Environment

110856

FINAL DESIGN REPORT NEPERA SUPERFUND SITE

draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
Maybrook and Harriman Environmental Trust
One Meadowlands Plaza
East Rutherford, NJ 07073

Submitted by:
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Latham, New York 12110

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Contents

List of Attachments

List of Appendices

List of Acronyms

AECOM	AECOM Northeast Technical Services
CAMP	Community Air Monitoring Plan
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
cfm	cubic feet per minute
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
COCs	contaminants of concern
C:N:P	carbon:nitrogen:phosphorus
CQAP	Construction Quality Assurance Project Plan
CRA	Conestoga Rovers and Associates
deg C	degrees Centigrade
deg F	degrees Fahrenheit
DOB	Department of Building
gpm	gallons per minute
HASP	Health and Safety Plan
HDPE	high density polyethylene
HSCP	Health and Safety Contingency Plan
IC	institutional controls
kg	kilogram
LOU	Letter of Understanding
MCL	maximum contaminant level
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
OM&M	Operation, Maintenance and Monitoring
PC	Project Coordinator
PID	photo ionization detector
PM	Project Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RAO	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SCOs	Soil Cleanup Objectives
SMP	Site Management Plan
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
SWPPP	Storm Water pollution Prevention Plan
TAGM	Technical and Administrative Guidance Memorandum
TBC	to be considered
TEP	Technical Execution Plan
TICs	tentatively identified compounds
TOC	total organic carbon

TOGS	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
ug	microgram
VOCs	volatile organic compounds

1.0 Introduction

This Design Report has been prepared on behalf of the Maybrook and Harriman Environmental Trust (Trust) and presents a Design for the remedy selected by the United States Environmental Protection Agency (USEPA) to address contaminated soils and groundwater at the Nepera Superfund Site (Site) located in Hamptonburgh, Orange County, New York. This Design was prepared in accordance with the Remedial Design Work Plan (RD Work Plan, AECOM, 2009) and pursuant to an Administrative Order on Consent (AOC) for the RD.

This RD Work Plan was developed consistent with applicable USEPA guidance documents, including:

- Guidance for Scoping the Remedial Design (USEPA, 1995a);
- Remedial Design/Remedial Action Handbook (USEPA, 1995b); and
- Guidance of USEPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties (USEPA, 1990).

1.1 Project Setting

The Site is located in the Town of Hamptonburgh, Orange County, New York on the southern side of Orange County Route 4. The Site is owned by Nepera, Inc. The Site is located approximately 1.5 miles southwest of the Town of Maybrook, New York. Approximately five acres of the 27.4 acres total property area were affected by historical lagoon operations. No buildings exist at the Site other than a temporary storage container to properly store residual wastes. Access from Orange County Route 4 is via a gravel road to a secured waste storage area. Other prominent Site features include the fenced in former lagoon area and an abandoned railway bed. Beaverdam Brook traverses the western edge of the Site flowing north to the Otter Kill just beyond the southern edge of the Site. The Site is bounded on the north by Orange County Route 4, Beaverdam Brook to the west, Otter Kill to the south, and an undeveloped track of land to the east.

Approximately 6,500 people live within three miles of the Site. The closest residences are located approximately 250-ft, 175-ft, and 450-ft to the west, north and northeast, respectively. These residences rely on private supply wells for water. The public water supply wells for the Village of Maybrook are located approximately 800-ft to the east-northeast of the Site. The land use in vicinity to the Site is residential and agricultural.

The Site was purchased by the Pyridium Corporation in 1952. The Site was used for wastewater disposal between 1953 and 1967 in six constructed lagoons. These lagoons were used to dispose of wastewater generated at the plant site in Harriman, New York. No wastewater disposal has taken place at the Site since December 1967. All of the lagoons were back-filled with clean soil by 1974.

The Site was placed on the National Priority List (NPL) on June 10, 1986. The Site Superfund Identification Number is NY000511451. The original remedial investigation/feasibility study (RI/FS) program was conducted in accordance with the Stipulation Agreement entered into by Nepera, Inc. and Warner-Lambert Company with the New York State Department of Environmental Conservation (NYSDEC) in March 1988. Subsequently, a Consent Decree lodged in 1988 by the NYSDEC superseded the Stipulation Agreement. A record of decision (ROD) for the Site was issued by the USEPA on September 28, 2007. The AOC was logged in Federal Court with Cambrex Corporation, Nepera, Inc., Warner-Lambert Company LLC and Pfizer, Inc, on October 3, 2008. A Remedial Action (RA) Work Plan dated February 2009 and a Letter of Understanding (LOU) dated May 2009 were submitted by AECOM and were approved by USEPA in June 2009.

1.2 Remedial Action Summary

This section summarizes the remedy selected in the USEPA's ROD finalized in September 2007 (USEPA, 2007). The EPA has addressed the entire Site as a single operable unit. The selected remedy involves remediation of both soil and groundwater. The remediation of the contaminated soil involves the excavation of the soils within the former lagoons and treatment of these soils utilizing soil vapor extraction (SVE) and biological degradation within an engineered, below-grade biocell. The remediation of groundwater involves enhanced bioremediation with oxygen enrichment, as necessary, within the excavation below the natural overburden water table.

The general Remedial Action Objectives (RAOs) for the Site are as follows:

- Prevent exposure of human health receptors to contaminated soil and groundwater;
- Minimize migration of contaminants from the soils to groundwater;
- Restore aquifer(s) to beneficial use;
- Ensure that contaminants of concern (COCs) within soil and groundwater meet acceptable levels consistent with present and future land use; and
- Minimize the potential for human contact with waste constituents.

As stated in the ROD, the major components of the selected remedy to meet the RAOs include:

- Excavating contaminated soils, with levels above the NYSDEC soil cleanup objectives (SCOs), and placement within the biocell;
- Treating contaminated soils within the biocell through SVE and biological degradation to levels below NYSDEC SCOs;
- Backfilling excavated areas not utilized for the placement of the biocell with clean fill;
- Bioremediation of COCs in Site groundwater with the addition of compounds that enhance natural oxygen concentrations within the excavated area of the former lagoons, as necessary;
- Long-term groundwater monitoring to evaluate the extent of groundwater COCs and to assess the effectiveness of enhanced bioremediation of groundwater COCs, as necessary;
- Implementing institutional controls (ICs) in the form of an environmental easement/restrictive covenant;
- Developing a Site Management Plan (SMP) to address post-construction soil and groundwater at the Site;
- Placing engineering controls, such as fencing and signs, to prevent inadvertent exposure to Site contaminants;
- Developing a contingency plan to provide treatment of the Village of Maybrook public water supply should the water supply be impacted by Site COCs; and
- Performing reviews of the Site remedies no less than once every five years, pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.3 Remedial Design Objectives

As stated in the RD Work Plan, the primary objective of the RD for the Site is to develop plans and specifications for implementing the USEPA-selected remedy, consistent with the ROD (USEPA, 2007), and to insure that the remedy is implemented in a safe and efficient manner. Specific activities to accomplish this RD objective include:

- Design a soil remediation program for the excavation, segregation, and treatment (i.e., below grade biocell) of soils containing COCs at levels above cleanup standards;
- Design a groundwater remediation program for the treatment (i.e., enhanced bioremediation with long-term monitoring) of groundwater containing COCs at levels above cleanup standards;
- Develop design documents for the soil and groundwater treatment programs consistent with the goal of achieving performance standards specified in the ROD; and
- Develop an effective monitoring program to allow an assessment of the results of the remedy implementation (including the monitored natural attenuation component) relative to the performance standards and remedial goals established by the USEPA.

1.4 Design Report Organization

This Design Report is organized into the following sections as shown below:

Section 1 – Introduction: presents background information, project objectives and remediation action (RA).

Section 2 – Overview of the RD: presents the engineering design process – including project constraints, design approach, design integration, optimization process, and RD schedule.

Section 3 – Site Characteristics: presents different aspects of site characteristics related to the design, hydraulic characteristics, habitats, and climatological factors.

Section 4 – General Design Consideration: presents the general design considerations for developing the Design.

Section 5 – Excavation and Material Handling: presents the methods to be used for excavating and stockpiling soils and dewatering and water treatment at the Site during excavation.

Section 6 – Biocell Design: describes the method and materials used for the construction of a biocell and placement of different layers.

Section 7 – Treatment System Design: describes the placement and functions of piping, utilities, blowers, moisture and nutrient supply system, off-gas treatment system, and leachate collection and recirculation system.

Section 8 – Backfilling/Capping: presents the methods for designing material to be used for backfilling/capping.

Section 9 – Performance Monitoring: describes the monitoring of conditions within the biocell, and collection and analysis of environmental samples during remediation.

Section 10 – Site Restoration: Describes the general approach to restore the Site to final conditions.

Section 11 – Permitting and Regulatory Requirements: identifies the environmental laws and regulations that may be applicable to the project and specific permit requirements.

Section 12 – Construction Schedule: provides a conceptual discussion of construction sequencing.

Section 13 – References: presents references used to prepare this Design Report.

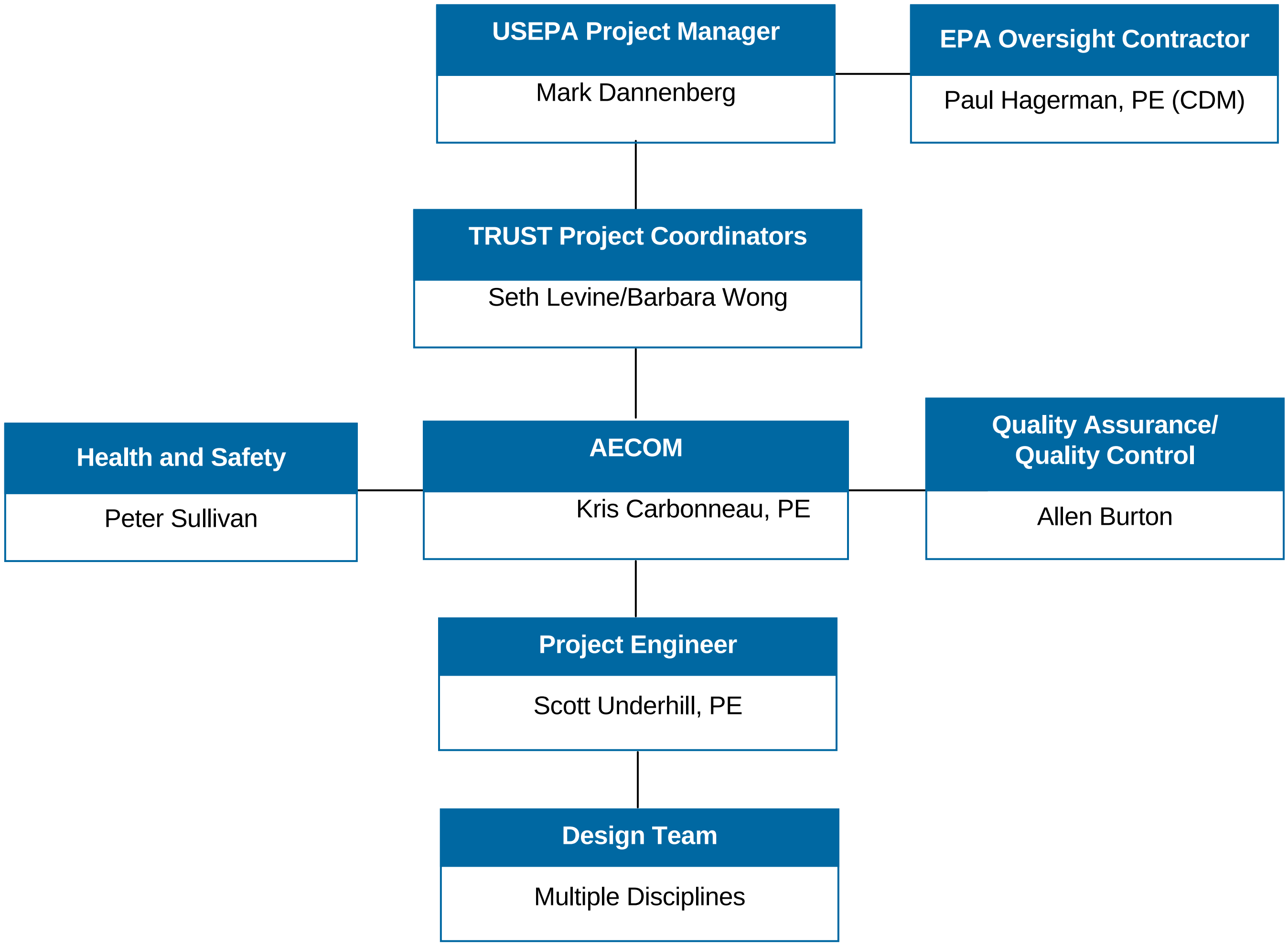
Section 14 – Engineering Estimate: presents estimated quantities and cost for project completion.

Section 15 - Certification

This Design Report was developed based on existing data and information. No additional field activities, besides a site survey, were performed pursuant to the RD Work Plan.

1.5 Organizational Structure and Responsibility

This project will be accomplished through the Trust, which consists of Cambrex and Pfizer. The Trust has selected AECOM (formerly Earth Tech) as the RD consultant. Further discussion about the AECOM organization can be found in the Quality Assurance Project Plan (QAPP) to be presented by the RA Contractor. The USEPA has full approval authority of all RD submittal documents. The USEPA remedial project manager (RPM), Mark Dannenberg, will work directly with the Project Coordinator for the day to day management of all work to be performed on the RD. The primary project coordinator (PC) for this work is Seth Levine (Cambrex). Barbara Wong (Pfizer) will serve as the secondary PC. The AECOM project Manager (PM) will be Kris Carbanneau who will report to the PCs and the USEPA PM. The organizational chart for the RD project is shown below.


USEPA Project Manager
Mark Dannenberg
EPA Oversight Contractor
Paul Hagerman, PE (CDM)
TRUST Project Coordinators
Seth Levine/Barbara Wong
Health and Safety
Peter Sullivan
AECOM
Kris Carbonneau, PE
Quality Assurance/
Quality Control
Allen Burton
Project Engineer
Scott Underhill, PE
Design Team
Multiple Disciplines

2.0 Overview of the Remedial Design Process

This section presents an overview of the RD process, project constraints resulting from the USEPA requirements and site characteristics (from logistical and physical constraints), design approach, design integration and optimization, and an overview of the RD schedule.

Preliminary Design: At the preliminary design stage, critical information was developed. The goal of this phase was to determine realistic process options to retain for each major step in the remedy and to determine key process variables for the various project elements. Information on areas to be excavated; volumes to be removed, and treated; dewatering requirements; vapor and liquid treatment requirements; construction and monitoring of the biocell; and air pollution limitations were developed. As a result, quantitative evaluations of all the process options were not possible at this stage of the design. The USEPA, as the lead regulatory agency for the project, and the NYSDEC were involved in the review process, as applicable by law. The Preliminary Design Report was submitted to the USEPA by AECOM in July 2009. The USEPA comments on the Preliminary Design Report were received by AECOM on December 21, 2009. Responses to the comments were submitted to the EPA on January 12, 2010 and incorporated into the Final Design as applicable.

Final Design: The Final Design has been developed with the goal of having enough design details to be submitted for construction. The Final Design includes detailed specifications and modifications suggested to the Preliminary Design by the USEPA and the NYSDEC. The Final Design, once approved by the USEPA and the NYSDEC will be certified and sealed by a Professional Engineer registered in the State of New York. Prior to and during the remedial action , further value engineering and actual site conditions may result in changes to the final design. Those changes would be incorporated into a final set of “As-Built” Drawings.

2.1 Project Constraints

Efficient development of the RD is challenged by several important constraints on the project design. These constraints are derived from the performance standards established by the USEPA, other requirements or prohibitions set forth in the ROD (USEPA, 2007) and existing logistical and physical conditions at the Site. These constraints are identified below and discussed further in Section 4.

2.1.1 Engineering Performance Standards

The RAOs were developed by the USEPA to provide a guideline for what the Superfund cleanup is designed to accomplish. The RAOs are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure.

The general RAOs identified for the Site include:

1. Prevent exposure of human receptors to contaminated soils and contaminated groundwater;

2. Minimize migration of contaminants from soils to groundwater;

3. Restore the aquifer(s) to beneficial use;

4. Ensure that hazardous constituents within the soil and groundwater meet acceptable levels consistent with reasonably anticipated future use; and

5. Minimize potential human contact with waste constituents.

The cleanup criteria and constituent concentration level goals are further described in Section 4.

2.2 Design Approach

Project: Use of SVE and bioremediation for contaminant remediation in soil and groundwater associated with the lagoon area.

Project Elements: The individual steps in the project such as excavation, segregation, biocell construction, backfilling, biocell operation through SVE and biodegradation, enhanced bioremediation of groundwater, and monitoring.

Project Requirements: These are the requirements that affect all or many of the project elements. Overall, the project must remove and segregate a certain quantity of material in a single construction season. On an individual project-element level, this would translate into biocell area preparation, construction, and site restoration. Management of water generated from the dewatering activities will be necessary. As a result, the entire project has been evaluated to maximize the probability of achieving the project goals.

Design Flexibility: The remediation system will be designed and constructed to accommodate some of the variables associated with the project. A few of these are discussed below:

- **Isolation Strategy:** The proposed RD approach includes an 'isolation' strategy in the design/construction of the biocell with 'remedial flexibility' in the operation of the biocell. This integrated approach removes uncertainties of the remedial action: attainment of the RAOs through source treatment (i.e., biodegradation) or removal, elimination of exposure pathways (i.e., isolating source material), and treating contaminated groundwater. This approach will also provide flexibility to adapt to varying Site conditions including encountering of soils impacted with COCs that may not be fully amenable to SVE and biodegradation in a reasonable period of time.. The extent to which the biocell will be isolated will be determined by further value engineering and actual site conditions.

- **Groundwater:** The groundwater level is expected to be below the biocell but may reach the base of the biocell. Groundwater monitoring wells will be installed in the vicinity of the biocell and an infusion piping network will be installed beneath the biocell. Additionally, oxygenating compounds may also be introduced into the groundwater using the infusion piping network to expedite the degradation of the organic contaminants. Based on further value engineering before and during the remedial action, as well as actual site conditions, the infusion piping network may be modified or eliminated.

- **Volume of Soils:** The vertical and horizontal extent of excavation depends on the observation of stained soil, depth to bedrock, and analytical results of the end-point samples. The volume of soils between the top of the historical contamination and the top of the bedrock is approximately 23,800 cubic yards (CY), of which 50% (12,000 CY) is assumed to be stained (contaminated). Further, it is assumed that approximately one third of the non-stained soils exceed the SCOs; therefore, the anticipated volume of contaminated soils is assumed to be 16,000 CY. The biocell has been designed with a capacity of 25,000 CY of soil to account for the uncertainty associated with the volume of contaminated soils and soil swell resulting from both excavate fluff and amendments. Field conditions will dictate the final volume of soils impacted in excess of SCOs and, therefore, the final capacity and configuration of the biocell. The drawings submitted herein, therefore, depict a possible design scenario but field conditions will dictate the final size of the constructed biocell.

3.0 Site Characteristics

Data on various aspects of the Site are integral to the design of each project element. Site characterization data were drawn from a number of sources to develop the design. Historical site information was obtained from previous environmental reports. The Treatability Study and National Oceanic and Atmospheric Administration (NOAA) data provided additional Site information. Specifically, the Design Report was developed using the following information.

- Site geology and hydrology
- Site contaminants
- Climatological factors

3.1 Site Geology and Hydrology

The two lithologic units (overburden and bedrock) at the Site are divided into three hydrogeologic units. The overburden units include a Shallow Aquifer underlain by a localized Overburden Aquitard. The Bedrock Aquifer resides in competent bedrock below the Site. The overburden is absent in several areas but has thicknesses of greater than 20-ft in the southern portion of the Site. The Shallow Aquifer consists of the more permeable outwash sand and gravel deposits and also the highly fractured, incompetent shale interface directly above the competent bedrock. A high water table typically occurs in the first half of the year with the low water table occurring during the second half of the year. A water table elevation difference of 3-ft to 6-ft is not uncommon between the first half and second half of the year. The lagoon area is located in the south-central portion of the Site, making the overburden thickness highly variable.

The Overburden Aquitard unit consists mostly of sand and gravel. However, there exists discontinuous pockets of silt and clay (till) throughout the Site. Where present, the till acts as a confining unit and results in isolated or perched pockets of groundwater.

The Bedrock Aquifer occurs in the competent portion of the shale bedrock with groundwater traveling through open fractures and along bedding planes. The bedrock shale becomes more competent with depth, with beds dipping to the southeast at 40 to 50 degrees below horizontal with a strike 30 degrees to the east.

3.2 Site Contaminants

Extensive sampling has identified a number of compounds exceeding the SCOs. The primary soil COCs are volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The VOCs include benzene, toluene, ethylbenzene and xylene (BTEX), acetone and chlorobenzene. The SVOCs include 2-aminopyridine, alpha picoline, pyridine, aniline and individual pyridine-related tentatively identified compounds (TICs). The primary groundwater COCs are also VOCs and SVOCs. The VOCs detected in either the Shallow or Bedrock Aquifer includes BTEX, acetone and chlorobenzene, with the higher concentrations being in the Shallow Aquifer. The SVOC detected in the Shallow and Bedrock Aquifer is 2-aminopyridine.

3.3 Climatological Factors

Climatological factors such as precipitation and temperature could affect the project implementation. Biodegradation of the organic contaminants is proportional to the microbial growth. The microbial activities are higher in warm, moist, and aerobic conditions. Hence, the biocell will be operational in the season when the temperature is at or above 50°F. Precipitation affects the groundwater recharge and hence the depth to groundwater in the areas where the biocell is proposed.

