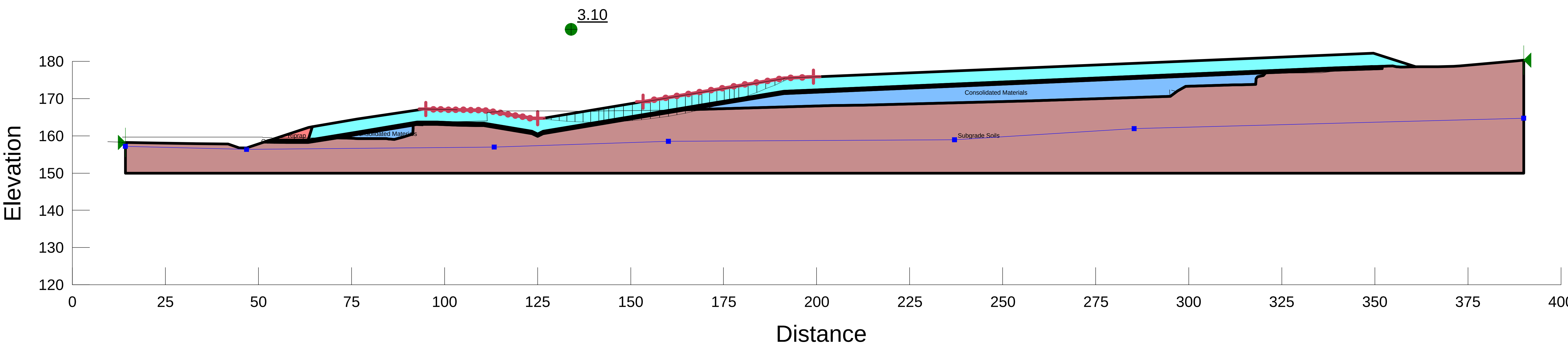


Seismic, Sliding, Toe

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

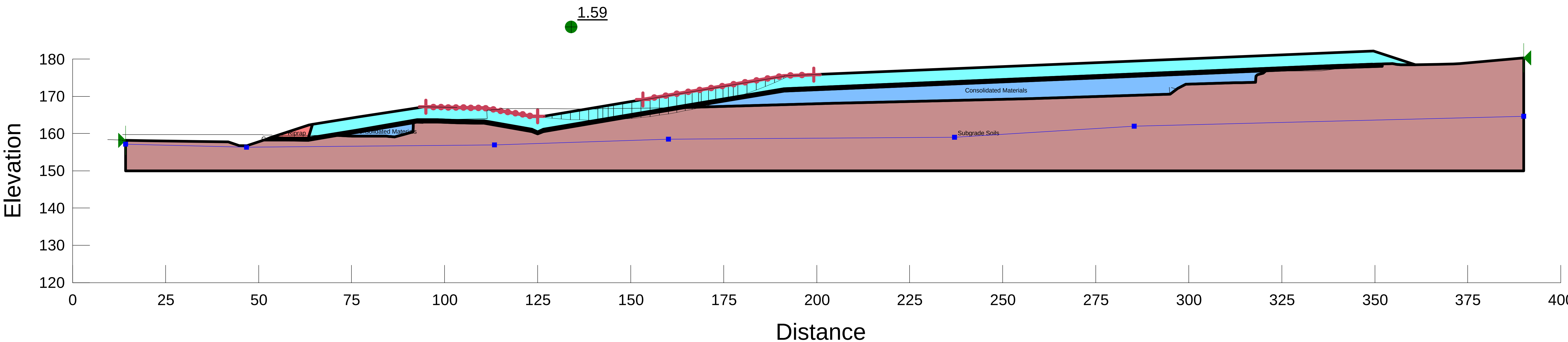


Static, Circular, 1V:6H Slope

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Consolidated Materials Mohr-Coulomb 110 pcf 0 psf 28 ° 1
Subgrade Soils Mohr-Coulomb 115 pcf 0 psf 26 ° 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

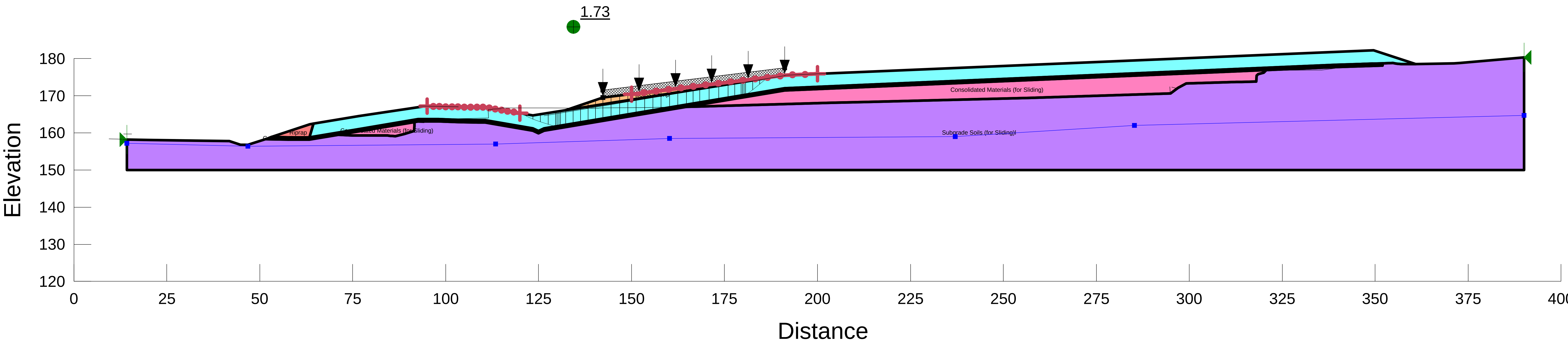


Seismic, Circular, 1V:6H Slope

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Consolidated Materials Mohr-Coulomb 110 pcf 0 psf 28 ° 1
Subgrade Soils Mohr-Coulomb 115 pcf 0 psf 26 ° 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1

CAP STABILITY EVALUATION
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

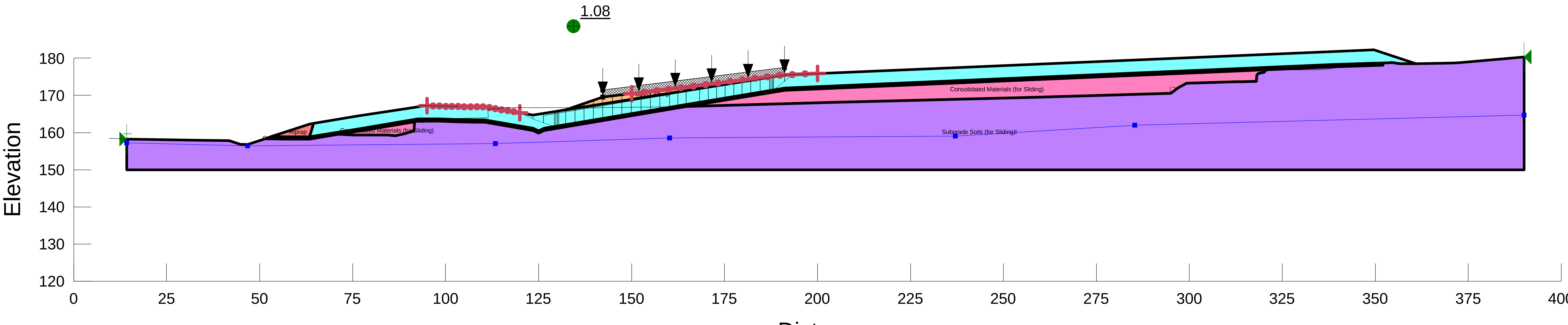


Static, Sliding, 1V:6H Slope, Surcharge

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1
Access Ramp Mohr-Coulomb 120 pcf 0 psf 34 ° 1

CAP STABILITY EVALUATION - ACCESS RAMP
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

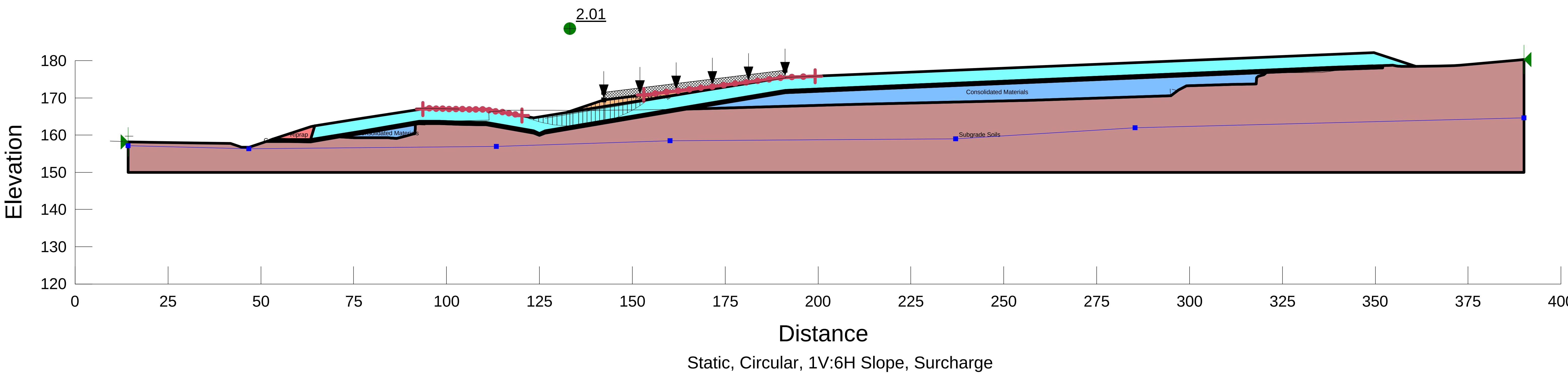


Seismic, Sliding, 1V:6H Slope, Surcharge

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Subgrade Soils (for Sliding)l Bedrock (Impenetrable) 1
Consolidated Materials (for Sliding) Bedrock (Impenetrable) 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1
Access Ramp Mohr-Coulomb 120 pcf 0 psf 34 ° 1

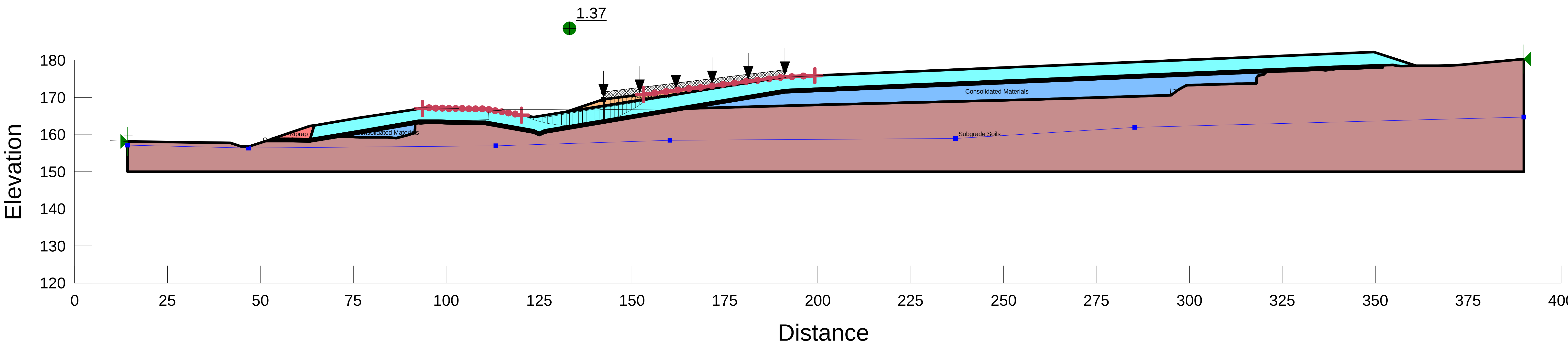
CAP STABILITY EVALUATION - ACCESS RAMP
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT



MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Consolidated Materials Mohr-Coulomb 110 pcf 0 psf 28 ° 1
Subgrade Soils Mohr-Coulomb 115 pcf 0 psf 26 ° 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1
Access Ramp Mohr-Coulomb 120 pcf 0 psf 34 ° 1

CAP STABILITY EVALUATION - ACCESS RAMP
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT



Seismic, Circular, 1V:6H Slope, Surcharge

MATERIALS:

Geosynthetic Clay Liner Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
LLDPE Geomembrane Mohr-Coulomb 58.6 pcf 0 psf 14 ° 1
Geocomposite Drainage Layer Mohr-Coulomb 58.6 pcf 0 psf 17 ° 1
General Fill Mohr-Coulomb 120 pcf 0 psf 32 ° 1
Consolidated Materials Mohr-Coulomb 110 pcf 0 psf 28 ° 1
Subgrade Soils Mohr-Coulomb 115 pcf 0 psf 26 ° 1
Riprap Mohr-Coulomb 140 pcf 0 psf 38 ° 1
Access Ramp Mohr-Coulomb 120 pcf 0 psf 34 ° 1

CAP STABILITY EVALUATION - ACCESS RAMP
RCRA CAP DESIGN
SRSNE SUPERFUND SITE
SOUTHINGTON, CT

APPENDIX F

RCRA Cap Fence Footing Calculations

Calculation Submittal

Chainlink Fence Supported by Shallow Fdn - Structural Analysis

SRSNE Cap B0054634.0000

6/7/2016 Rev 6/20/2016

Jason P. Riggs
Calculation Preparer

John E. Morgan
Calculation Reviewer

Table of Contents

Chainlink Fence Supported by Shallow Fdn - Structural Analysis

SRSNE Cap B0054634.0000

6/7/2016 Rev 6/20/2016

Calculation Summary and Conclusions

Chainlink Fence Supported by Shallow Fdn - Structural Analysis

SRSNE Cap B0054634.0000

6/7/2016 Rev 6/20/2016

<u>Summary of Calculations</u>

Rails to trails section over RCRA cap requires a fence that is supported by shallow footing to prevent damage to environmental barrier system.

<u>Conclusions</u>

Provide a 2.5 feet diameter round foundation embedded 2.5 feet in the ground.

References and Assumptions

Chainlink Fence Supported by Shallow Fdn - Structural Analysis
SRSNE Cap B0054634.0000
6/7/2016 Rev 6/20/2016

Software

Microsoft Excel

Technical Publications

American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures (ASCE 7-05)
American Institute of Steel Construction (AISC), Manual of Steel Construction, Allowable Stress Design, 13th Edition
ACI 318-11 (American Concrete Institute - Building Code Requirement for Structural Concrete)
Chain Link Fence Manufacturers Institute - Chain Link Fence Wind Load Guide
2009 International Building Code

Assumptions

Concrete	150	pcf
Steel	490	pcf

Wind Pressure Calculation

Chainlink Fence Supported by Shallow Fdn - Structural Analysis
SRSNE Cap B0054634.0000
6/7/2016 Rev 6/20/2016

User Input

Purpose: Determine wind pressures acting on fence for design of fence pole foundations and fence framing.

Design Parameters:

100	mph (Design Wind Speed 1)	1 Lazy Lane, Southington, CT
C	Exposure Category	
1	Importance Factor	

Analysis

Velocity Pressure

$$\boxed{qz = 0.00256\, K_z K_{zt} K_d V^2 I}$$

100 mph	18.5 psf	Equation 6-15 (ASCE 7-05)
Veloocity Pressure Exposure Coef. $\boxed{K_z}$	0.85	Table 6-3 (ASCE 7-05)
Topographic Factor $\boxed{K_{zt}}$	1	Section 6.5.7 (ASCE 7-05), not applicable = 1
Wind Directionality Factor $\boxed{K_d}$	0.85	Table 6-4 (ASCE 7-05) = 0.85

Adjusted Velocity Pressure

$$\boxed{qh = qzGC_f}$$

100 mph	24.0 psf		
Gust Factor (G)	1	Assumed	
Fence (fabric height), h=	7 ft		
Mesh Percent Area	13%	Chain link fencing	9 Gage and 2" mesh openings
Cf Use	1.30	*controlling case from debris + 9 gage mesh 2"*	
Unreduced Cf	1.3	Figure 6-22 (ASCE 7-05)	

Pole Spacing= b		Af=(h)(b)(% open)	Force @ mid point of pole (lbs)	Moment at base (ft-lbs)
10	ft	9.10	218.81	765.83

Ice and Wind Pressure Calculation

Chainlink Fence Supported by Shallow Fdn - Structural Analysis
SRSNE Cap B0054634.0000
5/13/2016

User Input

Purpose: Determine wind pressures acting on fence for design of fence pole foundations and fence framing.

Design Parameters:

50	mph (Design Wind, ice Speed 1)	1 Lazy Lane, Southington, CT
C	Exposure Category	
1	Importance Factor	

Rev 6/20/2016: Per ASCE 7-05 section 10.5 use a reduced wind velocity when combined with ice loading to represent ice storm event and low probability of icing to occur during hurricane force winds. See wind speed maps Figure 10-3

Analysis

Velocity Pressure

$$qz = 0.00256\, K_z K_{zt} K_d V^2 I$$

50 MPH	4.6	psf	Equation 6-15 (ASCE 7-05)

Veloocity Pressure Exposure Coef.
K_z — 0.85 — Table 6-3 (ASCE 7-05)

Topographic Factor
K_{zt} — 1 — Section 6.5.7 (ASCE 7-05), not applicable = 1

Wind Directionality Factor
K_d — 0.85 — Table 6-4 (ASCE 7-05) = 0.85

Adjusted Velocity Pressure

$$qh = qzGC_f$$

100 mph	6.0	psf	
Gust Factor (G)	1		Assumed
Fence (fabric height), h=	7	ft	
Mesh Percent Area	29%		Chain link fencing — 9 Gage and 2" mesh openings with ice
Cf Use	1.30		*controlling case from debris + 9 gage mesh 2"*
Unreduced Cf	1.3		Figure 6-22 (ASCE 7-05)

Pole Spacing= b		Af=(h)(b)(% open)	Force @ mid point of pole (lbs)	Moment at base (ft-lbs)	
10	ft	20.30	122.03	427.10	**Full wind controls (See Section 3.0)**

Pole Foundation Analysis

For Free-Top (Unconstrained) Rigid Round Piers Using UBC / IBC Method
Subjected Vertical Load, Horizontal Load, and/or Moment

Job Name:	Chainlink Fence Supported by Shallow Fdn - Stru	Subject:	Pole Foundation Design		
Job Number:	B0054624.0001	Originator:	JPR	Checker:	JEM

Input Data: Rev 6/20/16 - Include nominal axial load, Pv to represent fence weight

Pier Data:

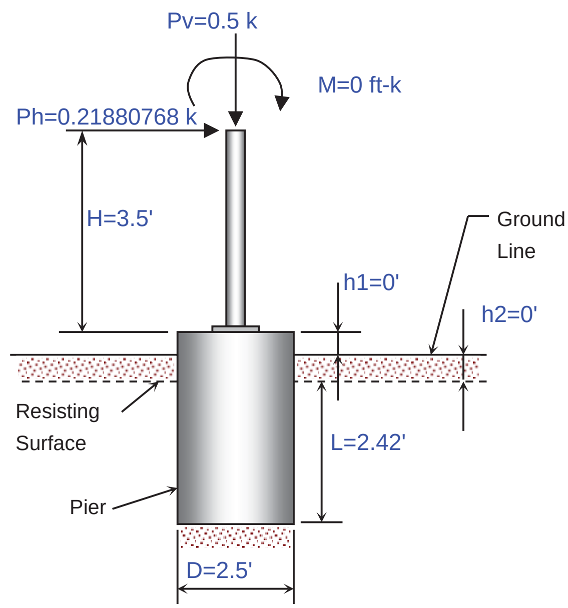
Pier Foundation Diameter, D =	2.500	ft.
Pier Height Above Soil, h1 =	0.000	ft.

Soil Data:

Unit Weight of Soil, γ =	0.090	kcf
Angle of Internal Friction, ϕ =	30.00	deg.
Depth to Resisting Surface, h2 =	0.000	ft.
Allow. Soil Bearing Pressure, Pa =	2.000	ksf

Pier Loadings:

Axial Load, Pv =	0.500	kips
Horizontal Load, Ph =	0.219	kips
Distance from Ph to Top/Pier, H =	3.500	ft.
Externally Applied Moment, M =	0.000	ft-kips



Nomenclature

Results:

Pier Embedment and Total Length:

Pe =	0.219	kips	Pe = Ph+(M/(H+h1+h2)) ("equivalent total" horizontal load)	
Kp =	3.000		Kp = TAN^2(45+ϕ/2) (passive pressure coefficient)	
Pp =	0.654	ksf	Pp = Kp*γ*L (passive pressure at bottom of pier)	
S1 =	0.218	ksf	S1 = Pp/3 (passive pressure at 1/3 embedment depth)	
A =	0.940		A = 2.34*Pe/(S1*D)	
L =	2.42	ft.	L = A/2*(1+SQRT(1+(4.36*(H+h1+h2)/A)))	(UBC 1997 Eqn. 6-1, p. 2-45)
Lt =	2.42	ft.	Lt = h1+h2+L (total length)	(IBC 2003 Eqn. 18.1, p. 370)

Pier End Bearing Pressure:

Af =	4.91	ft.^2	Af = π*D^2/4 (pier base area)	
Wf =	1.78	kips	Wf = (Af*Lt)*0.150 (pier weight)	
ΣPv =	2.28	kips	ΣPv = Pv+Wf (total vertical load)	
P(bot) =	0.465	ksf	P(bot) = ΣPv/Af	**Pa>=P(bot), O.K.**

Reference: 1997 Uniform Building Code (UBC), Section 1806.8, page 2-45
2003 International Building Code (IBC), Section 1805.7.2.1, pages 370-371

Comments:

While dimensions of 2.5' diameter by 2.5' depth are concluded to be sufficient for this purpose, an increased depth (3') will be used based on USEPA comments regarding the Draft 100% Design Report. No revised calculations are needed because if a smaller concrete slab wil resist the load, so will a larger one.

Check Load in Foundation

Pole Foundation Analysis

For Free-Top (Unconstrained) Rigid Round Piers Using UBC / IBC Method
Subjected Vertical Load, Horizontal Load, and/or Moment

Job Name:	Chainlink Fence Supported by Shallow Fdn - Stru	Subject:	Pole Foundation Design		
Job Number:	B0054624.0001	Originator:	JPR	Checker:	JEM

Moment in foundation is assumed to occur at the mid point of the embedded foundation

Ph=	0.22	kips	
L_{fdn} =	4.71	ft	$L_{fdn} = H + L/2$
M_{fdn} =	1.03	k-ft	$M_{fdn} = Ph * L_{fdn}$

Assume concrete is unreinforced plain concrete.

S_{fdn} =	1.534	ft^3	$S_{fdn} = Pi * D^3 / 32$
f_t =	0.005	ksi	$f_t = M_{fdn} / F_{fdn}$

Allowable Tensile Stress in Plain Concrete

f'c =	4.00	ksi	
Ft =	3.4	ksi	Ft = 0.85 f'c, ACI 318-08, Based on Eqn. 22.3

FS, Ft/ft =	728.66	Greater than Max Wind Load factor/Φ, 1.6/0.6 = 2.667, OK No reinforcing required.

APPENDIX F

RCRA Cap Cover System Soil Loss Calculation Sheet

ARCADIS Design & Consultancy for natural and built assets

Imagine the result

Calculation Sheet

Client: SRSNE Site Group

Project Location: Southington, CT

Project: SRSNE RCRA Cap Design **Project No.: B0054634.0001**

Subject: RCRA Cap Soil Loss Calculation

Prepared By: NWF **Date: June 2016**

Reviewed By: NWF **Date: June 2016**

Checked By: JEM **Date: June 2016**

OBJECTIVE:

Evaluate the soil loss potential for proposed RCRA Cap based on worst-case slope using the Revised Universal Soil Loss Equation (RUSLE).

REFERENCES:

1. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 6 titled "Cap Final Grading and Drainage Plan," ARCADIS, June 2016.

2. USDA. 1997. Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, D.C. Yoder, coordinators. *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE).* Agriculture Handbook No. 703.

3. USDA Soil Conservation Service (SCS). 1978. National Engineering Handbook. Section 3. Chapter 3. Sedimentation (portions attached).

4. "Evaluating Cover Systems for Solid and Hazardous Waste (SW-867)," United States Environmental Protection Agency (USEPA), September 1980 (portions attached).

ASSUMPTIONS:

1. Annual soil loss is calculated based on the worst-case slopes shown in Attachment 1. Based on Reference 1, the worst-case slope is a composite slope within the RCRA Cap. The worst-case slope length RCRA Cap is approximately 164 feet at 4.25% and 69 feet at 16.67% as shown in Attachment 1.
2. The topsoil for the RCRA Cap is assumed to be loam with a minimum of 4% organic material. Based on Reference 4, the soil erodibility factor (K) is 0.29.

3. The Cover Management Factor, C, is 0.003 (Reference 3; Table 3-2; no appreciable canopy, 95%-100% ground cover, grass).

4. The recommended maximum soil loss rate is 2 tons per acre per year.

5. No crop support practices are considered (i.e., Crop Support Practice Factor, P equals 1.0).

6. The topographic factor, LS, for each segment is determined using Table 4-3, high ratio of rill to interrill erosion (Reference 2). A high ratio of rill to interill erosion is applicable for newly constructed slopes

Calculation Sheet

as a worse case condition.

7. Rainfall Factor – R = 160 (Refer to Figure 1 – Reference 3).

CALCULATIONS:

The estimated soil loss rate is calculated using the RUSLE equation for the worst-case slope segment as discussed in Assumption 2. Based on Reference 2, the annual soil loss rate can be calculated using the RUSLE equation as follows:

A = R * K * LS * C * P

Where,

- A ≤ 2 tons per acre per year (maximum annual soil loss)
- R = 160 (rainfall factor, Reference 2, portions attached)
- K = 0.29 (soil edibility factor, discussed in Assumption 2)
- C = 0.003 (cover factor, discussed in Assumption 3)
- P = 1.0 (support practice factor, discussed in Assumption 5)
- LS = unknown (slope length and steepness factor (ft.))

Because the worst-case slope consists of several distinct slope gradients, a single LS value from reference tables cannot be used. Instead, a procedure from Reference 2 is used to calculate an "effective" LS value based on the component LS values for the individual slope gradients that make up the overall slope. The following table summarizes the LS calculation for the various slope gradients and segments, as well as the effective value for the entire slope.

Segment	% Slope	Max Slope Length (horizontal projection - ft)	β[1]	m[2]	LS[3]	SLF[4]	LS*SLF	Weighted LS[5] LS*SLF/n
1	4.25	164	0.59	0.54	0.92	0.69	0.63	0.32
2	16.67	69	1.45	0.74	5.38	1.40	7.55	3.77
Effective LS for Complex Slope[6]								**4.09**

Notes:

1 – β is based on Reference 2, Equation 4-3 (attached).
2 – m is based on Reference 2, Equation 4-2 (attached), high ratio of rill to interrill erosion (2*β).
3 – LS for each segment is based Reference 2, Table 4-3 (attached). When obtaining LS values from table 4-3, the segment slope gradient is used but slope length is equal to the cumulative length of the composite slope (i.e., 233 feet in this case).
4 – Soil Loss Factor is based on Reference 2, Table 4-6 (attached).
5 – Weighted LS for each segment equals the product of the determined LS and the Soil Loss Factor and dividing by number of slope segments (n = 2).
6 – Effective LS represents the total slope length factor for the complex slope by adding weighted LS factors for each segment.

Calculation Sheet

Using RUSLE with the effective LS value calculated above,

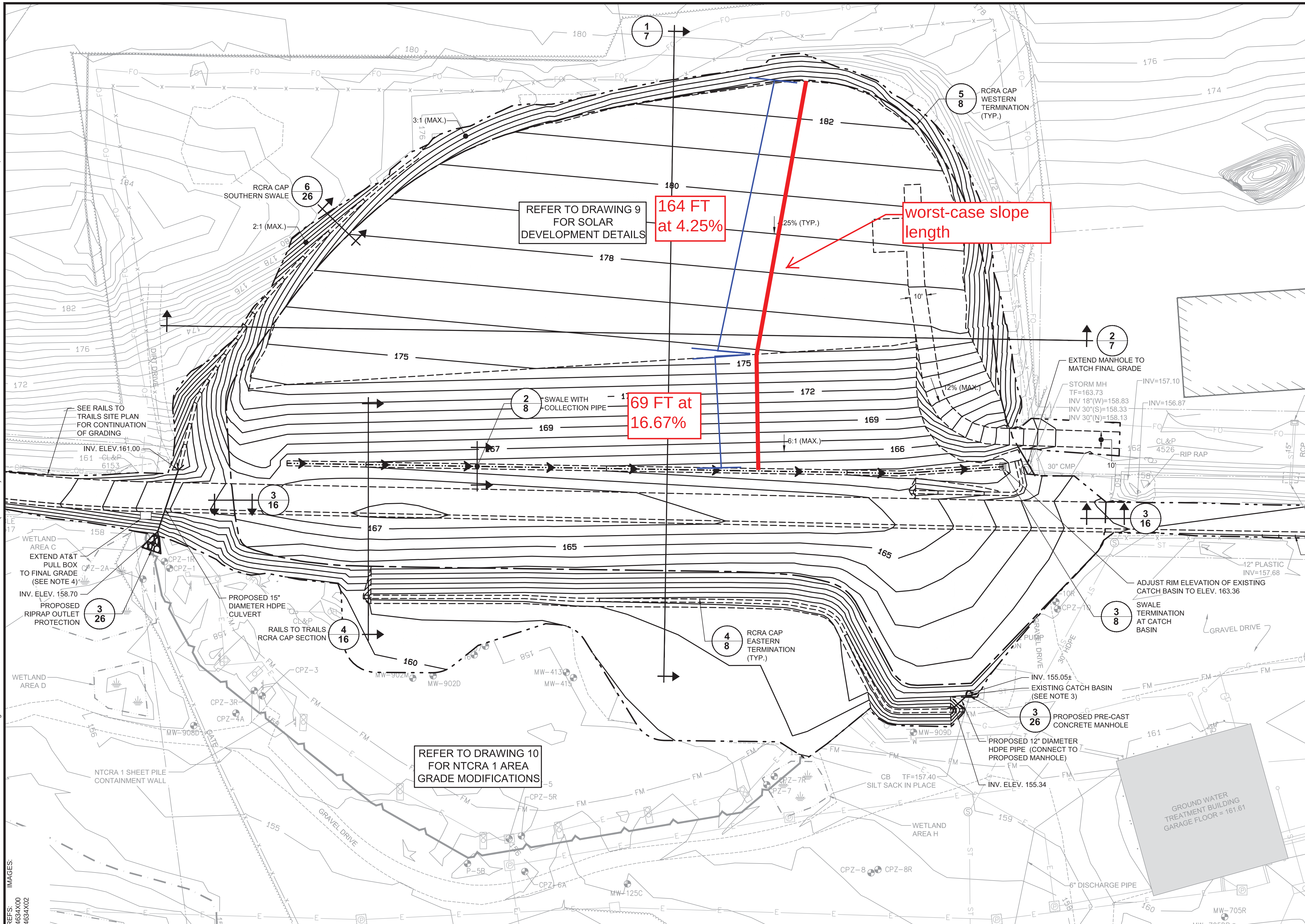
A = (160)(0.29)(4.09)(0.003)(1) = 0.57 ton/acre/year

SUMMARY:

Based on the RUSLE equation, the estimated soil loss rate from the cover is 0.57 tons per acre per year. This is considered to be a conservative value as it is based on the worst-case slope condition. The estimated soil loss rate is less than the maximum rate of 2 tons per acre per year recommended by the USEPA and is therefore deemed acceptable.

Attachment 1

Slope-Length Location Figure



LEGEND:

- 150 — PROPOSED FINAL GRADE CONTOUR (1-FOOT CONTOUR INTERVAL)
- PROPOSED GRADE BREAK
- LIMIT OF FINAL GRADING
- LIMIT OF CAP
- PROPOSED SWALE AND FLOW DIRECTION (2/8)
- PROPOSED CULVERT
- PROPOSED PRE-CAST CONCRETE MANHOLE (3/26)
- PROPOSED RIPRAP OUTLET PROTECTION (3/25)
- X — DETAIL REFERENCE NUMBER; XX — DRAWING REFERENCE NUMBER

NOTES:

1. REFER TO DRAWINGS 1 AND 2 FOR ADDITIONAL BASEMAP AND LEGEND INFORMATION.
2. PROPOSED FINAL GRADES SHOWN REPRESENT TOP OF RCRA CAP.
3. REMOVE EXISTING CATCH BASIN AND INSTALL NEW MANHOLE.
4. ALTER ELEVATION OF EXISTING 3' X 5' PULL BOX USING TWO 24" STACKABLE RISER SECTIONS. RISERS SHALL BE SYNERTECH COMPOSITE POLYMER CONCRETE BOXES AS MANUFACTURED BY OLD CASTLE PRECAST, INC. OR APPROVED EQUAL.

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Professional Engineer's Name: JEFFREY HOLDEN
Professional Engineer's No.: 0023403

State	Date Signed	Project Mgr.
CT		JH
Designed by	Drawn by	Checked by
NWF	BS	JEM

DRAFT

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ARCADIS U.S., INC.

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC. (SRSNE) SUPERFUND SITE • SOUTHINGTON, CONNECTICUT

RCRA CAP 100% DESIGN

CAP FINAL GRADING AND DRAINAGE PLAN

GENERAL

ARCADIS Project No. B0054634.0001.03900

Date JUNE 2016

ARCADIS OF NEW YORK
6723 TOWPATH RD.
PO BOX 66
SYRACUSE, NEW YORK
TEL. 315.446.9120

6

Attachment 2

References

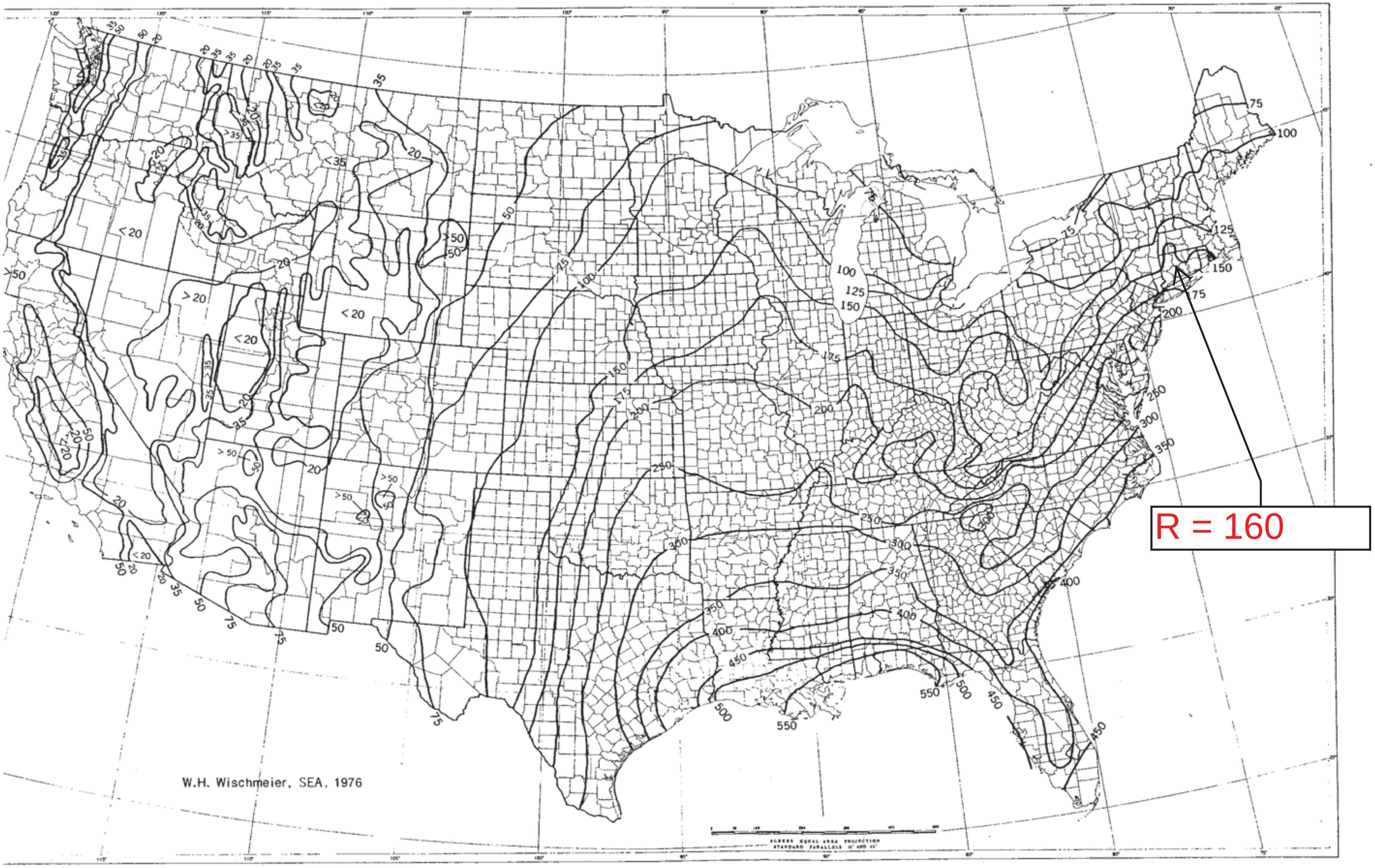


FIGURE 1.—Average annual values of the rainfall erosion index.

SOURCE: REFERENCE 2

SLOPE LENGTH FACTOR (L)

Plot data used to derive the slope length factor (L) have shown that average erosion for the slope length λ (in ft) varies as

$$L = (\lambda/72.6)^{m} \qquad [4\text{-}1]$$

where 72.6 = the RUSLE unit plot length in ft and m = a variable slope-length exponent (Wischmeier and Smith 1978). The slope length λ is the horizontal projection, not distance parallel to the soil surface.

The slope-length exponent m is related to the ratio β of rill erosion (caused by flow) to interrill erosion (principally caused by raindrop impact) by the following equation (Foster et al. 1977):

$$m = \beta/(1 + \beta) \qquad [4\text{-}2]$$

Values for the ratio β of rill to interrill erosion for conditions when the soil is moderately susceptible to both rill and interrill erosion were computed from (McCool et al. 1989)

$$\beta = (\sin \theta/0.0896) / \left[3.0(\sin \theta)^{0.8} + 0.56\right] \qquad [4\text{-}3]$$

where θ = slope angle. Given a value for β, a value for the slope-length exponent m is calculated from equation [4-2].

The middle column in table 4-5, calculated from equations [4-3] and [4-2], gives values for m that are typical of agricultural fields in seedbed condition. When runoff, soil, cover, and management conditions indicate that the soil is highly susceptible to rill erosion, the exponent m should be increased as shown in the right column of table 4-5. This condition is most likely to occur on steep, freshly prepared construction slopes. These values for m were determined by doubling the β values from equation [4-3] before applying equation [4-2].

SOURCE: REFERENCE 2

Table 4-6.
Soil loss factor to estimate soil loss on a segment of a uniform slope.

Number of segments	Sequential number of segments	Slope-length exponent (m) .05	.1	.2	.3	.4	.5	.6	.7	.8
2	1	0.97	0.93	0.87	0.81	0.76	0.71	0.66	0.62	0.57
	2	1.03	1.07	1.13	1.19	1.24	1.29	1.34	1.38	1.43
3	1	0.95	0.90	0.80	0.72	0.64	0.58	0.52	0.46	0.42
	2	1.01	1.02	1.04	1.05	1.06	1.05	1.05	1.04	1.03
	3	1.04	1.08	1.16	1.23	1.30	1.37	1.43	1.50	1.55
4	1	0.93	0.87	0.76	0.66	0.57	0.50	0.44	0.38	0.33
	2	1.00	1.00	0.98	0.96	0.94	0.92	0.88	0.85	0.82
	3	1.03	1.05	1.09	1.13	1.16	1.18	1.2	1.22	1.23
	4	1.04	1.08	1.17	1.25	1.33	1.40	1.48	1.55	1.62
5	1	0.92	0.85	0.73	0.62	0.53	0.45	0.38	0.32	0.28
	2	0.99	0.97	0.94	0.90	0.86	0.82	0.77	0.73	0.69
	3	1.01	1.03	1.04	1.05	1.06	1.06	1.06	1.05	1.03
	4	1.03	1.06	1.12	1.17	1.21	1.25	1.29	1.32	1.35
	5	1.05	1.09	1.17	1.26	1.34	1.42	1.50	1.58	1.65

Soil-loss factors = $[i^{m+1} - (i-1)^{m+1}]/n^m$
where i = sequential number of segment, m = slope length exponent, and n = number of segments. Values are forced to give a factor total equal to number of segments. Values from RUSLE computer program may differ slightly due to round-off.

0.92

SOURCE: REFERENCE 2

Table 4-3.
Values for topographic factor, LS, for high ratio of rill to interrill erosion.[1]

233 FT

Slope (%)	Horizontal slope length (ft) <3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	800	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
0.5	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.12	0.12	0.13
1.0	0.09	0.09	0.09	0.09	0.09	0.10	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.24	0.26	0.27
2.0	0.13	0.13	0.13	0.13	0.13	0.16	0.21	0.25	0.28	0.33	0.37	0.40	0.43	0.48	0.56	0.63	0.69
3.0	0.17	0.17	0.17	0.17	0.17	0.21	0.30	0.36	0.41	0.50	0.57	0.64	0.69	0.80	0.96	1.10	1.23
4.0	0.20	0.20	0.20	0.20	0.20	0.26	0.38	0.47	0.55	0.68	0.79	0.89	0.98	1.14	1.42	1.65	1.86
5.0	0.23	0.23	0.23	0.23	0.23	0.31	0.46	0.58	0.68	0.86	1.02	1.16	1.28	1.51	1.91	2.25	2.55
6.0	0.26	0.26	0.26	0.26	0.26	0.36	0.54	0.69	0.82	1.05	1.25	1.43	1.60	1.90	2.43	2.89	3.30
8.0	0.32	0.32	0.32	0.32	0.32	0.45	0.70	0.91	1.10	1.43	1.72	1.99	2.24	2.70	3.52	4.24	4.91
10.0	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72	3.09	3.75	4.95	6.03	7.02
12.0	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60	4.09	5.01	6.67	8.17	9.57
14.0	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48	5.11	6.30	8.45	10.40	12.23
16.0	0.39	0.49	0.56	0.62	0.67	0.98	1.64	2.21	2.73	3.68	4.56	5.37	6.15	7.60	10.26	12.69	14.96
20.0	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16	8.23	10.24	13.94	17.35	20.57
25.0	0.45	0.64	0.80	0.93	1.04	1.56	2.67	3.67	4.59	6.30	7.88	9.38	10.81	13.53	18.57	23.24	27.66
30.0	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55	13.35	16.77	23.14	29.07	34.71
40.0	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67	18.17	22.95	31.89	40.29	48.29
50.0	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42	22.57	28.60	39.95	50.83	60.84
60.0	0.63	1.07	1.47	1.84	2.19	3.36	5.97	8.37	10.63	14.89	18.92	22.78	26.51	33.67	47.18	59.93	72.15

4.25%

16.67%

[1]Such as for freshly prepared construction and other highly disturbed soil conditions with little or no cover (not applicable to thawing soil)

5.38

SOURCE: REFERENCE 3

Table 3–2.—C factors for permanent pasture, grazed forest land, range, and idle land[1]

Vegetative canopy		Cover that contacts the soil surface						
			Percent ground cover					
Type and height[2]	Percent cover[3]	Type[4]	0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall grass, weeds, or short brush with average drop fall height of 20 in. or less	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

[1]The listed C values require that the vegetation and mulch are randomly distributed over the entire area. For grazed forest land multiply these values by 0.7.
[2]Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.
[3]Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).
[4]G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter. W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

$$R = 185$$
$$K = 0.37$$
$$LS = 1.4$$
$$C = 0.43$$
$$P = 1.00$$

$$A \text{ (annual soil loss)} = 185 \times 0.37 \times 1.4 \times 0.43 \times 1.0 = 41.2 \text{ tons/acre}$$

Pasture: 170 acres; 50 percent of area has canopy cover of short brush (0.5-m [1.6-ft] fall height); 80 percent of surface is covered by grass and grasslike plants; soil is Fayette silt loam; slopes are 8 percent and 200 ft long.

$$R = 185$$
$$K = 0.37$$
$$LS = 1.4$$
$$C = 0.012$$

$$A \text{ (annual soil loss)} = 185 \times 0.37 \times 1.4 \times 0.012 = 1.15 \text{ tons/acre}$$

soil in a unit plot, pinpoints differences in erosion according to differences in soil type. Long-term plot studies under natural rainfall have produced K values generalized in Table 5 for the USDA soil types.

TABLE 5. APPROXIMATE VALUES OF FACTOR K FOR USDA TEXTURAL CLASSES[11]

Texture class	Organic matter content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine sand	.16	.14	.10
Very fine sand	.42	.36	.28
Loamy sand	.12	.10	.08
Loamy fine sand	.24	.20	.16
Loamy very fine sand	.44	.38	.30
Sandy loam	.27	.24	.19
Fine sandy loam	.35	.30	.24
Very fine sandy loam	.47	.41	.33
Loam	.38	.34	.29
Silt loam	.48	.42	.33
Silt	.60	.52	.42
Sandy clay loam	.27	.25	.21
Clay loam	.28	.25	.21
Silty clay loam	.37	.32	.26
Sandy clay	.14	.13	.12
Silty clay	.25	.23	.19
Clay		0.13-0.29	

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

The evaluator must next consider the shape of the slope in terms of length and inclination. The appropriate LS factor is obtained from Table 6. A nonlinear slope may have to be evaluated as a series of segments, each with uniform gradient. Two or three segments should be sufficient for most engineered landfills, provided the segments are selected so that they are also of equal length (Table 6 can be used, with certain adjustments). Enter Table 6 with the total slope length and read LS values corresponding to the percent slope of each segment. For three segments, multiply the chart LS values for the upper, middle, and lower segments by 0.58, 1.06, and 1.37, respectively. The average of the three products is a good estimate of the

Attachment 3

RUSLE Calculations

SRSNE Site Group
Southington, CT
Complex Slope Soil Loss Evaluation

Proposed RCRA Cap:

A = R * K * LS * C * P

R =	160	(USDA 1978; Figure 1 - Average Annual Rainfall Runoff Erosivity Factor)
K =	0.29	(USDA 1997; Fig 3; See geotech results below for assumptions)
LS =	solve for	(USDA 1997; Table 4-1; high ratio of rill to interill erosion)
C =	0.003	(USDA 1978; Table 3-2; No appreciable canopy,95%-100% ground cover)
P =	1	(USDA 1997; no special contouring practice)

A ≤ 2 tn/ac/yr

LS ≤ A / (R*K*C*P) = **14.37** (LS must be less than or equal to this value)

n 2

Total Slope Length 233

Segment	% Slope	Max Slope Length (horiz projection - ft)	beta[1] (USDA 1997; eq. 4-3)	m[2] (USDA 1997; eq. 4-2; using 2*beta)	LS[3] USDA 1997; Table 4-3	SLF[4] 1997; soil-loss factor table 4-6	LS*SLF	Effective LS LS*SLF/n
1	4.25	164	0.59	0.54	0.92	0.69	0.63	0.32
2	16.7	69	1.45	0.74	5.38	1.40	7.55	3.77
Effective LS for Complex Slope								**4.09**

APPENDIX F

RCRA Cap Swale Conveyance and Stability Calculation Sheet

Imagine the result

Calculation Sheet

Client: SRSNE Site Group

Project Location: Southington, CT

Project: SRSNE RCRA Cap Design **Project No.: B0054634.0001**

Subject: Swale Capacity and Erosion Resistance Calculations

Prepared By: NWF/PTO **Date: July 2016**

Reviewed By: JEM **Date: July 2016**

Checked By: JEM **Date: July 2016**

OBJECTIVE:

Demonstrate that the four (4) swales constructed as part of the RCRA cap design have the hydraulic capacity to convey the peak discharge resulting from the 100-year, 24-hour design storm. Demonstrate the aforementioned swales are hydraulically stable when subjected to the fluid shear stresses associated with the 100-year, 24-hour design storm. Demonstrate that the culvert outlet pipes from the swales have adequate capacity to convey the peak discharge resulting from the 100-year, 24-hour storm event.

REFERENCES:

1. Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site RCRA Cap Design Drawings No. 6 titled “Final Grading and Drainage Plan,” ARCADIS, May 2016.

2. HydroCAD. Version 10.0. Computer Software. HydroCAD Software Solutions LLC, 2015.

3. Terramodel. Version 10.52. Computer Software. Trimble Navigation Limited. 2007.

4. Urban Hydrology for Small Watersheds Technical Release 55 (TR-55). US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). June 1986. (select pages attached)

5. Atlas of Point Precipitation Frequency Estimates, National Oceanic and Atmospheric Association (NOAA). Atlas 14, Volume 10, Version 2. For Southington, CT. September 2015 (select pages attached).

6. Design of Roadside Channels with Flexible Linings. Hydraulic Engineering circular No. 15 (HEC-15). US Department of Transportation Federal Highway Administration. April 1988.

7. Stability Design of Grass-Lined Open Channels. Agriculture Handbook No. 667. US Department of Agriculture (USDA) Agricultural Research Service (ARS). September 1987.

8. Turf reinforcement matting (TRM) product literature. Tensar/ North American Green (NAG) website: www.nagreen.com.

ASSUMPTIONS:

1. The hydrologic data (i.e., watershed characteristics, storm type, and rainfall amounts) used to perform this analysis were obtained from Reference 5. The design storm is a Type III, 100-year, 24-hour storm which producing 8.61 inches of rainfall.

Calculation Sheet

2. The South Drainage Swale, as depicted on Reference 1, is the swale that conveys stormwater runoff from the southern slope of the RCRA cap area, and run-on from south of the RCRA cap area, east to a proposed culvert which conveys flows beneath the rails to trails berm. The swale is trapezoidal in geometry with a basewidth of 2-feet and sideslopes of 2H:1V and 3H:1V. The longitudinal invert bedslope varies from 0.5% to 12.0%. Therefore, the minimum and maximum slope are analyzed for conveyance and stability to verify the extents of the swale are adequate for managing the peak discharge resultant from the design storm. The minimum depth of the swale is 1.6-feet.

3. The Southern Outlet Drainage Swale, as depicted on Reference 1, is the swale that conveys stormwater runoff from the South Drainage Swale, and run-on from south of the RCRA cap area, southeast to an existing drainage swale. The swale is trapezoidal in geometry with a basewidth of 3-feet and 2H:1V sideslopes. The longitudinal invert bedslope varies from 0.5% to 4.8%. Therefore, the minimum and maximum slope are analyzed for conveyance and stability to verify the extents of the swale are adequate for managing the peak discharge resultant from the design storm. The minimum depth of the swale is 1.0-foot.

4. The Central Drainage Swale, as depicted on Reference 1, is the swale that conveys stormwater runoff from the western RCRA cap area as well as portions of the “rails to trails” area within the RCRA cap. The swale is trapezoidal in geometry with a basewidth of 2-feet and sideslopes of 6H:1V. The longitudinal invert bedslope is a constant 0.7%. The minimum depth of the swale is 2.2-feet.

5. The Eastern Drainage Swale, as depicted on Reference 1, is the swale that conveys stormwater runoff from the eastern RCRA cap area and existing areas east of the RCRA cap area. The swale conveys runoff to a proposed culvert which drains to a subsurface drainage system located at the northeast corner of the Site. The swale is trapezoidal in geometry with a basewidth of 2-feet and sideslopes of 3H:1V. The longitudinal invert bedslope is a constant 0.6%. The minimum depth of the swale is 1.0-foot.