In-situ soil temperatures were measured from January 1997 to July 1997 and were found to be between 36°F to 68°F, with most of the variability occurring at shallower depths. An increase in temperature resulted in an increase in microbial activity. The soil temperature in the 3-ft to 9-ft bgs soils reached 50°F during May.

Historical temperature and precipitation at Port Jervis near the Site were obtained from NOAA database. The below tables present daily maximum temperature, daily minimum temperature, and mean monthly temperatures measured at Port Jervis from 1971 to 2000 (including air temperature during the 1997 experiment) and mean monthly precipitation data from 1971 to 2000. Generally, high groundwater elevations correspond to high precipitation and snow melt periods (March through June) while low groundwater conditions correspond to low precipitation periods (July through November). The two groundwater elevations used as part of the design were for June 3, 2002 (representative of the wet season) and July 12, 2001 (representative of the dry season).

Temperature (°F) Measured at Port Jervis (1971-2000)

Month	Daily Maximum Temperature (°F)	Daily Minimum Temperature (°F)	Mean Temperature (°F)	1997 Average Monthly Temperature (°F)
January	34.9	17.7	26.3	24.0
February	38.9	19.3	29.1	35.8
March	49.3	27.1	38.2	37.2
April	62.1	36.5	49.3	47.6
May	73.0	46.9	60.0	55.0
June	80.1	55.4	67.8	68.9
July	84.4	60.2	72.3	72.0
August	81.9	59.1	70.5	NA
September	73.5	51.8	62.7	NA
October	62.3	40.1	51.2	NA
November	50.5	32.2	41.4	NA
December	39.1	23.1	31.1	NA
Jan-July	60.4	37.6	49.0	48.6
Annual	60.8	39.1	50.0	NA

Mean Monthly Precipitation (Port Jervis; 1971-2000)

Month	Mean Monthly Precipitation (inches)
January	3.52
February	2.97
March	3.85
April	4.03
May	4.43
June	4.30
July	4.17
August	3.66
September	4.48
October	3.36
November	3.70
December	3.54
Annual	46.01

4.0 General Design Consideration

The primary challenges of the RD are to design the project to efficiently remove, manage and treat the required volume of contaminated soil and, as necessary, effectively use oxygenating compounds to enhance aerobic biodegradation to treat the groundwater at the Site. This overall task is subjected to project requirements and other constraints identified in section 2.1. This section provides further discussion of several of those project constraints and related design considerations. Specifically, this section discusses the following important design considerations:

- Design Approach
- Engineering Performance Standards
- Temperature
- Equipment and material
- Outline of Individual Design Sections

4.1 Summary of the Design Approach

A conceptual site model was developed to understand when and how the contamination reached and spread into the sub-surface environment at the Site. A remediation design was selected based on the conceptual site model and from results of the RI/FS.

4.1.1 Conceptual Site Model

The source of contamination was wastewater disposed into six lagoons between 1952 and 1967. The total volume of wastewater disposed and the constituents present are unclear, however it has been reported that up to 250 million gallons were disposed of at the Site during its operation. Material discharged into the lagoons either evaporated or drained into the underlying Shallow Aquifer. No additional “source” material was added after 1967. Contaminants would have first adsorbed onto the underlying soils or evaporated into the atmosphere. Subsequent loadings would have continued to adsorb onto the soil matrix until the soil’s adsorption capacity was exceeded, at which point the contaminants would have begun migrating downward to the underlying groundwater.

Groundwater contamination observed during the RI and subsequent monitoring events likely represents initial lagoon seepage and the continued dissolution of contaminants from lagoon sediments into infiltrating precipitation. Current release mechanisms include rain and snow melt infiltrating through the former lagoons and entering the Shallow Aquifer. A downward vertical gradient exists between the Shallow and Bedrock Aquifer; therefore, a portion of the groundwater traveling horizontally through the Shallow Aquifer eventually travels vertically into the underlying Bedrock Aquifer. Groundwater flow in the Shallow and Bedrock Aquifer both have a northern and southern component, with a groundwater high existing within the area of former Lagoons 4 and 5. The horizontal groundwater velocities in the Shallow and Bedrock Aquifer are reported at 36 ft/year and 5.0 ft/year, respectively, indicating that groundwater is more likely to travel horizontally through the more permeable overburden and saprolite zones in the Shallow Aquifer than through the fractured shale Bedrock Aquifer.

4.1.2 Isolation Approach

The proposed RD approach, which is consistent with the ROD, is to integrate an ‘isolation’ strategy in the design/construction of the biocell with ‘remedial flexibility’ in the operation of the biocell. This integrated approach removes uncertainties of the remedial action: attainment of the RAOs through source treatment (i.e., biodegradation), elimination of exposure pathways (i.e., isolating/removing source material), and treating contaminated groundwater. This approach will also provide flexibility to adapt to varying Site conditions during system operations.

The 'isolated' biocell design will prevent human exposure and infiltration of precipitation and groundwater from the underlying Shallow Aquifer. The extent to which the biocell will be isolated will depend on further value engineering prior to and during construction as well as actual site conditions. Isolation will include a low permeability cover system, liner system or both. With a liner system, a water collection system will be installed in the base of the 'isolated' biocell, to collect any leachate generated from within the biocell. As detailed in Section 7.2.2, water from the collection system will be removed and then reintroduced through an injection system installed at the top of the biocell system. Water recirculation will be used to maintain proper moisture control within the biocell soils. Preventing saturation of the contaminated soils and having the proper moisture available for biodegradation will be crucial to the overall success of the biocell.

An infusion piping network will be installed within the underlying excavation area that may be used for future injections of oxygenating compounds to enhance bioremediation of the groundwater. Based on further value engineering prior to and during remedial action as well as site conditions, the proposed infusion piping network in the RD may be modified or substituted with another means for injecting oxygenating compounds .

4.1.3 SVE/Bioremediation

The remediation system has been designed to concurrently operate in the SVE and bioremediation modes. The ROD specifies "the biocell will operate as a dual-technology system utilizing SVE and biological degradation within an engineered below-grade biocell". The intent of this design is to provide a balanced approach between SVE and bioremediation. Typically, SVE systems require larger blowers and air treatment system (e.g., thermal oxidation or activated carbon) while bioremediation systems require smaller blowers and air treatment systems (e.g., activated carbon) to support oxygen enrichment. In the past, such systems would be operated for the first few months in a moderate to high flow SVE mode to remove a significant amount of readily accessible volatile contaminant mass. Shortly after startup the mass removal rates would become asymptotic and the system would then be converted to bioremediation mode to facilitate aerobic biodegradation of the less volatile contaminants, utilizing the same SVE-sized equipment over a much longer period.

The goal of this design is to size the equipment such that the system can be operated concurrently in both SVE and bioremediation modes. The intent is to reduce the overall cleanup time and minimize the carbon footprint of the remedial action (e.g., less power requirements, less off-site disposal of activated carbon), which is consistent with the USEPA's Green Remediation Initiative. By subjecting the biocell to a lower air flow rate in comparison to traditional SVE systems, the volatilization of VOCs is minimized in the initial stages while oxygen enrichment is maximized. The VOCs not volatilized would support an aerobic biomass capable of degrading the more difficult SVOC compounds. At all times during active biocell operation – whether in SVE and bioremediation mode – all air will be extracted and treated to maintain vapor control and management. Air entry into the biocell will be through passive pipes.

4.2 Engineering Performance Standards

General descriptions of the design objectives are presented in the RAOs. The RAOs are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure and are outlined in Section 2.1.1. Remedial action goals are media specific goals to protect human health and the environment and are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to be-considered (TBC) guidance, and risk-based levels established in the risk assessment. Section 121(d) of CERCLA requires that, at a minimum, any remedial action implemented at a site achieve overall protection of human health and the environment and comply with all ARARs. ARARs at a site may include other federal and state environmental statutes and regulations.

Implementing active remedies in the source area and in the groundwater aquifers will address the risks associated with the site-related contaminants. Specifically, implementation of the remedies is expected to reduce the concentration of contaminants in soils below SCOs and reduce the concentrations of contaminants in groundwater to drinking water standards. To meet these remedial action objectives, the following cleanup objectives have been selected based on federal and state promulgated ARARs, risk-based levels, background concentrations, and guidance values.

Cleanup Objectives

Contaminant	Soil Cleanup Objective[1] (ug/kg)	Groundwater Cleanup Objective[2] (ug/L)	Cleanup Objective Source (ARAR or TBC)[3]
Benzene	60	1	ARAR
Chlorobenzene	1,100	5	ARAR
Ethylbenzene	1,000	5	ARAR
Toluene	700	5	ARAR
Xylenes (total)	1,600	5	ARAR
Acetone	50	50	ARAR
2-Aminopyridine	400	1	TBC
Pyridine	400	50	TBC
Alpha Picoline	575	50	TBC
Aniline	1,510	5	TBC (Soil)/ARAR (GW)
Pyridine-related TICs	400	50	TBC

[1]Soil cleanup objectives are from NYSDEC Subpart 375: Remedial Program Soil Cleanup Objectives or derived from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Determination of Soil Cleanup Objectives and Cleanup Levels, Division of Hazardous Waste Remediation (January 24, 1994).
[2]Groundwater cleanup objectives are based on the more conservative of the federal Maximum Contaminant Levels (MCLs) and the NYS Ambient Groundwater Standards and Guidance Values (NYSDEC, June 1998).
[3]Applicable or relevant and appropriate requirement (ARAR) or to be-considered (TBC) guidance.

As part of the approval letter for the remedial design (USEPA, 2010b; Appendix A), a procedure was agreed upon by the USEPA and Trust to develop a 'short-list' of pyridine compounds (AECOM, 2010c). Once an agreed upon list of pyridine compounds has been agreed upon by both the USEPA and Trust, the above table will be revised to remove 'Pyridine-related TICs' and include the 'short-list' of pyridine compounds. The revised table including individual pyridine compounds from the TIC study will be considered the final cleanup objectives for both soil and groundwater.

The vapor extracted from the biocell will be treated and discharged into the atmosphere. In 2003, the NYSDEC issued a policy memorandum (NYSDEC, 2003) indicating that remedial installations such as the soil vapor extraction systems are exempt from obtaining air discharge permits either through a programmatic exemption (NYSDEC NYCRR Part 375 exemption) or regulatory exemption (NYSDEC NYCRR Part 201). However, as described in the 2003 policy memorandum, all remedial projects must demonstrate that they comply with the substantive regulations and remediation activities must not cause unacceptable air emission impacts. The 2003 policy memorandum indicates that the NYSDEC has determined that "any installation with an emission rate potential exceeding 0.5 lb/hour of total volatile organic compounds require air pollution controls." Given that the biocell system has the potential to exceed this 0.5 lb/hour threshold, a vapor treatment system will be installed to minimize VOCs released to the atmosphere as a result of the designed SVE system.

4.3 Temperature

Climatological factors such as precipitation and temperature could affect the project implementation by restricting the work schedule or even necessitating temporary shut-down of operations or early seasonal closure of operations. The in-situ soil temperatures were measured from January 2007 to July 2007 and were observed to range between 36°F and 68°F, with most of the variability occurring at shallower depths. At 12-ft bgs (most likely in the saturated soils), the temperatures ranged from 42 deg F to 59 deg F (5.5 deg C to 15 deg C). Based on available literature, an increase in temperature results in an increase in microbiological activity: for example, an 18 deg F (10 deg C) rise in temperature results in doubling of biological activity (Leeson and Hinchee, 1996). Operation of the proposed biocell would thereby be limited to warmer months when the temperature of the biocell is at or above 50 deg F (10 deg C). The soil temperature in the 3-ft to 9-ft bgs soils reached 50°F during May 1997. Treatment system operation is also more difficult during colder months (e.g., snow removal, heating costs, and line freezing). For these reasons, system operation will be limited to the growing season (May through November), where the greatest contaminant reduction can be realized with the minimal amount of energy expended.

4.4 Outline of Individual Design Parameters

The RD can be broken down into several components, as identified below:

- Excavation
  - Delineation of limits of excavation
  - Material handling
  - Dewatering
  - Storm water management
- Biocell Design
  - Soil preparation
  - Analysis of the Site for the biocell construction
  - Construction of the biocell
- Treatment System Design
  - Utilities
  - Piping
  - Treatment System
  - Off-gas treatment
  - Water recirculation
  - Controls
- Performance Monitoring
  - Operational approach
  - Soil moisture, oxygen and temperature monitoring
  - Nutrient addition

- o Oxygenating compound injection
- Site Restoration

These tasks are explained in detail in the following sections.

5.0 Excavation / Material Handling

Excavation of the contaminated soil is the first of the linked and mutually dependent project elements. As the initial project element, the volume and extent of excavation will have significant impact on the subsequent project elements, including, but not limited to: 1) the need and magnitude of excavation and, therefore, the need and magnitude of dewatering; 2) the physical area needed for stockpiling and material mixing; 3) the volume and areal extent of the biocell; and 4) the volume of backfill material. In turn, these elements will also influence the excavation process. For example, depth to bedrock and available stockpiling areas will affect the extent and rate of excavation, respectively. These feedback relationships and the need to balance daily excavation, stockpiling, sampling, biocell construction, dewatering, material screening, and backfilling have been addressed, but not completely resolved at the Final Design stage because impacted/non-impacted soil delineation has not been conducted. Rather, the Final Design is limited to an evaluation of available information. Specific excavation sequencing and methods will be required for submittal by the Contractor as part of the Contractor's Remedial Action Work Plan (RAWP) as well as the contingent operations that will be taken as field conditions dictate final area and volume of impacted soil.

This section discusses the following topics regarding the excavation and material handling:

- Basis of design
- Design approach
- Preliminary evaluation of extent of excavation
- Material handling
- Dewatering
- Environmental controls and monitoring

5.1 Basis of Design

Excavation, isolation, and below-grade SVE and biodegradation were selected as the remediation strategy for the treatment of Site contamination by ROD (USEPA, September 2007). The extent of the excavation will be determined based on analytical results of end point confirmation soil samples.

5.1.1 Project Requirements

The project requirements for excavation and remediation are set forth in the USEPA ROD (September 2007). The cleanup criteria for the Site soil are presented in the table in section 4.2.

Soil will be excavated from the lagoon areas at the Site to the approximate limits shown in the Design Drawings (Attachment 1). The proposed horizontal limits of excavation are based on the location of the lagoons. Vertically, the excavation will extend until no stained soil is observed or bedrock is encountered, whichever occurs first.

Confirmation soil samples will be collected along the entire perimeter (sidewall) and base of the excavations in compliance with the NYSDEC sampling requirements found in DER-10. Perimeter samples will be collected at a frequency of one VOC grab sample and one SVOC grab sample per 30-ft of sidewall; the location of the sidewall samples will be biased to either visual impacted or elevated photo ionization detector (PID) readings. If neither visual impacts nor PID readings are encountered, grab samples will be collected from the water table interface.

If bedrock is not encountered along the bottom of the excavation, samples will be collected at a frequency of one VOC grab sample and one SVOC grab sample per 900 square feet of exposed bottom excavation (i.e., one sample in a 30-ft by 30-ft grid).

5.2 Design Approach

The identification of the source material is relatively straightforward as demonstrated during the treatability study. The highest concentrations of 2-aminopyridine and BTEX compounds were contained in stained soils. While the non-stained soils exhibited no detected levels of 2-aminopyridine (with one exception) and only low levels of BTEX (all below cleanup criteria). The source material extent, though not completely defined during the RI, should be readily identifiable during the RA through visual observation coupled with the sampling of the non-stained soils and excavation confirmation sampling.

Exceedances of 2-aminopyridine and BTEX in soil samples collected during the Treatability Study

Soil Type	Number of Samples	Number of 2-aminopyridine Exceedances	Number of BTEX Exceedances
Non-stained	10	1 (10%)	0 (0%)
Stained	13	12 (92%)	6 (46%)

The analytical data from the RI confirmed that the black staining is directly related to the contaminants and effectively defines source material. Conversely, the existing data also indicates that the absence of black-staining typically reflects non-impacted conditions. This condition will allow the visually stained soils to be rapidly screened and automatically assumed contaminated, requiring treatment in the biocell. In a similar fashion, the non-stained soils will be segregated and sampled to verify if the soils are below SCOs in accordance with Section 5.4.

In 1991 and 1995, a total of 2,149 cubic yards of soil was excavated and logged from 51 test pit excavations based on the results obtained during the RIs (Conestoga-Rovers & Associates (CRA), 1991, 1996, and 2003). The test pit logs identified 31 percent or 656 cubic yards of this soil was stained. The test pit logs indicated that a majority of the stained soils existed 4-ft or more below ground surface. The percentage of stained soils below 4-ft, based on the test pit logs, was estimated to be 58 percent.

Percentage of Stained Soils from Test Pit Logs

Year	Number of Test Pits	Total Volume Removed from Test Pits (cubic yards)	Total Volume Stained in Test Pits (cubic yards)	Percentage of Stained Soil (Total Volume)	Percentage of Stained Soil (Below 4')
1991	38	1,925	584	30%	59%
1995	13	224	72	32%	56%
TOTAL	51	2,149	656	31%	58%

During the 2010 TIC evaluation field investigation, a total of 34 soil borings were collected from within the former lagoon areas. The total percentage of stained soil below the upper unstained layer was estimated at 50%. Therefore, for the basis of design, 50% of the soils below the upper unstained layer is assumed stained but will be confirmed through soil sampling and analysis during the implementation phase.

5.3 Preliminary Evaluation of Extent of Excavation and Soil Volumes

The total volume of soil to be excavated for this removal action is estimated to be 67,000 cubic yards. This volume consersvatively includes all the stained/non-stained soils under the lagoons, all the unstained soils required to provide safe benching of the side walls, and all the unstained soils residing in areas outside the previous mentioned areas that need to be excavated to construct the biocell, including borrow material for cover soil. The proposed horizontal limit of the excavation is shown in the Design Drawings. However, the volumes and drawings depicted in the RD are only a conservative approximation of potential site excavations. Actual conditions will ultimately dicatate volumes that need to be handled and placed in the biocell. Therefore, the final approaches to materials management as well as the biocell construction will be determined during the remedial action. Sidewall samples will be collected where the excavation limits are met surrounding the lagoons. Vertically, excavation bottom samples will be collected where the stained soils do not extend to the bedrock. If the results of either the sidewall or bottoms samples exceed SCOs, the excavation will be continued until samples confirm that SCOs have been met (or bedrock has been encountered). Should field conditions or site restrictions require contaminated soils to remain in place (i.e., a sidewall sample indicates exceedances in the SCO's, but excavation can go no further horizontally due to a property line or physical obstruction), the location of the exceedance shall be documented and orange plastic fencing shall be placed over the area to indicate the presence of contaminated soils. This area shall be surveyed and documented in the SMP.

Lagoon Backfill Soils: The volume of backfill in the lagoon areas is conservatively estimated to be approximately 11,000 cubic yards. This is based on a total surface area of the lagoons of 75,000 square feet (1.7 acres) and a depth of 4-ft. For the purpose of this design, these soils have been assumed clean, but sampling will be performed to validate this assumption.

Stained/Non-Stained Soils Under the Lagoons: The volume of soil extending from the top of stained soils down to the top of competent bedrock is conservativelyestimated to be approximately 24,000 cubic yards. As described in section 5.2, it is assumed that approximately 50% of the soil below the 4-ft backfill material is stained. Hence, approximately 12,000 cubic yards of the 24,000 cubic yards has been assumed to be stained and the remaining 12,000 cubic yards is believed to be non-stained. For the basis of this design, one third of this non-stained material, or 4,000 cubic yards has been assumed to exceed the SCOs. The total volume of contaminated material is therefore estimated to be 16,000 cubic yards.

Other Non-Stained Soils: Additional soils will need to be excavated to allow for safe sloping of side walls for the construction of the biocell, or for the construction of a detention pond at the south western portion of the property as shown in the Design Drawings. The total amount of soil associated with these excavations is conservatively estimated to be 32,000 cubic yards; however, the overall capacity of the biocell will be determined as field conditions are revealed and adjustments to the volume will occur. The final requirements for a detention pond will also be determined based on actual field conditions. For the purpose of this design, these soils are assumed clean and no sampling will be performed as long as these soils are removed from beyond the area where sidewall confirmation samples have been deemed to meet SCOs.

A conservative breakdown of the estimated volume of material to be excavated on-Site is shown below. These volumes are approximate and will likely change depending on field conditions. The biocell layout, as outlined in Section 6.4, incorporates flexibility in its design to handle potential shortages or increases in contaminated soil volumes.

Estimated Breakdown of Excavated Soil

Excavation Location	Material	Total Volume (cubic yards)
Lagoon Backfill Soil	Soil	11,000
Stained/Non-Stained Material Under Lagoons	Soil/Rock	24,000
Other Non-Stained Soils	Soil/Rock	32,000
TOTAL		67,000

5.4 Material Handling

The soil from the lagoon areas will generally be excavated from south to north. Excavations will be limited in size to facilitate dewatering and effective soil management. The soil staging area will be minimized and windrows will be created around the lagoon areas to stage and prepare the soil before being placed in a biocell or used as backfill material. Secondary containment and covering of soil piles will be used as necessary to prevent the migration of contaminants from the staging areas. All excavations will be sloped in accordance with OSHA requirements and all other applicable local, state, and federal laws and regulations.