6. Swale conveyance capacity is evaluated using Reference 6 and the Manning equation to estimate required flow depths. The calculated flow depth is compared to the minimum swale depth of each swale to ensure flow in restricted to the swale. All three swales analyzed will be vegetated for erosion resistance. The vegetation is assumed to be Class C vegetation (6-12 inches tall) and a mix of sod and bunch growth. The Manning “n” is calculated from Reference 6.

7. Swale lining is evaluated for stability using the shear stress approach described in Reference 6. Maximum shear stress is compared to the permissible shear stress of the lining material (as determined according to the procedures described in Reference 6) to determine a factor of safety against failure. The lining material is considered to be stable when the factor of safety equals or exceeds 1.0.

8. Portions of the South Swale and Southern Outlet Swale will be lined with a permanent turf reinforcement mat (TRM). The, Central Swale and East Swale will be lined with unreinforced vegetation. A temporary erosion control mat (ECM) will be used for swale stabilization before vegetation is established. The permissible shear stress, τ_p, for each swale lining material is as follows:

Calculation Sheet

- Permanent TRM = 10 psf (Reference 8)
- Unreinforced Vegetation = 1.0 psf (Class C Vegetation) (Reference 7)
  - The ECM will only provide temporary reinforcement prior to vegetation establishment, and therefore the unreinforced vegetation is the long term permissible shear stress for the swale

9. Flow from the South Swale and the East Swale are drained via culvert flow as depicted in Reference 1. The culverts consist of 15-inch and 12-inch diameter corrugated HDPE pipe with Smooth interior. (Manning n = 0.013) for the South Swale and East Swale respectively. The culverts are analyzed for the peak discharge resultant from the 100-year, 24-hour design storm. The required headwater depth is determined using Reference 2 and is compared to the minimum swale depth at the culvert locations to demonstrate that the capacity of the pipe is great enough such that the required headwater depth does not exceed the depth of the swale at the culvert inlet. Both culverts assume a free discharge condition at the culvert outlets.

CALCULATIONS:

1. Swale Capacity Evaluation

Table 1 below summarizes the watershed characteristics and estimated 100-year, 24-hour peak discharges for the swales.

Table 1. Swale Watershed Characteristics and Estimated Peak Discharges

Swale I.D.	Total Watershed Area (acres)	CN	Tc (Min)	100-yr, 24-hr Peak Discharge (cfs)
South Swale	0.9	46	16.1	1.44
Southern Outlet Swale	2.3	41	18.1	2.42
Central Swale	2.1	65	12.4	8.83
East Swale	1.4	61	14.7	4.92

Flow depths were estimated using Manning's equation presented below:

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ where,

Q = Flow rate (cfs)
n = Manning n
A = Flow area (ft²)
R = Hydraulic radius (ft)
S = Bed slope (ft/ft)

Calculation Sheet

Flow depths were determined by iteratively solving Manning's equation, using trial flow depths, until the calculated flow rate matched the 100-year, 24-hour peak discharge for the swale segment. Table 2, below, summarizes the estimated flow depth and freeboard for each swale segment. Calculations are provided in Attachment B.

Table 2. Swale Capacity Evaluation Results

Swale I.D.		100-yr, 24-hr Peak Discharge (cfs)	Flow Depth (ft)	Minimum Swale Depth (ft)	Freeboard (ft)
South Swale	Min. Slope (0.5%)	1.44	0.7	1.6	0.9
	Max Slope (12.0%)		0.2		1.4
Southern Outlet Swale	Min. Slope (0.5%)	2.42	0.8	1.0	0.2
	Max Slope (4.8%)		0.3		0.7
Central Swale		8.83	1.0	2.2	1.2
East Swale		4.92	1.0	2.0	1.0

2. Swale Stability Evaluation

The equation used to calculate the maximum shear stress, τ_b (in pounds per square foot [psf]), on the bed of each swale segment is:

$\tau_b = (\gamma_w)(d)(S)$ where,

γ_w = Unit weight of water (62.4 lb/ft^3)
d = Depth of flow (ft)
S = Bed slope (ft/ft)

The factor of safety was then determined as follows:

Factor of Safety = Permissible Shear Stress / Maximum Shear Stress = $\frac{\tau_p}{\tau_b}$

The resulting shear stresses and factors of safety for each swale segment are summarized in Table 3, below.

Calculation Sheet

Table 3. Swale Stability Evaluation Results

Swale I.D.		100-yr, 24-hr Peak Discharge (cfs)	Flow Depth (ft)	Maximum Shear Stress (lb/ft^2)	Lining Material	Permissible Shear Stress (lb/ft^2)	Factor of Safety
South Swale	Min. Slope	1.44	0.7	0.2	Unreinforced Vegetation	1.0	4.8
	Max Slope		0.2	1.4	Permanent TRM	10.0	7.4
Southern Outlet Swale	Min. Slope	2.42	0.8	0.23	Unreinforced Vegetation	1.0	4.3
	Max Slope		0.3	0.86	Permanent TRM	10.0	11.61
Central Swale		8.83	1.0	0.5	Unreinforced Vegetation	1.0	2.2
East Swale		4.92	1.0	0.5	Unreinforced Vegetation	1.0	2.0

3. Culvert Outlet Pipes Capacity Evaluation

Flow depths in the culverts are estimated by routing the peak discharge through each pipe using Reference 1, and determining the headwater depth at the inlet of the pipe using Reference 2. The resulting headwater depth and swale freeboard are summarized in Table 4, below.

Table 4. Culvert Outlet Pipe Capacity Evaluation Results

Culvert I.D.	100-yr, 24-hr Peak Discharge (cfs)	Headwater Depth at Culvert Inlet (ft)	Swale Depth at Culvert Inlet (ft)	Freeboard (ft)
South Culvert Pipe	1.44	0.6	1.6	1.0
East Culvert Pipe	4.92	1.1	2.0	0.9

<u>SUMMARY:</u>

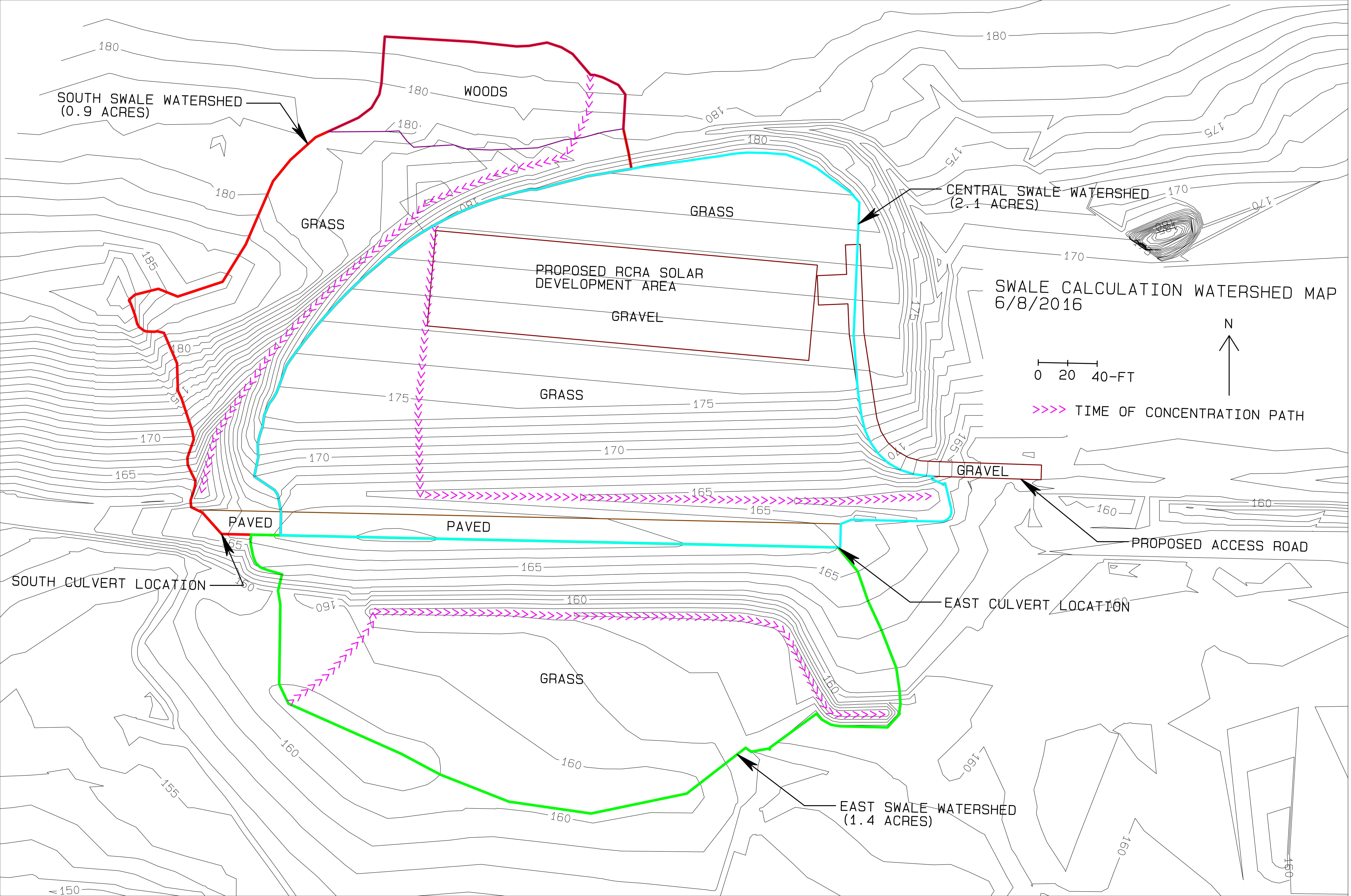
Based on the results of the calculations presented above, the three on-site swales have sufficient capacity to convey the estimated 100-year, 24-hour peak discharge without overtopping the swale banks, as summarized in Tables 2 and 4. The swale linings are hydraulically stable when subjected to the fluid shear stresses associated with the 100-year, 24-hour peak discharge, as summarized in Tables 2 and 4.

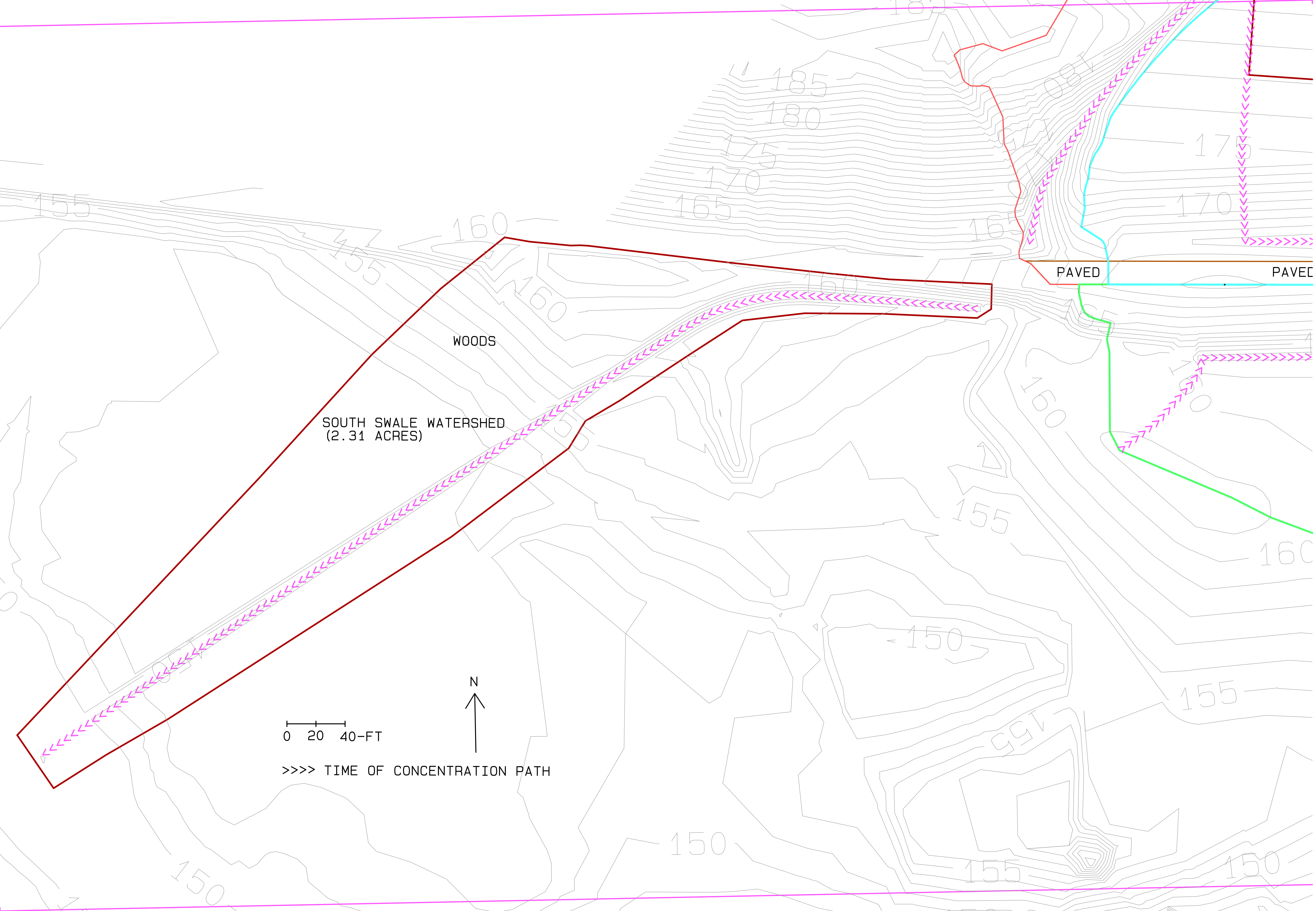
Calculation Sheet

Additionally, the outlet culvert pipes have sufficient capacity to convey the 100-year, 24-hour peak discharge without causing overtopping of the swales as summarized in Table 4.

ATTACHMENT A

Watershed Area Map


SWALE CALCULATION WATERSHED MAP
6/8/2016
N
0 20 40-FT
>>>> TIME OF CONCENTRATION PATH
SOUTH SWALE WATERSHED (0.9 ACRES)
CENTRAL SWALE WATERSHED (2.1 ACRES)
EAST SWALE WATERSHED (1.4 ACRES)
SOUTH CULVERT LOCATION
EAST CULVERT LOCATION
PROPOSED ACCESS ROAD
PROPOSED RCRA SOLAR DEVELOPMENT AREA
WOODS
GRASS
GRAVEL
PAVED
180
175
170
165
160
155
150
185



WOODS
SOUTH SWALE WATERSHED
(2.31 ACRES)
PAVED
PAVED
N
0 20 40-FT
>>>> TIME OF CONCENTRATION PATH
185
180
175
170
165
160
155
150

ATTACHMENT B

Calculations

Summary for Subcatchment 3S: Central Swale

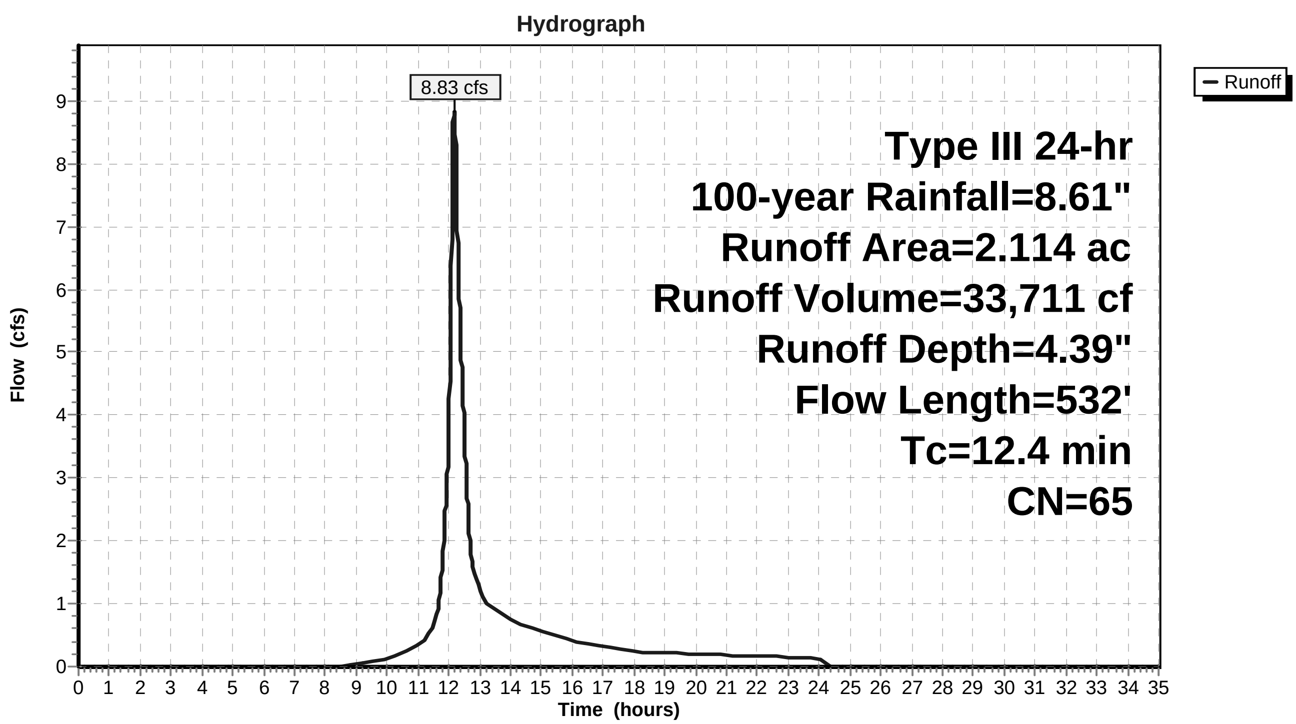
Runoff = 8.83 cfs @ 12.17 hrs, Volume= 33,711 cf, Depth= 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.61"

Area (ac)	CN	Description
1.568	58	Meadow, non-grazed, HSG B
0.140	89	Paved roads w/open ditches, 50% imp, HSG B
0.406	85	Gravel roads, HSG B
2.114	65	Weighted Average
2.044		96.69% Pervious Area
0.070		3.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	100	0.0430	0.16		**Sheet Flow, Sheet flow from RCRA Cap** Grass: Dense n= 0.240 P2= 3.20"
0.4	33	0.0430	1.45		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	48	0.1700	2.89		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	351	0.0070	4.74	18.98	**Channel Flow, RCRA Cap Central Swale** Area= 4.0 sf Perim= 6.0' r= 0.67' n= 0.020
12.4	532	Total			

Subcatchment 3S: Central Swale



Summary for Subcatchment es: East Swale

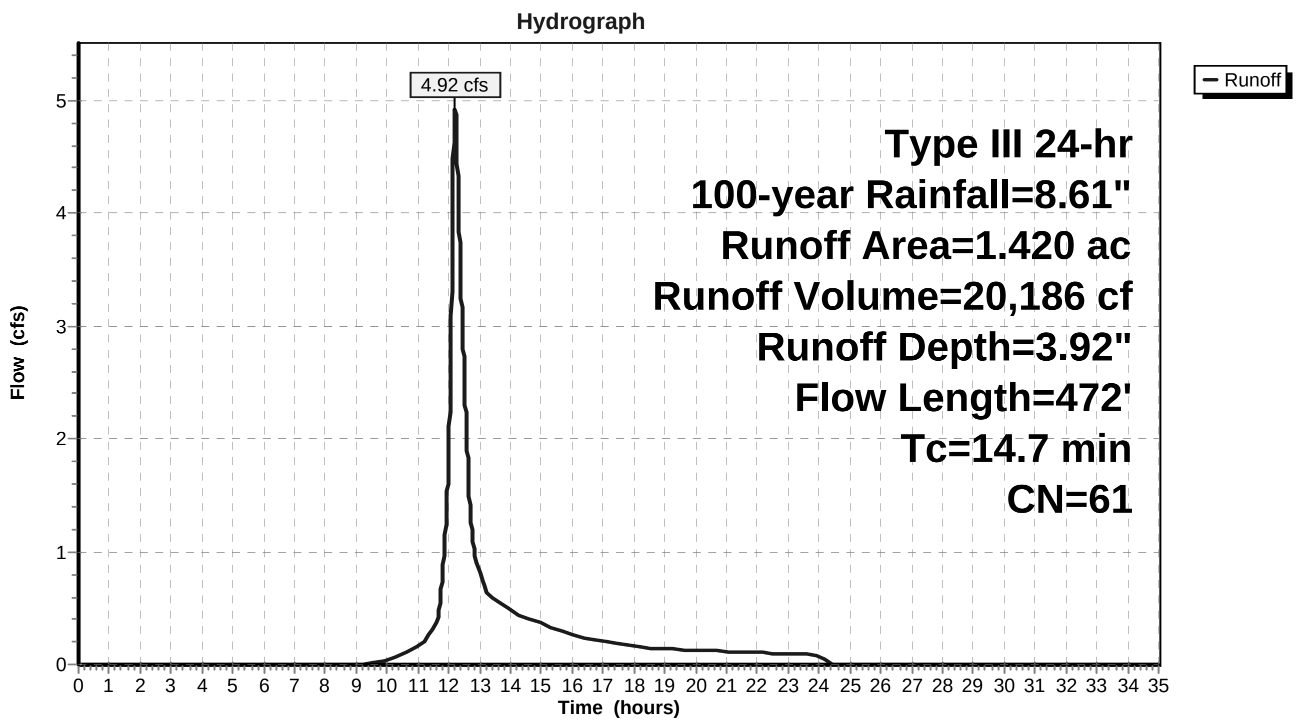
Runoff = 4.92 cfs @ 12.20 hrs, Volume= 20,186 cf, Depth= 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.61"

Area (ac)	CN	Description
1.420	61	>75% Grass cover, Good, HSG B
1.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.2	76	0.0140	0.10		**Sheet Flow, Sheet flow from NTCRA 1** Grass: Dense n= 0.240 P2= 3.20"
0.0	10	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.5	386	0.0060	4.39	17.57	**Channel Flow, RCRA Cap East Ditch** Area= 4.0 sf Perim= 6.0' r= 0.67' n= 0.020
14.7	472	Total			

Subcatchment es: East Swale



Summary for Subcatchment ss: South Swale

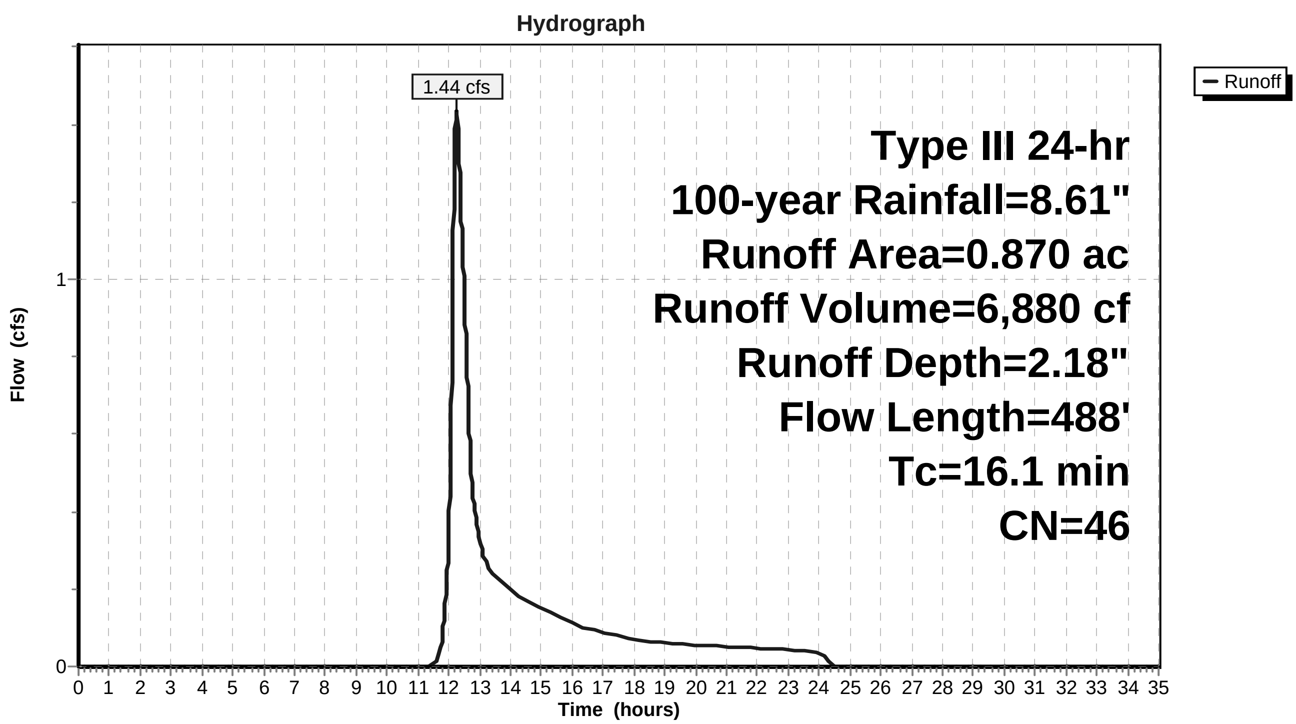
Runoff = 1.44 cfs @ 12.25 hrs, Volume= 6,880 cf, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.61"

Area (ac)	CN	Description
0.603	49	50-75% Grass cover, Fair, HSG A
0.247	36	Woods, Fair, HSG A
0.020	89	Paved roads w/open ditches, 50% imp, HSG B
0.870	46	Weighted Average
0.860		98.85% Pervious Area
0.010		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0500	0.11		**Sheet Flow, Slope from PL high point** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	73	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	315	0.0390	7.39	44.37	**Channel Flow, Flow in South Ditch to Culvert** Area= 6.0 sf Perim= 12.0' r= 0.50' n= 0.025
16.1	488	Total			

Subcatchment ss: South Swale



Summary for Subcatchment 4S: Southern Outlet Swale

Runoff = 2.42 cfs @ 12.31 hrs, Volume= 13,691 cf, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.61"

Area (ac)	CN	Description
0.603	49	50-75% Grass cover, Fair, HSG A
0.247	36	Woods, Fair, HSG A
0.020	89	Paved roads w/open ditches, 50% imp, HSG B
0.200	49	50-75% Grass cover, Fair, HSG A
1.240	36	Woods, Fair, HSG A
2.310	41	Weighted Average
2.300		99.57% Pervious Area
0.010		0.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	100	0.0500	0.11		**Sheet Flow, Slope from PL high point** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	73	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	315	0.0390	7.39	44.37	**Channel Flow, Flow in South Ditch to Culvert** Area= 6.0 sf Perim= 12.0' r= 0.50' n= 0.025
2.0	750	0.0480	6.40	32.02	**Channel Flow, Flow in South Ditch to Culvert** Area= 5.0 sf Perim= 14.5' r= 0.34' n= 0.025 Earth, clean & winding
18.1	1,238	Total			

Summary for Pond 1P: Proposed Culvert-South

[57] Hint: Peaked at 161.62' (Flood elevation advised)

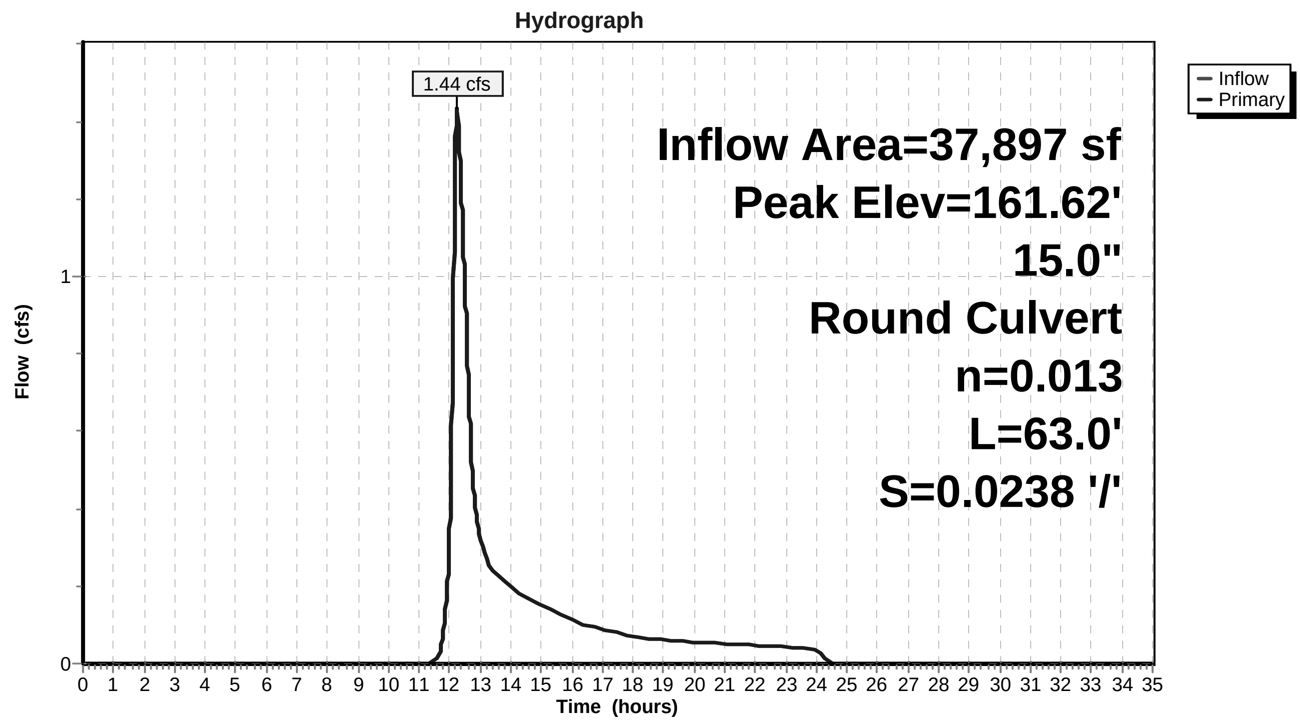
Inflow Area =	37,897 sf,	1.15% Impervious,	Inflow Depth = 2.18"	for 100-year event
Inflow =	1.44 cfs @	12.25 hrs, Volume=	6,880 cf	
Outflow =	1.44 cfs @	12.25 hrs, Volume=	6,880 cf,	Atten= 0%, Lag= 0.0 min
Primary =	1.44 cfs @	12.25 hrs, Volume=	6,880 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Peak Elev= 161.62' @ 12.25 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	161.00'	**15.0" Round Culvert** L= 63.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 161.00' / 159.50' S= 0.0238 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=1.44 cfs @ 12.25 hrs HW=161.62' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.44 cfs @ 2.37 fps)

Pond 1P: Proposed Culvert-South



Summary for Pond 2P: Proposed Culvert-East

[57] Hint: Peaked at 156.40' (Flood elevation advised)

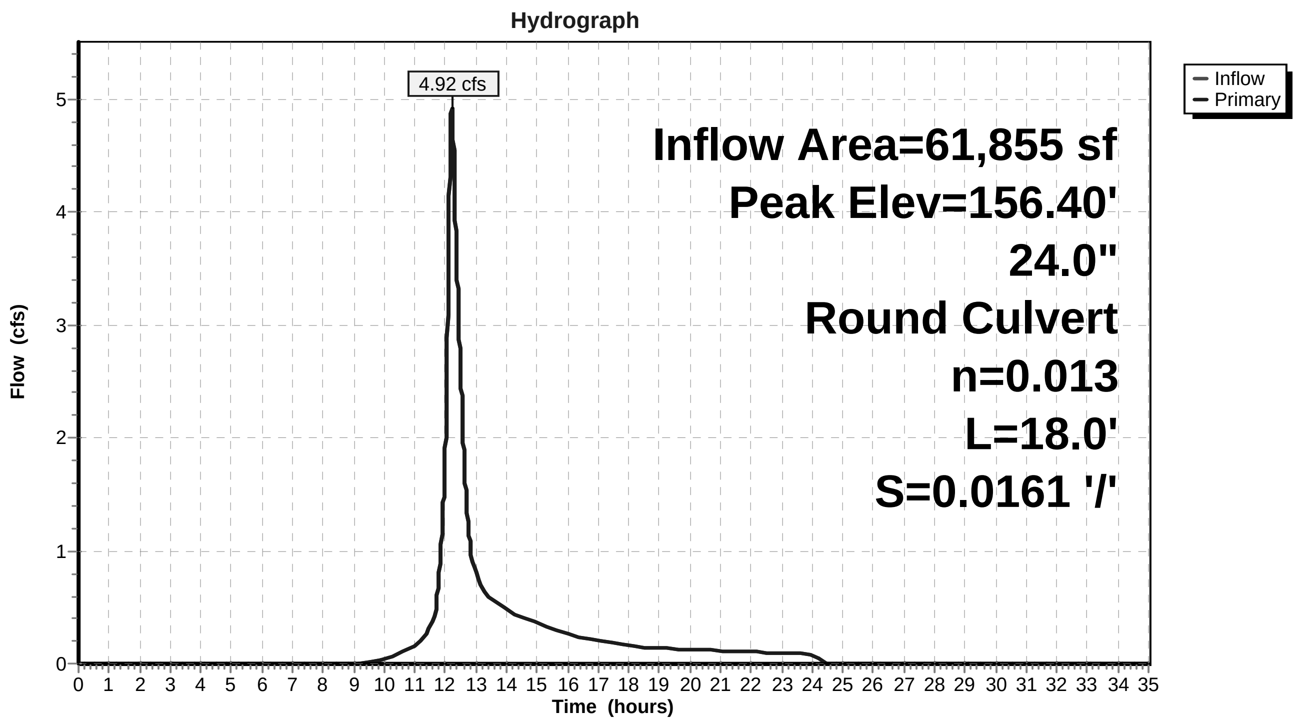
Inflow Area =	61,855 sf,	0.00% Impervious, Inflow Depth = 3.92"	for 100-year event
Inflow =	4.92 cfs @ 12.20 hrs, Volume=	20,186 cf	
Outflow =	4.92 cfs @ 12.20 hrs, Volume=	20,186 cf,	Atten= 0%, Lag= 0.0 min
Primary =	4.92 cfs @ 12.20 hrs, Volume=	20,186 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-35.00 hrs, dt= 0.01 hrs
Peak Elev= 156.40' @ 12.20 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	155.34'	**24.0" Round Culvert** L= 18.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 155.34' / 155.05' S= 0.0161 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=4.92 cfs @ 12.20 hrs HW=156.40' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.92 cfs @ 4.25 fps)

Pond 2P: Proposed Culvert-East



Central Swale- Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	8.83
Base Width (ft)	2.00
Left Side Slope (x:1)	6.00
Right Side Slope (x:1)	6.00
Bed Slope	0.007
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	1.00
Manning "n"	0.081

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	8.83
Required Flow Depth (ft)	1.02
Resulting Flow Velocity (ft/s)	1.06
Resulting Flow Width at Top (ft)	14.27
Resulting Flow Area (ft^2)	8.32
Resulting Wetted Perimeter (ft)	14.44
Resulting Hydraulic Radius (ft)	0.58
Maximum Shear Stress (psf)	0.45
Average Shear Stress (psf)	0.25
Factor of Safety	
Shear Stress Factor of Safety	2.24
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

Row	Col	6	7	8	9	10
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2$$ Eq. 4.7

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4}$$ Eq. 4.2

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

South Swale- Min. Slope-Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	1.44
Base Width (ft)	2.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	3.00
Bed Slope	0.005
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	1.00
Manning "n"	0.104

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	1.44
Required Flow Depth (ft)	0.67
Resulting Flow Velocity (ft/s)	0.59
Resulting Flow Width at Top (ft)	5.35
Resulting Flow Area (ft^2)	2.46
Resulting Wetted Perimeter (ft)	5.62
Resulting Hydraulic Radius (ft)	0.44
Maximum Shear Stress (psf)	0.21
Average Shear Stress (psf)	0.14
Factor of Safety	
Shear Stress Factor of Safety	4.79
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

	Col	*6*	*7*	*8*	*9*	*10*
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2 \qquad \text{Eq. 4.7}$$

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4} \qquad \text{Eq. 4.2}$$

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

South Swale- Max. Slope- Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	1.44
Base Width (ft)	2.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	2.00
Bed Slope	0.120
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	10.00
Manning "n"	0.045

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	1.44
Required Flow Depth (ft)	0.18
Resulting Flow Velocity (ft/s)	3.24
Resulting Flow Width at Top (ft)	2.91
Resulting Flow Area (ft^2)	0.44
Resulting Wetted Perimeter (ft)	2.98
Resulting Hydraulic Radius (ft)	0.15
Maximum Shear Stress (psf)	1.36
Average Shear Stress (psf)	1.12
Factor of Safety	
Shear Stress Factor of Safety	7.37
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

	Col	*6*	*7*	*8*	*9*	*10*
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2 \qquad \text{Eq. 4.7}$$

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4} \qquad \text{Eq. 4.2}$$

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

Southern Outlet Swale- Min. Slope-Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	2.42
Base Width (ft)	3.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.005
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	1.00
Manning "n"	0.096

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	2.42
Required Flow Depth (ft)	0.75
Resulting Flow Velocity (ft/s)	0.72
Resulting Flow Width at Top (ft)	6.00
Resulting Flow Area (ft^2)	3.37
Resulting Wetted Perimeter (ft)	6.35
Resulting Hydraulic Radius (ft)	0.53
Maximum Shear Stress (psf)	0.23
Average Shear Stress (psf)	0.17
Factor of Safety	
Shear Stress Factor of Safety	4.28
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

	Col	6	7	8	9	10
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2$$ Eq. 4.7

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4}$$ Eq. 4.2

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

Southern Outlet Swale- Max. Slope- Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	2.42
Base Width (ft)	3.00
Left Side Slope (x:1)	2.00
Right Side Slope (x:1)	2.00
Bed Slope	0.048
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	10.00
Manning "n"	0.053

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	2.42
Required Flow Depth (ft)	0.29
Resulting Flow Velocity (ft/s)	2.36
Resulting Flow Width at Top (ft)	4.15
Resulting Flow Area (ft^2)	1.03
Resulting Wetted Perimeter (ft)	4.29
Resulting Hydraulic Radius (ft)	0.24
Maximum Shear Stress (psf)	0.86
Average Shear Stress (psf)	0.72
Factor of Safety	
Shear Stress Factor of Safety	11.61
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

	Col	*6*	*7*	*8*	*9*	*10*
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2$$ Eq. 4.7

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4}$$ Eq. 4.2

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

East Swale- Vegetated Lining

Channel Design (Input)	
Flow Capacity (cfs)	4.92
Base Width (ft)	2.00
Left Side Slope (x:1)	3.00
Right Side Slope (x:1)	3.00
Bed Slope	0.006
Vegetative Retardance Class (A, B, C, D, or E)	C
Vegetative Growth Form (Sod [S], Bunch [B], or Mixed [M])	M
Cover Density (Excellent [E], Verry Good [VG], Good [G], Fair [F], Poor [P])	VG
Maximum Allowable Shear Stress (psf)	1.00
Manning "n"	0.084

Flow Conditions (Output)	
Flowrate from Manning Equation (cfs)	4.92
Required Flow Depth (ft)	0.99
Resulting Flow Velocity (ft/s)	1.00
Resulting Flow Width at Top (ft)	7.94
Resulting Flow Area (ft^2)	4.92
Resulting Wetted Perimeter (ft)	8.26
Resulting Hydraulic Radius (ft)	0.60
Maximum Shear Stress (psf)	0.39
Average Shear Stress (psf)	0.23
Factor of Safety	
Shear Stress Factor of Safety	2.57
--- Channel is STABLE ---	

REFERENCE:

USDOT FHWA. Hydrologic Engineering Circular No. 15 (HEC-15). *Design of Roadside Channels with Flexible Linings*. September 2005.

TABLES:

Grass Roughness Coefficients (Table 4.4)

Cn = 0.22

Retardance Class	Cn
A	0.605
B	0.418
C	0.220
D	0.147
E	0.093

Cover Factor Values for Uniform Stands of Grass (Table 4.5)

Cf = 0.79

	Col	*6*	*7*	*8*	*9*	*10*
Row	**Cover / Density**	**E**	**F**	**G**	**P**	**VG**
19	**B**	0.55	0.47	0.50	0.41	0.53
20	**M**	0.82	0.70	0.75	0.62	0.79
21	**S**	0.98	0.84	0.90	0.75	0.95

(Table 4.1)

Vegetation Class	Stem Ht.
A	24"-36"
B	12"-24"
C	6"-12"
D	2"-6"
E	0"-2"

EQUATIONS:

$$Tp = \frac{Tpsoil}{(1-Cf)}\left(\frac{n}{ns}\right)^2$$ Eq. 4.7

Tp = Permissible shear stress for lining (psf)
Tpsoil = Permissible shear stress for soil (Tpsoil = 0.02 for fine-grained, non-cohesive)
Cf = Cover factor (Table 4.5)
ns = soil grain roughness (ns = 0.016 for fine-grained soils)
n = overall lining roughness (see Eq. 4.2)

$$n = (0.213)CnTo^{-0.4}$$ Eq. 4.2

Cn = Grass roughness coefficient (Table 4.4)
To = mean boundary shear stress (psf) = γRS

ATTACHMENT C

References

NOAA Atlas 14, Volume 10, Version 2
Location name: Southington, Connecticut, US*
Latitude: 41.6194°, Longitude: -72.8773°
Elevation: 164 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.343 (0.267–0.437)	0.414 (0.321–0.528)	0.530 (0.410–0.678)	0.626 (0.481–0.806)	0.758 (0.565–1.02)	0.860 (0.628–1.19)	0.962 (0.682–1.38)	1.09 (0.730–1.60)	1.25 (0.808–1.92)	1.37 (0.867–2.15)
10-min	0.486 (0.378–0.619)	0.586 (0.455–0.748)	0.751 (0.581–0.960)	0.887 (0.682–1.14)	1.07 (0.800–1.45)	1.22 (0.889–1.68)	1.36 (0.966–1.96)	1.54 (1.04–2.27)	1.77 (1.15–2.72)	1.94 (1.23–3.05)
15-min	0.572 (0.444–0.728)	0.690 (0.535–0.880)	0.883 (0.683–1.13)	1.04 (0.802–1.34)	1.26 (0.941–1.71)	1.43 (1.05–1.98)	1.60 (1.14–2.31)	1.81 (1.22–2.67)	2.08 (1.35–3.19)	2.28 (1.45–3.59)
30-min	0.781 (0.607–0.995)	0.940 (0.730–1.20)	1.20 (0.928–1.54)	1.42 (1.09–1.82)	1.71 (1.28–2.31)	1.94 (1.42–2.68)	2.17 (1.54–3.12)	2.45 (1.65–3.62)	2.82 (1.82–4.33)	3.09 (1.96–4.86)
60-min	0.991 (0.770–1.26)	1.19 (0.924–1.52)	1.52 (1.17–1.94)	1.79 (1.38–2.30)	2.16 (1.61–2.92)	2.45 (1.79–3.38)	2.73 (1.94–3.93)	3.09 (2.08–4.56)	3.55 (2.30–5.46)	3.91 (2.47–6.13)
2-hr	1.29 (1.01–1.64)	1.55 (1.21–1.96)	1.96 (1.53–2.49)	2.30 (1.78–2.95)	2.78 (2.08–3.73)	3.14 (2.31–4.32)	3.50 (2.50–5.03)	3.97 (2.68–5.85)	4.60 (2.99–7.03)	5.07 (3.22–7.92)
3-hr	1.50 (1.18–1.89)	1.79 (1.40–2.26)	2.27 (1.78–2.88)	2.67 (2.07–3.41)	3.22 (2.42–4.32)	3.64 (2.69–5.01)	4.07 (2.92–5.84)	4.63 (3.14–6.80)	5.38 (3.50–8.20)	5.95 (3.78–9.27)
6-hr	1.90 (1.50–2.38)	2.29 (1.80–2.87)	2.92 (2.29–3.68)	3.45 (2.69–4.37)	4.18 (3.16–5.58)	4.73 (3.52–6.49)	5.29 (3.83–7.59)	6.08 (4.13–8.88)	7.12 (4.65–10.8)	7.91 (5.05–12.3)
12-hr	2.34 (1.86–2.91)	2.86 (2.27–3.56)	3.71 (2.93–4.64)	4.41 (3.46–5.55)	5.38 (4.10–7.16)	6.13 (4.58–8.37)	6.87 (5.01–9.84)	7.98 (5.43–11.6)	9.44 (6.18–14.2)	10.5 (6.74–16.3)
24-hr	2.74 (2.19–3.39)	3.41 (2.72–4.23)	4.51 (3.58–5.61)	5.42 (4.28–6.78)	6.68 (5.12–8.86)	7.64 (5.76–10.4)	8.61 (6.35–12.4)	10.2 (6.94–14.7)	12.2 (8.00–18.3)	13.7 (8.81–21.1)
2-day	3.08 (2.47–3.78)	3.91 (3.13–4.80)	5.26 (4.20–6.49)	6.38 (5.07–7.93)	7.92 (6.13–10.5)	9.11 (6.94–12.5)	10.3 (7.69–14.9)	12.4 (8.48–17.8)	15.1 (9.96–22.6)	17.2 (11.1–26.3)
3-day	3.34 (2.69–4.09)	4.26 (3.43–5.21)	5.75 (4.61–7.07)	6.98 (5.57–8.65)	8.69 (6.75–11.5)	10.0 (7.64–13.6)	11.3 (8.48–16.3)	13.7 (9.37–19.6)	16.8 (11.0–25.0)	19.1 (12.3–29.1)
4-day	3.59 (2.90–4.38)	4.56 (3.68–5.57)	6.15 (4.94–7.54)	7.47 (5.97–9.22)	9.28 (7.22–12.2)	10.7 (8.18–14.5)	12.1 (9.07–17.4)	14.6 (10.0–20.9)	17.9 (11.8–26.6)	20.3 (13.1–30.9)
7-day	4.28 (3.48–5.20)	5.37 (4.35–6.52)	7.14 (5.77–8.71)	8.61 (6.91–10.6)	10.6 (8.30–13.9)	12.2 (9.35–16.4)	13.8 (10.3–19.6)	16.4 (11.3–23.4)	19.9 (13.2–29.5)	22.6 (14.6–34.2)
10-day	4.98 (4.06–6.02)	6.12 (4.98–7.42)	7.99 (6.47–9.72)	9.54 (7.68–11.7)	11.7 (9.12–15.2)	13.3 (10.2–17.8)	15.0 (11.2–21.1)	17.6 (12.2–25.0)	21.2 (14.1–31.3)	23.9 (15.5–36.0)
20-day	7.17 (5.88–8.62)	8.38 (6.86–10.1)	10.3 (8.44–12.5)	12.0 (9.71–14.6)	14.2 (11.2–18.2)	16.0 (12.2–21.0)	17.7 (13.2–24.4)	20.2 (14.0–28.4)	23.4 (15.6–34.3)	25.8 (16.8–38.8)
30-day	9.01 (7.41–10.8)	10.2 (8.41–12.3)	12.3 (10.0–14.8)	13.9 (11.3–16.9)	16.2 (12.7–20.6)	18.0 (13.8–23.5)	19.8 (14.6–26.9)	22.0 (15.4–30.8)	24.9 (16.7–36.4)	27.1 (17.7–40.6)
45-day	11.3 (9.31–13.4)	12.5 (10.3–15.0)	14.6 (12.0–17.5)	16.3 (13.3–19.7)	18.7 (14.7–23.6)	20.6 (15.7–26.5)	22.4 (16.5–30.0)	24.3 (17.1–33.9)	26.9 (18.1–39.1)	28.8 (18.8–43.0)
60-day	13.2 (10.9–15.6)	14.5 (12.0–17.2)	16.6 (13.7–19.9)	18.4 (15.0–22.1)	20.8 (16.4–26.1)	22.7 (17.4–29.2)	24.6 (18.1–32.7)	26.4 (18.6–36.6)	28.7 (19.3–41.5)	30.4 (19.9–45.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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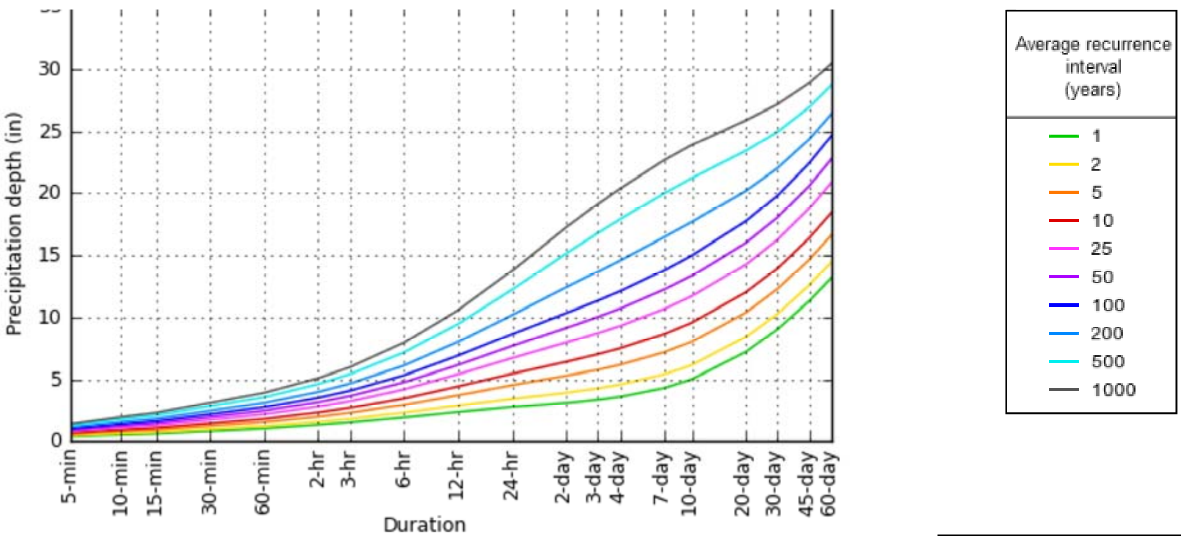
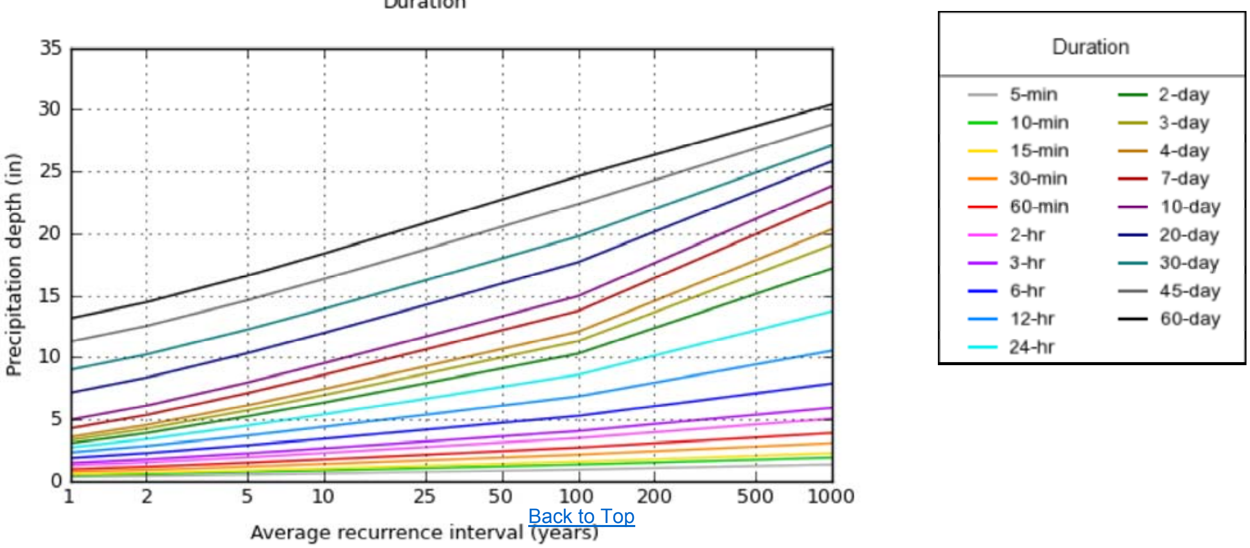
PF graphical





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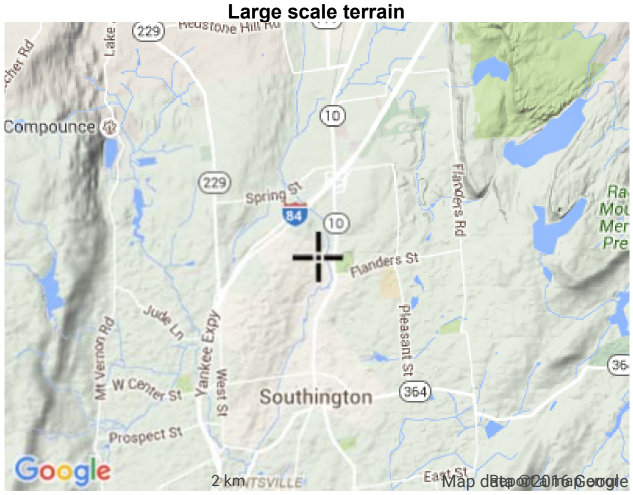
NOAA Atlas 14, Volume 10, Version 2 Created (GMT): Tue May 24 14:10:37 2016

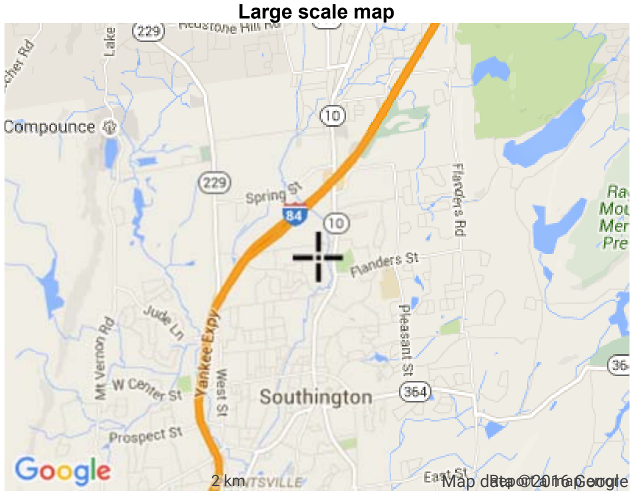
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

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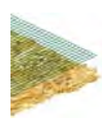
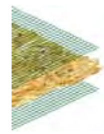
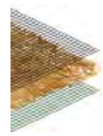
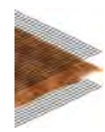
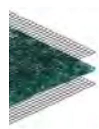
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910

The complete line of RollMax™ products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.