Soils will be excavated and segregated as stained soil and non-stained soil. Soil samples will be collected from the non-stained soil intended for reuse onsite at a frequency of one VOC grab sample and one SVOC five-point composite sample per 250 cubic yards. If the COCs are detected at concentrations at or above SCOs, the soil will be placed in a biocell or, if determined that concentrations exceed levels that are likely to be ab efficiently bioremediated to SCO concentrations, potentially managed offsite. The soils below the SCOs will be used as backfill material on the Site.

Soils above the SCOs may be segregated based on magnitude of contamination (i.e., levels above SCOs) and placed in separate areas of the biocell in case additional treatment amendments or time are required. Decisions to segregate will be determined in the field based upon analytical results and field ovservations. In the instances where anomalous soils are indentified and treatment within the biocell may be deemed impractical, then soils may be stockpiled separately and disposed at a permitted facility.

An estimated breakdown of the final disposition of the segregated soil based on the current conservatively estimated volumes is shown below.

Estimated Final Disposition of Segregated Soil

Segregated Material	Sources	Total Volume (cubic yards)
Clean Soil	• Lagoon Backfill Soils (11,000 CY) • Non-Stained Soils Under Lagoon (8,000 CY) • Other Non-Stained Soils (32,000 CY)	51,000
Contaminated Soil	• Stained/Non-Stained Soil Under Lagoons	16,000
TOTAL		67,000

5.5 Dewatering

Water seeping into the excavation will be pumped to an on-site treatment unit. The physical area of excavation will be managed to minimize the amount of dewatering required (i.e., restriction on size). However, if the water infiltration rate is lower than expected, larger areas may be excavated. If unusual wet conditions or high groundwater are encountered, then work may be suspended by the contractor until either conditions are eliminated or controlled through appropriate engineered solutions.

5.5.1 Dewatering Rate Estimation

The dewatering rate has been calculated assuming a 75-ft by 100-ft excavation. No sheeting and shoring will be installed, as the sides of the excavation will be safely sloped based on soil type and infiltration rates. The rate of water infiltration is estimated in the range of 3 to 15 gallons per minute (gpm). To account for variability and allow for increased dewatering, a temporary water treatment unit will be used capable of handling a minimum of 50 gpm.

5.5.2 Treatment and Disposal of Groundwater

During the construction phase, water infiltrating into the excavation will be pumped to a temporary, on-site water treatment unit. This unit will consist of settling tank(s) (e.g., 18,000 gallon Weir Tank), transfer pumps, bag filters, and granular activated carbon units. The treated water will then be transferred into on-site storage tank(s) (e.g., 20,000 gallon Frac tanks) prior to discharge to Beaver Dam Brook under the temporary SPDES Permit. The water will be sampled to ensure compliance with the SPDES permit prior to discharge. See Specification 0001 - Temporary Waste Water Treatment System for more details. Some of the water may also be stored on site for use in adjusting the moisture content of the biocell once in operation and for use as a dust suppression during construction.

5.6 Environmental Monitoring and Controls

The contractor will provide environmental controls to ensure that the work activities do not spread impacted soil and wastes outside the impacted areas and maintain the protection of human health and the environment throughout the project.

5.6.1 Air Monitoring

Perimeter and work zone air monitoring will be performed per the New York State Department of Health (NYSDOH) and OSHA requirements, and according to the Community Air Monitoring Plan (CAMP, Appendix B) and the Contractor's Health and Safety Plan (HASP). The COCs are VOCs, SVOCs (e.g., 2-aminopyridine, pyridine) and particulates. The Contractors HASP will be submitted as part of the Contractor's RAWP.

Monitoring will be continuous during the excavation and handling of impacted soils. On-site action levels, which are used to enact engineering controls, are presented in the CAMP. Monitoring will be periodic during non-intrusive activities such as mobilization.

Summaries of all air monitoring data will be provided to the USEPA, NYSDEC and NYSDOH on a weekly basis to facilitate the transfer of information related to potential health risks.

5.6.2 Erosion and Sediment Control

A construction storm water pollution prevention plan (SWPPP) will be prepared by the selected Contractor such that all RA work will meet the substantive requirements of an NPDES Phase II Construction Storm Water Permit. The SWPPP will be submitted as part of the Contractor's RAWP. Since the work is being done under a Consent Order, a permit will not be required.

The Contractor will prevent erosion and control sediment during all on-site earthwork activities in accordance with the applicable Federal, State, and local requirements. The Contractor will use hay bales, silt fence, and armor stone as necessary to prevent erosion of exposed soils. The Contractor will control storm water run-on to prevent contact with impacted soils. Any storm water that does contact impacted soils will be collected and managed with the on-site temporary waste water treatment system.

Following construction completion, the construction SWPPP will be developed into an operational SWPPP by the Contractor and incorporated into the SMP. As part of the SMP, all permanent erosion control and drainage structures will be sized and certified by a licensed New York State Engineer.

5.6.3 Equipment Decontamination Pad

An equipment contamination reduction pad, with a minimum size of 20-ft by 40-ft, will be constructed and maintained as detailed in the Design Drawings. The final sizing will be dictated by actual site conditions.The interior of the pad will be sloped to an internal sump so that the wash water and sediment can be collected and managed with the on-site temporary waste water treatment system. A high-pressure washer will be maintained to clean all vehicles and equipment exiting the exclusion zone.

5.7 Monitoring Well Abandonment

Existing on-site monitoring wells identified in the design drawings shall be abandoned prior to excavation activities. Monitoring wells shall be decommissioned in accordance with the NYSDEC's Commissioner Policy 43 – Groundwater Monitoring Well Decommissioning Policy (CP-43). Available historical information indicates on-site wells are located both in bedrock and overburden soils. Actual excavation limits are presently unknown and will vary in accordance with Section 5.0. Therefore, all on-site wells within the proposed excavation limits will be grouted in place prior to excavation activities to eliminate the potential of the well to act as a conduit for contaminated groundwater as indicated in NYSDEC's CP-43.

6.0 Biocell Design

The options for the remediation of the contaminated soil at the Site were evaluated during RI/FS and a treatability study (CRA, September 1997) was performed to evaluate the effectiveness of SVE and biodegradation. Based on these studies, SVE and biodegradation are selected as the best suited remedy for the Site. As part of the selected remedy, a sub-grade biocell will be constructed on site to treat the contaminated soils. The following sections describe the process of biocell design and construction.

- Basis of the design
- Segregation and preparation of the material
- Design Approach
- Preliminary evaluation of the Site for the construction of the biocell

6.1 Basis of Design

The majority of contamination was observed in the soils in the area below the former lagoons on the Site. The COCs at the Site are BTEX compounds, pyridine, and its various substituted analogs (i.e., 2-aminopyridine). A thorough literature review and a treatability study (CRA, September 1997) were performed to analyze the treatability of the Site contaminants using SVE and bioremediation. Based on the study and professional experience, the proposed remedy was selected by the USEPA (ROD 2007) as the most feasible remedy for the Site. The proposed remedy has the potential to meet the RAOs and will treat the source material on the Site in an economically and environmentally beneficial manner. Additionally, the proposed remedy will isolate the source material preventing human and environmental exposure to the contaminants, allow for the addition of oxygen, nutrients, moisture and bioaugmentation cultures to facilitate remediation of soils within the biocell, and allow for the infusion of oxygenating compounds into the groundwater. The basis of the design is discussed in detail in the following sections.

6.1.1 Site Constituent Biodegradability

Biodegradation of BTEX compounds by direct metabolism is well documented under a wide variety of environmental conditions. Numerous studies have documented the metabolism of these compounds under aerobic conditions. Mineralization of BTEX has also been reported under a variety of facultative and anaerobic conditions including nitrate reducing, iron reducing, sulfate reducing and methanogenic conditions. Of these conditions, the biodegradation of BTEX under aerobic and nitrate reducing conditions is most rapid and energetically favorable compared to other anoxic mechanisms.

Anilines are used widely in the production of polyurethanes, rubber, azo dyes, pesticides, and other chemical products. Biodegradation of aniline has been demonstrated in both aquatic and soil environments and biodegradation has been observed under both aerobic and anoxic conditions, although aerobic degradation is believed to be a more ubiquitously applicable mechanism.

Pyridine and its various substituted analogs (i.e., 2-aminopyridine) are hetrocylic nitroaromatic amines that occur in the environment as a by-product of industrial operations including coal gasification, mining, wood preserving, and chemical manufacturing. Pyridine and its monosubstituted derivatives are more water-soluble than their homocyclic analogs, and as such, are mobile in soil and more easily transported to groundwater. Mechanisms exist for the attenuation of pyridine and substituted pyridine compounds in the environment. Of these mechanisms, biological degradation constitutes a major attenuation pathway for detoxification and dissipation of pyridine compounds. Biodegradation of pyridine is well documented under a wide variety of environmental conditions. Numerous studies have documented the metabolism of pyridine under aerobic conditions.

The biodegradation of various substituted pyridines has also been evaluated. The degradation of these compounds is typically slower than that of unsubstituted pyridine compounds. Degradability of substituted pyridine compounds generally follows the order of pyridine = mono-hydroxypyridines > methylpyridines > aminopyridines and chloropyridines. Similar to pyridine, the greatest rates of biodegradation for the substituted amino pyridine compounds are typically observed under aerobic or nitrate reducing conditions. The differential in degradation rates is largely believed to be a function of the permeability of microorganisms to these compounds.

Since an understanding of the biodegradation and chemistry of pyridine and pyridine derivatives is a key RD component, a literature research was conducted into the biodegradation of pyridine and 2-aminopyridine. The result of this research concluded that the fate and transport of pyridine in the environment is well documented as illustrated above, but less data and information pertaining to the fate of 2-aminopyridine and other derivatives is available in the scientific community. Therefore, the biocell has incorporated features to allow for the addition of water, nutrients and microorganisms, as required, to increase the efficient biodegradation of 2-aminopyridine and other substituted analogs.

6.1.2 Isolation Strategy Insert same changes from earlier section.

The remediation approach, which is consistent with the ROD, is to integrate an ‘isolation’ strategy in the design/construction of the biocell with ‘remedial flexibility’ in their operation. This integrated approach removes uncertainties associated the remedial action: attainment of the RAOs through source treatment (i.e., SVE/biodegradation) or removal, elimination of exposure pathways (i.e., isolating source material), and removing and treating contaminated groundwater. This approach also will provide flexibility to adapt to varying Site conditions during system operation.

The ‘isolated’ biocell will prevent human exposure and infiltration of precipitation and overburden groundwater. A water collection system will be installed as part of a liner system to collect any excess liquids from within the biocell. Liquids from the collection system will be removed and reinjected through an irrigation system installed at the top of the biocell to maintain favorable soil moisture.

In addition, a series of perforated pipes encased in permeable stone will be placed at several locations at the base of the excavation (below the biocell liner). This piping system will facilitate future injections of oxygenating compounds to enhance bioremediation of the groundwater, as required.

6.2 Preparation of the Material

Prior to being placed in a biocell, the contaminated soils will be amended with a bulking agent to increase air flow within the biocell and nutrients (fertilizer) to increase nitrogen and phosphorus. During clearing and grubbing, the contractor will make every reasonable effort to collect on-site organic material for reuse within the biocell including, but not limited to, the processing of on-site vegetative material (See Specification 0002 - Bulking Agent). Organic material shall be stockpiled on site in such a manner as to isolate the material from possible contaminated soils. Once the organic material comes into contact with contaminated soil, it shall become subject to the same on-site storage restrictions as the contaminated soils. The hydraulic conductivity of the conditioned soils should be at least 4×10-2 cm/sec. This value is based on the results of the conductivity measured during the treatability study (CRA, September 1997) prior to and following amending. As shown below, the composite soil sample had conductivity increases of 257%, 529% and 343% for amendment with 2%, 4% and 8% sawdust, respectively. The design requires that the soil be amended with at least 4% bulking material to maximize air conductivity through the biocell.

Conductivity of the Soil Samples during Treatability Study (CRA, 1997)

Sample	Description	Average Conductivity, cm/sec
CL-12	53.4% gravel, 45.2% sand, 1.4% silt/clay	0.090
CL-9/10	26.4% gravel, 65.6% sand, and 8.0% silt/clay	0.021
CL-25/26	26.4% gravel, 69.4% sand, and 4.2% silt/clay	0.037
CL-COMP	Composite Sample (unamended)	0.014
CL-COMP with 2% sawdust	Composite sample amended with 2% sawdust	0.036
CL-COMP with 4% sawdust	Composite sample amended with 4% sawdust	0.074
CL-COMP with 8% sawdust	Composite sample amended with 8% sawdust	0.048

To maintain a stable biomass within the biocell, nutrient requirements may be estimated from biomass to nutrient ratios. A variety of ratios are found in literature and have been used in practice. For this design, the required amount of nitrogen and phosphorus are calculated based on the carbon, nitrogen, and phosphorus (C:N:P) ratio of 100:10:1 in the soils in the biocell. Using the average total organic carbon (TOC) concentration value from Treatability Study (CRA, September 1997) of 19,700 mg/kg (1.97% by weight) plus the additional organic material added as bulking agent, the nitrogen (as measured by total Kjeldahl nitrogen [TKN]) and phosphorous (as measured by total phosphorous) concentrations should be approximately 2,000 mg/kg and 200 mg/kg, respectively. To achieve this ratio, dry fertilizer will be mixed with the biocell soils (See Specification 0003 - Fertilizer). The estimated quantity of nitrogen and phosphorous to be applied to the biocell is 83,850 lbs and 8,385 lbs, respectively. The contractor will submit proposed fertilizer mixes for approval by the Engineer as part of the Contractor's RAWP.

6.3 Design Approach

The overall approach of designing a biocell to isolate and treat contaminated soil and to provide a mechanism to introduce oxygenating compounds for groundwater remediation is consistent with the RD Work Plan (AECOM, 2009). The components of the biocell system, from bottom up, include:

- **Groundwater Oxygen Infusion System**
  The biocell will be constructed upon existing soils that meet the soil reuse criteria as described in Section 4.2. Prior to backfilling and construction of the biocell, up to five 4-inch perforated pipes with a surrounding permeable layer (i.e., washed stone) will be installed at the base of the excavation as shown in the Design Drawings. The 4-inch perforated pipe and permeable layer provides a means and methods to introduce oxygenating agents into the groundwater to accelerate degradation of groundwater contaminants following biocell construction.Based on further value engineering, the proposed infusion system in the RD may be modified or changed to a different approach to achieve the requirements of the ROD.
  Should a value engineering determination confirm that a liner system is appropriate, the biocell liner system may consist of a 12 oz. nonwoven needle punch geotextile, a 60 mil HDPE textured (both sides) geomembrane, and a geocomposite consisting of a 200 mil geonet and a 6 oz. geotextile. The liner would rest on a six inch layer of sand. The geotextile

would act as a protective cushion for the geomembrane. The geomembrane would provide an impervious layer to isolate the soils placed in the biocell. The geocomposite would act as a drainage layer to facilitate collection of leachate within the biocell. The biocell liner would be sloped in accordance with the Design Drawings and all materials would conform to the Specifications. All liner overlaps shall be properly welded or tied in accordance with the Specifications.

- **Contaminated Soil Laye**
  Contaminated soils mixed with the bulking agent and fertilizer will be placed in the biocell (based on RD design with liner system). Two layers of lateral 2-inch perforated piping will be placed in this layer to ensure necessary distribution of air in the biocell: one layer along the base and the other layer in the middle of the contaminated soil layer. These pipes will be connected to a blower via a header pipe. Valves will be placed on these pipes to control the volume of air extracted from the biocell.

- **Permeable Stone Layer**
  A minimum 6-inch thick layer of imported permeable stone will be placed on top of the contaminated soil layer. Moisture/nutrient and air supply 2-inch perforated piping will be placed in this layer. The function of this permeable layer is to facilitate distribution of moisture, air, and nutrients into the biocell to support biodegradation. The permeable stone layer will have a horizontal base to ensure distribution of any moisture/nutrients added through the perforated piping system.

- **Biocell Divider**
  The biocell will be divided into approximately 5,000 CY sections by a poly-sheeting. The purpose of the biocell divider is to separate the soils within the biocell into manageable sections. The biocell divider will provide an air-flow barrier between sections. However, the poly-sheeting will not be seamed to the liner or cap and, therefore, cannot be considered a means of completely isolating each 5,000 CY section from the other.

- **Cap**
  A low permeability cover will be placed on top of the biocell to prevent surface water infiltration and human or environmental exposure. The cap will be sloped towards the sides to drain rainwater or water from melting snow to the storm water collection trenches located east and west of the biocell. Final material selection will be confirmed in the RAWP, however , a synthetic cover system would likely consist of a 12 oz. non-woven geotextile cushion layer will be installed on either side of the 60 mil HDPE textured (both sides) geomembrane cap to protect the integrity of the liner. All liner overlaps shall be properly welded or tied in accordance with the Specifications. A minimum 12-inch topsoil layer will be placed on top of the geotextile cap and provided a vegetative cover to prevent erosion (See Specification 0007 - Hydroseeding).

6.4 Evaluation of the Site for Construction of the Biocell

Historic test pit logs and boring logs were used as a reference to estimate the proposed horizontal and vertical limits of the excavation. These include the CRA 1991 and 1996 test pit logs and CRA 2003 field notes used to determine the proposed limits of the stained soil vertically and horizontally.

The bedrock at the Site is shallow and crops out at several locations. The location of the biocell is intended to minimize competent bedrock removal. The anticipated top of bedrock contours in the excavation areas are shown in the Design Drawings.

The proposed biocell layout is shown Design Drawings. The actual placement,configuration, size and number of the biocells may change during construction to account for bedrock surfaces and to minimize the amount of non-contaminated soils need for placement of the biocells.

7.0 Treatment System Design

All air extracted from the biocell will be treated before being discharged to the atmosphere. It is the intent of the design that all liquids removed from the biocell will be re-injected into the biocell, however, at a minimum, liquids removed from the biocell will be managed in accordance with ARARs. This section discusses different components associated with the vapor and liquid treatment system.

7.1 Utilities

The portion of the Site requiring remediation is currently undeveloped. Electricity will be brought to the Site from the Orange County Route 4. Central Hudson Gas & Electric (CHG&E) Corporation will be contacted for connection to the overhead electric lines located on the northern side of Route 4. The contractor will be required to submit a commercial electrical data form to CHG&E.

No water service extends on Route 4, therefore any water required on the Site will be from an off-site source or site groundwater.

No public sewer system is located near the Site. Groundwater removed during construction dewatering will be treated and discharged into the Beaverdam Brook through a temporary SPDES permit. Water extracted from the biocell during system operation will be re-injected into the biocell.

7.2 Piping

Two piping systems will be required: piping (2-inch to 6-inch) for the extraction of air and addition of moisture and nutrients within the biocell and 4-inch perforated pipes installed below the biocell at the base of the excavation to allow for the infusion of oxygenating compounds into the groundwater in the overburden aquifer.

7.2.1 Piping for Moisture Supply and Vacuum Application

Perforated 2-inch pipes will be placed in the permeable stone layer and in the contaminated soil layer. One end of the piping in the contaminated soil layer/permeable stone layer will be connected to a header assembly compromised of 4-inch and 6-inch piping that feed the blower assembly (at the center of the biocell – refer to the Design Drawings). The other end of the 2-inch piping (at the edge of the biocell) will be connected to a header and either be open to the atmosphere (when not under vacuum) or be closed to the atmosphere (when under vacuum). One layer of piping will be placed within the permeable stone layer within the biocell, which will be used for air extraction/circulation and moisture/nutrient addition (this layer will not be used for air circulation when moisture/nutrients are added). The second and third layers of piping will be placed in the middle and base of the biocell and used for air extraction/circulation. All pipes will be placed 12-ft apart horizontally (See Design Drawings for typical piping layout). Each pipe in each layer will have a valve and sample port to measure air flows and concentrations of VOCs in extracted air.

The piping will be constructed of HDPE which is both flexible and durable. As such, pipe collapse or rupture is anticipated to be remote. Since the biocell will be constructed with homogeneous material, air flow rates among individual extraction pipes should be similar. Should a collapse or rupture in a pipe occur, a change in air flow would be recognizable and the impact situation would be evaluated. In an extreme measure, the biocell would be opened and the pipe replaced or repaired.

7.2.2 Piping for Introduction of Oxygenating Compounds

Five 4-inch perforated pipes will be installed at the base of the top of competent bedrock or the maximum depth of the excavation beneath the biocell. The pipes will be installed in accordance with the

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Design Drawings and will facilitate introduction of oxygenating compounds into the groundwater, as necessary. Solid riser pipes will be installed on one side of each pipe. Any infusion of oxygenated agents will be done through these riser pipes.

7.3 Treatment System

A rotary positive displacement blower will be used to extract air from each section of the biocell to maintain the circulation of air to maintain the aerobic conditions necessary for the biodegradation of the organic contaminants. The final blower sizing will be based on the total volume of impacted soil in the biocell. The current blower was sized based on the airflow required to maintain oxygen level above 5%, the volume of the biocell, and the estimated head losses. Based on these calculations, a blower capable of providing a flow rate of at least 510 cfm at 6 inches of Hg vacuum will be used for each section of the biocell. This air flow rate will allow for approximately three air-pore volume exchanges in four hours and maintain oxygen levels above 5%. The operation period of the blowers will be adjusted as necessary based on field monitoring data. As noted, the sizing of the blower will be assessed based on varying soil quantities and value engineering considerations in the RAWP.

The blower will have a variable frequency drive and control panel to switch between sections of the biocell and to adjust the air extraction rate. The extracted air will be passed through a 180 gallon moisture knock-out tank and a particulate filter prior to entering the blower. The moisture knock-out tank will be connected to a ¾ HP transfer pump that transfers liquid to the 1,000 gallon overflow storage tank. The piping and instrumentation diagram depicts the process flow (refer to Design Drawings).

The system will be housed in a prefabricated steel system enclosure. The dimensions of the enclosure will be approximately 40 feet (l) × 8 feet (w) × 9.5 feet (h) with separate process and control room. The enclosure will be divided into two sections, a process room and a control room. The process room is designed to meet Class 1 Division 2 National Electrical Code (NEC) requirements and will house the moisture separator, transfer pump, and SVE blowers. The control room will be designed as non classified and will contain the system control panels, transformer, and distribution panels. The carbon canisters and the 1,000 gallon overflow storage tank will be located outside the enclosure. The enclosure will be placed northeast of the biocell on an area of crushed rock as shown in the Design Drawings.

A 480 V, 200 amp, 3 phase power control panel will be installed in the control room along with a step-down transformer. All electrical and mechanical applications shall meet Specification 0008 - Electrical and Specification 0009 - Mechanical, respectively.

7.4 Treatment of Off-gas

The air extracted from the biocell will be treated by activated carbon before being discharged into the atmosphere. The activated carbon vessels were sized based on the estimated flow rate from the biocell and contaminant loading. Two activated carbon vessels will be placed in series after the blower systems. The process flow diagram is shown in the Design Drawings.

7.5 Leachate Collection Sump (for liner system installation only)

Excess water from the biocell will be drained using the sloping liner system and 6-inch underdrain tubing within the biocell and will be collected at the southern boundary using a perforated pipe located in the sump. The bottom of the biocell will be sloped toward the middle of the biocell from east to west and toward the south at a 1% slope from north to south. The biocell will have a recess in the southern portion where the collection pipe and sump will be located. This design will prevent saturation of soils in the vicinity of the leachate collection system.

An ½ HP vertical submersible pump will be placed in the biocell sump to transfer leachate into a storage tank. Only small amounts of water are anticipated to be generated from the biocell. The selected pump shall operate at a minimum of 10 GPM at 50 feet of head. The pump will activate when the water level reaches approximately 17 inches in the sump. The leachate will be pumped by the sump pump to the 1,000 gallon overflow storage tank located northeast of the biocell via a 1.5 inch diameter pipe.

The water from the moisture knock-out tank will also be pumped to this storage tank. Water collected in this storage tank will be recirculated into the biocell. If the moisture content in the biocell is more than 50% and the storage tank reaches the high level, arrangements will be made to dispose of the water off-site. If the water in the storage tank reaches the high-high level, the sump pump will be shut down to prevent overflow condition.

7.6 Moisture and Nutrient Supply System

Moisture and availability of nutrients are essential for the growth of the microorganisms necessary for the degradation of the COCs. Moisture will be generated by the condensation of the humid air entering the biocell or as a by-product of the biodegradation of the organic compounds. Soil moisture will be monitored using the pre-installed soil moisture probes. If the soil moisture falls below 10%, water will be added to the biocell using the moisture supply system and piping located in the top permeable stone layer in each biocell. The amount of water supplied will be carefully selected to prevent saturation of the soil in the biocell. Excess water will be conveyed by the drainage layer into the sump located in the southern portion of the biocell. Leachate from the sump in the biocell will be collected in a storage tank for recirculation. If additional water is required to maintain soil moisture levels, groundwater from on-site wells may be extracted and transferred to the storage tank for recirculation.

Soil samples will be collected from the biocell annually and will be analyzed for target compounds. If the concentrations of these compounds are found to be decreasing at an undesirable rate, the amount of nutrients available to the microorganisms will be analyzed. If necessary, nutrients will be added through the piping network.

8.0 Backfilling

The proposed limits of excavation are shown in the Design Drawings. The excavation may extend outside this area if the confirmation sidewall samples exceed the SCOs. All excavations below the biocell and beyond the biocell will be backfilled with clean fill as determined by Section 4.2. All backfill soils will be compacted in accordance with the specifications. If enough clean material is not available on-site, then clean fill will be brought on-site as required. Clean top soil will be used as cover material above the biocell cap. All imported soils shall meet NYSDEC Part 375-6 unrestricted use SCOs, as required in Specification 0010 - Select Fill.

9.0 Performance Monitoring

After the biocell is constructed and operational, the conditions inside the biocell will be monitored. The chemical and physical parameters of the content within each section of the biocell are very important for the sustainable growth of the microorganisms and hence the success of this remediation project. These parameters will be monitored on a regular basis to analyze performance of the system and to make adjustments for optimum operation. The groundwater in the vicinity of the biocell will also be monitored through the use of either existing or newly installed monitoring wells surrounding the biocell. The details of the monitoring program are outlined in the SMP found in Appendix C.

9.1 Operational Approach

After the biocell is constructed and the piping is connected to their respective systems, the blowers will be turned on to extract air from inside the biocell. The airflow rate within the biocell will be adjusted to deliver enough airflow to maintain optimal oxygen levels and minimize volatilization of VOCs. This is essential for microbial growth and degradation of the organic contaminants. Oxygen levels will be monitored through the use of monitoring points installed throughout the biocell and also in the extracted air measured prior to the blower.

Soil moisture will be monitored through sensors placed throughout the biocell at varying depths. Routine monitoring will ensure that soil moisture levels are maintained at optimum conditions (above 10% and below 50%). In the case of excessive water, the pores in the soils will become water filled, resulting in reduced air flow and an oxygen deficient environment. In this event, continual operation of the SVE system would serve to bring the moisture content back into balance over time through evaporation. If the moisture level is too low, however, the desiccated soils will impede the growth of the microorganisms. Nutrients may also be added via the moisture supply system, as necessary, to further support microbial growth. Excess liquids in the biocell would also drain through the soils and be collected in the sump located in the southern portion of the biocell. These liquids will be pumped to a storage tank and then recirculated back through the biocell.

The levels of oxygen, moisture and temperature will be monitored remotely using the probes installed within the biocell. This data will then be used to determine air flow rates and the need to provide additional moisture. Soil samples will be collected from the biocell on an annual basis to evaluate the performance of the biocell.

9.2 Soil Temperature, Oxygen, and Moisture Monitoring

Temperature, oxygen, and moisture content control the growth of the microorganisms that breakdown the organic contaminants in the soils. These parameters will be monitored in the biocell remotely through the use of probes installed in the biocell. Oxygen, soil moisture, and soil temperature probes will be installed within the biocell in accordance with the Design Drawings and the manufacturer's recommendations.

The optimum temperature range for the growth of microorganisms is 50°F to 100°F. Temperature below this range reduces the growth of the microorganisms. The proposed approach is to operate the system when temperatures are at or above 50°F. When temperatures within the biocell drop below 50°F, the treatment system will be turned off until temperatures reach 50°F.

An adequate level of moisture is very important for optimum biodegradation. If the moisture content is too low (i.e., less than 10%), the soil within the biocell will become too dry to support biodegradation. If the moisture content is too high (i.e., the soil approaches saturation), oxygen transport through the soil will be reduced and therefore reduce the rate of microbial growth.

The level of oxygen in the soil pore space will affect the growth of the microorganisms and is very important to the success of this remediation project. If the level of available oxygen in a biocell is found to be below 5%, the airflow rate will be increased. Monitoring oxygen levels will be important to prevent anaerobic conditions from developing with a biocell.

9.3 Groundwater Monitoring and Oxygenating Compound Addition

Nine new wells will be installed around the biocell following the remedial construction. The new wells will be installed to monitor the condition of the groundwater upgradient, downgradient and crossgradient of the remediation area. Five overburden wells and four bedrock wells will be installed at locations depicted in the design drawings and SMP. The location and elevation of each well will be provided as part of the Contractor’s as-built survey. The groundwater in these wells will be monitored in accordance with the SMP. Data obtained from monitoring events will be compared to the NYSDEC GCOs using selected methods from "Methods for Evaluating the Attainment of Cleanup Standards: Volume 2: Groundwater, respectively (Environmental Statistics and Information Division, July 1992) and/or Guidance for Data Quality Assessment called Practical Methods for Data Analysis (EPA, 2000)..

If post-biocell construction groundwater sample results are above the cleanup objectives, an oxygenating agent may be introduced into the groundwater via the perforated pipe in the underlying drainage layer under the biocell (or by alternative means as determined by further value engineering and actual site conditions) to expedite the degradation of the organic compounds in the groundwater. The decision to perform active groundwater remediation through the addition of an oxygenating compound will be determined jointly between the Nepera Trust and the USEPA once sufficient data has been collected ascertain the need to stimulate biological degredation of dissolved phase COCs (USEPA, 2010b).

9.4 Remediation Treatment Performance Monitoring

Annual soil samples will be collected and analyzed for COCs as listed in the Final SMP . The biocell will be operated during the active growing season each year, as defined in the SMP, until the contaminant concentrations of the soils in the biocell are below the SCOs or otherwise agreed upon between the Trust and USEPA.

For performance monitoring, soil samples will be collected from within biocell at a frequency of 20 samples per biocell quadrant (or approximately one sample per 250 cubic yards of soil) at the end of each operating season and analyzed for target compounds. If required, additional samples may be collected to analyze for nutrients and microbial growth. Bioaugmentation may be undertaken or nutrients may be added to ensure optimum performance of the biocell. Soil samples will be taken using direct push sampling equipment from manholes installed in the biocell cap as shown on the Design Drawings. Data obtained from monitoring events will be compared to the NYSDEC SCOs using selected methods from "Methods for Evaluating the Attainment of Cleanup Standards: Volume 1: Soil (Environmental Statistics and Information Division, July 1992) and/or Guidance for Data Quality Assessment called Practical Methods for Data Analysis (EPA, 2000).

10.0 Site Restoration

If excavation in the areas where the biocell will be constructed extends to a depth greater than the depth of the biocell, the areas will be backfilled and compacted with clean soil segregated on the Site. The excavation in the areas outside of the biocell construction will be backfilled to grade with clean soils segregated on the Site. If enough clean material is not available on site, then clean fill will be brought on site as required. Clean top soil will be used as cover material above the biocell cap. All imported soils shall meet NYSDEC Part 375-6 unrestricted use SCOs.

Due to the impenetrable nature of the biocell cap, additional rain water runoff is expected. To counteract this additional runoff, a detention basin has been included in the site restoration (refer to Design Drawings). During construction activities, the Contractor shall be responsible for all storm water management. Following construction, the Contractor will be responsible for developing an operational SWPPP as described in Section 5.6.2.

An access road shall be constructed as indicated by the Design Drawings. The site will be accessible by security fence gate only. A vegetative cover will be provided by the Contractor in accordance with the Design Drawings and Specifications. All above ground wells and piping will be clearly labeled with yellow/orange safety tape prior to Contractor demobilization.

Following site restoration, the Contractor shall submit an as-built survey which will include, at a minimum:

- All onsite and offsite monitoring well locations and elevations;
- All above ground piping locations;
- The extents of the biocell;
- The extents of the detention pond;
- The extents of the access road;
- The extents of the security fence;
- The locations of confirmation samples (including the placement of orange plastic fence where SCOs were not attained and further excavation could not be performed);
- The extent of excavated soils; and
- The location of the treatment unit.

11.0 Permitting and Regulatory Requirements

11.1 Permitting

In addition to performance requirements established to ensure the RD meets the RAOs set in the ROD (USEPA, 2007), the remediation system is also designed to meet permitting and other regulatory requirements of local, state, and federal laws and regulations. As specified in Section V.8 Permits of the Consent Decree and Section 121(e) of CERCLA, no permit is required for any portion of work conducted entirely on Site (i.e., within the areal extent of contaminant or in very close proximity to the contamination and necessary for implementation of the work). However, the substantive requirements of the permit programs must be met. The following permits or permit programs will be required during the remediation:

- A permit from the Department of Building (DOB) of the Town of Hamptonburgh for the construction of the biocell;
- Substantive requirements of an Air Permit for the off-gas treatment and emission;
- A temporary SPDES permit issued by the NYSDEC regulating the volume and effluent critieria for the discharge of treated water generated during construction activities (e.g., groundwater dewatering, decontamination water);
- County Highway Work Permit for work within County Route 4 Right-of-Way; and
- Substantive requirements of a construction and operational Storm Water Pollution Prevention Plan (SWPPP).

11.2 Regulatory Requirements

Compliance with regulatory requirements applicable to this work includes the following work activities:

- Wastewater handling, treatment, and discharge requirements;
- Hazardous and non-hazardous waste management; and
- Air quality maintenance and monitoring.

12.0 Preliminary Construction Schedule

This section provides a preliminary construction schedule and a list of requirements for the Contractor's RAWP.

12.1 Construction Sequencing

In this design stage, only a conceptual discussion of schedule and construction sequencing is possible. A detailed construction schedule will be provided by the Contractor as part of the Contractor's RAWP. The following outline provides a list of key construction related events necessary for the project to proceed.

- Upon the USEPA approval of the Final Design, contracts for the work can be let out for bid, negotiated and awarded.
- Permits will be obtained.
- Site walkover with a representative of Central Hudson Gas & Electric Corporation.
- Ordering of processing equipment.
- Mobilization.
- Preparing Site for the construction SWPPP implementation.
- Grading for roads and Site drainage.
- Trenching for Site utilities (e.g., power, water).
- Preparation of temporary support building.
- Preparation of staging areas.
- Installation of water treatment plant storage tanks and processing equipments.
- Installation of site security measures and monitoring equipment.
- Excavation of the lagoon areas.
- Dewatering and treatment of groundwater entering the excavation.
- Segregation of the excavated soil.
- End point and stockpile soil sample collection.
- Additional excavation if necessary.
- Installation of the perforated pipe to introduce oxygenating compounds (as further determined).
- Backfilling and compaction.
- Installation of the liner system (as required).
- Mixing bulking agent and fertilizers with the contaminated soil.
- Placing the contaminated soils in the biocell along with bottom and middle layers of perforated piping.
- Placing six inches of permeable stone above the contaminated soils along with the top layer of perforated piping.
- Installation of the cap.

- Placing one foot of topsoil on the biocell cap to protect the cell and support vegetation.
- Connecting the pipes to a header.
- Connecting the headers to the blower assembly or moisture supply system.
- System startup.
- Issue Final SMP.
- Site Restoration.
- Implement operational SWPPP.

12.2 Contractor's Remedial Action Work Plan

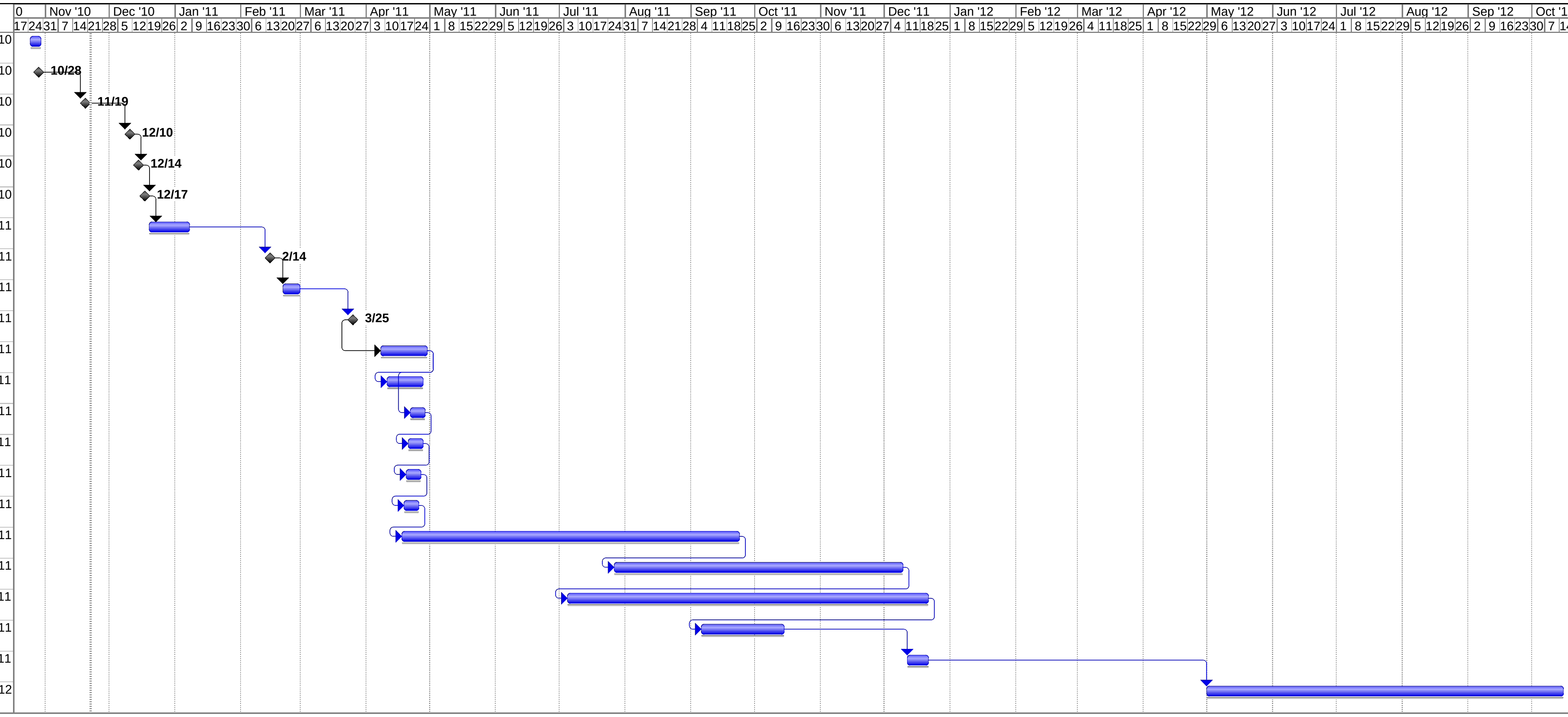
A RAWP will be prepared and submitted by the prospective contractors during the bidding process for this work for the engineer's review and TRUST approval. The RAWP will include:

- The materials, equipment, and methods to be used to perform the work;
- The proposed schedule for completing the work;
- Resumes of key project personnel;
- Bulking Agent and Fertilizer Mixes;
- Submittals required by the Specifications;
- RA Management Plan;
- SWPPP;
- QAPP;
- HASP; and
- Monitoring Plan for carrying out the RA..

The selected contractor may be required by the engineer to provide additional clarifications to their RAWP prior to and during the course of the work.

Maybrook Remedial Action Schedule for EPA Submittal 11/24/10

ID	Task Name	Duration	Start	Finish
1	Conduct TIC Evaluation field work	5 days	Mon 10/25/10	Fri 10/29/10
2	AECOM/Trust Meet to Discuss Remedial Action Approach	1 day	Thu 10/28/10	Thu 10/28/10
3	Submit Draft Final Design Report (SMP/O&M, CQAPP, Specifications)	1 day	Fri 11/19/10	Fri 11/19/10
4	Submit TIC Report	1 day	Fri 12/10/10	Fri 12/10/10
5	Meeting with EPA to discuss TIC Evaluation Report	1 day	Tue 12/14/10	Tue 12/14/10
6	Submittal of QAPP and Engineering Cost Estimate	1 day	Fri 12/17/10	Fri 12/17/10
7	EPA Reviews and Approves Design Documents	15 days	Mon 12/20/10	Fri 1/7/11
8	Trust notifies EPA of Contractor Selection	1 day	Mon 2/14/11	Mon 2/14/11
9	EPA Reviews and Approves	6 days	Mon 2/21/11	Mon 2/28/11
10	RAWP Submitted to EPA	1 day	Fri 3/25/11	Fri 3/25/11
11	EPA Reviews and Approves RAWP	16 days	Fri 4/8/11	Fri 4/29/11
12	Mobilize to Field	13 days	Mon 4/11/11	Wed 4/27/11
13	Preconstruction Survey/Layout	5 days	Fri 4/22/11	Thu 4/28/11
14	Install S&E Controls/Construct Detention Basin	5 days	Thu 4/21/11	Wed 4/27/11
15	Construct Soil Staging Areas	5 days	Wed 4/20/11	Tue 4/26/11
16	Water Treatment Facility Installation	5 days	Tue 4/19/11	Mon 4/25/11
17	Excavation/Dewatering	115 days	Mon 4/18/11	Fri 9/23/11
18	Biocell Construction	98 days	Wed 7/27/11	Fri 12/9/11
19	Backfilling/SVE System Process and Equipment	122 days	Tue 7/5/11	Wed 12/21/11
20	Operation (early Phase only)	29 days	Tue 9/6/11	Fri 10/14/11
21	Site Restoration	8 days	Mon 12/12/11	Wed 12/21/11
22	Year 2 Operation	120 days	Tue 5/1/12	Mon 10/15/12



Project: Maybrook Remedial Action Schedule for EPA Submittal_11_24_10
Date: Mon 11/22/10

Task		Progress		Summary		External Tasks		Deadline
Split		Milestone		Project Summary		External Milestone	

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13.0 Reporting Requirements

The reporting requirements following approval of this Final RD report include the following:

- A RA Work Plan to be submitted by the selected contractor within 60 days of the award of the RA contract.
- Monthly periodic progress reports to be submitted by the contractor during the RA.
- An Operations and Management Plan shall be submitted to the USEPA by the Contractor no later than 30 days prior to the completion of the remedial construction phase.
- An Interim RA Report shall be submitted by the Contractor within 60 days of USEPA's determination that construction is complete and is consistent with the ROD, the USEPA's Scope of Work, and the Consent Decree.
- A final SMP will be submitted to the USEPA by the Contractor following acceptance of the interim RA Report.
- Upon acceptance of the final SMP by the USEPA/NYSDEC, an environmental easement will be recorded by the Trust with the Orange County Clerk.
- Annual Reports will be submitted to the USEPA/NYSDEC summarizing all OM&M activities associated with the Site.
- Pursuant to Section 121(c) of CERCLA, USEPA will review site remedies no less than often than five years. The first five-year review would be due within five years of when construction activities are initiated.
- Within 60 days of the USEPA's determination that Performance Standards and cleanup objectives have been attained, the Trust shall submit a final RA Report.