RollMax Product Selection Chart

	TEMPORARY						
	ERONET						BIONET
							
	DS75	**DS150**	**S75**	**S150**	**SC150**	**C125**	**S75BN**
Longevity	45 days	60 days	12 mo.	12 mo.	24 mo.	36 mo.	12 mo.
Applications	Low Flow Channels 4:1-3:1 Slopes	Moderate Flow Channels 3:1-2:1 Slopes	Low Flow Channels 4:1-3:1 Slopes	Moderate Flow Channels 3:1-2:1 Slopes	Medium Flow Channels 2:1-1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	Low Flow Channels 4:1-3:1 Slopes
Design Permissible Shear Stress lbs/ft^2 (Pa)	Unvegetated 1.55 (74)	Unvegetated 1.75 (84)	Unvegetated 1.55 (74)	Unvegetated 1.75 (84)	Unvegetated 2.00 (96)	Unvegetated 2.25 (108)	Unvegetated 1.60 (76)
Design Permissible Velocity ft/s (m/s)	Unvegetated 5.00 (1.52)	Unvegetated 6.00 (1.52)	Unvegetated 5.00 (1.2)	Unvegetated 6.00 (1.83)	Unvegetated 8.00 (2.44)	Unvegetated 10.00 (3.05)	Unvegetated 5.00 (1.52)
Top Net	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft^2 (1.47 kg/100 m^2) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft^2 (1.47 kg/100 m^2) approx wt	Leno woven. 100% biodegradable jute fiber 9.30 lbs/1000 ft^2 (4.53 kg/100 m^2) approx wt
Center Net	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fiber Matrix	Straw fiber 0.50 lbs/yd^2 (0.27 kg/m^2)	Straw fiber 0.50 lbs/yd^2 (0.27 kg/m^2)	Straw fiber 0.50 lbs/yd^2 (0.27 kg/m^2)	Straw fiber 0.50 lbs/yd^2 (0.27 kg/m^2)	Straw/coconut matrix 70% Straw 0.35 lbs/yd^2 (0.19 kg/m^2) 30% Coconut 0.15 lbs/yd^2 (0.08 kg/m^2)	Coconut fiber 0.50 lbs/yd^2 (0.27 kg/m^2)	Straw fiber 0.50 lbs/yd^2 (0.27 kg/m^2)
Bottom Net	N/A	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	N/A	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft^2 (0.73 kg/100 m^2) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft^2 (1.47 kg/100 m^2) approx wt	N/A
Thread	Accelerated degradable	Accelerated degradable	Degradable	Degradable	Degradable	UV-stabilized polypropylene	Biodegradable

	TEMPORARY			PERMANENT			
	BIONET			ERONET	VMAX		
							
	S150BN	SC150BN	C125BN	P300	SC250	C350	P550
Longevity	12 mo.	18 mo.	24 mo.	Permanent	Permanent	Permanent	Permanent
Applications	Moderate Flow Channels 3:1-2:1 Slopes	Medium Flow Channels 2:1-1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 and Greater Slopes	Extreme High-Flow Channels 1:1 and Greater Slopes
Design Permissible Shear Stress lbs/ft² (Pa)	Unvegetated 1.85 (88)	Unvegetated 2.10 (100)	Unvegetated 2.35 (112)	Unvegetated 3.0 (144) Vegetated 8.0 (383)	Unvegetated 3.0 (144) Vegetated 10.0 (480)	Unvegetated 3.2 (153) Vegetated 12.0 (576)	Unvegetated 4.0 (191) Vegetated 14.0 (672)
Design Permissible Velocity ft/s (m/s)	Unvegetated 6.00 (1.83)	Unvegetated 8.00 (2.44)	Unvegetated 10.00 (3.05)	Unvegetated 9.00 (2.7) Vegetated 16.0 (4.9)	Unvegetated 9.5 (2.9) Vegetated 15.0 (4.6)	Unvegetated 10.5 (3.2) Vegetated 20.0 (6.0)	Unvegetated 12.5 (3.8) Vegetated 25.0 (7.6)
Top Net	Leno woven. 100% biodegradable jute fiber 9.30 lbs/1000 ft² (4.53 kg/100 m²) approx wt	Leno woven. 100% biodegradable jute fiber 9.30 lbs/1000 ft² (4.53 kg/100 m²) approx wt	Leno woven. 100% biodegradable jute fiber 9.30 lbs/1000 ft² (4.53 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 5.0 lbs/1000 ft² (2.44 kg/100 m²) approx wt	Heavyweight polypropylene 5.0 lbs/1000 ft² (2.44 kg/100 m²) approx wt	Extra heavyweight polypropylene 8.0 lbs/1000 ft² (3.91 kg/100 m²) approx wt	Ultra heavyweight polypropylene 24.0 lbs/1000 ft² (11.7 kg/100 m²) approx wt
Center Net	N/A	N/A	N/A	N/A	Ultra heavyweight polypropylene – corrugated 24.0 lbs/1000 ft² (11.7 kg/100 m²)	Ultra heavyweight polypropylene – corrugated 24.0 lbs/1000 ft² (11.7 kg/100 m²)	Ultra heavyweight polypropylene – corrugated 24.0 lbs/1000 ft² (11.7 kg/100 m²)
Fiber Matrix	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw/coconut matrix 70% Straw 0.35 lbs/yd² (0.19 kg/m²) 30% Coconut 0.15 lbs/yd² (0.08 kg/m²)	Coconut fiber 0.50 lbs/yd² (0.27 kg/m²)	UV-stabilized polypropylene fiber 0.70 lbs/yd² (0.38 kg/m²)	Straw/coconut matrix 70% Straw 0.35 lbs/yd² (0.19 kg/m²) 30% Coconut 0.15 lbs/yd² (0.08 kg/m²)	Coconut fiber 0.50 lbs/yd² (0.27 kg/m²)	UV-stabilized polypropylene fiber 0.50 lbs/yd² (0.27 kg/m²)
Bottom Net	Woven. 100% biodegradable jute fiber 7.70 lbs/1000 ft² (3.76 kg/100 m²) approx wt	Woven. 100% biodegradable jute fiber 7.70 lbs/1000 ft² (3.76 kg/100 m²) approx wt	Woven. 100% biodegradable jute fiber 7.70 lbs/1000 ft² (3.76 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 3.0 lbs/1000 ft² (1.47 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 5.0 lbs/1000 ft² (2.44 kg/100 m²) approx wt	Extra heavyweight polypropylene 8.0 lbs/1000 ft² (3.91 kg/100 m²) approx wt	Ultra heavyweight polypropylene 24.0 lbs/1000 ft² (11.7 kg/100 m²) approx wt
Thread	Biodegradable	Biodegradable	Biodegradable	UV-stabilized polypropylene	UV-stabilized polypropylene	UV-stabilized polypropylene fiber	UV-stabilized polypropylene

APPENDIX G

MODFLOW Model Information

MEMO

Design & Consultancy for natural and built assets

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To:

Bruce Thompson, *de maximis, inc.*

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Mike Gefell, Anchor QEA

Jeff Holden, Arcadis

From:

Tracy O'Fallon

Date:

July 14, 2016

Arcadis Project No.:

B0054634.0000.02600

Subject:

Evaluation of Groundwater Flow From the Non-Time-Critical Removal Action No. 1 (NTCRA 1) Area at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site (Site) -- Southington, Connecticut

1. INTRODUCTION AND PURPOSE

This technical memorandum summarizes numerical groundwater flow modeling performed by Arcadis to evaluate potential groundwater flow conditions that may occur as a result of planned modifications to the NTCRA 1 sheetpile wall and pumping system operations at the above-referenced site. The modifications to the sheetpile wall are proposed in anticipation of potential future modifications to the existing Hydraulic Containment and Treatment System (HCTS). Such modifications are proposed consistent with SOW Section IV.B.2, which allows for modifications or enhancements to the HCTS that decrease the costs or time of system operation provided they are carried out in a protective, compliant, effective, and cost-effective manner, as determined by USEPA.

The Record of Decision (ROD) selected in-situ thermal treatment as a component of the Site remedy, to be applied in the area containing non-aqueous phase liquid (NAPL) within the overburden at and near the former SRSNE Operations Area (i.e., the Overburden NAPL Area). In September 2006, BBL (an Arcadis Company) developed a groundwater flow model to simulate groundwater flow rates into the conceptual thermal treatment area during overburden heating to the boiling point of groundwater. Predictive simulations included various permutations of hydraulic barriers, upgradient extraction wells, and a hypothetical high permeability zone within bedrock. The specific purpose of the modeling was to estimate the rates of groundwater flow into the thermal treatment area, including the simulated locations and magnitudes of highest flow from the adjacent overburden and the underlying bedrock. The simulation results were summarized in a memorandum dated September 11, 2006 (BBL 2006).

The baseline, calibrated model was updated again in 2011 to simulate the final thermal treatment area design. Results of the model updates and predictive simulation results were presented in a technical memorandum dated January 31, 2012 (Arcadis 2012).

The 2011 updated model was modified and used to evaluate groundwater flow conditions that may result from sheetpile wall modifications to allow overburden groundwater to migrate downgradient from the NTCRA 1. Various simulations were performed to evaluate the areas and magnitude of potential groundwater mounding after NTCRA 1 groundwater extraction is discontinued. It is important to note that overburden groundwater historically has been very shallow in the NTCRA 1 area. Even before the installation of the NTCRA 1 sheetpile wall in 1995, groundwater was observed seasonally in surface depressions within the NTCRA 1 Containment Area, and wetlands were delineated adjacent to the area. Groundwater has also been observed seasonally in such depressions since NTCRA 1 startup in 1995. The proposed NTCRA 1 modifications are intended to limit the potential for future mounding of groundwater to the post-construction ground surface by promoting effective drainage of groundwater and adding new fill materials at ground surface in appropriate areas.

The proposed NTCRA 1 modifications include openings in the sheetpile wall at select locations and shallow gravel-filled trenches inside and outside the sheetpile wall to effectively collect overburden groundwater, convey it through the designed openings in the sheetpile wall, and distribute the flow to the downgradient saturated overburden formation. The model evaluation included the use of forward particle tracking from each of the simulated openings in the NTCRA 1 sheetpile wall to depict groundwater flow directions, predict the potential ultimate discharge locations for that groundwater, and estimate the groundwater travel time between the NCTRA 1 sheetpile wall and the predicted groundwater discharge locations.

The following sections briefly describe the model structure, the most recent calibration scatter plot and residual statistics, and the development of and results for the recent predictive simulations of groundwater flow due to the NTCRA 1 sheetpile modifications.

2. MODEL DESCRIPTION

The original 2006 thermal treatment model was constructed using detailed onsite and offsite hydrogeologic data from numerous previous investigations (BBL 2006). Figure 1 presents the model domain and model boundary conditions; the domain includes an area of approximately 0.36 square miles, with dimensions of 4,000 feet in the north-south direction and 2,500 feet in the east-west direction.

The model was developed using MODFLOW-SURFACT (HydroGeoLogic, Inc. 1996) to simulate groundwater flow, and MODPATH (Pollock 1994) to simulate groundwater flow paths within the simulated flow field. The original model included six layers representing three hydrogeologic units. To assist in evaluating groundwater elevation changes as part of the NTCRA 1 modifications, an additional five-foot thick model layer was added to the upper surface of the model to simulate and evaluate the locations and magnitude of groundwater mounding that may occur due to system shut down, and identify areas where additional fill materials may be needed at ground surface to avoid potentially groundwater “daylighting” at ground surface.

The current model layers represent the following stratigraphic units:

- Layer 1 – Fill within the NTCRA 1 area; Fill and Outwash outside the general vicinity of the NTCRA 1 area

- Layers 2 and 3 – Fill and Outwash
- Layer 4 – Glacial Till, with the exception of "till windows" where till is absent (i.e., not observed in boring logs); in this case, the Layer 4 thickness is reduced to 0.5 feet and its hydraulic properties are representative of the underlying bedrock unit
- Layer 5 – Upper Bedrock (upper 5 feet of bedrock)
- Layer 6 – Intermediate Bedrock (5 to 20 feet below the top of bedrock)
- Layer 7 – Deeper Bedrock (25 to 100 feet below the top of bedrock)

Preliminary field construction activities in 2010 and 2011 (which included excavations and dewatering via pumping) identified a previously unknown medium-to-coarse sand unit of high permeability within the glacial outwash unit along the railroad right-of-way. Previous conceptual and numerical models of the Site inferred that the railroad ballast could serve as a high permeability zone near ground surface. The new information indicated high-permeability sand extending at least several feet below ground surface, and laterally beyond the limits of the railroad right-of-way. Subsequent investigation of this unit by additional soil borings and reassessment of historical drilling logs suggested that the unit also extends into a portion of the former Operations Area. Therefore, the 2006 calibrated model was modified to incorporate this unit (Figure 2). For additional details regarding the delineation of the high permeability sand unit, see Arcadis 2012.

During the 2011 model updates and predictive simulations of thermal treatment, the following additional modifications were made to the model:

- It was determined that localized areas of the bedrock surface required adjustment in the vicinity of the overburden NAPL area. Therefore, portions of the bedrock surface from the regional NTCRA 2 model (Arcadis 2011) were imported into the thermal treatment model.
- Sheetpile "wing walls" extending westward into the former Operations Area from the north and south ends of the existing NTCRA 1 sheetpile wall were installed at the site and simulated in the model (see Figure 1).
- Slight modifications to the aerial recharge rates were made as follows:
  - The area over the thermal treatment zone was assigned a value of zero to account for the surface cover (cap) emplaced over this area.
  - The areas where till is inferred to be at or near ground surface had previously been assigned a relatively lower rate than the surrounding valley fill area; during the 2011 updates, these distinct areas were removed and assigned either valley fill or the lower highlands values as appropriate.

Figure 3 presents the distribution of a hypothetical fill layer added above the existing overburden. The distribution of the fill layer was extended outside the boundaries of the NTCRA 1 area to evaluate the full extent of the area where fill may be required. The fill material hydraulic conductivity was assigned a value of 2 ft/d which is representative for the shallow overburden materials in the NTCRA 1 area.

All other structural features and boundary conditions in the current model are as described in the 2006 BBL model memorandum.

3. MODEL RESIDUALS AND CALIBRATION STATISTICS

The 2006 model was originally calibrated to average hydraulic head data measured at 200 monitoring well and piezometer locations between January 21, 1997, and August 17, 1998. As described in Arcadis 2012, simulated groundwater elevations at the 200 monitoring well/piezometer locations in the 2011 model were compared to the calibration targets previously used to calibrate the 2006 model. Tables 1 and 2 present the 2011 simulated residuals (observed groundwater elevation minus simulated groundwater elevation) for the entire model domain and the overburden NAPL area, respectively. Figures 4 and 5 present scatter plots (observed groundwater elevation versus simulated groundwater elevation) for the entire model domain and the overburden NAPL area, respectively (also for the 2011 model). Figure 4 also presents the original, 2006 calibrated model targets for comparison.

The residual statistics for the 2011 model simulation indicate that the simulated groundwater elevations are still similar to the observed groundwater elevations, and the calculated statistics are within acceptable ranges. As shown in Figure 4, the residuals are reasonably close to the diagonal, “ideal match” line. As indicated in the tables, the ratios of the standard deviations to the range in residuals for both the entire domain and the specific overburden NAPL area wells are 0.02 and 0.10, respectively, indicating a good agreement between the simulated and observed values. Figure 5 shows that the simulated heads in the overburden NAPL area in the revised model are slightly lower than those in the original calibrated model (1.1 feet lower, on average, for overburden calibration targets in the thermal treatment area). The hydraulic gradient across the overburden NAPL area, however, is still consistent with the observed gradient and the simulated gradient in the original calibrated model. That is, the slope defined by the data plotted as circles (2012 model update) is similar to that defined by the data plotted as diamonds (2006 calibrated model; Figure 5). Therefore, the updated model was considered acceptable for performing additional simulations of potential groundwater flow conditions during thermal treatment as well as for performing an evaluation of NTCRA 1 shut down.

4. PREDICTIVE SIMULATIONS

As described above, predictive simulations were performed to design passive groundwater drainage features to mitigate water-table mounding upgradient of the sheetpile wall following the potential future cessation of NTCRA 1 system groundwater extraction. The model was used to support the design of sheetpile wall openings (number and locations), the locations and extent of gravel collection trenches to collect groundwater upgradient of the sheetpile wall and distribute it to the native overburden materials downgradient of the sheetpile wall, and the thickness and extent of fill materials above the existing ground surface to minimize the potential for groundwater reaching the ground surface following NTCRA 1 system shutdown.

Multiple simulations were performed to compare various alternatives and develop the proposed NTCRA 1 modifications. Predictive simulations used an initial head condition representing the groundwater flow field with the NTCRA 1 system pumping at a steady-state rate of 10 gpm. The predictive simulations were run in transient mode with the NTCRA 1 wells no longer pumping (but with the NTCRA 2 wells pumping at 30 gpm in the Town of Southington Well Field property). The predictive simulations included removal of specific sections of the sheetpile wall to simulate openings in the sheetpile wall to limit the degree of groundwater mounding, and various designs of shallow (4-foot deep) interior and exterior gravel trenches (specified as high hydraulic conductivity model grid cells [10,000 ft/d]) to collect groundwater from the interior of the NTCRA 1 area and distribute the groundwater to the native overburden materials downgradient of the sheetpile wall.

Each simulation included forward particle tacking from each of the simulated openings in the NTCRA 1 sheetpile wall to depict the flow directions and ultimate discharge locations of groundwater that may migrate through the openings. In addition, particle tracking was used to estimate the groundwater travel time between the NCTRA 1 sheetpile wall and the predicted discharge locations.

5. RESULTS OF PREDICTIVE SIMULATIONS

The design for NTCRA 1 modifications is presented on Figure 6, and includes three openings in the south-southeastern portion of the sheetpile wall. It is anticipated that one opening near well RW-1 and another near RW-8 will operate under normal conditions. An third opening will also be included further to the east to provide redundancy and operating flexibility, although this opening was not included in the model simulations. The design also includes 4-foot deep, gravel-filled trenches to convey groundwater as follows:

- Along most of the interior side of the sheetpile wall,
- Along the exterior of the sheetpile wall from the south near well RW-7, and
- Four 60-foot long, linear trenches near the location of the sheetpile openings, extending toward the south.

Figure 7 presents the simulated saturated thickness of fill above existing grade (i.e., in model layer 1). The greatest degree of saturated fill is located in the southern (downgradient) portion of the NTCRA 1 area, and within the general vicinity of well RW-9 (up to approximately 2.5 feet); note that this area is located within a natural topographic low and has historically had water levels observed above grade at various times throughout the year.

Figure 8 presents the simulated groundwater elevations within the native overburden material (model layer 2) and includes simulated groundwater flow paths from the MODPATH forward particle tracking analysis. Particles were released within the simulated flow field along the sheetpile openings at four depths within this layer of native overburden (model layer 2) and tracked forward in time. The figure includes arrows depicting one year of simulated groundwater travel time. Travel times for these flow paths (read directly from the MODPATH endpoint output file) range from 1.4 years to 10.2 years.

The proposed design is predicted to effectively collect groundwater within the NTCRA 1 area, convey it through designed openings in the sheetpile wall, and discharge the groundwater to the downgradient saturated overburden. The groundwater that migrates through the western and central openings in the sheetpile wall migrates downgradient, where it is ultimately captured by the NTCRA 2 groundwater extraction wells that are expected to continue operating for the foreseeable future. The design for the NTCRA 1 area modifications also includes addition of sufficient fill materials above existing ground surface to reduce or avoid occurrences of groundwater emerging at ground surface, which have historically occurred within the NTCRA 1 area.

REFERENCES

Arcadis. 2012. Additional Evaluation of Groundwater Flow During Thermal Remedy. Letter to Mr. Bruce Thompson of *de maximis, inc.* January 31, 2012.

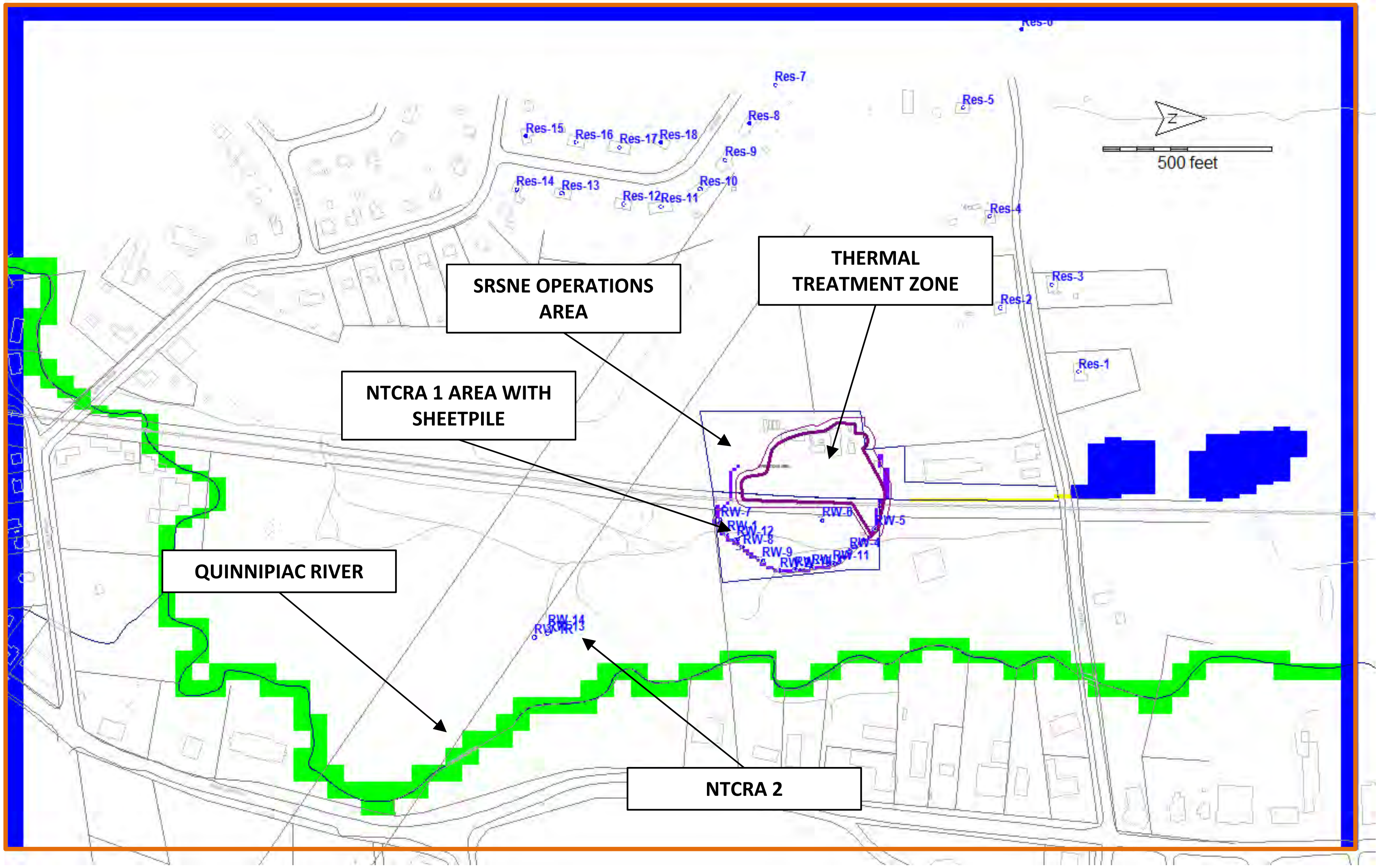
Arcadis. 2011. Updates to the Existing MODFLOW Groundwater Flow Model. Letter to Mr. Bruce Thompson of *de maximis, inc.* January 5, 2011.