14.0 Engineering Construction Cost Estimate

An engineering construction cost estimate to implement the remedial action including annual O&M costs is provided in Appendix A. This engineering construction estimate will be provided after the selection of the RA contractor.

15.0 Engineering Certification

I hereby certify, as a Professional Engineer registered in the State of New York, that this Final Design Report was prepared in accordance with all applicable statues and regulations and in substantial conformance with the ROD, Order on Consent, USEPA's Final Scope of Work, and accepted standards of practice.

Respectfully submitted,

AECOM Technical Services Northeast, Inc.

Scott Underhill Registered Professional Engineer New York License No. 075332	Date

16.0 References

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Appendix A

USEPA Approval Letter of Remedial Design

September 1, 2010

Mr. Seth Levine **VIA ELECTRONIC MAIL**
Cambrex Corporation
One Meadowlands Plaza
East Rutherford, NJ 07030

Re: Approval of the Remedial Design, Nepera Chemical Superfund Site
Town of Hamptonburgh, Orange County, New York

Dear Mr. Levine:

The United States Environmental Protection Agency (EPA) has reviewed the Remedial Design (RD) Report and the additional submittals which supplement the RD Report. Specifically, the EPA provided detailed comments on the Preliminary RD Report on December 21, 2009. Earth Tech / AECOM (on behalf of the Nepera Trust) provided responses (on January 12, 2010 and on March 9, 2010) to EPA's comments. Additional figures were also submitted to EPA to supplement the Preliminary RD Report. On April 15, 2010, the EPA responded again to the Nepera Trust. This response noted agreement between EPA and the Nepera Trust on all but five remaining issues; these five remaining issues were specifically noted in EPA's April 15, 2010 letter. After several discussions, EPA and the Nepera Trust conducted a meeting on June 7, 2010 to resolve the five remaining issues. After that meeting, only two issues remained needing resolution. These two issues were:

1. establishing a process to address the analytical issues associated with implementing the cleanup objective for pyridine-related Tentatively Identified Compounds (TICs);
2. establishing criteria to determine whether the introduction of oxygenating compounds into the groundwater will be a necessary component of the groundwater remedy prescribed in the Record of Decision (ROD).

In response to the first issue noted above, the parties have agreed to a procedure to accomplish this. Specifically, on July 19, 2010, Allen Burton of AECOM submitted, a laboratory procedure (Analytical Identification and Quantification Criteria for TICs as Target Compounds) to address the analytical issues associated with implementing the cleanup objective for pyridine-related TICs. Essentially, this procedure will generate a short list of pyridine-related compounds which will act as a surrogate for the contaminant of concern (COC) referenced in the ROD as "pyridine-related TICs". This COC (pyridine-related TICs) is potentially a very large list of possible compounds and currently utilized laboratory analyses methods would reflect data in "estimated" values. The agreed to procedure will generate a short list of pyridine-related compounds which we will use as a surrogate for the much larger list of compounds referred to as "pyridine-related TICs". This procedure was reviewed by EPA chemists and a conference call was conducted on August 9, 2010 between myself, Allen Burton, Greg Santacroce (EPA chemist), and Ursula Middel (H2M chemist). During that conference call, the EPA indicated that the proposed procedure was acceptable. H2M provided additional technical information to EPA pertaining to some of the equipment that H2M would be using to conduct the procedure. This, too, is acceptable to EPA.

The EPA anticipates that the agreed upon laboratory procedure will generate a "short list" comprised of two to four compounds (though it might be a little more or a little less). We will then be able to calibrate the analytical equipment (namely, the Gas Chromatograph-Mass Spectrometer) to analyze for the short list (e.g., two to four pyridine compounds). This will enable us to generate actual data instead of estimated data values. The short list of pyridine-related compounds is, again, a surrogate for all pyridine-related TICs. This short list will be used as an indicator for the location of pyridine-related TICs and to measure the adequacy of the treatment (through biodegradation) of pyridine-related TICs in the biocell.

However, the July 19, 2010 submittal from AECOM also included a section under the heading "Toxicity Evaluation of Target Compound Short List". This section recommends performing a toxicological review of each target compound that met the criteria established in the laboratory procedure (Analytical Identification and Quantification Criteria for TICs as Target Compounds). The EPA rejects this recommendation. The toxicity of compounds in the short list is not relevant because these compounds are surrogate indicators of the presence of any and all other pyridine-related TICs. This section is not a deliverable required under the Consent Decree and will not be included as part of the Remedial Design.

As pertains to the second issue of establishing criteria to determine whether the introduction of oxygenating compounds into the groundwater will be a necessary component of the groundwater remedy prescribed in the Record of Decision (ROD), the EPA notes the following:

1. groundwater in the overburden aquifer and the bedrock aquifer (which are hydrologically linked to each other) are contaminated with site-related contaminants;
2. the ROD and the Consent Decree require an active remedy for groundwater (namely, the introduction of oxygenating compounds into targeted areas of the groundwater aquifer);
3. the Remedial Design for the biocell includes a system, in its design, for the delivery of an oxygenating compound into the groundwater system; and
4. several monitoring wells will be installed around the perimeter of the biocell. These groundwater monitoring wells will be monitored as required.

The Nepera Trust has proposed that this component of the groundwater remedy will not be necessary if the dissolved oxygen (DO) levels in groundwater below/near the biocell are at 2mg/l or higher. The EPA does not intend to establish a "trigger number" (e.g., 2mg/l) for dissolved oxygen at this time. The EPA notes, again, that the ROD requires an active groundwater remedy. Furthermore, we repeat our assertion that the intent of the groundwater remedy is to stimulate (not merely support) aerobic activity in the groundwater. Based on the remedial design, the active groundwater remedy will be deferred until after the biocell has been constructed and begins operating. By that time, we will have had the opportunity to analyze the data generated from the groundwater monitoring activities and will be able to ascertain whether the source areas have been sufficiently excavated and placed within the biocell, whether the groundwater in the vicinity of the former source areas is sufficiently aerobic, and whether the COCs are biodegrading.

Based on our review of all submittals, the discussions held between EPA and the Nepera Trust, and the rationale described in this letter for addressing the two issues noted above, the EPA approves the Remedial Design for the Nepera Chemical Superfund Site.

Sincerely,

Mark Dannenberg
Remedial Project Manager

cc: Salvatore Badalamenti, EPA
Michael Scorca, EPA
Henry Guzman, EPA
Jamie Verrigni, NYSDEC
Joseph Yavonditte, NYSDEC
Barbara Wong, Pfizer
George Hollerbach, Quantum Management
Scott Underhill, AECOM
Jim Coleman, AECOM
Allen Burton, AECOM

Appendix B

Engineering Construction Cost Estimate

Appendix C

Community Air Monitoring Plan

AECOM Environment

REMEDIAL DESIGN REPORT COMMUNITY AIR MONITORING PLAN

draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
Maybrook and Harriman Environmental Trust
One Meadowlands Plaza
East Rutherford, NJ 07073

November 2010

Project Number 106559

Environment

REMEDIAL DESIGN REPORT
COMMUNITY AIR MONITORING PLAN
draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
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East Rutherford, NJ 07073

Contents

1.0 Introduction

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work are when certain activities are in progress at contaminated sites. This CAMP was prepared for work associated with the Nepera Chemical Company Superfund Site located in the Town of Hamptonburgh, Orange County, New York and supplements the Design Work Plan.

2.0 Purpose

This CAMP is a companion document to the site-specific Health and Safety Plan (HASP). The HASP is directed primarily toward the protection of workers within the designated work zones. The CAMP is directed primarily toward the protection of the community downwind of site activities (i.e., off-site receptors including residences and businesses). This CAMP identifies action levels and subsequent responses to insure the safety of the downwind community. In addition, the CAMP aids in affirming that work activities do not spread constituents off site through the air.

3.0 Air Monitoring

The constituents of concern at the Nepera Chemical Company Superfund Site are VOCs and semi-volatile organic compounds (SVOCs). The VOCs include benzene, toluene, ethylbenzene, and xylene (BTEX), acetone, and chlorobenzene. The SVOCs include 2-aminapyridine, 2-picoline, pyride, aniline and individual pyridine-related tentatively identified compounds (TICs). VOCs will be monitored using a photo-ionization detector (PID) with a 10.2 eV lamp. VOCs and SVOCs will also be monitored olfactorily. Particulates will be monitored using a particulate air monitor equipped with a micro-processor to measure real-time measurements of airborne particulate concentrations in micrograms per cubic meter (ug/m^3).

Real-time air monitoring field logs will be maintained to allow for future interpretation of the logged data. Site conditions, weather conditions, work activities, implemented engineering controls, and periodic real-time VOCs, odors and total particulate readings will be recorded on field logs. Copies of all field logs will be available for review on a daily basis.

3.1 VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the perimeter of the site at three locations (upwind, downwind, and nearest receptor) on a continuous basis or as otherwise specified. Upwind concentrations will be measured to establish site-specific background concentrations.

Monitoring instrumentation will include a real-time PID monitor for VOCs equipped with a 10.2-eV lamp, which will be calibrated daily with a 100 parts per million (ppm) isobutylene air standard. Monitoring will be continuously logged by each of the air monitoring instruments during the course of daily operations and each instrument will have an audible alarm to indicate when an action level has been exceeded. Following each work day, each air monitoring instrument will be downloaded and saved electronically. Instantaneous readings, if any, will be recorded, scanned, and saved electronically following each work day.

The table below describes the action levels for perimeter VOC air monitoring and the associated responses to each level.

Action Level	Response
Total VOC concentration greater than or equal to 5 ppm	Work halted until total VOC concentrations drop below 5 ppm
Sustained total VOC concentration greater than or equal to 5 ppm (15 minute average)	Work halted, emission source located, and corrective actions taken to abate emissions. Work continued once sustained total VOC concentrations drop below 5 ppm (15 minute average)
Total VOC concentration Greater than or equal to 25 ppm	Work halted, emission source located, and corrective actions taken to abate emissions. NYSDOH personnel informed of event and work suspended until approval from NYSDOH.

3.2 Odor Monitoring, Response Levels, and Actions

Odors will be monitored at the perimeter of the site olfactorily during the regular checks of the three locations (upwind, downwind, and nearest receptor).

The table below describes the action levels for perimeter odor air monitoring and the associated responses to each level.

Action Level	Response
Noticable odor	Work halted until noticeable odor disappates
Noticable odor does not dissapate after 15 minutes	Work halted, emission source located, and corrective actions taken to abate odor.

3.3 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored at the permiter of the site at three locations (upwind, downwind, and nearest receptor) on a continuous basis or as otherwise specified. Upwind concentrations will be measured to establish site-specific background concentrations

Particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. Each particulate monitor will be calibrated daily with a filtered air sample. Following each work day, each air monitoring instrument will be downloaded and saved electronically. Instantaneous readings and visual dust assessments, if any, will be recorded, scanned, and saved electronically following each work day.

The table below describes the action levels for perimeter particulate air monitoring and the associated responses to each level.

Action Level	Response
Downwind particulate concentrations 100 ug/m^3 greater than upwind particulate monitor sustained over 15 minute average	Dust suppression techniques are employed
Downwind particulate concentrations 150 ug/m^3 greater than upwind particulate monitor sustained over 15 minute average	Work halted and dust techniques evaluated. Work continues once dust techniques proven successful

Appendix D

Site Management Plan (draft)

AECOM Environment

REMEDIAL DESIGN REPORT
SITE MANAGEMENT PLAN
draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
Maybrook and Harriman Environmental Trust
One Meadowlands Plaza
East Rutherford, NJ 07073

January 2010

Project No. 60134059

Environment

REMEDIAL DESIGN REPORT
SITE MANAGEMENT PLAN
draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
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Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 Introduction

This Site Management Plan (SMP) has been developed for the Nepera Chemical Company Superfund Site located in the Town of Hamptonburgh, Orange County, NY (the Site). This SMP is developed on behalf of the Maybrook and Harriman Environmental Trust (Trust) and supplements the Final Design for the remedy selected by the Unites States Environmental Protection Agency (USEPA) in the September 2007 Record of Decision (ROD).

The Site is located on the southern side of Orange County Highway 4 in the Town of Hamptonburgh, NY (Figure 1) {*Refer to Drawing 1 of Draft Final Design Report}*. The Site is located approximately 1.5 miles southwest of the Town of Maybrook and is owned by Nepera, Inc. Approximately five acres of the 29.3 acre property were affected by historical lagoon operations (Figure 2) {*Refer to Drawing 3 of Draft Final Design Report}*. The Site is bounded on the north by Orange County Highway 4, Beaverdam Brook to the west, Otter Kill to the south, and an undeveloped track of land to the east.

This SMP includes an Engineering Control/Institutional Control (EC/IC) plan, a Monitoring Plan, and an Operation and Maintenance (O&M) Plan. This SMP has been prepared to document the requirements and procedures for Engineering Controls (ECs) and Institutional Controls (ICs) as well as monitoring of the portion of the Site being remediated as shown on Figure 2 {*Refer to Drawing 3 of Draft Final Design Report}*. This SMP does not supersede any federal, state, or local statutes, regulations, or ordinances pertaining to the environment, and current and future holders of interests of the Site will remain obligated to comply with the same. This SMP will be used to facilitate the redevelopment of the Site and has been prepared to outline general soil management practices for redevelopment of the Site and future management thereof.

The USEPA, its agents, employees, or other representatives of the government may enter and inspect the Site in a reasonable manner and at reasonable times to assure compliance with the above-stated requirements.

This SMP has been prepared as a mechanism to assure that consistent and effective inspection, maintenance, and enforcement activities are occurring and will occur in the future throughout the Site. The objectives will be achieved primarily through the implementation of EC/ICs, long-term monitoring and O&M of the remedial system. Future owners of any portion of the Site will be bound by the provisions of this SMP relevant to the portion of the property owned or controlled on the Site.

1.1 Objectives

The specific objectives of this SMP are as follows:

- To describe the binding and enforceable ECs/ICs that will facilitate future construction activities on the Site.
- To establish controls on groundwater use.
- To establish long-term monitoring at the Site.
- To outline the O&M requirements for the remedial system.

1.2 Site History

The Site was purchased by the Pyridium Corporation in 1952. The Site was used for wastewater disposal between 1953 and 1967 in six constructed lagoons. These lagoons were used to dispose of wastewater generated at the plant site in Harriman, New York. No wastewater disposal has taken place at the Site since December 1967. All of the lagoons were back-filled with clean soil by 1974.

The Site was placed on the National Priority List (NPL) on June 10, 1986. The Site Superfund Identification Number is NY000511451. The original remedial investigation/feasibility study (RI/FS) program was conducted in accordance with the Stipulation Agreement entered into by Nepera, Inc. and Warner-Lambert Company with the New York State Department of Environmental Conservation (NYSDEC) in March 1988. Subsequently, a Consent Decree lodged in 1988 by NYSDEC superseded the Stipulation Agreement. A ROD for the Site was issued by the USEPA on September 28, 2007. The Administrative Order on Consent (AOC) was logged in Federal Court with Cambrex Corporation, Nepera, Inc., Warner-Lambert Company LLC and Pfizer, Inc, on October 3, 2008. A Remedial Design Work Plan (RDWP) dated February 2009 and a Letter of Understanding (LOU) dated May 2009 were submitted by AECOM and were approved by USEPA in June 2009. A Preliminary Design Report dated July 2009 was submitted to by AECOM and the USEPA comments were received in December 2009. The SMP is being issued as part of the Final Design Report and will be submitted by the Remedial Action Contractor no later than 30 days prior to the scheduled completion date of the remedial construction phase for the Biocell.

1.3 Site Characteristics

The two lithologic units (overburden and bedrock) at the Site are divided into three hydrogeologic units. The overburden units include a Shallow Aquifer underlain by a localized Overburden Aquitard. The Bedrock Aquifer resides in competent bedrock below the Site. The Overburden Aquitard unit consists of silt and clay (till) and is discontinuous over the Site. Where present, the till acts as a confining unit and results in isolated or perched pockets of groundwater. The Bedrock Aquifer occurs in the competent portion of the shale bedrock with groundwater traveling through open fractures.

Extensive sampling has identified a number of compounds exceeding the NYSDEC Site-Specific Soil Cleanup Objectives (SCOs) and Groundwater Cleanup Objectives (GCOs). The primary soil contaminants of concern (COCs) are volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The VOCs include benzene, toluene, ethylbenzene and xylene (BTEX), acetone and chlorobenzene. The SVOCs include 2-aminopyridine, 2-picoline, pyridine, aniline, benzoic acid, bis(2-ethylhexyl)phthalate and phenol. The primary groundwater COCs are also VOCs and SVOCs. The VOCs detected in either the Shallow or Bedrock Aquifer includes BTEX, acetone and chlorobenzene, with the higher concentrations in the Shallow Aquifer. The SVOCs detected in either the Shallow or Bedrock Aquifer include 2-aminopyridine, 4-choloraniline (1 well) and bis(2-ethylhexyl)phthalate.

1.4 Conceptual Site Model

The source of contamination was wastewater disposed into six lagoons between 1952 and 1967. Total volume of wastewater disposed and the constituents present are unclear, however it has been reported that up to 250 million gallons were disposed of at the Site during its operation. Material discharged into the lagoons either evaporated or drained into the underlying Shallow Aquifer. No additional “source” material was added after 1967.

Contaminants would have first adsorbed onto the underlying soils or evaporated into the atmosphere. Subsequent loadings would have continued to adsorb onto the soil matrix until the soil’s adsorption capacity was exceeded, at which point the contaminants would have begun migrating downward to the underlying aquifer. Groundwater contamination observed during the RI and subsequent monitoring events likely represents initial lagoon seepage and the continued dissolution of contaminants from lagoon sediments into infiltrating precipitation.

Current release mechanisms include rain and snow melt infiltrating through the former lagoons and entering the Shallow Aquifer. A downward vertical gradient exists between the Shallow and Bedrock Aquifer; therefore a portion of the groundwater traveling horizontally through the Shallow Aquifer eventually travels into the Bedrock Aquifer. Groundwater flow in the Shallow and Bedrock Aquifer both have a northern and southern component, with a groundwater high existing within the area of former Lagoons 4 and 5. The horizontal groundwater velocities in the Shallow and Bedrock Aquifer are reported at 36 feet/year and 5.0 feet/year, respectively, indicating that groundwater is more likely to travel horizontally through the more permeable overburden and saprolite zones in the Shallow Aquifer than through the fractured shale Bedrock Aquifer.

1.5 Remediation Approach

Construction of an on-site biocell with installation of underground horizontal piping for administering oxygenation agents to the groundwater has been selected for the remediation of the Site. The soils will be excavated, segregated, mixed with bulking agents and fertilizers, and placed in the biocell for stripping and biodegradation of the contaminants. The biocell will be divided into sections, such that each section will contain approximately 5,000 cubic yards of contaminated soils. The biocell will be equipped with piping for moisture supply and soil vapor extraction (SVE) capable of introducing fresh air into the biocell to obtain optimum oxygen level. The biocell has been designed to concurrently operate in SVE and bioremediation modes. Horizontal infusion wells will be placed in a permeable gravel layer along the bottom of the excavation to introduce oxygenating compounds to the groundwater should oxygen levels drop below levels necessary to support biodegradation of groundwater, where contaminants are detected above the GCOs.

The remediation design (RD) approach, which is consistent with the ROD, is to integrate an ‘isolation’ strategy in the design/construction of the biocell with ‘remedial flexibility’ in the operation of the biocell. This integrated approach removes uncertainties of the remedial action: attainment of the remedial action objectives (RAOs) through source treatment (i.e., biodegradation), elimination of exposure pathways (i.e., isolating source material), and treating contaminated groundwater. This approach will also provide flexibility to adapt to varying Site conditions during system operations.

1.6 Engineering Performance Standards

The RAOs were developed by USEPA to provide a guideline for what the Superfund cleanup is designed to accomplish. The RAOs are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure.

The general RAOs identified for the Site include:

1. Prevent exposure of human receptors to contaminated soils and contaminated groundwater;
2. Minimize migration of contaminants from soils to groundwater;
3. Restore the aquifer(s) to beneficial use;
4. Ensure that hazardous constituents within the soil and groundwater meet acceptable levels consistent with reasonably anticipated future use; and
5. Minimize potential human contact with waste constituents.

Remedial action goals are media specific goals to protect human health and the environment and are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs), to be-considered (TBC) guidance, and risk-based levels established in the risk assessment. Section 121(d) of CERCLA requires that, at a minimum, any remedial action implemented at a Site achieve overall protection of human health and the environment and comply with all ARARs. ARARs at a Site may include other federal and state environmental statutes and regulations.

Implementing active remedies in the source area and in the groundwater aquifers will address the risks associated with the site-related contaminants. Specifically, implementation of the remedies is expected to reduce the concentration of contaminants in soils below soil cleanup objectives and reduce the concentrations of contaminants in groundwater to drinking water standards. To meet these remedial action objectives, the following cleanup objectives have been selected based on federal and state promulgated ARARs, risk-based levels, background concentrations, and guidance values.