BBL (an Arcadis company). 2006. Evaluation of Groundwater Flow During Potential Thermal Remedy, SRSNE Site, Southington, Connecticut. Memorandum to Mr. Bruce Thompson, *de maximis, inc.* September 6, 2006.

HydroGeoLogic, Inc. 1996. MODFLOW-SURFACT Software (Version 3.0) Overview: Installation, Registration, and Running Procedures. HydroGeoLogic, Inc., Herndon, Virginia.

Pollock, David W. 1994. User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U. S. Geological Survey finite-difference ground-water flow model. U. S. GEOLOGICAL SURVEY Open-File Report 94-464. September.

FIGURES



LEGEND

- Domain
- Constant Head
- River
- Drain
- Horizontal Flow Barrier (Sheetpile)
- Extraction Well

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

MODEL DOMAIN AND BOUNDARY CONDITIONS

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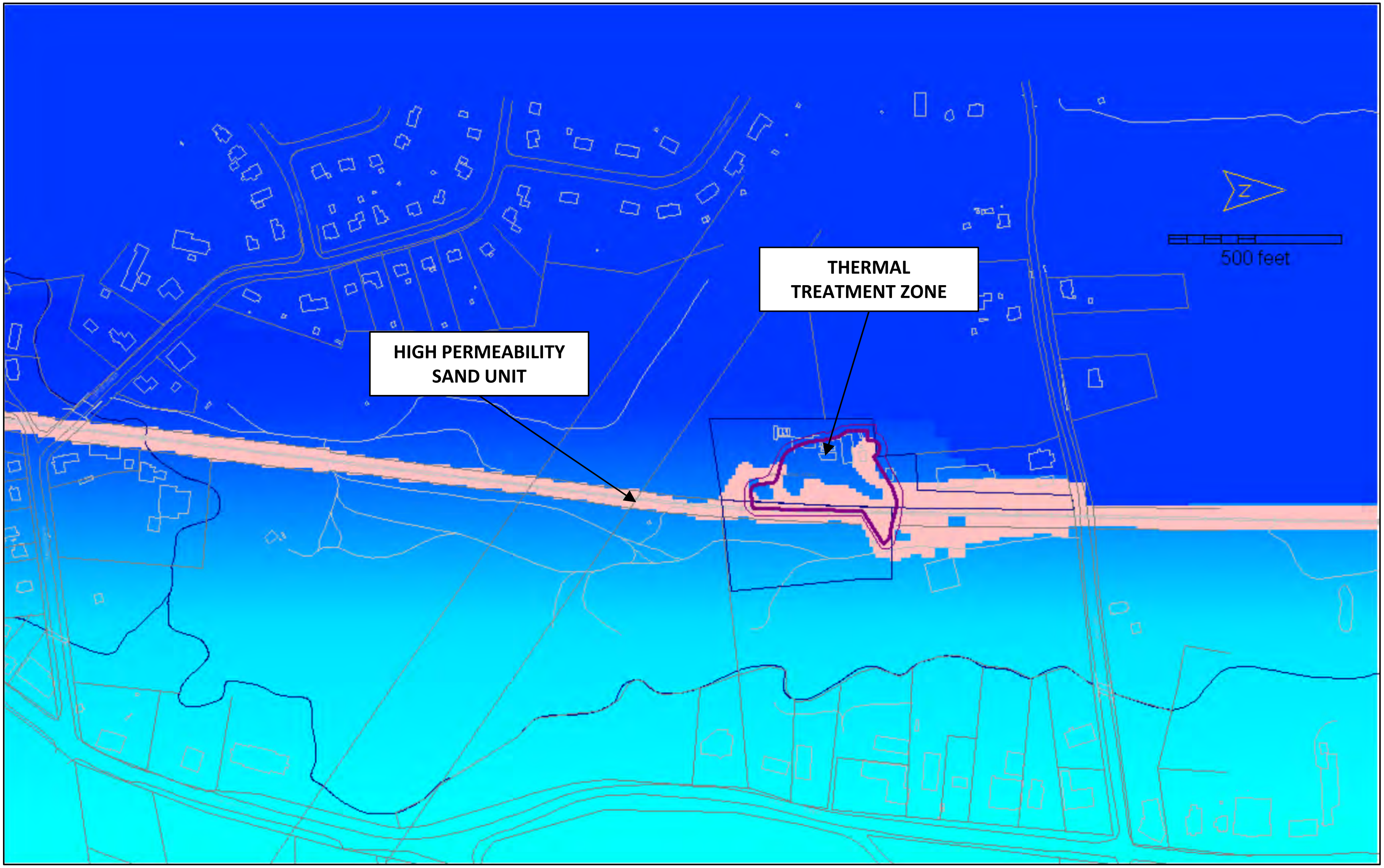
FIGURE 1



SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

LOCATION OF HIGH PERMEABILITY SAND UNIT WITHIN NATIVE OVERBURDEN

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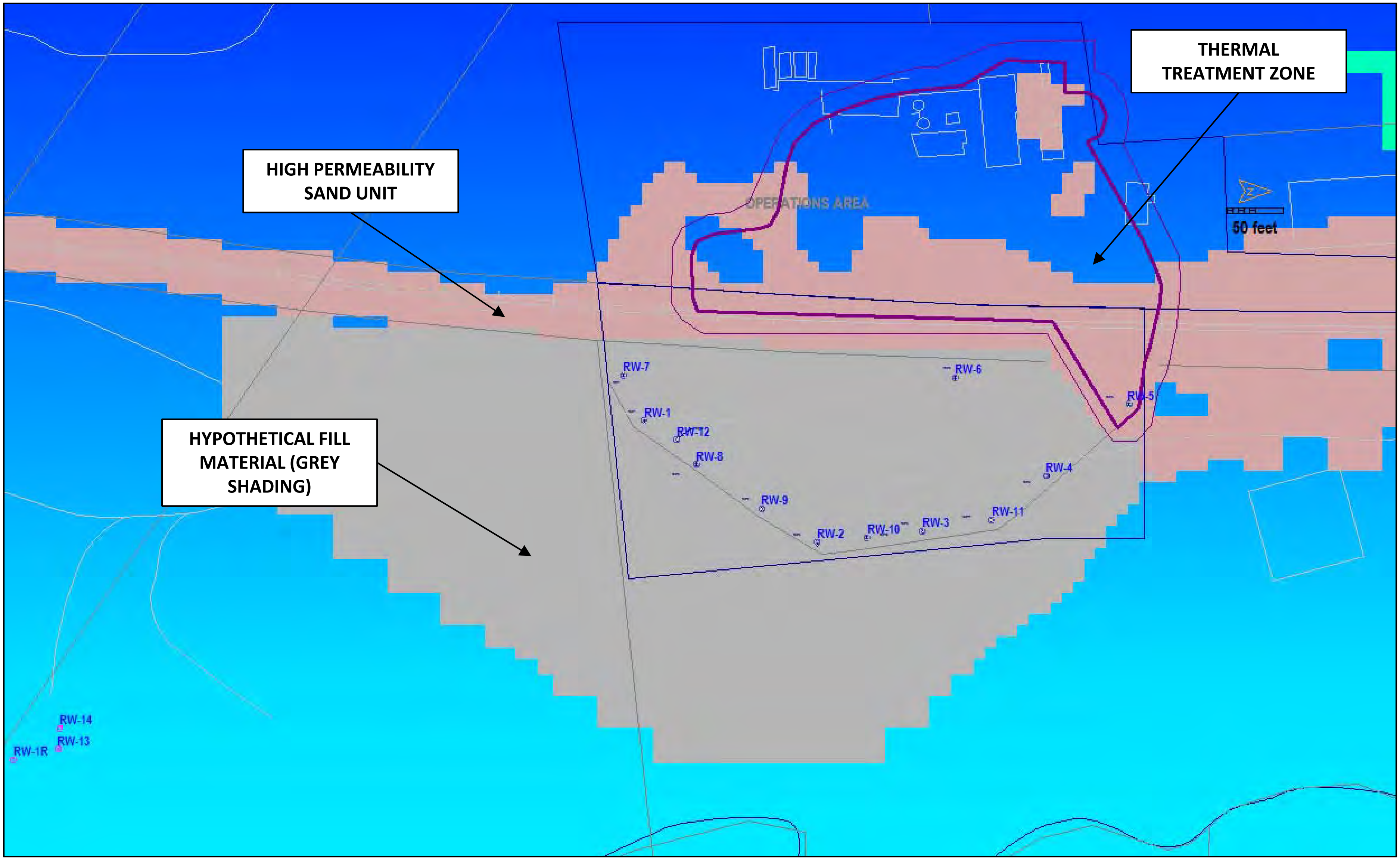
FIGURE 2



SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

LOCATION OF FILL MATERIAL IN HYPOTHETICAL MODEL LAYER 1

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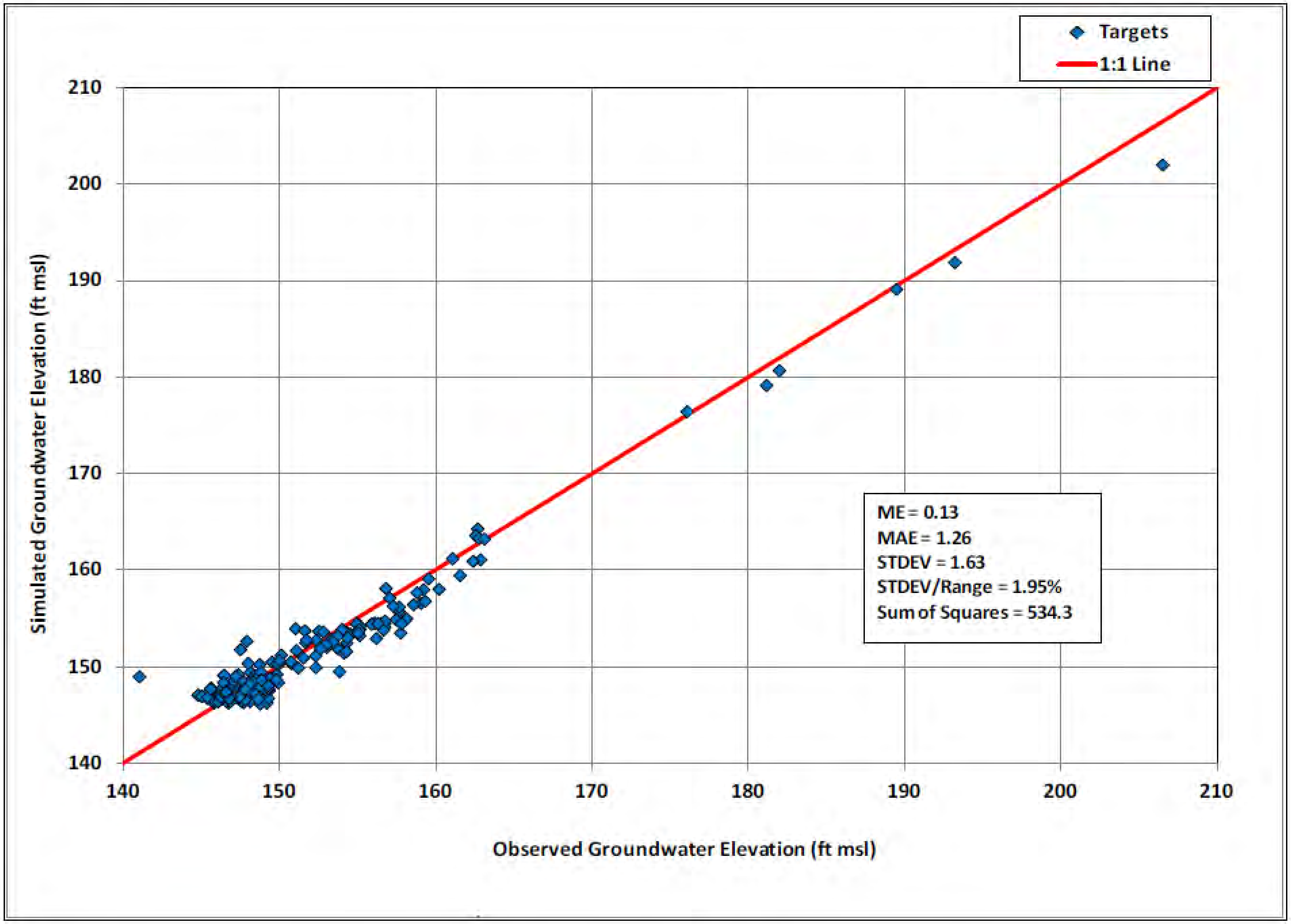
FIGURE 3



Notes:

1. Statistical parameters are a measure of the match between simulated and observed groundwater elevations.

   ME = mean error

   MAE = mean absolute error

   STDEV = standard deviation

   STDEV/Range = standard deviation normalized to the range of observed heads

   Sum of Squares = sum of the squared residuals

ft msl = feet above mean sea level

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EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

SIMULATED AND OBSERVED GROUNDWATER ELEVATION SCATTER PLOT – MODEL DOMAIN

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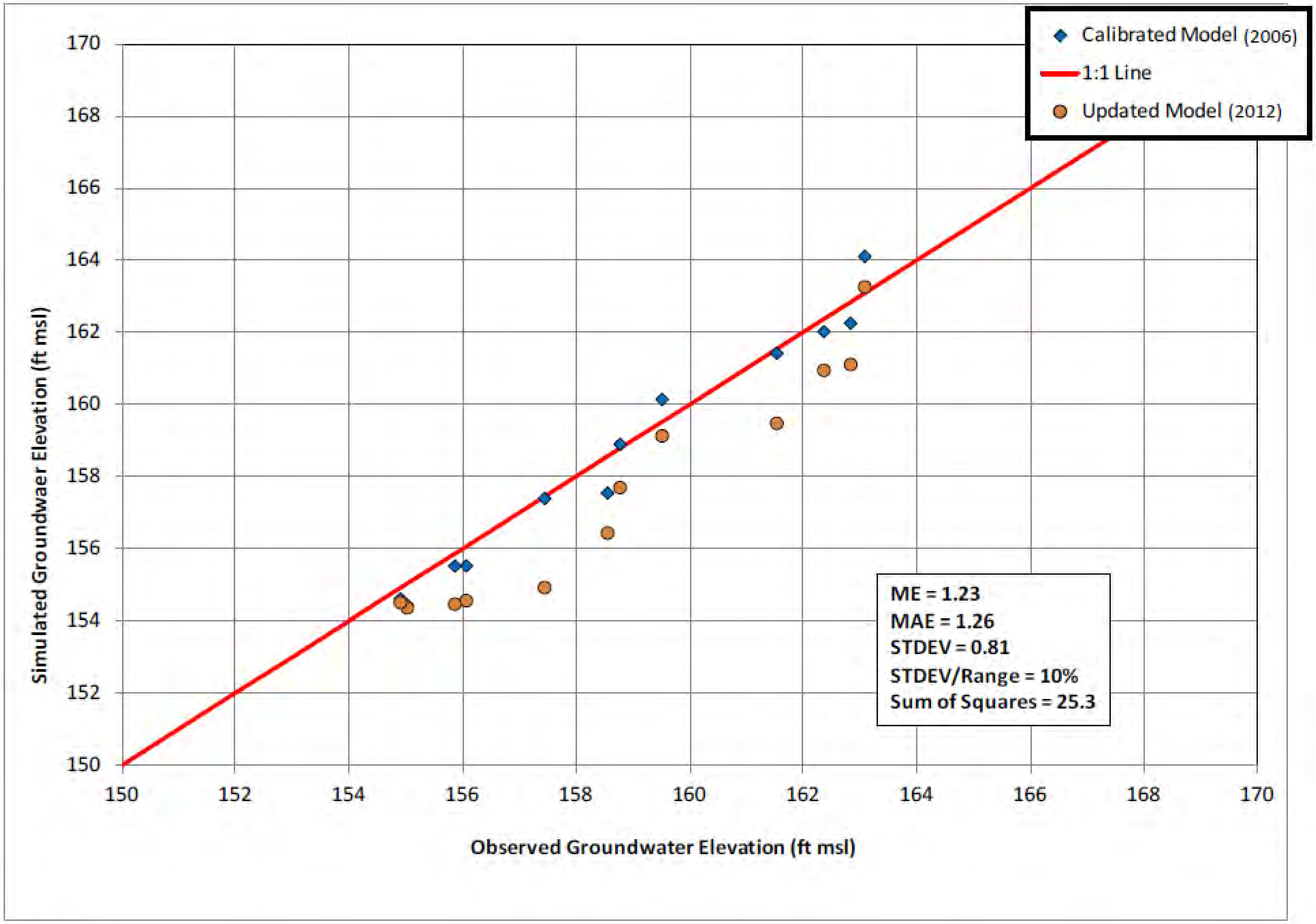
FIGURE
4



Notes:

1. Statistical parameters are a measure of the match between simulated and observed groundwater elevations.

   ME = mean error
   MAE = mean absolute error
   STDEV = standard deviation
   STDEV/Range = standard deviation normalized to the range of observed heads
   Sum of Squares = sum of the squared residuals

ft msl = feet above mean sea level

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EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

SIMULATED AND OBSERVED GROUNDWATER ELEVATION SCATTER PLOT – OVERBURDEN NAPL AREA

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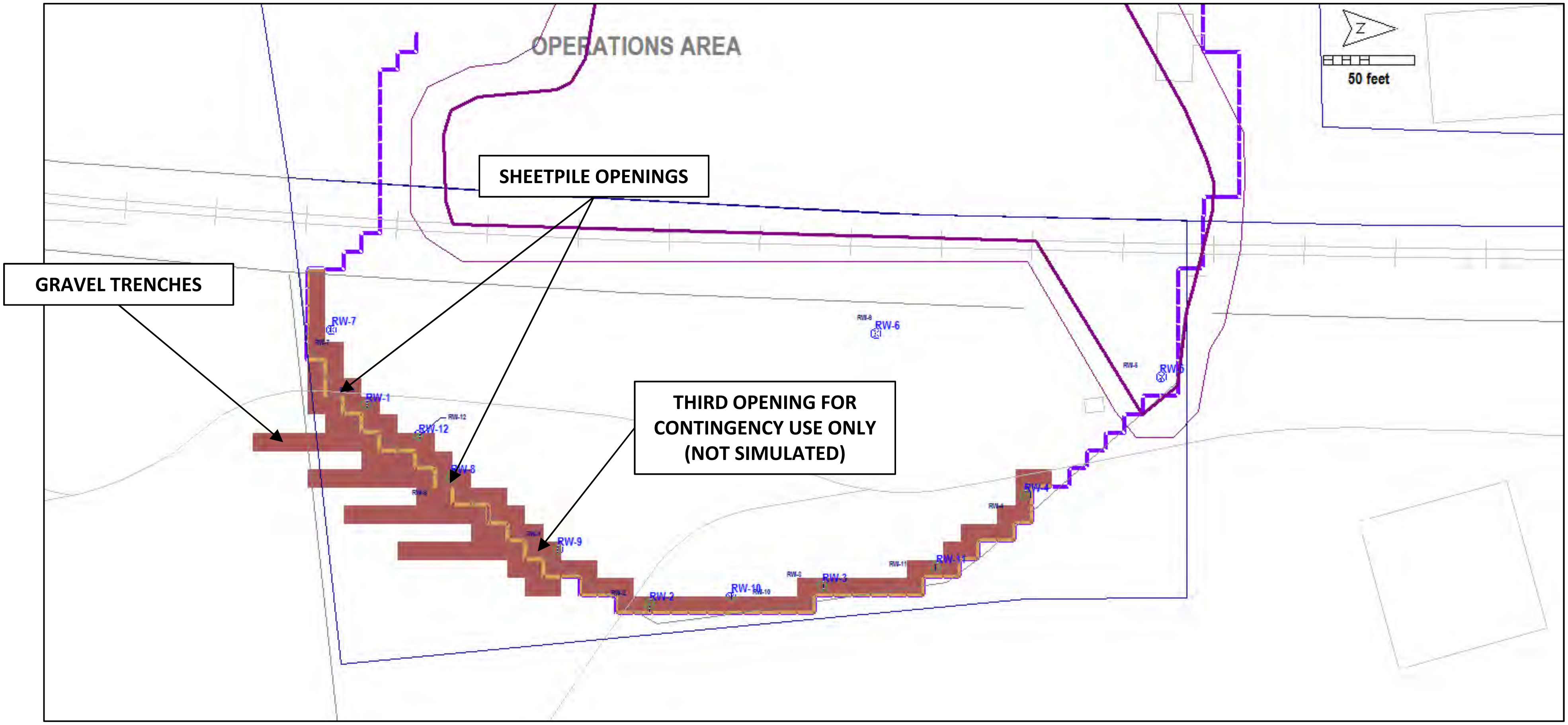
FIGURE
5



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EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

OPTIMIZED DESIGN FOR LONG-TERM GROUNDWATER MANAGEMENT AT NTCRA 1

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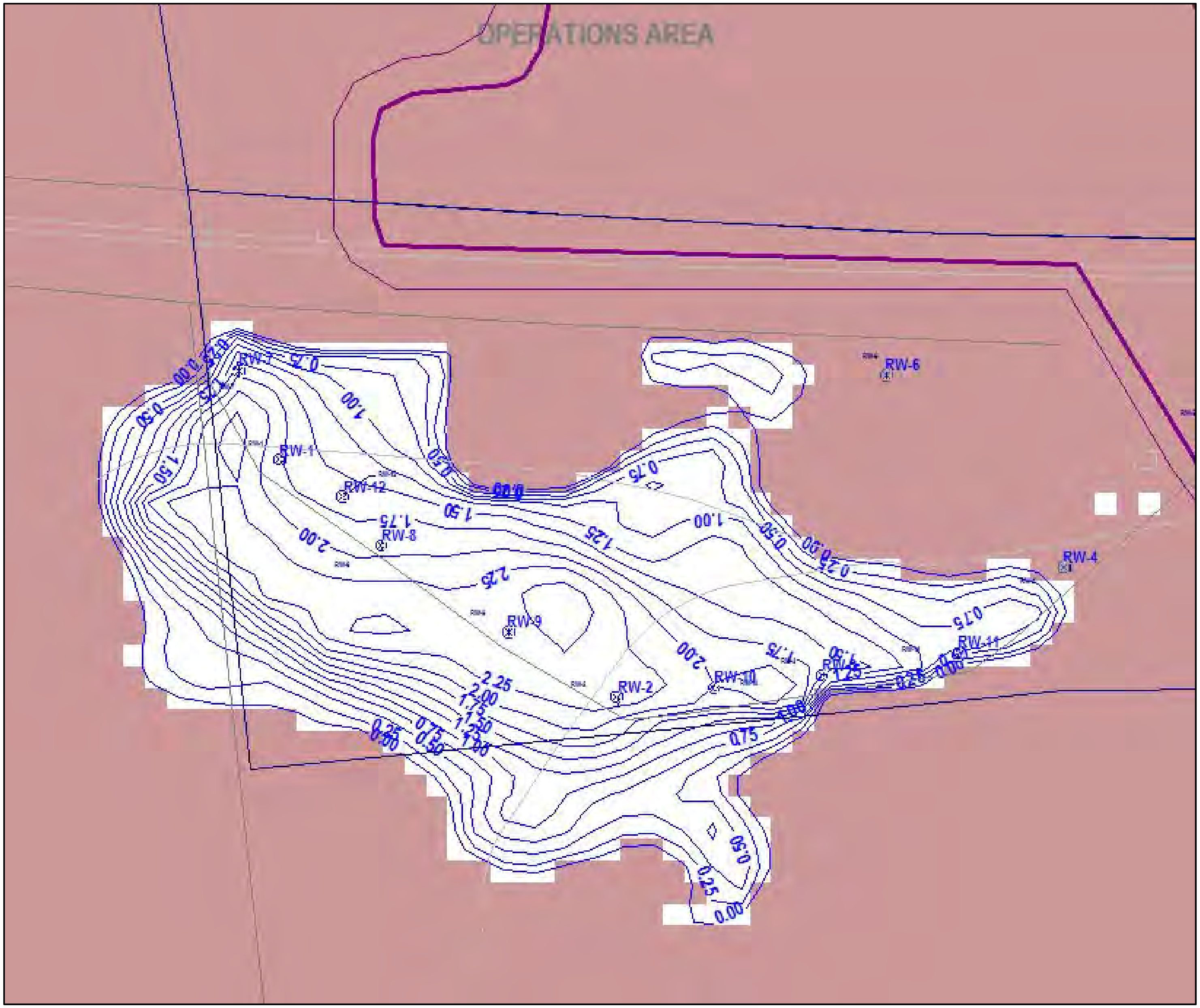
FIGURE 6



NOTES:

1. Brown shading represents unsaturated (dry) model grid cells.
2. Saturated thickness contour interval = 0.25 feet

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SOUTHINGTON, CONNECTICUT

EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

SATURATED THICKNESS OF FILL MATERIAL ABOVE EXISTING GRADE

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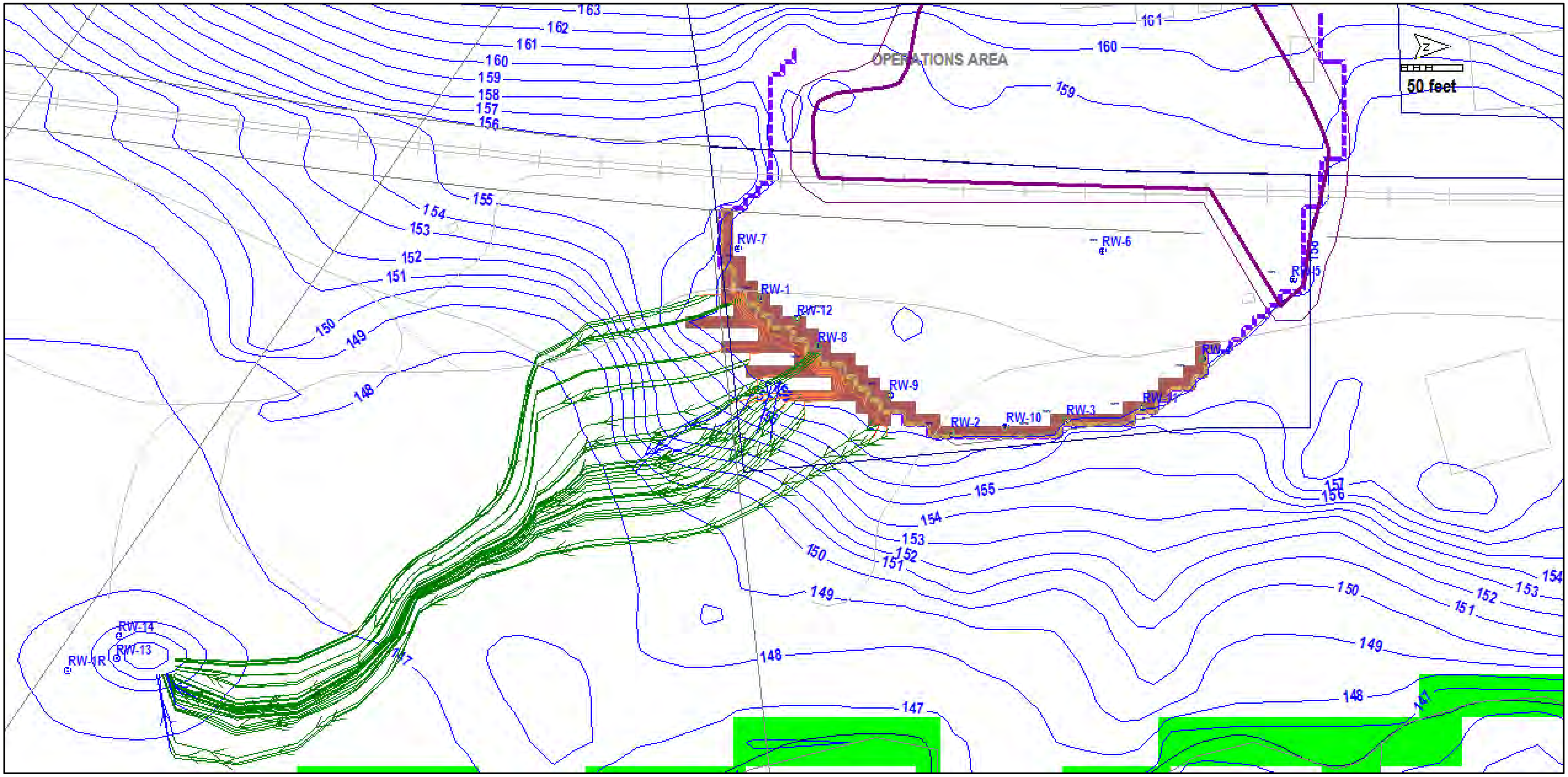
FIGURE
7



LEGEND

River

Gravel Trench

Horizontal Flow Barrier (Sheetpile)

Extraction Well

NOTES:

1. Orange pathlines represent groundwater flow paths within the upper four feet of native overburden (model layer 2); green and blue pathlines represent groundwater flow paths within deeper model layers of native overburden (model layers 3 and 4).
2. Simulated groundwater elevation contours are in feet above mean sea level.
3. Simulated groundwater elevation contour interval = 1 ft

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EVALUATION OF GROUNDWATER FLOW FROM THE NTCRA 1 AREA

SIMULATED GROUNDWATER ELEVATION CONTOURS AND FLOW PATHS FROM SHEETPILE OPENINGS

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FIGURE 8

ATTACHMENT 1

Agency Comments and SRSNE Site Group Responses regarding the July 2016 Draft 100% Design Report; Copy of USEPA Approval Letter

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September 28, 2016

Ms. Karen Lumino
Remedial Project Manager
USEPA Region 1
5 Post Office Square, Suite 100
Mailcode OSRR07-4
Boston, MA 02109

**Re: SRSNE Site – Responses to Comments –
100% Remedial Design Report – RCRA Cap**

Dear Ms. Lumino:

Pursuant to Section XI, paragraph 38 of the Consent Decree (CD) for the Remedial Design/Remedial Action at the Solvents Recovery Service of New England, Inc. Superfund Site entered on March 26, 2009 by the United States District Court for the District of Connecticut in connection with Civil Actions No. 3:08cv1509 (SRU) and No. 3:08cv1504 (WWE), enclosed please find responses to agency comments on the draft 100% Remedial Design (RD)Report addressing the RCRA cap and associated work for your review and comment.

Please contact me if you have any questions.

Sincerely,

Bruce Thompson
Project Coordinator

Enclosures – Responses to Comments on draft 100% Remedial Design Report

cc: Shannon Pociu, CTDEP
SRSNE Executive Committee
Jeffrey Holden, P.E., LEP, ARCADIS

CT DEEP comments on Draft RCRA Cap 100% Remedial Design of September 19, 2016

RCRA Cap 100% Design Report

1. p. 3, Section 1.2.2, Vapor Control System Evaluation. In the Response to Comments document, Arcadis responded to my comment #12 adequately but did not modify the text. I believe an additional bullet is needed in this section that summarizes their response to my comment and further explains why vapor control is unnecessary. The text states generally that methane build-up is not expected and that the ISTR removed DNAPL, but they don't say why vapor build-up is not expected and why the ISTR results are significant for supporting the position that vapor control is unnecessary. This can easily be addressed by summarizing the methane groundwater results from the ISTR and NTCRA 1 wells as was done in the Response to Comments document.

Response: Additional text will be added to this section of the text to reflect the evaluation that was provided with response to CT DEEP's comment #12 from the 65% Design Report.

2. p. 13, Section 3.9, Monitoring Well Modifications. In the last sentence of paragraph 1, reference should be to Design Drawing #11, not #10.

Response: Noted. The correct figure reference will be reflected in the final report.

RCRA Cap Construction RAWP

p. 14, Section 3.6, Equipment Cleaning. On line 4, a comma is needed between "…handling fill materials" and "after having handled impacted materials…".

Response: A comma is not intended at this location. The intent of the wording is that equipment will only be cleaned before handling fill material if that equipment has previously been used to handle impacted material. Equipment that has not handled impacted materials will not require cleaning before handling fill materials. The text will be revised to more clearly indicate that intent.

USEPA comments on Draft RCRA Cap 100% Remedial Design of September 9, 2016

1. Response to Draft 65% Comments, page 13/15, comment #19. This is acceptable as long as stockpiles of large trees don't become permanent features scattered about the site.

   Response: Noted, large tree stockpiles will not become permanent features.

2. Response to Draft 65% Comments, page 14/15, comment #26, and, new text in section 8.1.3, page 34. The new table and text just above it appear not to agree on the total loss of wetlands from C, D and H. is it 0.15 acres or 0.11 acres that will be

permanently lost? Also, revise table and last sentence in preceding paragraph to refer to either "net credit" or "loss" in place of "net credit and loss" which is somewhat confusing. And adjust table to either "Net Project Gain" or "Net Project Loss".

Response: The table and associated text will be modified to clarify the expected outcome, which is a net project wetland GAIN of 0.04 acres.

3. Page iv and 24. Add "Subtitle C" cap to the TOC and the Section 6 heading so that it now reads "RCRA Subtitle C Cap" in those two places.

   Response: The section title will be changed as indicated. The corresponding section title in the RAWP will also be modified per this comment.

USEPA comments on Draft RCRA Cap 100% Remedial Design of August 31, 2016
I have reviewed the referenced report. Overall, the proposed cap components appear to represent best practices for design of a final cover at the site. However, the Draft 100% Remedial Design should include **<u>all complete and accurate site-specific design calculations and analyses</u>** to demonstrate that the final cover design is practical and meets the long-term performance and design criteria. Below are preliminary review comments.

1. RCRA Cap Geocomposite Transmissivity Calculation in Appendix F (Engineering Calculations): The proposed geocomposite drainage layer design needs the following clarifications and modifications:

- What is the basis of the provided Giroud Equation used to calculate the minimum required transmissivity? How has the equation been derived? Can this equation be used for two different slopes?
- What is the basis of using 1.97 x 10^{-5} cm/sec? It is inconsistent with k = 3.7 x 10^{-4} cm/sec with HELP model input data. We recommend using the <u>long-term permeability</u> of 1 x 10^{-4} cm/sec for the top cover soil. The different surface cover permeability conditions in the solar system area need to be considered as well.

Additional related comments provided via email on September 19, 2016:

- The reference for the Giroud Equation is still <u>incorrect</u> (Typo?). Your reference might be other companion article in the special edition. Please re-check!
- The Region 1 has consistently used the "Unit gradient method" for the landfill applications (see attached file and also Region 1 Cap Guidance). Thus, your estimated impingement rate from the HELP model is <u>not recommended.</u> The EPA recommends the HELP model simulations be mainly used to estimate the annual average percolation through the proposed cap components for relative comparison (as a screening tool for hydraulic equivalency) of the proposed alternative caps (if any) with the EPA recommended cap.

Response 1: **The reference for the Giroud Equation is:**

Giroud, J.P., Zornberg, J.G, and Zhao, A., 2000, "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers," ***Geosynthetics International*****, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 285-380.**

The specific equation used is number 145 in that paper. The reference cited in the calculation sheet was to another Giroud et al document within the same ***Geosynthetics International*** **document entitled "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers Comprising Two Different Slopes." That document is intended for applications involving two different slopes, and also references the other document within which the equation was presented. The calculation sheet will be modified to explicitly cite both Giroud et al documents.**

Based on the USEPA's clarifying email of September 19, we understand that USEPA prefers the transmissivity calculation be based on the Unit Gradient Method rather than HELP model calculations. As a result, the calculation sheet will be revised to include the Unit Gradient calculation. This is expected to indicate a higher water transmissivity calculation that will need to be accommodated via the design and/or product selection for the GDC. The fact that the Unit Gradient Method will be used, and will reflect USEPA's suggested long-term cover soil permeability value of $1x10^{-4}$ cm/sec, also obviates the need for further justification of the permeability and impingement rates utilized in the HELP Model approach.

A separate calculation for the planned solar area is not needed. The stone cover thickness in the solar area is only six inches thick, and is more permeable than the underlying soil. Accordingly, the soil will govern the infiltration rate and, therefore, the required transmissivity of the GDC.

2. RCRA Cap Swale Collection Pipe Design in Appendix F: The design transmissivity of geocomposite should be modified as noted in Comment 1 above. The length of geocomposite (equal to 233 ft. total) that drains to the collection pipe needs to be increased considering the area of eastern slope downgradient of the collection pipe (see Cross section 1 on Design Drawing #7). The collection pipe will not run completely filled with water and over time some sedimentation may occur. Thus, the minimum pipe size needs to be greater than currently calculated. Please modify the design calculations of the selected size of the proposed 6 inch-diameter pipe. In addition, the selected pipe should have sufficient material strength so that it will not be crushed during the service life.

- Collection pipe specifications are not provided in the Technical Specifications.

Response 2: **The geocomposite transmissivity requirements will be modified to reflect the Unit Gradient Method calculations, as noted in the preceding comment.**

The location of the "worst case slope" was shown in Attachment 1 to the transmissivity calculation sheet included with the Draft 100% Design Report. It is comprised of 164 feet of slope at 4.25% and 69 feet of slope at 16.67%. This represents a total slope length of 233 feet. The calculation also included an appropriate factor of safety and the selected pipe diameter (nominal 6 inches) was larger than the required diameter based on the calculation sheet. Additionally, the pipe diameter specified in the design (8 inches, see Detail 2 in Design Drawing 8) was even larger than the design calculations require. Significant sedimentation in the collection pipe is not anticipated given that water entering the pipe will have been filtered through soil fill, the geotextile surrounding the geocomposite drainage net, the geotextile surrounding the pipe bedding material, and/or the pipe bedding material itself. That notwithstanding, the selected pipe size (8 inches) was larger than the required flow area required by over 75%, providing additional capacity even in the unlikely event of sediment accumulation.

Regardless of the prior pipe diameter calculation, new calculations will be completed to determine the required pipe size(s) needed to convey the anticipated flow rates. The revised calculations will be provided with the 100% design report.

The drainage pipe specified is N-12 HDPE pipe manufactured by ADS, Inc. that is rated for much higher loading than will be realized in this service application.

3. Swale Capacity and Erosion Resistance Calculations (Stormwater Management) in Appendix F: To properly evaluate the stormwater control systems, the following items need to be provided:

- Whole drainage areas of concern (beyond the cap area to the west, southwest, northwest, north, etc.) including flow directions, adequacy of the existing drainage detention basin (details on dimensions, cross sections, etc) and storm pipes, culverts, outlets, etc.
- Peak runoff flow rates (and volume) for both the pre-cap development and post-cap development conditions.
- Runoff Curve Numbers (CN) for the Solar Development Area and the Access Road: Please explain why the CN of the grass cover was considered instead of the gravel cover.

Response 3: **The whole watershed areas contributing to each of the cap design features is shown on the watershed area maps that are provided at the end of (and referenced within) the calculation sheet.**

A complete hydrologic and hydraulic analysis that evaluated the contributing off-site drainage areas of concern and peak runoff flow rates for pre-ISTR, ISTR and

post-cap development was prepared for the culvert relocation design included with the Pre-ISTR Design Report (Arcadis, March 2010).

The Runoff Curve Numbers for the Solar Development Area and Access Road, that includes a total area of 0.406 acres, are designated as gravel roads with a CN of 85 in the HydroCAD output included in Attachment B of the calculation sheet. Refer to weighted CN calculation for Subcatchment 3S – Central Swale.

4. HELP Model in Appendix F: HELP modeling is used to estimate the average annual percolation/leakage (or recharge rate for GW modeling) through cover system configuration. It also provides hydrologic cap efficiency (defined as the percentage of total precipitation that does not percolate through the cover system). Please provide all HELP model output files showing simulated monthly precipitation data, average monthly and annual total percolation and cap efficiency, etc. We recommend using the permeability of 1×10^{-4} cm/sec for Layer 1. Also, run HELP model in the NTCRA 1 Area (Grade Modifications) to obtain the reasonable recharge rate for GW Modeling.

Response 4: **This comment is no longer pertinent because the transmissivity calculation will be based on USEPA's preferred Unit Gradient Method rather than HELP Model and Giroud equation, as indicated in the response to Comment #1 above.**

5. Chain-link Fence Supported by Shallow Foundation – Structural Analysis in Appendix F: We recommend using the design wind load based on ASCE 7 -10 wind load standards. Since the concrete footer (see Design Drawing 16) is located near the slope, the bearing capacity analysis on slope needs to be provided. Please specify the pole diameter and height (6 ft. or 7 ft). Is the proposed depth of the concrete pier footings sufficient enough to resist the risk of frost heave damage?
Additional related information provided on September 21, 2016 conference call: USEPA would prefer larger and deeper concrete fence supports within the cap area to further protect against frost heave, and that the concrete supports be moved further from the adjacent slope to further enhance lateral stability.

Response 5: **Our wind load calculations reflect the current (2013) Connecticut State Building Code which is based on the adopted 2009 International Building Code (IBC) with amendments which references ASCE 7-05. The state is planning to adopt a 2016 State Building Code on October 1, 2016 which will be based on the 2012 IBC and references ASCE 7-10. ASCE 7-10 is based on ultimate wind speeds of 125 mph by risk category II, but the 2016 CT Building Code is amended to allow nominal wind speeds of 93 mph for Risk Category II per Appendix N. Our calculations (based on ASCE 7-05) are based on a nominal basic wind speeds of 100 mph which is higher than required by the 2016 CT building code. We also note that if the ultimate wind speeds are used per ASCE 7-10 that it will result in a slightly lower wind pressure requirement than the ASCE 7-05 nominal wind speeds when the applicable wind load factors of 0.6 are applied. Accordingly, we**

believe that the ASCE 7-05-based calculations are more conservative than would be developed using the ASCE 7-05 requirements, and are suitable for this application.

A slope bearing analysis is not warranted because the slope is very minor and the footing loads are very low.

Post heights are 6' above grade as indicated on Design Drawing 25. Diameters vary from 2.375" to 2.875" depending on the function (see Technical Specification 32 31 00). The engineering calculation sheet assumed a 7' fence height, which is conservative and overestimates both the vertical and wind loads applied to the footers.

Significant frost heave damage to fence footers is not anticipated because the cap materials are adequately drained and therefore not susceptible to frost heave. The above notwithstanding, it was agreed on the September 21, 2016 conference call that concrete footer heights would be extended to 36 inches, and that the locations of the fence posts would be offset from the center of the footer so that the footer could be moved closer to the trail (i.e., further from the slope) without affecting the location of the fence relative to the trail. This will be reflected in the final design drawings.

6. Geomembrane Stress Analysis in Appendix F: We are not very concerned about the strength or stress failure of the geomembrane. Rather, it is important to note that **construction equipment traffic during the construction phase including solar system installation** can damage the integrity of the geomembrane cap leading to leakage over time. Equipment operation should not stress, deform or damage the geomembrane during installation and over the service life (no increase in the geomembrane permeability). If the geomembrane permeability is increased over time, more infiltration of the water will occur (more leachate generation). We recommend the following - Equipment for Operating above Geomembrane, Geotextile, Geosynthetic Clay Liner and Geocomposite Drainage Net:

- Track-mounted equipment with low ground pressure tracks, having a ground pressure of 5 pounds per square inch (psi) or less, should be used to spread materials over the geomembrane. In no circumstance tracked equipment should be allowed to operate on less than 12 inches of cover over the geosynthetic products
- For practical construction and CQA purposes, please study the following recommended article (see **Attachment 1**): The Ongoing Quality Issue regarding Polyethylene Geomembrane Material Manufacturing & Installation by Erickson et al., 2008; http://www.ausenco.com/uploads/papers/64169_Ongoing_quality_issues_regarding_polyethylene_geomembrane_material_manufacture.pdf

In Calculation Sheet, the equation provided for estimating allowable normal stress on geomembrane is unclear in lieu of the equation itself, M value, geomembrane type (LLDPE vs. HDPE), etc. Please provide detailed information on equation derivation. What is the basis of using M = 16 oz/yd^2 and what is the purpose of this geotextile for the project?

Additional related comments provided on September 21, 2016 conference call: USEPA prefers that the allowable stress calculation be performed using an alternative equation, which was provided in a technical paper provided by USEPA on September 19, 2016.

Response 6: **The first part of this comment is unclear because Technical Specification 31 05 19.16 DOES SPECIFY a maximum vehicle loading of 5 psi and a minimum initial lift thickness of 12 inches. No change to the design is needed based on this comment.**

As specified in the design documents and the calculation sheet, the geomembrane is 60 mil textured LLDPE (see also response to comment 7 below). The calculation formulae are available from GSE Lining technology, Inc. via the reference provided in the calculation sheet; please consult the referenced cited for derivation of the formulae.

The calculations used to determine the allowable stress on a geomembrane are based on the failure pressure of HDPE geomembrane in the Truncated Cone Puncture Test (ASTM D 5514) which is related to the cone height H (mm) and the mass per unit area of a nonwoven needle punched protection geotextile - M (oz/yd^2). The design method was developed primarily for smooth HDPE geomembranes. However, the use of the method for LLDPE geomembranes results in conservative design recommendations since HDPE geomembranes fail at significantly lower pressures than LLDPE geomembranes.

The LLDPE geomembrane for this project will be underlain by a geosynthetic clay layer which consists of a layer of bentonite clay with a mass per unit area of approximately 100 oz/yd^2 between two non-woven geotextiles with a mass per unit area of 6 oz/yd^2. A non-woven geotextile with a mass per unit area of 16 oz/yd^2 was used in the calculations because it is typically used for a geomembrane protection layer and assumed to be a conservative approximation of the combined protective properties of the geosynthetic clay layer.
The geomembrane stress analysis calculation was performed using the alternative equation suggested by USEPA (Koerner 2008); this approach yielded a factor of safety of over 100. The additional calculation will be included with the finalized document.

7. Page 26 Section 6.4 Cap Components 2nd Bullet Point 60 mil LLDPE Geomembrane in the Report: What type of LLDPE geomembrane is proposed, smooth or textured or both?

Response 7: **The intended product is <u>textured</u> 60 mil LLDPE. The correct material is called out on the Design Drawings. The text reference will be corrected in the final document.**

8. Technical Specifications Section 31 05 19.16 Geomembranes for Earthwork Section 2.1.A.1 Density and Break Resistance Strain: These specification limits are incorrect. Please correct them.

Additional related comments provided on September 21, 2016 conference call: The density value is not incorrect… the issue is that it is represented as a "minimum" value and should be a "maximum" value.

Response 8: **The values provided for these properties are correct based on the latest version of GRI GM17 (11/4/15), with the exception that the density value has been rounded from 0.939 g/ml to 0.940 g/cc. The specification will be modified to note this as a maximum value.**

9. Technical Specifications Section 31 05 19 23 Geosynthetic Clay Liner (GCL) Section 3.2.H. Overlap Length: It is unclear how the overlap length is determined "after shrinkage and before placing cover." We recommend a minimum overlap of 12 inches on edge seams and of 24 inches on end seams. We also recommend <u>placing minimum 6" thick clean fill materials below the GCL</u> to establish a good subgrade above the consolidated waste.

- Section 3.1.A.2: It is stated that "the prepared soil surface shall have 'no stones or other protrusions' that may be damaging to the GCL as determined by the Construction Manager." It is unclear how all protrusions shall be handled to provide an acceptable surface.
- Section 3.2.E: Do you intend to deploy the GCL and overlying geomembrane on the same day to avoid exposure of GCL to precipitation as stated?

Response 9: **"After shrinkage and before placing cover" means the minimum specified overlaps must exist after the GCL is placed and temperature equilibrated (as needed), and before any overlying cover materials are placed. Minimum overlaps of 6 inches on the edges and 24 inches on the ends are consistent with manufacturer recommendations and ASTM D6102–15 - Standard Guide for Installation of Geosynthetic Clay Liners. The required end overlap will be modified to be a minimum of 24 inches.**

The design calls for the placement of a 6-inch layer of soil containing no material greater than ½-inch in dimension (Technical Specification 31 23 05 Part 3.8D); we

intend this to be achieved by sizing of the site soils to be placed under the cap (rather than by importing offsite materials at added expense and sacrifice of available capacity). The design also calls for a review of the prepared subgrade prior to installation, with acceptance and certification by the Construction Manager and the Contractor's QA inspector. This will be accomplished through the use of IQAT personnel and field reconnaissance.

The Contractor will be required to take measures to prevent wetting and hydration of the GCL, including timely placement of overlying geomembrane, or other temporary cover, to prevent wetting, as needed based on field conditions and weather forecast.

10. Technical Specifications Section 31 23 05 Excavation and Fill Section 2.1. F & G:
What is the basis of using D_{17} to select the fill materials for the NTCRA 1 area?

- Table 31 23 05 Required Minimum Density for On-site Excavated Materials Consolidated Below RCRA Cap: The Percent Compaction (ASTM 1557) required is 90 %. Do you propose Modified Proctor tests for these materials?

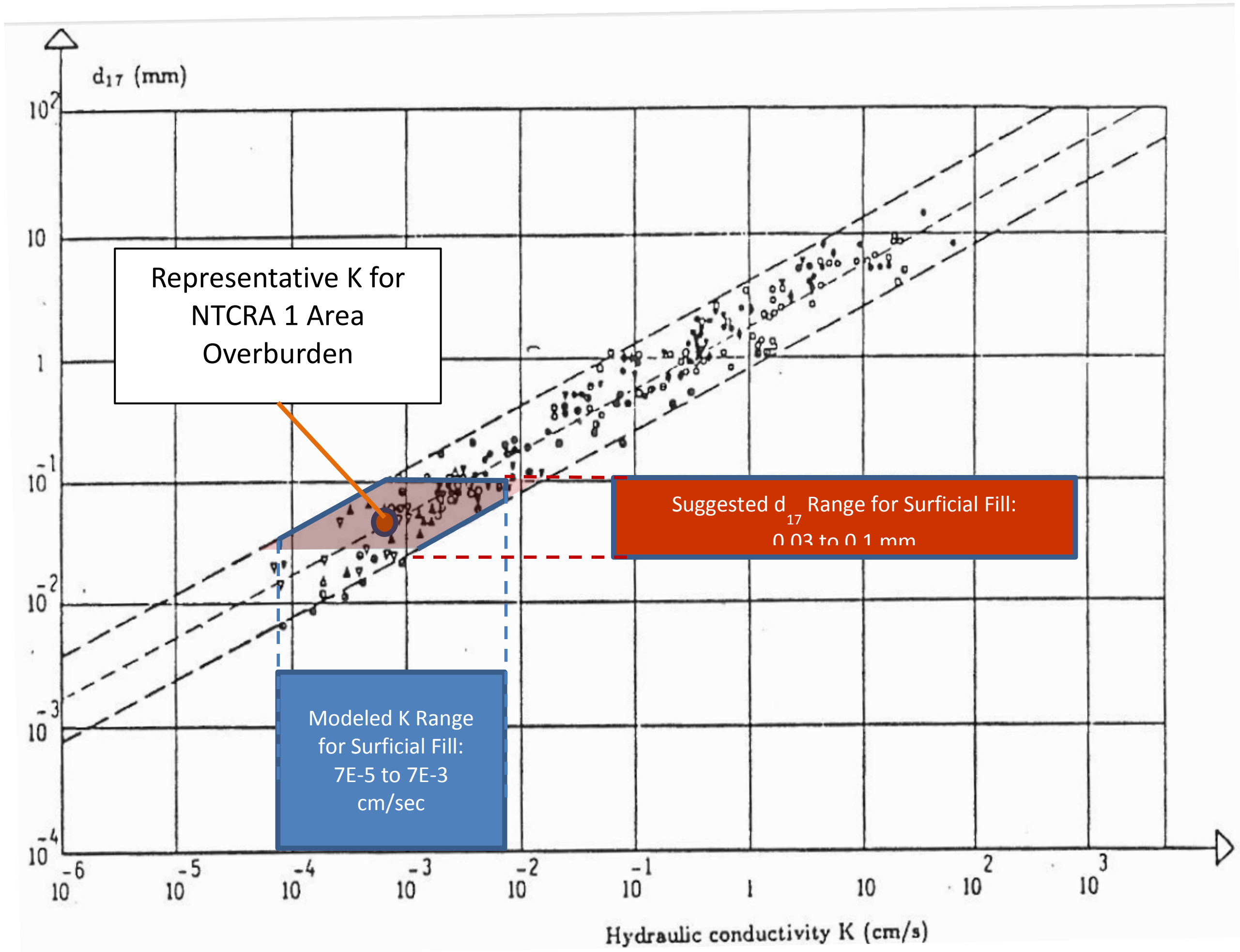
Additional related comments provided on September 21, 2016 conference call:

- The sieve size requirements specified for the NTCRA 1 fill material are not an appropriate specification.
- What is the rationale for providing liquid limit and plasticity index value requirements for the general fill material (Specification 31 23 05 Section 2.1.B)?