Table 1
List of Site-Specific VOCs and SVOCs Cleanup Objectives

Contaminant	Soil Cleanup Objective[1] (ug/kg)	Groundwater Cleanup Objective[2] (ug/L)	Cleanup Objective Source (ARAR or TBC)[3]
Benzene	60	1	ARAR
Chlorobenzene	1,100	5	ARAR
Ethylbenzene	1,000	5	ARAR
Toluene	700	5	ARAR
Xylenes (total)	1,600	5	ARAR
Acetone	50	50	ARAR
2-Aminopyridine	400	1	TBC
Pyridine	400	50	TBC
Alpha Picoline	575	50	TBC
Aniline	1,510	5	TBC (Soil)/ARAR (GW)
Pyridine-related TICs[5]	400[4]	50[4]	TBC

[1]Soil cleanup objectives are from NYSDEC Subpart 375: Remedial Program Soil Cleanup Objectives or derived from the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Determination of Soil Cleanup Objectives and Cleanup Levels, Division of Hazardous Waste Remediation (January 24, 1994).
[2]Groundwater cleanup objectives are based on the more conservative of the federal Maximum Contaminant Levels (MCLs) and the NYS Ambient Groundwater Standards and Guidance Values (NYSDEC, June 1998).
[3]Applicable or relevant and appropriate requirement (ARAR) or to be-considered (TBC) guidance.
[4]Individual pyridine-related Tentatively Identified Compounds (TICs) are for site specific soil and groundwater cleanup *guidance* (not an objective).
[5]As part of the approval letter for the remedial design (USEPA, 2010b; Appendix A), a procedure was agreed upon by the USEPA and Trust to develop a ‘short-list’ of pyridine compounds (AECOM, 2010). Once an agreed upon list of pyridine compounds has been agreed upon by both the USEPA and Trust, the above table will be revised to remove ‘Pyridine-related TICs’ and include the ‘short-list’ of pyridine compounds. The revised table including individual pyridine compounds from the TIC study will be considered the final cleanup objectives for both soil and groundwater.

2.0 Engineering and Institutional Controls

2.1 Engineering Controls

Engineering Controls (ECs) are physical mechanisms which restrict access to the Site and the Site contaminants. Engineering Controls include any physical barrier or methods employed to actively or passively contain, stabilize, or monitor hazardous waste, restrict the movement of hazardous waste to ensure the long-term effectiveness of a remedial program, or eliminate potential exposure pathways to hazardous waste.

Engineering Controls for this Site include:

- Site Access Controls – A chain link security fence will be maintained with locked gates to prevent unauthorized access to the Site.
- Signage – “Posted” signs will be placed on the perimeter of the fence to notify the community that the Site has restricted access and that no trespassing is allowed until the time of development of the Site.
- Excavation Areas with SCOs Exceedances – In the event subsurface material at the Site exceeding SCOs cannot be excavated due to engineering or property boundary constraint, these areas will be marked on a figure at the end of the remedial construction. Any areas with sample results exceeding SCOs that cannot be further excavated or remediated, will be lined with poly-coated plastic as a marker and then backfilled over the liner.

2.2 Institutional Controls

Institutional controls (ICs) are non-physical mechanisms which restrict the use of the Site, limit human exposure, and prevent any actions which would threaten the effectiveness or operation and maintenance of a remedy at or pertaining to the Site. Under NYSDEC policy, the ICs apply when contaminants remain at a Site at levels above the SCOs or GCOs that would otherwise allow unrestricted human use of the property. Institutional controls may include restrictions on the use of structures, land, and groundwater as well as deed notices and covenants. Institutional controls for the site will be removed once soil and groundwater has been remediated to levels below the SCOs or GCOs that would allow for unrestricted human use of the property. The proposed end-use of this property is park land.

Institutional controls to protect human health and the environment will be implemented at the Site through an Environmental Easement. The following institutional controls will be implemented and enforced through a deed restriction associated with the Environmental Easement.

1. Site Use Restriction – The owner of the Site will be prohibited from using the Site for purposes other than for restricted-residential use and the services associated with such use. Future use of the Site is expected to be undeveloped. The Environmental Easement shall be binding on all future owners of the property and will consign consent to enforcement by the USEPA of all prohibitions and restrictions and agreement not to contest the authority of the USEPA to seek enforcement.

2. Soil Management Plan – Future excavation of the soils at the Site or removal of soil from the property will not be conducted unless undertaken in accordance with a Soil Management Plan as prepared by the developer, to be submitted to and approved by the USEPA prior to initiating any soil excavations. This will describe procedures for soil excavation and removal

of soils from the property that are designed to protect human health and the environment. This plan will include, at minimum:

- A provision for prior notification and approval of USEPA for any ground intrusive activities that could result in exposure of subsurface soils, using a figure to be prepared as a guideline in determining where contamination is still present on the Site. In addition, data from any post excavation monitoring efforts are to be reviewed prior to any intrusive activities.
- Protocols and procedures for sampling soils to determine the concentration of contaminants.
- A description of health and safety requirements and general procedures to be followed during any Site soil excavation. This should be designed to minimize human exposure to Site contaminants during the excavation of soil.
- In the case of off-site disposal, a hazardous waste determination protocol will be included to verify whether deposition into a secure hazardous waste landfill or a solid waste landfill is necessary.
- A provision for a submittal of a construction completion report to the USEPA for all activities conducted pursuant to the Soil Management Plan.

3. Groundwater Use Restriction – The use of groundwater underlying the Site will be prohibited until deemed acceptable by the USEPA following the completion of long-term monitoring.

4. Groundwater Monitoring – The Site owner will monitor the groundwater quality at each of the Site monitoring wells until collected data indicates that groundwater standards have been achieved. New groundwater monitoring wells will be installed following the biocell construction to replace the monitoring wells decommissioned during the remedial construction. These wells (along with existing on-site wells identified in Figure 3) will be sampled to obtain a post-construction baseline data set. If groundwater contamination in the wells around the biocell is detected at concentrations exceeding the GCOs and oxygen levels are found below those necessary for biodegradation, oxygenating compounds will be introduced into the groundwater using the horizontal infusion wells placed under the biocell to expedite the degradation of the organic compounds in the groundwater. The decision to perform active groundwater remediation through the addition of an oxygenating compound will be determined jointly between the Nepera Trust and the USEPA once sufficient data has been collected to ascertain the need to stimulate biological degradation of dissolved phase COCs (USEPA, 2010b). The monitoring wells will be sampled semi-annually to monitor the effect of the remedial action and to determine the need for introducing oxygenating compound to further stimulate the biodegradation of the organic contaminants in the groundwater. Groundwater sampling will be semi-annual for the first two years and annually thereafter. Data obtained from monitoring events will be compared to the GCOs using selected methods from "Methods for Evaluating the Attainment of Cleanup Standards: Volume 2: Groundwater (USEPA, 1992) and Guidance for Data Quality Assessment: Practical Methods for Data Analysis QA/G-9 (USEPA 2000).

5. Notification – An IC notification in accordance with the Soil Management Plan will be provided to the USEPA whenever ground intrusive activities are to be performed on the Site area that requires contaminated soil to be disturbed. The purpose of this IC notification is to notify the USEPA of any intrusive activities that will be performed at the Site and to ensure that the controls remain effective over time.

6. Periodic Review Report – The Trust will certify the institutional controls are in place and remain effective for the protection of public health and the environment. The Trust will identify any activities undertaken pursuant to the SMP, and identify anticipated forthcoming activities that require implementation of the SMP.

- The periodic review report will be prepared by a professional engineer or other qualified environmental professional who must certify that the institutional controls and/or engineering controls employed are unchanged from the previous certification (unless otherwise approved by the USEPA), are in place and effective, performing as designed, and that nothing has occurred that would impair the ability of the controls to protect the public health and environment or constitute a violation or failure to comply with any maintenance plan for such controls. The report will include:
    1. Groundwater monitoring and soil sample analytical results;
    2. Analysis of groundwater contamination concentrations;
    3. Description of Site conditions and maintenance activities; and
    4. Recommendations for any corrective measures or changes in the SMP.

The certification report will be distributed to:

United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, NY 10007

New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, NY 12233

Town of Hamptonburgh
18 Bull Road
Campbell Hall, NY 10916

New York State Department of Health
Flanigan Square, 547 River Street
Troy, NY 12180-2216

The Environmental Easement will be recorded and filed with the Orange County Clerk and proof of the recording and filing will be submitted to the USEPA within thirty days of the completion of the Environmental Easement. The environmental easement will be removed upon satisfactory completion of the remedial action by the USEPA.

3.0 Monitoring Plan

3.1 Groundwater Monitoring

To monitor the effectiveness of the remedial action and the Site's groundwater quality, selected Site monitoring wells will be sampled semi-annually during the first two years of the monitoring plan. If the Site related contaminants are detected in groundwater samples at concentrations exceeding the GCOs and oxygen levels are below those necessary for biodegradation, oxygenating compounds will be introduced using the horizontal infusion wells below the biocell. The horizontal infusion wells, in the vicinity of the monitoring well in which the contamination is detected, will be used to inject the oxygenating compounds into the groundwater.

During the remedial construction, nine monitoring wells will be decommissioned and nine new monitoring wells will be installed around the remediation area. Figure 3 {*Refer to Drawing 19 of Draft Final Design Report}* shows the location of the wells to be decommissioned within the remediation area and the location of the proposed replacement monitoring wells around the biocell. Wells proposed for decommissioning include MW-1U-91, MW-1D-91, MW-2D-91, MW-3, MW-4, SW-3, SW-4, SW-6, and PZ-2. These wells will be decommissioned in conformance with NYSDEC Commissioner Policy 43 – Groundwater Monitoring Well Decommissioning Guidelines. The nine proposed replacement wells are depicted on Figure 3 *{Refer to Drawing 19 of Draft Design Report}* and are as follows:

- MW-1D-10: located south of the existing Lagoon 3, this well monitor the bedrock aquifer.
- MW-1U-10: located south of the existing Lagoon 3, this well monitor the shallow aquifer (replaces MW-2D-91).
- MW-2D-10: located east of the existing Lagoon 4, this well will monitor the bedrock aquifer.
- MW-2U-10: located east of the existing Lagoon 4, this well will monitor the shallow aquifer (replaces SW-4).
- MW-3D-10: located north of the existing Lagoon 5, this well will monitor the bedrock aquifer.
- MW-3U-10: located north of the existing Lagoon 5, this well will monitor the shallow aquifer (replaces MW-3).
- MW-4D-10: located west of the existing Lagoon 4 and 5, this well will monitor the bedrock aquifer (replaces MW-1D-91).
- MW-4U-10: located west of the existing Lagoon 4 and 5, this well monitor the shallow aquifer (replaces SW-3).
- MW-5U-10: located west of the existing Lagoon 1 and 2, this well will monitor the shallow aquifer (replaces SW-6).

The shallow monitoring wells will be installed in the overburden to the top of competent bedrock, with depths ranging from approximately 15 to 20 feet below grade. The monitoring wells will consist of 2 inch, 0.010 slot PVC pipe with 10 feet of screen.

The deep monitoring wells will be installed in the bedrock. The bedrock wells will be 20-ft open rock boreholes extending from 5-ft below top of competent rock. Approximate depths of the bedrock wells are estimated to vary between 35 to 55 feet below grade. After completion of well installation and development, the well locations and construction details (grade elevation, measuring point elevation, and top of protective casing elevation) will be surveyed and added to the Site map. Details of the monitoring well installations will be presented in the first Annual Monitoring Report.

A total of 37 monitoring wells are currently present on and around the Site, and an equal number of wells will be on-site following completion of the remedial construction. The groundwater monitoring plan will include three components:

1. Continued monitoring of the perimeter wells on an annual basis to ensure no off-site migration of contamination. These wells will be sampled in the fall and samples will be analyzed for site-specific VOCs and SVOCs.
2. Semi-annual monitoring of these wells (existing and newly installed) surrounding the biocells during the spring and the fall. These wells will be sampled for site-specific VOCs and SVOCs. Sampling frequency will be semi-annually for first two years and will be evaluated thereafter. These data will be used to assess contaminant concentration trends in the Site groundwater following source removal.
3. Quarterly monitoring of groundwater wells surrounding the biocell. These wells will only be monitored for field parameters (e.g., dissolved oxygen [DO], oxidation reduction potential [ORP], turbidity, temperature) and water levels. These data will be used to evaluate the need for a supplemental oxygen source in the groundwater. The decision to perform active groundwater remediation through the addition of an oxygenating compound will be determined jointly between the Nepera Trust and the USEPA once sufficient data has been collected ascertain the need to stimulate biological degredation of dissolved phase COCs (USEPA, 2010).

These well are shown in Figure 4 {*Refer to Drawing 19 of Draft Final Design Report}* and included in the table below:

Monitoring Event	Objective	Monitoring Locations	Measurements/Analysis
Quarterly	Monitor groundwater elevations and DO levels in groundwater around biocell	MW-1U-10 MW-1D-10 MW-2U-10 MW-2D-10 MW-3U-10 MW-3D-10 MW-4U-10 MW-4D-10 MW-5U-10	Water Levels Field Parameters (DO, ORP, turbidity, temp)
Semi-Annual (Spring and Fall)	Monitoring concentrations of contaminants in groundwater around biocells	List above plus: MW-3D-91 MW-7 SW-8 DW-1-95 MW-4D-91 MW-2 SW-2 DW-2-95	Water Levels Field Parameters Site-specific VOCs and SVOCs
Annual (Spring)	Monitor concentrations of contaminants in off-site groundwater	MW-1 MW-5U-95 MW-8U-95 MW-9U-01 MW-10U-01 MW-11U-01 SW-9 MW-5D-91 MW-9D-01	Water Levels Field Parameters Site-specific VOCs, and SVOCs

		MW-10D-01 MW-11D-01 T-2	

3.2 Groundwater Sampling and Analysis

Prior to sampling, the wells will be opened, and head-space VOC readings will be collected using a photoionization detector (PID). The wells will then be purged with a peristaltic pump using new dedicated Teflon tubing until a minimum of three well volumes have been removed from each well. The purge water will be disposed of on the ground next to the well.

The groundwater samples will be collected from the wells by a peristaltic pump or dedicated bailer, taking care to cause minimal agitation or turbulence. The groundwater will be passed through flow-through cell and water quality will be recorded every 5 minutes. The wells will be purged and sampled using the low-flow or minimal draw-down technique which monitors groundwater quality parameters until three consecutive rounds of readings stabilize to within an established range indicating no significant change. Further information about low-flow sampling can be found in Ground Water Issue Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures (USEPA, 1995). After purging, the samples will be transferred immediately to the appropriate laboratory-supplied containers. Once filled, the containers will be placed immediately in ice-filled coolers for shipment to the laboratory. No filtered groundwater samples will be collected.

The samples will be submitted to a NYSDOH Environmental Laboratory Approval Program (ELAP) approved laboratory under standard chain of custody procedures along with a blind field duplicate, trip blank and a temperature blank; as well as sufficient sample quantity for site specific matrix spike/matrix spike duplicate analysis. The groundwater samples will be shipped to a NYSDOH certified laboratory following the NYSDEC/USEPA Analytical Protocols. The samples will be analyzed for Site-specific VOCs and SVOCs (listed in Table 1). Based on the analytical results, selected wells may be chosen to be sampled at a more frequent interval. After achieving groundwater standards for two consecutive years, the monitoring frequency will be reevaluated.

Groundwater levels will be used to develop a potentiometric map for both shallow and deep groundwater zones. Groundwater contour maps will be provided in the Annual Monitoring Reports.

In addition, analytical data for the COCs in the groundwater at the Site will be tabulated and graphed to assess the effectiveness of the remedy for the groundwater. Any increasing or decreasing trends will be noted. Due to the varying nature of the flow at the Site, analytical groundwater flow and solute fate and transport modeling is not recommended for evaluating the effectiveness of the remediation. Statistical analysis will be performed instead of evaluation of spatial and temporal trends. The analysis will include, at a minimum, an areal distribution of contaminants for both the shallow and deep groundwater aquifer units. All monitoring data will be evaluated in regards to the GCOs. The results of this analysis will assist in determining the effectiveness of the remedial action and provide the basis for future recommendations (i.e., no further monitoring, continued monitoring, or introduction of oxygenating compounds).

3.3 Biocell Monitoring

The chemical and physical parameters of the content within each section of the biocell are very important for the sustainable growth of the microorganisms and hence the success of this remediation project. These parameters will be monitored. Temperature, oxygen, and moisture content control the growth of the microorganisms that breakdown the organic contaminants in the soils. These parameters will be monitored using the probes installed within the biocell to analyze performance of the system and to make adjustments for optimum operation. To that extent, oxygen, soil moisture, and soil temperature probes installed within the biocell will be used to monitor biocell performance.

A total of 4 oxygen, soil moisture and temperature monitoring locations will be installed for each 5,000 cubic yard biocell section. Each location will contain sensors at three depths. This equates to 12 soil moisture sensors and 12 dual oxygen and temperature sensors per section; the biocell is proposed to have a total of five sections. The proposed locations of the monitoring points are shown on Figure 5 {*Refer to Drawing 12 of Draft Final Design Report}*. The sensors (a soil moisture sensor and a coupled oxygen and temperature sensors) will be installed at 2-3 feet, 4.5-5.5 feet, and 7-8 feet at each location to monitor the soil moisture, temperature and oxygen distribution at different heights of the biocell. The specifications of the oxygen sensors and soil-moisture probes are included in Appendix A. The sensors will be connected to the data-loggers dedicated to each section of the biocell. The data loggers will be connected to each other and to a cellular modem that can be dialed to obtain data from a remote location. Specifications of the proposed data-loggers are also included in Appendix A. The sensors will collect measurements hourly, which will be recorded by the data loggers.

The level of oxygen in the soil pore space will affect the growth of the microorganisms. Based on the oxygen level at different levels and sections of the biocell, the vacuum rate will be adjusted to maintain oxygen levels above 5%. Each pipe will have a valve to control the flow and will be connected to a blower with a variable speed drive. A network of 2-inch perforated HDPE pipes will be laid at three different depths in each section of the biocell (in the upper permeable stone layer, mid-point depth of the contaminated material and along the base of the biocell). One end of the piping will be connected to a header that has a valve to open them to the atmosphere. Two of the three layers of piping will be used to apply vacuum and other end of the third layer will be open to atmosphere to introduce fresh air to maintain oxygen level greater than 5%. If the level of available oxygen in a biocell is below 5%, the air circulation may not be enough to support aerobic degradation and the airflow will be increased. Monitoring the oxygen levels is important to maintain aerobic conditions.

An adequate level of moisture is very important for optimum biodegradation. If the moisture content is too low (i.e. less than 10%), the soil within the biocell will become too dry to support biodegradation. If the moisture content in the soil is too high, the soil will become saturated with water, which will reduce the air-filled porosity and hence, the rate of microbial growth. If the soil moisture is too low, water will be introduced into the biocell via the top layer of perforated piping. The quantity, location, and frequency will be decided based on the soil moisture readings.

The optimum temperature range for the growth of microorganisms is 50 ºF to 100 ºF. Temperature out of this range inhibits the growth of the microorganisms. The system will be turned off in the winter when the temperature falls below 50 ºF. The oxygen sensors will also monitor the temperature of the soils in the biocell. The temperature data will be used as one of the factors in analysis of microbial growth.

3.4 Soil Sampling from Biocell

Annual soil samples will be collected from each section of the biocell prior to shutting down the system for winter. The soil samples will be analyzed for the site specific VOCs and SVOCs by an NYSDOH ELAP approved laboratory. For performance monitoring, one soil sample will be collected from every 250 cubic yards of the contaminated material in the biocell. Twenty soil samples will be collected from each section of the biocell, since each section contains approximately 5000 cubic yards of contaminated soils.

Eight locations have been selected on each section of the biocell. Four locations will be selected near the center and the soil samples will be collected from three different depths since this portion of the biocell is deeper than near the edges. The other four locations will be selected near the edges and two soil samples will be collected at two different depths from there. At the interior four locations the samples will be collected from depths of 2-3-ft, 4.5-5.5-ft and 7.5-8.5-ft below the surface and at the other four locations, the soil samples will be collected from depths 3-4-ft and 6-7-ft below surface. The proposed sample locations are selected to avoid damage to piping and liner and are shown on

Figure 5 {*Refer to Drawing 12 of Draft Final Design Report}*. Manhole covers will be installed at the selected locations to access the sampling location without damaging the liner. The manhole will be sealed after each sampling event to prevent water infiltration into the biocell.

The samples will be collected at the same depths every year to achieve comparable results and to avoid the spatial effects. Initial soil samples will be collected immediately after the construction of the biocell to provide the baseline data for comparison. If concentrations of target compounds do not reduce, additional samples may be collected to analyze for nutrient availability and microbial growth, count, and type. Bioaugmentation may be undertaken or nutrients may be added to ensure optimum conditions for bioremediation.

3.5 Off-Gas Vapor Monitoring

Sample ports will be installed before the primary carbon unit, in between two carbon units and after the secondary carbon unit. The vapors extracted from the biocell can be monitored for VOCs using a PID. Once a month vapor samples will be collected from the influent and effluent sampling ports using 6 L summa canisters and 30 minute flow regulators. The samples will be analyzed for VOCs using EPA Method TO-15 by Gas Chomatography Mass Spectrometry (GCMS) by a NYSDOH ELAP certified laboratory.

If the VOC concentrations in between the carbons (measured with a PID) are 10 percent or higher than the influent contaminant concentration, the preliminary carbon will be considered spent and will be replaced with fresh carbon. The secondary carbon canister will become the primary carbon canister and the fresh carbon canister will become the secondary canister.

The air flow will be measured using an in-line air flow meter. Contaminant mass discharges will be calculated by multiplying the air flow, as measured in standard cubic feet per minute, by the total VOC concentration as reported by EPA Method TO-15. Results of the effluent off-gas monitoring will be reported in the Annual Monitoring Report.