Additional USEPA input provided on a telephone call September 28, 2016:

- USEPA believes the NTCRA 1 General Fill material specification is inappropriate and should be struck. Defer instead to the General Fill specification in Specification 31 23 05 Part 2.1.B.

Response 10: **The intent of the NTCRA 1 General Fill material specification was to provide a fill material with comparable characteristics (e.g., permeability and grain size) to the native soils in the NTCRA 1 area. The d_{17} specification was obtained using the Pavchich Method (Vukovic, M., and Soro, A. 1992. Determination of Hydraulic Conductivity of Porous Media from Grain-Size Composition. Water Resources Publications, Littleton, Colorado), which empirically predicts the relationship between hydraulic conductivity and the d_{17} grain size for a soil material. A copy of the pertinent graphic is provided below and supports the target grain size utilized in the specification. Since the permeability of the fill material is the primary target characteristic, other engineering properties are not necessary for specifying the fill material type. A d_{17} size in the specified range can be determined using sieve analysis or a combination of sieve and hydrometer analysis.**



Regardless of the above, the NTCRA 1 General Fill Material specification will be withdrawn and refer to the General Fill material specification in Specification 31 23 05, part 2.1.B.

The liquid limit and plasticity index requirements for the general fill were not necessary and will be struck from the final version of the document.

Yes, the Contractor will be required to provide Modified Proctor testing to demonstrate compliance with the compaction requirements specified in 31 23 05.

We note, however, that certain modifications were made to similar compaction requirements during the course of the pre-ISTR site preparation project:

- **Onsite fill material sources originally had a compaction requirement of 95% Modified Proctor density. Due to heterogeneity of the various onsite soils, this requirement could not be consistently applied or met. The requirements were modified in response to the Contractor's Request for**

Information (RFI) #9 (see Section 3.6) to be a minimum of five passes with a vibratory roller for on-site fill sources.

- **For General Fill from an offsite source, the compaction requirement was modified in response to RFI #16 to be based on Standard Proctor test values rather than Modified Proctor. A minimum compaction of 90% (Standard Proctor) was determined to be acceptable for General Fill for non-loaded areas (i.e., outside roadways). The minimum compaction for General Fill required for loaded areas remained at 95% (based on Standard Proctor).**

To the extent that material heterogeneity or other factors preclude achievement of the target compaction requirements, modifications may be implemented based on field coordination during the course of this project. For example, Standard Proctor testing (ASTM D698) at a percent compaction of 95% may be acceptable if the Modified Proctor density is found to be difficult to attain during field density testing of fill materials.

11. Long-term Groundwater/leachate Monitoring: In general closure requirements mandate that upper aquifer beneath the capped (and contaminated) area or landfill be monitored to determine if it is causing degradation of groundwater quality. We recommend that groundwater monitoring wells be place both up- and down-gradient from the capped area and be located within the cap footprint if feasible. Before the cover is constructed, all existing monitoring wells should be evaluated to see if they would be useful for the long-term monitoring. The groundwater quality and elevation should be determined during sampling and changes in groundwater flow conditions evaluated. In addition, please provide the groundwater monitoring programs for the HCTS Modification Design to verify its effectiveness.

Response 11: **Section IV.A.1 (page 6) of the SOW states "Because waste is left in place, the point of compliance for groundwater is to the edge of the waste management unit." Groundwater cleanup levels do not apply under the cap. There is no need to monitor groundwater quality in the area beneath the cap, as we already know there was NAPL in that area of bedrock. The overlying overburden is orders of magnitude less contaminated post-ISTR. We already have monitoring wells up- and down-gradient of the cap, and an approved long-term monitoring program that includes evaluation of groundwater quality and elevations. The ISTR and TW-08 wells proposed for abandonment are within the capped area, where they would interfere with cap construction, and where groundwater cleanup levels do not apply, and therefore monitoring is not needed. Also, the cap is a component of the soil remedy and intended to prevent exposure to residual contaminants in surficial soils that were not remediated by ISTR (metals, PCBs, etc.). The cap is not a component of the groundwater remedy, which includes hydraulic containment and monitored natural attenuation. Groundwater monitoring downgradient of the HCTS to be performed**

once NTCRA 1 pumping ceases, will be presented in the "Optimization Report," a separate submittal.

12. Landfill Cover Conditions (settlement, slope stability, runoff controls, access roads, mowing, etc) and solar system impacts on the cover need to be inspected and maintained.

Response 12: **Acknowledged. These requirements are intended to be addressed in the Operation and Maintenance Plan, as discussed in Section 9 of the 100% Design Report.**

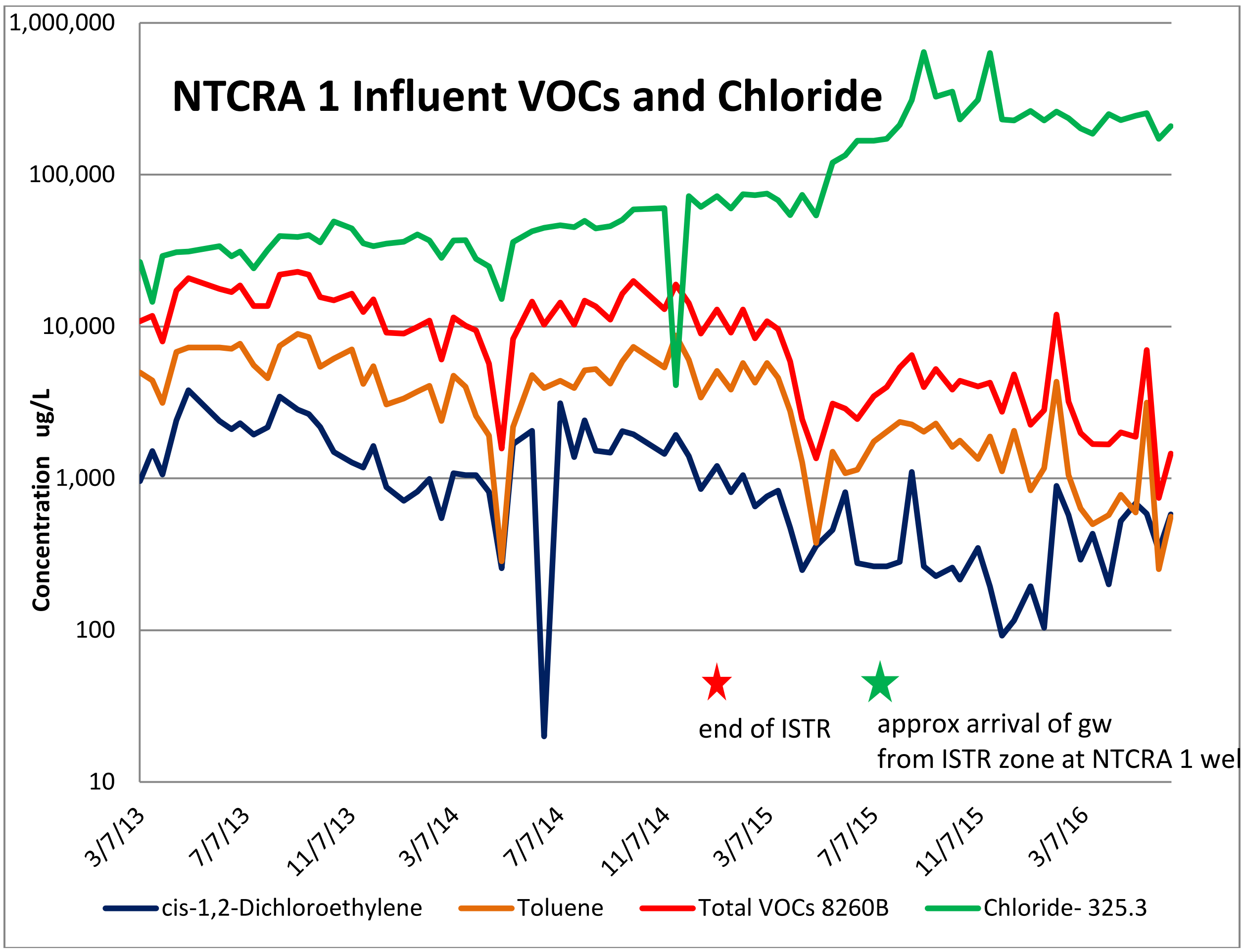
13. Evaluation of Groundwater Flow From NTCRA 1 Area: After reviewing the memo from July 14, 2016 (Appendix G), there isn't sufficient information to check the adequacy of flow model and subsequent subsurface drainage design because the GW flow governing equation and the output listing and input data set are not provided (see **Attachment 2**).

As a note, the vertical sheet pile barrier walls appear leaky because the joints between the steel sheet piles were not sealed and the bottom of the vertical walls has been placed on top of the fractured bedrock. According to the 2016 Annual Compliance Report, fewer than 12 extraction wells are currently operating and are not efficient to function as a hydraulic containment. As shown on Shallow Bedrock Hydraulic Head Contours Map in the report, the groundwater flow directions were not reversed under the steel sheet pile walls. It is also noted that French drains will experience physical, biological and chemical clogging problems of the geotextile over time, resulting in zero water flow into the trench and through a few small holes in the steel sheet pile walls. Thus, the proposed drainage trench is not likely to function as proposed for the long-term (or under the steady-state conditions).

Response 13: **With the completion of ISTR, groundwater concentrations in the NTCRA 1 area have declined by approximately an order of magnitude in the past two years, and continue to decline (see chart below). NTCRA 1 has served its purpose, and through the Optimization Study Report, we expect to propose to shut it down. The "groundwater flow governing equation" is part of the model code (USGS's MODFLOW, which is widely considered the "industry-standard" 3-D, numerical groundwater flow model). The underlying governing equation and model code represent the state-of-the-practice tool for this type of application. Accordingly, evaluation of the underlying functionality of the model does not seem warranted for this application. Note also that the model has been calibrated based on numerous years of data collection, and has repeatedly been demonstrated as a highly functional predictive tool.**

The leakiness (or lack thereof) of the sheet pile wall is irrelevant to this review. However, during NTCRA 1 startup we found that the head difference across the sheet pile wall was greater than the head difference predicted during NTCRA 1

design, suggesting that the sheet pile wall is less permeable than assumed during NTCRA 1 design (i.e., <1x10^{-6} cm/sec). The NTCRA 1 demonstration of compliance requirements apply to overburden, not bedrock, so there is no need to demonstrate a reversal of gradient in bedrock for the NTCRA 1 area. A French drain has been part of the NTCRA 1 pumping system since approximately 1998, and has had no clogging issues. The proposed drain system will be maintained as part of the O&M responsibility for the SRSNE Site Group. The anticipated groundwater flow rates are small considering the large extent and surface area of the proposed drain system. Thus, the potential of clogging issues is remote, and is not a reason to preclude installation of the proposed sheet pile wall penetrations and drain system.



14. Design Drawing (DD) #2 and DD #8: Please describe/provide the existing riprapped detention or sediment basin in detail (type and size of the basin or pipe used for storm water control). And please also provide the details of the existing storm manhole on DD #8 (see Detail 3).

Response 14: **We assume this reference to the riprapped area pertains to the existing swale north of the proposed cap area. This feature was installed during the pre-ISTR site preparation phase of the project, and the as-built information is provided in a document entitled "Pre-ISTR Site Preparation Completion Report" (submitted to the USEPA in April 2013).**

The cross section detail for the referenced catch basin (Storm Manhole) is provided on Section A-A' on Drawing 8. This catch basin was designed and installed as part of the pre-ISTR site preparation, and was based on Connecticut DOT Type C-L catch basin design.

15. DD #3 Soil Borrow Area: Have the borrow source materials (volume of ~830 CY) been classified/tested for suitable use as a general fill? Do you have any slope protection measures against 100-yr flood events for finished slopes in the borrow excavation area? In addition, please provide <u>total volume estimates of the imported borrow materials</u> for the project in the report.

Response 15: **The borrow source soils have not been specifically tested, but are known to be consistent with the soil types present within the remainder of the site. The design intent is to place soil fill materials in the NTCRA 1 area (where this borrow material will be placed) that are consistent with the existing soils in that area so that the fill zone has hydrogeologic properties reasonably similar to the existing native soils in the area. Using existing site borrow materials is ideal for this purpose.**

The excavation borrow area will be restored with native vegetation per the restoration plans provided on Design Drawings 13 and 14. This is consistent with the requirements in Section IV.B.4 of the SOW, and with prior wetland mitigation work performed in this area.
Estimated fill volumes are summarized as follows:

Imported Fill Type	Estimated Volume (CY)
Select Fill	225
General Fill	14,600
Stone Screenings	100
Aggregate Base	1,000
Topsoil (min 5% organic)	2,350
Topsoil (min 10% organic)	6,800
Filter Stone	400
NTCRA 1 General Fill	4,400
NTCRA 1 Trench Fill	580
Solar Panel Stone	325

Actual quantity requirements will vary based on various factors, including field conditions, Contractor's use of temporary access roads, whether additional excavation is required in areas where post-excavation confirmation sampling, etc.

16. DD #5: It is unclear how the collection pipe along the northern perimeter of the cap is connected to existing manhole. Please provide the detail and explain how the water from the drainage layer is discharged between the existing manhole and the riprapped basin.

Response 16: **Perimeter collection pipe connections to the manholes will be made with a non-shrink grout, consistent with what is shown for larger pipes on Details 3 and 8 on Drawing 26. Water from the drainage layer is conveyed from the northern manhole to the rip-rapped swale via an existing 24-inch corrugated metal pipe, which is shown on Design Drawing 2.**

17. DD #7: What is the maximum size of debris consolidated beneath the cap in Note 1?

Response 17: **In general, material consolidated beneath the cap is to be sized to less than 6 inches in largest dimension (Note 8 on Drawing 4). Material within 6 inches of the geosynthetics layer shall be no greater than ½ inch in largest dimension (Technical Specification 31 23 05 Part 3.8D). Note 1 on Drawing 7 refers to existing debris piles to be consolidated beneath the cap. These piles contain material that is greater than 6-inches in largest dimension (up to approximately 12 inches in size). This material may be placed at the toe of the existing slope (as indicated on cross section 1 on Drawing 7), where at least 2 feet of separation will exist between the oversized fill and the geosynthetics. If not re-sized to a maximum dimension of 6 inches, the Contractor will be required to place and compact such materials in a manner that eliminates the potential for excess void spaces within the consolidated debris.**

18. DD #10 Note 6: It is stated that groundwater elevation contours were based on June 2014 comprehensive water level measurement event. They appear incomplete adjacent to the steel sheet pile walls and inconsistent with the actual groundwater elevation data. Please provide all the monitoring well information (locations and groundwater levels measured and used for the groundwater contour map) including extraction wells. Since groundwater levels can change with time, we recommend using the recent monitoring data (last 12 months or after ISTR) to reflect current field conditions for proper subsurface drainage design.

- It is unclear if the 100-yr flood area is reduced by the NTCRA 1 Area Grade Modifications. Please provide the 100-year flood boundary in that area to verify changes.

Response 18: **It is not clear why the contours are called "incomplete adjacent to the steel sheet pile wall". The contours are truncated at the sheet pile wall**

because the wall is a hydraulic discontinuity. The groundwater elevations on one side of the wall differ from those on the other side of the wall, so the contours do not extend through the wall. We have been monitoring groundwater elevations, including seasonal changes, in the NTCRA 1 area since 1994. Details of hydraulic heads in the NTCRA 1 area have been presented in the RI Report and numerous monthly and annual NTCRA 1 compliance reports. The groundwater contours were added to this drawing at USEPA's request, and represent the latest set of comprehensive water-level data available for the area; it is not possible to represent all conditions and variability on a design drawing.

The 100-year flood boundary is shown and labelled on Drawings 2 and 10. Drawing 10 shows the 100-year flood elevation as intersecting the NTCRA 1 fill area. As discussed in Section 8.2.4 of the 100% Design Report, the estimated flood storage impact from the NTCRA 1 fill area is approximately 400 CY, and is offset by a net flood storage capacity increase of approximately 460 CY in the borrow area.

19. DD # 11: Provide the detailed cross sections perpendicular to the current profiles: 1) at the Valve Service Box, and 2) at the Distribution Trench. The cross sections should show all Collection/Distribution Pipe Trenches including Sheet Pile Wall and Lateral Distribution Trench, and Groundwater Conditions (levels). The bottom elevation of the Valve Service (6" Gate Valve) appears inconsistent with that in DD #12 (see Details 3 and 6).

Response 19: **Cross sections at the valve service box are provided on Detail 3 on Drawing 12 and cross sections at the distribution trench are provided on Detail 6 of Drawing 12. Additional details are not considered necessary for construction purposes. Note that Drawing 11 was revised and reissued to bidders to address discrepancies between Drawings 10 and 11 (generally associated with the southern starting point for the collection piping), but there is no discrepancy with Drawing 12 because the details in Drawing 12 do not specify pipe invert elevations. The revised Drawing 11 is attached for USEPA records.**

20. DD #12 NTCRA 1 Area Detail: Please provide the following information:

- Rationale for using the distribution pipe downgradient of the sheet pile wall.
- Penetration details of the cleanout, utility pipe, gate valve through the geotextile fabric of the trench.
- Potential damage of the trench system due to differential settlement on top of the steel sheet pile walls (traffic loads on gravel access road).
- Purpose of the Lateral Distribution Trench.

Response 20: **As discussed at our meeting and calls, the rationale for the downgradient distribution pipe (first bullet) and the lateral distribution trenches fourth bullet) is to distribute the NTCRA 1 groundwater flow downgradient of the sheet pile wall and promote flow toward the NTCRA 2 extraction wells.**

Since this geotextile application does not require a water tight seal, a pipe penetration detail is not typically provided. The cleanout, utility pipe and valves will extend through a slot cut into the geotextile and sealed with a mastic tape to prevent fines from entering the trench filter stone section.

Damage to the trench system due to differential settlement is not expected, as the trench will be full of gravel, the sheet pile won't heave or settle, and surcharge loads are low. Also, the pipes are located in the bottom of the trenches and the underlying soils are already consolidated; settlement, if any, is most likely to occur in the materials placed above the pipe, not at a depth that is likely to damage the pipe.

21. DD # 16 Typical RCRA Cap Termination at Trail: Recommend extending the geomembrane to the level above the top of the perforated collection pipe.

Response 21: **The perforated collection pipe and high permeability bedding material represent a preferential pathway relative to the less permeable adjacent soils, so the vast majority of the infiltrated water collected by the cap will be conveyed by the pipe to the discharge point. Even if some small amount of water enters the adjacent soils, the drainage system has still performed its function… namely, to shed water away from the cap.**

22. DD #26 (Detail 5) and DD #27 (Detail 4) Pipe Bedding: We recommend placing "Sand" bedding instead of "Select Fill." Please specify the sand bedding.

Response 22: **Select fill bedding shown on Design Drawing 26 (Detail 5) meets HDPE pipe manufacturer's recommended bedding requirements and conduit bedding shown on Design Drawing 27 (Detail 5) meets Connecticut Power and Light bedding requirements. In addition, select fill has been previously used at the site for the pre-ISTR drainage and utility pipe installations. However, we will modify the specification slightly to require 100% passes the 1.5" sieve to be more consistent with AASHTO Type I material specifications.**

23. DDs # 27 and #28 Gravel Access Road and Cover (Veneer) Stability in Appendix F: The design does not sufficiently address the potential for construction related impacts (including during solar panel construction) to the cover system. Special attention is required for the sloped area of the access road. Geotechnical slope stability analysis of the loads (additional loads which are generated by acceleration and braking of the equipment as it moves on the sideslope) on the sloped portion of the access roads should be performed. Please perform a veneer stability analysis that would allow equipment loads and braking forces to be evaluated both on and off of the access roads. Since surface drainage conditions in this area are unknown, saturated conditions should also be evaluated.

- What is the basis of the surcharge loading of 250 psf applied on the access ramp (Assumption 7) in Appendix F? Please provide supporting calculations.

- Detail 1 (DD #27): Placing "6-inch" Select Fill" as an access ramp appears insufficient. Additional 6 to 12-inch Select Fill should be added/required to protect the underlying geosythetic cap.
- Detail 2 (DD #28): Please provide detailed cross section of the transition area between the gravel access road and the paved area
- What is the maximum design pressure of the proposed solar system applied to the geosythetic cap materials?

Additional related comments provided on September 21, 2016 conference call: USEPA suggests the use of a geogrid stabilizing material beneath the access road ramp, especially where the road transitions from asphalt to gravel.

Response 23: **Given the relatively flat design slopes of the access road (12%) and cap (6H:1V or 16.7%) (both greater than 98% horizontal) and the thickness of the cover soils over the geotextile, equipment loads are not anticipated develop critical failure surfaces along the geosynthetic surface. For vehicles forces at these slopes and cover soil thickness, expected failure surfaces (if any) would develop at or near the ground surface beneath the tires/tracks, and not along the geosynthetic surface. However, we have prepared a veneer stability evaluation that considers the equipment loading as requested. The veneer stability evaluation indicates an acceptable factor of safety. The veneer stability calculations will be presented with the final report.**

The 250 psf uniform surcharge is considered representative of the light construction equipment that would be employed for construction of the solar field. It is the equivalent of 2 feet of additional soil placed on the slope. Regarding Detail 1 on Drawing 27, this applies in general to any access road on the site. On the cap, the select fill is also underlain by 36 inches of compacted general fill to protect the cap. The 6-inch select fill thickness placed for the access road ramp is considered adequate based on anticipated light truck traffic and light equipment loads during maintenance of the cap. As can be seen in the geomembrane stress evaluation calculations, a large factor of safety is provided for protection of the geomembrane even under the heavy truck loads and reduced cover depth that may occur during construction of the cap.

Regarding Detail 2 on Drawing 28, we do not believe an additional detail showing the transition from gravel to asphalt is needed. This access road is expected to be rarely used and the transition is outside the site boundary. At worst, the transition represents an occasional maintenance issue that can be readily addressed.

Regarding the final bullet, this issue was addressed in response to USEPA's comments on the 65% design, as follows:

> **"Calculations provided by the solar installer indicate that the surcharge of the solar array materials is approximately 5 pounds per**

square foot. This is substantially less than the loading associated with a person walking on the cap, and far below the bearing capacity of the materials."

Based on USEPA's recommendation from the September 21, 2016 conference call, geogrid will be incorporated into the design to underlie the gravel access road leading up the cap and adjacent to the solar array area.

EPA comments on Draft RCRA Cap 100% Remedial Design of August 18, 2016
I looked through the habitat restoration plans for SRSNE, and checked the plant list out with respect to a USDA document that lists pollinator friendly plants. Most of the plants listed in the SRSNE document appear to be high value plants and suitable to the type of habitat in which they will be planted. Everything looks reasonable to me in the SRSNE plan. In particular, I was pleased to see that they specified requirements for survival rates of various plantings.

One threat to the survival of plantings such as trees and shrubs is grazing by deer. I would recommend that a plan be in place to protect plantings from grazing by deer. Usually this is achieved through fencing off the area, or by putting deer exclusion fencing around the individual plantings. There are chemical repellents that can be applied to the plants, however I don't think that they are all that effective on a landscape scale since they often need to be re-applied from time to time.

Other than the suggestion about deer browsing management, I have no comments.

Response: Much of the restoration area is already surrounded by fencing. We will evaluate further measures to protect plantings from deer grazing.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
5 POST OFFICE SQUARE
BOSTON, MA 02109-3912

September 28, 2016

Bruce Thompson
Project Coordinator, SRSNE Site Group
de maximis, inc
200 Day Hill Road, Suite 200
Windsor, Connecticut 06095

RE: RCRA Cap 100% Remedial Design
Solvents Recovery Service of New England, Inc (SRSNE)
Southington, CT

Dear Mr. Thompson:

EPA, after providing CT DEEP with an opportunity for review and comment, approves the 100% design for a RCRA cap, a component of the remedy selected for the SRSNE Superfund Site in September 2005, and certain modifications to the NTCRA 1 groundwater containment system. The following documents, submitted by the Settling Defendants pursuant to the Consent Decree, effective March 26, 2009, form the basis of the final design and were the subject of agency review:

- *RCRA Cap 100% Design Report (Draft).* Arcadis, July 2016.
- *RCRA Cap Construction Remedial Action Work Plan (Draft).* Arcadis, July 2016.
- *Responses to Comments – 100% Remedial Design Report.* Letter from Bruce Thompson to Karen Lumino, September 28, 2016.

Within 21 days of receipt of this letter, please submit a final 100% design report and remedial action work plan that have been revised to incorporate the modifications included in the responses to comments provided today.

Pursuant to section VI.B of the RD/RA SOW (Appendix B to the Consent Decree), submittal of an implementation schedule for construction of the RCRA cap, and, modifications to the NTCRA 1 system is due to EPA within 30 days of receipt of this approval letter.

I can be reached at 617-918-1348, should you have any questions.

Sincerely,

Karen M Lumino

Karen Lumino, Remedial Project Manager
Maine/Vermont/Connecticut Superfund Section

cc: Ruthann Sherman, EPA
Shannon Pociu, CT DEEP

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