4.0 Operation and Maintenance Plan

Following the construction of the biocell, a detailed Operation and Maintenance (O&M) Manual will be prepared by the selected remedial action contractor. This O&M manual will have a detailed description of the system equipment, startup & shutdown procedures, and maintenance requirements. General considerations are provided below.

4.1 System Start-up

After the biocell construction, all pipe connections will be inspected and the header pipes will be connected to the blower system. The piping network and the system will be monitored and the necessary adjustments will be made daily for the first weeks of operation. The blower will be set to extract air from each section of the biocell to maintain a minimum of 5% oxygen levels. Valves on the individual lateral pipes will be adjusted to obtain equal air distribution in all parts of the biocell.

A portable anemometer will be used to monitor the air flow at each lateral to adjust the valves until the desired air flow is achieved each lateral. During startup, one or two layers of piping will be kept open to atmosphere in order to introduce fresh air to maintain air circulation and oxygen level in the biocell. The air flow will be recorded and adjusted daily during the first weeks to balance the system and to ensure stability of air flow. Airflow and the vacuum will be monitored at the blower system by in-line flow meter and vacuum gauges. The entire system will be closely monitored during the first week of start-up for any leaks or pressure losses. Any identified leaks will be addressed immediately.

The moisture knock-out tank will be checked on a daily basis during the system start-up to estimate moisture removal. Soil moisture, oxygen, and temperature readings will be downloaded on a daily basis and necessary adjustments to the system will be made to ensure adequate distribution air and moisture throughout the biocell. VOCs will be monitored using a PID at the influent vapor sampling port, intermediate sampling port, and at the effluent sample port on a daily basis during this start-up phase.

The frequency at which the sump pump operates will be noted and the water level in the holding tank will be monitored to estimate future trends and to avoid alarm conditions. After all five sections of the biocell are built and initial start-up process is completed, water from the holding tank will be introduced into the biocell through the first layer of piping to ensure functionality of the distribution system. Soil moisture will be monitored and any necessary adjustments to the distribution system will be made during this phase.

4.2 Operation, Monitoring and Maintenance

After the initial start-up, the system will be monitored on a weekly basis in the first year. The system will be shut-down during winter months (when the biocell temperature falls below 50ºF) and will be restarted the following year (when biocell temperature rises above 50°F). The system will be monitored biweekly following the startup in the second year. The soil moisture, temperature, and oxygen data will be monitored remotely on a weekly basis.

During each Site visit, the entire system will be checked to ensure proper operation. The water level in the storage tank will be recorded. If the water levels in the tank are approaching its capacity and the moisture content in the biocell is above 30%, arrangement will be made to dispose the collected water off-site. If high level alarm condition exist at the tank and the soil moisture in the biocell is lower than 50%, the water will be distributed in the selected sections of the biocell through the top layer of piping. Every attempt will be made to recirculate the water through the biocell sections with the lowest moisture content.

Vapors will be monitored for VOCs using a PID at the influent, intermediate, and effluent sample ports to ensure the integrity of the carbon. If elevated levels of VOCs are recorded at the intermediate or effluent port, vapor samples will be collected and analyzed immediately. If the laboratory analysis identifies the contaminant concentration in the intermediate sample port at 10 percent of the influent concentration or higher, the carbon from the preliminary vessel will be replaced with fresh carbon and the second carbon unit will become the primary carbon unit.

During routine maintenance, the data for soil moisture and oxygen levels in the soil gas will be downloaded on a computer. If the soils are too dry (<10% moisture content), water will be added via the top layer of perforated piping from the 1,000 gallon collection tank. Water will be taken from either the biocell collection sump, water extracted from on-site groundwater wells, detention basin or other off-site water supply.

If the soils are saturated with water, the sump pump will be checked and steps will be taken to reduce the moisture by increasing the vacuum and hence, the air flow. This can be done for the portions of the biocells by adjusting the valves on individual laterals and varying the layers of piping for vacuum application. Similarly, if level of oxygen is determined to be lower in a portion of biocell, the valves, blower extraction rate and air supply piping layer will be adjusted to achieve optimum air distribution.

If a problem is encountered with any treatment equipment, the equipment will be repaired immediately. Manuals of the proposed instruments will be included as Attachment A. The technician should refer to these manuals and follow the instructions to repair the equipment. All maintenance activities will be recorded in an on-site logbook. The operator will make sure that the moisture from all pipes is drained prior to winter shutdown to prevent freezing and breaking of pipes.

4.3 Reporting

A monitoring report will be submitted to the USEPA following each spring groundwater sampling event. Each report will present a comparison of the most recent groundwater conditions with the Groundwater Cleanup Objectives (see Section 1.5). Additionally, all current and historical data generated in association with this SMP will be presented in graphical and/or tabular format to highlight any groundwater quality trends that may arise.

An Annual Certification Report will be submitted to the USEPA in digital format after winter shut-down every year and following receipt and analysis of the fall groundwater and soil sampling monitoring event. This report will summarize the results of the long-term monitoring program and performance monitoring and will confirm that the conditions of the IC/ECs are being met. An inspection form will be developed for the Site for the assessment of overall Site conditions or IC/EC's conditions, such as monitoring wells, fence, liner, sensors, treatment unit, and notice conditions. This completed form will be included with each annual report. This report will include:

- The remedial activities performed at the Site in that year;
- Details of any maintenance performed;
- Any variance from scope of work;
- Results of annual soil sample collection from biocell;
- Results of the fall semi-annual groundwater sample results, and summary of the spring groundwater sample results;
- Summary of public/private water supply wells;
- Summary of air sample results;
- Condition of IC/ECs; and
- Recommendations for the remediation during the following year.

Pursuant to Section 121(c) of CERCLA, USEPA will review Site remedies at least every five years. The first five-year review would be due within five years of when construction activities are initiated.

4.4 Site Closeout

Once the remedial performance objectives have been met and agreed upon by the USEPA, a Final Remedial Action Report will be submitted. The performance objectives are defined in Section 1.5. Once all performance objectives have been met, all ICs/ECs shall be removed for the site.

5.0 References

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Figures

Appendices

Appendix E

Contingency Plan for Well Head Treatment

AECOM Environment

REMEDIAL DESIGN REPORT CONTINGENCY PLAN

To Implement Wellhead Treatment

draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
Maybrook and Harriman Environmental Trust
One Meadowlands Plaza
East Rutherford, NJ 07073

November 2010

Project Number 106559

500409

Environment

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CONTINGENCY PLAN
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Contents

1.0 Introduction

This Contingency Plan (CP) has been developed to provide wellhead treatment of the Village of Maybrook public water supply wells should monitoring of these wells indicate that they have been impacted by the contamination present at the Nepera Chemical Company Superfund Site located in the Town of Hamptonburgh, Orange County, NY (the Site). This contingency plan is developed on behalf of the Maybrook and Harriman Environmental Trust (Trust) and supplements the Final Design of the remedy selected by the Unites States Environmental protection Agency (USEPA) in the September 2007 Record of Decision (ROD).

The Site is located on the southern side of Orange County Highway 4 in the Town of Hamptonburgh, NY. The Site is located approximately 1.5 miles southwest of the Town of Maybrook and is owned by Nepera, Inc. Approximately five acres of the 29.3 acres total property area were affected by historical lagoon operations. The Site is bounded by Orange County Highway 4 to the north, Beaverdam Brook to the west, Otter Kill to the south and an undeveloped track of land to the east.

Approximately 6,500 people live within three miles of the Site. The closest residences are located approximately 250 feet to the west, and 175 feet and 450 feet to the northeast. These residences rely on private supply wells for drinking water. Monitoring of these residential wells is conducted on an ongoing basis for all site-related contaminants. Furthermore, three public water supply wells owned by the Village of Maybrook are located approximately 800 feet north of the Site. These wells are monitored for site-related contaminants on an annual basis. The land use in vicinity to the Site is residential and agricultural.

If the groundwater monitoring indicates that the Village of Maybrook public water supply wells have been impacted by the site-related contaminants above the health-based levels, this contingency plan will be used to provide for a wellhead treatment for the Village of Maybrook wells on an interim basis pending further consideration of groundwater treatment alternatives.

1.1 Site History

The Site was purchased by the Pyridium Corporation in 1952. The Site was used for wastewater disposal between 1953 and 1967 in six constructed lagoons. These lagoons were used to dispose of wastewater generated at the plant site in Harriman, New York. No wastewater disposal has taken place at the Site since December 1967. All of the lagoons were back-filled with clean soil by 1974.

The Site was placed on the National Priority List (NPL) on June 10, 1986. The Site Superfund Identification Number is NY000511451. The original remedial investigation/feasibility study (RI/FS) program was conducted in accordance with the Stipulation Agreement entered into by Nepera, Inc. and Warner-Lambert Company with the New York State Department of Environmental Conservation (NYSDEC) in March 1988. Subsequently, a Consent Decree lodged in 1988 by the NYSDEC superseded the Stipulation Agreement. A record of decision (ROD) for the Site was issued by the United States Environmental Protection Agency (USEPA) on September 28, 2007. The Administrative Order on Consent (AOC) was logged in Federal Court with Cambrex Corporation, Nepera, Inc., Warner-Lambert Company LLC and Pfizer, Inc, on

October 3, 2008. A Remedial Action Work Plan dated February 2009 and a Letter of Understanding (LOU) dated May 2009 was submitted by AECOM and were approved by USEPA in June 2009. A Preliminary Design Report dated July 2009 was submitted by AECOM and the USEPA comments were received in December 2009. The Final Design Report has been prepared by AECOM to address the USEPA's comments and to provide detailed design (submitted in January 2010).

The two lithologic units (overburden and bedrock) at the Site are divided into three hydrogeologic units. The overburden units include a Shallow Aquifer underlain by a localized Overburden Aquitard. The Bedrock Aquifer resides in competent bedrock below the Site. The Overburden Aquitard unit consists of silt and clay (till) and is discontinuous over the Site. Where present, the till acts as a confining unit and results in isolated or perched pockets of groundwater. The Bedrock Aquifer occurs in the competent portion of the shale bedrock with groundwater traveling through open fractures.

Extensive sampling has identified a number of compounds exceeding the NYSDEC Site-Specific Cleanup Objectives (SCOs). The primary soil contaminants of concern (COCs) are volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The VOCs include benzene, toluene, ethylbenzene and xylene (BTEX), acetone and chlorobenzene. The SVOCs include 2-aminopyridine, 2-picoline, pyridine, aniline and pyridine related tentatively identified compounds (TICs). The primary groundwater COCs are also VOCs and SVOCs. The VOCs detected in either the Shallow or Bedrock Aquifer includes BTEX, acetone and chlorobenzene, with the higher concentrations in the Shallow Aquifer. The SVOCs detected in either the Shallow or Bedrock Aquifer include 2-aminopyridine, 4-choloraniline (1 well) and bis2-ethylhexylphthalate.

1.2 Conceptual Site Model

The source of contamination was wastewater disposed into six lagoons between 1952 and 1967. The total volume of wastewater disposed and the constituents present are unclear; however; it has been reported that up to 250 million gallons were disposed of at the Site during its operation. Material discharged into the lagoons either evaporated or drained into the underlying Shallow Aquifer. No additional "source" material was added after 1967.

Contaminants would have first adsorbed onto the underlying soils or evaporated into the atmosphere. Subsequent loadings would have continued to adsorb onto the soil matrix until the soil's adsorption capacity was exceeded, at which point the contaminants would have begun migrating downward to the underlying aquifer. Groundwater contamination observed during the RI and subsequent monitoring events likely represents initial lagoon seepage and the continued dissolution of contaminants from the lagoon sediments into infiltrating precipitation.

Current release mechanisms include rain and snow melt infiltrating through the former lagoons and entering the Shallow Aquifer. A downward vertical gradient exists between the Shallow and Bedrock Aquifer; therefore, a portion of the groundwater traveling horizontally through the Shallow Aquifer eventually travels into the Bedrock Aquifer. Groundwater flow in the Shallow and Bedrock Aquifer both have a northern and southern component with a groundwater high existing within the area of former Lagoons 4 and 5. The horizontal groundwater velocities in the Shallow and Bedrock Aquifer are reported at 36 feet/year and 5.0 feet/year, respectively; indicating that groundwater is more likely to travel horizontally through the more permeable overburden and saprolite zones in the Shallow Aquifer than through the fractured shale Bedrock Aquifer.

1.3 Remediation Approach

Construction of the on-site biocell along with installation of the horizontal infusion wells has been selected in the ROD for remediation of the Site. The soils will be excavated, segregated, mixed with bulking agents and nutrients, and placed in biocell lined with impermeable liner for biodegradation of the contaminants. The biocell will be equipped with piping for moisture supply and air extraction to introduce fresh air for optimum oxygen level. The biocell has been designed to concurrently operate in the SVE and bioremediation modes. Horizontal infusion wells will be placed in a permeable layer along the bottom of the excavation to introduce oxygenating compounds to treat the groundwater should the COCs be detected above the groundwater cleanup objectives and oxygen in the groundwater drops below the levels necessary for biodegradation.

The proposed remediation design (RD) approach, which is consistent with the ROD, is to integrate an ‘isolation’ strategy in the design/construction of the biocell with ‘remedial flexibility’ in the operation of the biocell. This integrated approach removes uncertainties associated with the remedial action: attainment of the remedial action objectives (RAOs) through source treatment (i.e., biodegradation), elimination of exposure pathways (i.e., isolating source material), and treating contaminated groundwater. This approach will also provide flexibility to adapt to varying Site conditions during system operations. Refer to the Final Remedial Design Report for additional remedial design details.

2.0 Water Supply Wells

The Village of Maybrook serves a population of approximately 3,000 within the Town of Montgomery and Hamptonburgh and also services a portion of County Route 4 (also known as Maybrook Road). The water is obtained from seven bedrock wells with average depths of 357 feet. The water, which is withdrawn from these wells, is treated with chlorine for disinfection and polyphosphates for sequestering of iron and manganese (naturally occurring earth elements) for corrosion control prior to delivery. Due to the close proximity of the Site to three wells (1,2,3) on County Route 4, the Village is required to monitor for VOCs, pesticides, and SVOCs (pyridine, alpha pyridine, and picoline) on an annual basis. As per the Village of Maybrook 2008 Annual Water Quality Report (AWQR), none of the compounds were found above the regulatory limits in the groundwater obtained from these wells.

2.1 Contingency Plan

The three public water supply wells and four residential water supply wells in the proximity of the Site will continue to be annually monitored for site-related contaminants during and following the remedial construction. The monitoring will be conducted at least until the remediation system (biocell and groundwater treatment) is active at the Site and until the objectives of the remediation have been achieved. USEPA, the Village of Maybrook and/or individual home owners will be contacted for approval prior to any change in the frequency or discontinuation of monitoring.

Should the site-related contaminants, as listed in the below table, be detected in the Village of Maybrook public water supply wells or in the residential water supply wells above the New York State Ambient Water Quality Standards (AWQSs) and Guidance Values (GVs) and be directly attributed to the Nepera Chemical Site – and not another release (e.g., gasoline spill) – then immediate steps will be taken to bring the concentration of the contaminants below the AWQS and GVs.

The immediate step will be to install an activated carbon system as part of the current water treatment system to remove VOCs and SVOCs from the water supply. The water from the wells will then be monitored monthly for the site-related contaminants. The use of the activated carbon treatment will be continued on an interim basis while additional groundwater treatment alternatives are evaluated. Three alternatives (e.g., extended groundwater treatment system, addition of a physical-chemical treatment unit, or new well installation) will be evaluated based on the type and concentration of contaminants detected. The safest and the most cost-effective alternative will be selected and implemented as soon as possible with the USEPA and the Village of Maybrook or individual residential owner's approval.

Cleanup Objectives

Contaminant	Ambient Water Quality Standard/Guidance Value (μg/L)
Benzene	1
Chlorobenzene	5
Ethylbenzene	5
Toluene	5
Xylenes (total)	5
Acetone	50
2-Aminopyridine	1
Pyridine	50
Alpha Picoline	50
Aniline	5

Appendix F

Construction Quality Assurance Project Plan

Environment

REMEDIAL DESIGN REPORT
CONSTRUCTION QUALITY ASSURANCE PLAN
draft

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Town of Hamptonburgh
Orange County, New York 10916

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November 2010

Project No. 60134059

AECOM Environment

REMEDIAL DESIGN REPORT
CONSTRUCTION QUALITY ASSURANCE PLAN
draft

Site:
Nepera Chemical Company Superfund Site
Town of Hamptonburgh
Orange County, New York 10916

Submitted to:
United States Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007

Prepared for:
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One Meadowlands Plaza
East Rutherford, NJ 07073

Contents

List of Appendices

1.0 Introduction

This Construction Quality Assurance Project Plan (CQAPP) is designed to assure the quality of the project by monitoring, inspecting, and testing the processes and materials associated with the remediation to be completed at the Nepera Chemical Company Superfund Site located in the Town of Hamptonburgh, Orange County, New York. This CQAPP supplements the Design Report and is intended to work in conjunction with the site Quality Assurance Project Plan (QAPP).

2.0 Construction Quality Assurance Plan Objectives

The objective of this CQAPP is to identify and standardize measures to provide confidence that activities in all phases of the project will be completed in accordance with the Remedial Action Design, applicable local, state and federal regulations and appropriate industry standards. The CQAPP will be implemented through inspection, sampling, testing, and review of services, workmanship, and materials. Specific objectives of this plan establish protocols and procedures for the following components:

1. Responsibility and Authority - The responsibility and authority of the key personnel involved in the completion of the project.

2. Inspection and Testing Activities - Establish the observations and implement inspections and tests that will be used to ensure that the construction activities for the project meet or exceed all design criteria, (i.e., Design Report, and local, state and federal regulations).

3. Sampling Strategies - Establish responsibility for sampling activities and methods including frequency and acceptance criteria for ensuring that sampling meets criteria in the Design Report, local, state and federal regulations.

4. Documentation and Reporting - Establish appropriate field documents (i.e., photographic log, sampling log, and variances to the Design Report).

3.0 Responsibility and Authority

Responsibilities of each component of the construction project team are described below. Prior to beginning construction work individuals will be selected to perform the responsibilities of each component of the construction project team.

3.1 Contractor

The contractor is responsible for coordinating field operations for the remediation, including coordination of subcontractors, to comply with the requirements of the Remedial Design and permitting agencies. The Contractor is responsible for completing and submitting documentation required by this CQAPP and also has the authority to accept or reject the materials and workmanship of any subcontractors at the site.

The contractor is also responsible to ensure a functional construction quality control organization is active during the project and provide support for the construction quality control system to perform inspections, tests and retesting in the event of failure of any item of work, including that of the subcontractors, and to assure compliance with the contract provisions. The construction quality control system includes, but is not limited to, the inspections and tests required in the technical provisions of the Remedial Design, and will cover all project operations.

3.2 Construction Quality Assurance Officer – Trust Representative TBD

The responsibility of the construction quality assurance officer is to perform those activities in this CQAPP deemed necessary to assure the quality of construction and support quality control efforts. The construction quality assurance officer will be on-site as required during construction activities. The responsibility of the construction quality assurance officer is to ensure the quality of construction meets or exceeds that defined by the Remedial Design. Specific responsibilities of the construction quality assurance officer include:

- Directing and supporting the construction quality control representative inspection personnel in performing observations and tests by verifying that the data are properly recorded, validated, reduced, summarized, and inspected.
- Evaluating the construction activities and the construction quality control representative's efforts.
- Evaluating sampling activities and efforts of the sampling quality assurance officer.
- Educating construction quality control inspection personnel on construction quality control requirements and procedures.
- Scheduling and coordinating construction quality assurance inspection activities.

3.3 Sampling Quality Assurance Officer – AECOM Representative TBD

The responsibility of the sampling quality assurance officer is to perform those activities in this CQAPP, Remedial Design, and Quality Assurance Project Plan (QAPP) deemed necessary to assure the quality of sampling and testing and support quality control efforts.

The sampling quality assurance officer provides the permitting agency an assurance that all sampling efforts, for both field and laboratory analysis, meet or exceed that defined by the Remedial Design and identified in this CQAPP. The sampling quality assurance officer will be on site as required during the project. The sampling quality assurance officer will report directly to the construction quality assurance officer.

Specific responsibilities of the sampling quality assurance officer include:

- Confirming that the test data are properly recorded and maintained (this may involve selecting reported results and back tracking them to the original observation and test data sheets).
- Confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process.
- Confirming that specified or required calibration of testing equipment occurs and is properly recorded.
- Providing the construction quality control officer with up to date sampling results.

3.4 Construction Quality Control Representative – AECOM Representative TBD

A construction quality control representative, supplemented as necessary by additional personnel, is to be on the work site during the construction process, with complete authority to take any action necessary to ensure compliance with the Remedial Action Design as necessary to achieve required quality in the constructed facility. Specific responsibilities of the construction quality control representative include:

- Reviewing the Remedial Design for clarity and completeness so that the construction activities can be effectively implemented.
- Observe and document contractor's construction quality for compliance with this CQAPP.
- Performing on-site inspection of the work in progress to assess compliance with the Remedial Design.
- Prepare a transportation log documenting all loads of solid or liquid waste that are transported off site.
- Reporting the results of all observations and tests as the work progresses, modifying materials, and work to comply with Remedial Design. This includes:

    1. Review and interpretation of all data sheets and reports.

2. Identification of work that should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval.

3. Rejection of defective work and verification that corrective measures are implemented.

4. Make observations and records that will be used in the Remedial Action Report.

- Reporting to the construction quality assurance officer results of all inspections including work that is not of acceptable quality or that fails to meet the Remedial Design requirements or Contract Documents.

- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the proper standardized procedures.

- Verifying that materials are installed as specified, except where necessary field modifications were required.

- Serves as the overall Project Emergency Coordinator and have ultimate authority in specifying and facilitating any contingency action during any potential emergencies when the Contingency Plan is implemented.

The construction quality control representative will report directly to the quality assurance officer.

3.5 Sampling Representative/Sampling Technician – AECOM Representative TBD

A sampling representative, supplemented as necessary by additional personnel, is to be on the work site at all times during the construction process. The sampling representative reports directly to the sampling quality assurance officer. Specific responsibilities of the sampling representative include:

- Set up and operation of the weather station.

- Daily recording of meteorological data.

- Daily calibration and operation of real time total VOCs and suspended particulate monitoring equipment.

- Daily recording of real time air quality data. Informs project coordinator and on-site New York State Department of Health (NYSDOH) representatives when concentration of air contaminants approaches or exceeds action levels specified in the CAMP.

- Collection, packaging, and shipment of soil and water samples per guidelines specified in the QAPP and Design Report. Maintaining a master log of all air, water and soil samples collected. Supplying copies of the chain of custody sheets to the Sampling Quality Assurance Officer daily. Tracking confirmation sample points and verifying that sample locations are surveyed for the purpose of producing an as-built drawing depicting confirmation sample point locations.

- Consultation with Sampling Quality Assurance Officer for all technical questions, problems, considerations, or requests for supplies or equipment.

- Maintaining and organizing of an on-site field specialized equipment and supplies storage area.

- Performing the duties of Assistant Health & Safety Officer.

4.0 Performance Testing

The Design Report identifies the following tests/inspections to be performed as part of the Remedial Action:

- All applicable manufacturer fact sheets, warranties, user guides, Material Safety Data Sheets, cut sheets, and quality control documents shall be presented to the Engineer prior to use of the associated material onsite.
- Visual inspection of soils placed within the biocell including photographic documentation of mixing and placement activities.
- Visual inspection of all materials brought onsite including photographic documentation of each type of material.
- Inspection and documentation that backfill soils below the biocell have been properly compacted using a field Standard Proctor test every 2,500 square feet or as directed by the Engineer.
- Inspection and documentation of geotextile and geocomposite placement and repair (if any) as specified in the Specifications included in the Design Report.
- Non-destructive seam testing of the HDPE Liner as specified in Specification 0005 - HDPE Geomembrane.
- Destructive seam testing of the HDPE Liner as specified in Specification 0005 - HDPE Geomembrane.
- Temporary Waste Water Treatment System discharge and system sampling as determined by the State Pollutant Discharge Elimination System Permit of which the Contractor shall meet all substantive requirements of.
- Excavation sidewall and bottom (if applicable) soils confirmation sampling.

The tests/inspections are further defined in the Design Report, CAMP, and QAPP and include who is responsible for performing each test/inspection, the documentation requirements for each test/inspection, and the reporting requirements of each test/inspection. The results and associated documentation of each test/inspection shall be kept by the Construction Quality Control Representative and shall be made available to the Engineer upon request.

5.0 Documentation of Site Activities

In addition to the documentation requirements presented in the Design Report, CAMP, and QAPP the Construction Quality Control Representative shall prepare a daily field construction report (Appendix A) to document daily onsite activities. The daily field construction report shall be submitted to the Construction Quality Assurance Officer at the end of each week and shall be made available to the Engineer upon request.

6.0 Field Measurements and Surveying

The Contractor shall obtain a listened surveyor on call at all times during construction activities. Minimum survey requirements are presented in the Design Report. Additional surveys will be performed at the Engineer's request. Following each survey event, the Contractor will provide an as-built drawing to the Engineer. A site map will be kept onsite at all times with up-to-date excavation and construction limits.

Appendix A

Daily Field Construction Report Template

AECOM		**Project Name:**
		Nepera Chemical Site
		Biocell Construction
		Project Number:

Construction Manager's Daily Report

Date		**Report #**		**Weather**

Summary of Site Activities

Site Health and Safety

Air Monitoring Summary

Field Work Summary

Site Deliveries	**Site Visitors/Association**

AECOM		Project Name:
		(PAGE 2)
		Project Number:

Request For Information

Meetings Held
Tailgate safety meeting

Transmittals / Submittals

Verbal Instructions – Given / Received

Remarks / Comments

Landfill total to date-
Foam- Day/To Date-

Water treated today-
Water treated to date-
Water samples submitted today-
Plant maintenance/issues-

Appendix G

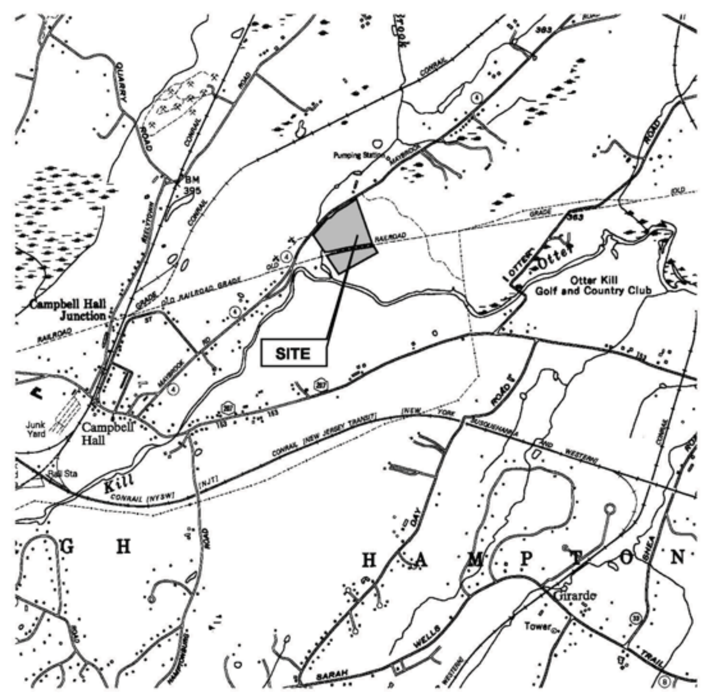
Quality Assurance Project Plan

Attachment A

Design Drawings

NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
EPA SITE ID NYD000511451
Maybrook Road (CR 4)
Town of Hamptonburgh, Orange County, New York

NOVEMBER 2010



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Scott A. Underhill, P.E. Date
NYSPE Lic. No. 075332

500435

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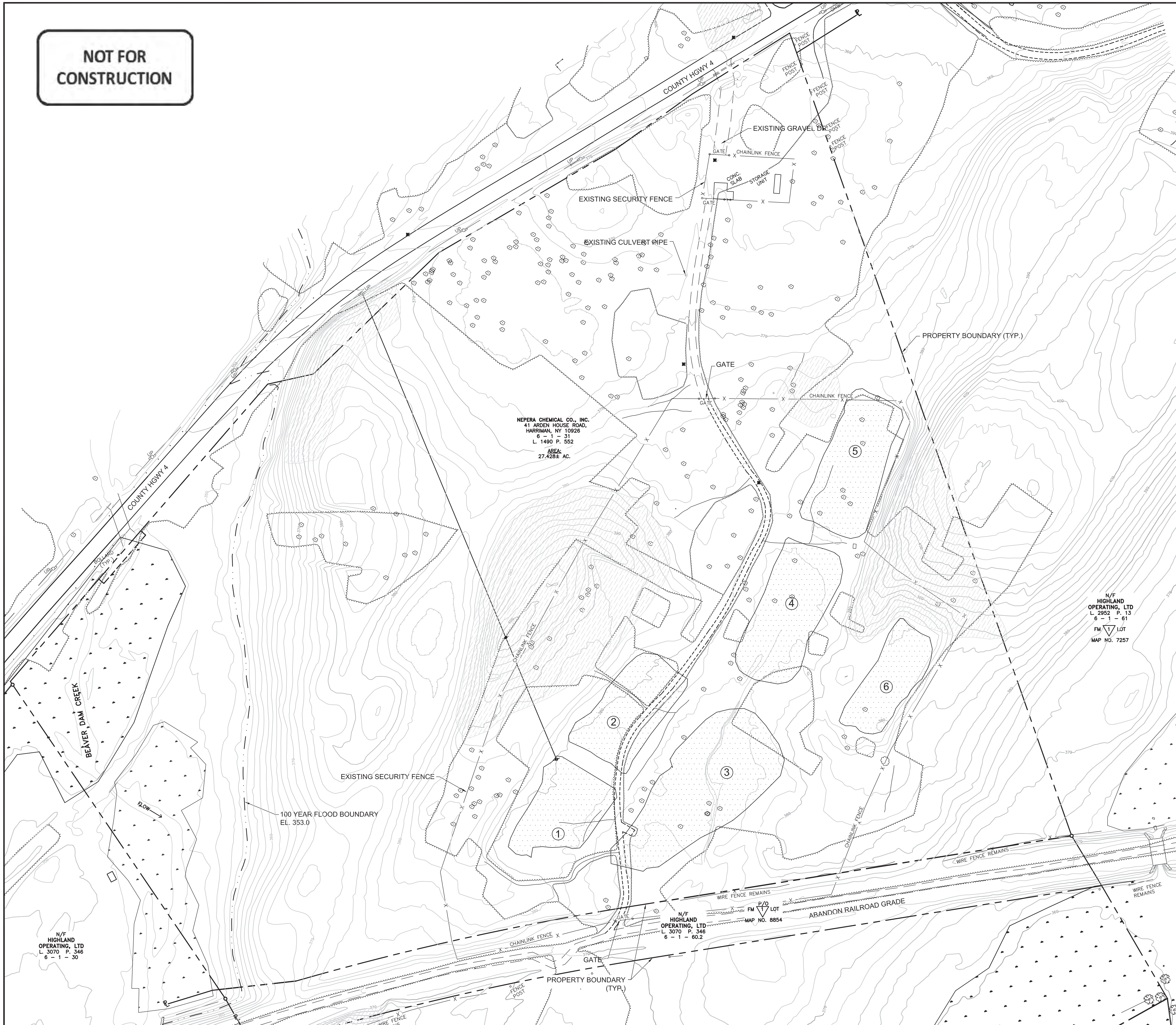

LEGEND

- ELEVATION CONTOUR
- SITE PROPERTY BOUNDARY
- PREVIOUS LOCATION OF LAGOON (SUPERIMPOSED FROM 06/24/1963 AERIAL PHOTOGRAPH)
- APPROXIMATE LIMITS OF BEDROCK OUTCROP
- WETLAND
- FENCE LINE
- TREE LINE
- TREE
- UTILITY POLE WITH OVERHEAD WIRES
- 100 YEAR FLOOD BOUNDARY

MAP REFERENCE:

Base mapping shown from report titled Feasibility Study by CRA dated August 2004.

Mapping aligned onto a property boundary survey drawing No. A-09-0030-01, by Lanc & Tully Engineering and Survey dated May 1 2009.

Mapping on New York State Plane Coordinate System NAD83 - East.

Vertical datum based on site datum of above referenced report by CRA.

100 Year Flood Boundary taken from Flood Insurance Rate Map (FIRM), Town of Hamptonburg - Map 360716303E (FEMA 2009)

PLAN

0' 30' 60' 120'

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

VERIFY SCALE IF PLAN SHEET IS REDUCED — 1-INCH

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NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

EXISTING SITE CONDITIONS

PROJECT START DATE (M / Y): NOVEMBER 2010

PROJECT NO.: 106559

FILENAME: NEPERA_RDWP-DESIGN-1.dwg

SHEET NO.: 2

DRAWING NO.: 2

500436

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NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

LIMITS OF EXCAVATION

PROJECT START DATE (M / Y)
NOVEMBER 2010

PROJECT NO.
106559

FILENAME
NEPERA_RDWP-DESIGN-1.dwg

SHEET NO.
3

DRAWING NO.
3

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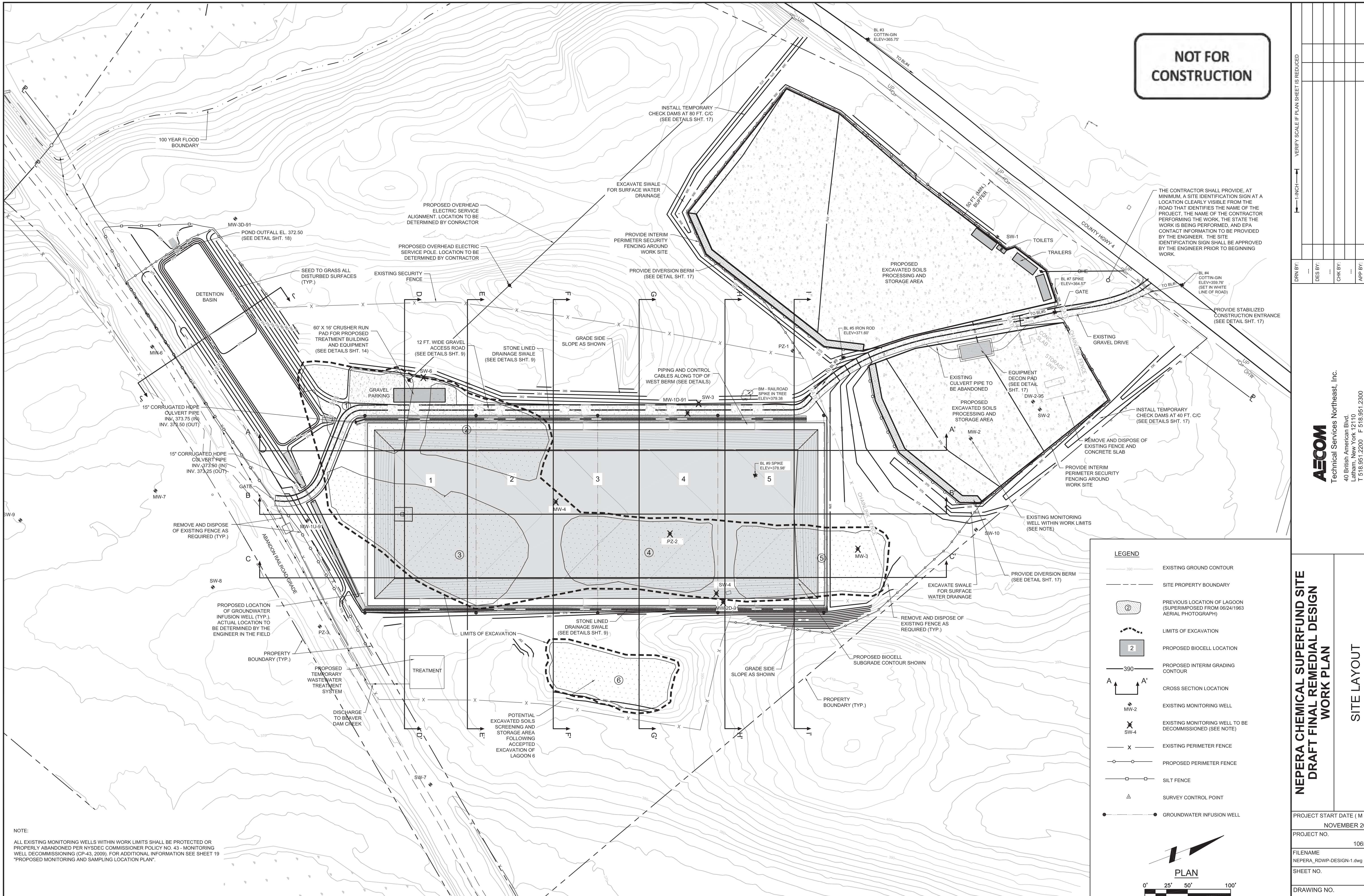
NOT FOR CONSTRUCTION
100 YEAR FLOOD BOUNDARY
INSTALL TEMPORARY CHECK DAMS AT 80 FT. C/C (SEE DETAILS SHT. 17)
EXCAVATE SWALE FOR SURFACE WATER DRAINAGE
PROPOSED OVERHEAD ELECTRIC SERVICE ALIGNMENT. LOCATION TO BE DETERMINED BY CONRACTOR
PROPOSED OVERHEAD ELECTRIC SERVICE POLE. LOCATION TO BE DETERMINED BY CONTRACTOR
PROVIDE INTERIM PERIMETER SECURITY FENCING AROUND WORK SITE
PROVIDE DIVERSION BERM (SEE DETAIL SHT. 17)
MW-3D-91
POND OUTFALL EL. 372.50 (SEE DETAIL SHT. 18)
SEED TO GRASS ALL DISTURBED SURFACES (TYP.)
EXISTING SECURITY FENCE
DETENTION BASIN
60' X 16' CRUSHER RUN PAD FOR PROPOSED TREATMENT BUILDING AND EQUIPMENT (SEE DETAILS SHT. 14)
12 FT. WIDE GRAVEL ACCESS ROAD (SEE DETAILS SHT. 9)
STONE LINED DRAINAGE SWALE (SEE DETAILS SHT. 9)
GRADE SIDE SLOPE AS SHOWN
PIPING AND CONTROL CABLES ALONG TOP OF WEST BERM (SEE DETAILS)
BM - RAILROAD SPIKE IN TREE ELEV=379.38
PZ-1
MW-6
GRAVEL PARKING
SW-6
SW-3
MW-1D-91
15" CORRUGATED HDPE CULVERT PIPE INV. 373.75 (IN) INV. 373.50 (OUT)
15" CORRUGATED HDPE CULVERT PIPE INV. 373.50 (IN) INV. 373.25 (OUT)
GATE
MW-7
SW-9
REMOVE AND DISPOSE OF EXISTING FENCE AS REQUIRED (TYP.)
MW-1U-91
ABANDON RAILROAD GRADE
SW-8
PROPOSED LOCATION OF GROUNDWATER INFUSION WELL (TYP.). ACTUAL LOCATION TO BE DETERMINED BY THE ENGINEER IN THE FIELD
PZ-3
PROPERTY BOUNDARY (TYP.)
PROPOSED TEMPORARY WASTEWATER TREATMENT SYSTEM
TREATMENT
DISCHARGE TO BEAVER DAM CREEK
LIMITS OF EXCAVATION
STONE LINED DRAINAGE SWALE (SEE DETAILS SHT. 9)
POTENTIAL EXCAVATED SOILS SCREENING AND STORAGE AREA FOLLOWING ACCEPTED EXCAVATION OF LAGOON 6
GRADE SIDE SLOPE AS SHOWN
PROPERTY BOUNDARY (TYP.)
PROPOSED BIOCELL SUBGRADE CONTOUR SHOWN
REMOVE AND DISPOSE OF EXISTING FENCE AS REQUIRED (TYP.)
EXCAVATE SWALE FOR SURFACE WATER DRAINAGE
PROVIDE DIVERSION BERM (SEE DETAIL SHT. 17)
SW-7
MW-4
PZ-2
MW-3
SW-4
MW-2D-91
SW-10
BL #9 SPIKE ELEV=378.98'
BL #3 COTTIN-GIN ELEV=365.75'
TO BL#4
50 FT. (MIN.) BUFFER
COUNTY HGWY 4
SW-1
TOILETS
TRAILERS
PROPOSED EXCAVATED SOILS PROCESSING AND STORAGE AREA
BL #7 SPIKE ELEV=364.57'
GATE
BL #5 IRON ROD ELEV=371.60'
BL #4 COTTIN-GIN ELEV=359.76' (SET IN WHITE LINE OF ROAD)
PROVIDE STABILIZED CONSTRUCTION ENTRANCE (SEE DETAIL SHT. 17)
EXISTING GRAVEL DRIVE
THE CONTRACTOR SHALL PROVIDE, AT MINIMUM, A SITE IDENTIFICATION SIGN AT A LOCATION CLEARLY VISIBLE FROM THE ROAD THAT IDENTIFIES THE NAME OF THE PROJECT, THE NAME OF THE CONTRACTOR PERFORMING THE WORK, THE STATE THE WORK IS BEING PERFORMED, AND EPA CONTACT INFORMATION TO BE PROVIDED BY THE ENGINEER. THE SITE IDENTIFICATION SIGN SHALL BE APPROVED BY THE ENGINEER PRIOR TO BEGINNING WORK.
EXISTING CULVERT PIPE TO BE ABANDONED
EQUIPMENT DECON PAD (SEE DETAIL SHT. 17)
DW-2-95
PROPOSED EXCAVATED SOILS PROCESSING AND STORAGE AREA
CONC. SLAB
STORAGE UNIT
CHAINLINK FENCE
SW-2
MW-2
INSTALL TEMPORARY CHECK DAMS AT 40 FT. C/C (SEE DETAILS SHT. 17)
REMOVE AND DISPOSE OF EXISTING FENCE AND CONCRETE SLAB
PROVIDE INTERIM PERIMETER SECURITY FENCING AROUND WORK SITE
EXISTING MONITORING WELL WITHIN WORK LIMITS (SEE NOTE)
LEGEND
EXISTING GROUND CONTOUR
SITE PROPERTY BOUNDARY
PREVIOUS LOCATION OF LAGOON (SUPERIMPOSED FROM 06/24/1963 AERIAL PHOTOGRAPH)
LIMITS OF EXCAVATION
PROPOSED BIOCELL LOCATION
PROPOSED INTERIM GRADING CONTOUR
CROSS SECTION LOCATION
EXISTING MONITORING WELL
EXISTING MONITORING WELL TO BE DECOMMISSIONED (SEE NOTE)
EXISTING PERIMETER FENCE
PROPOSED PERIMETER FENCE
SILT FENCE
SURVEY CONTROL POINT
GROUNDWATER INFUSION WELL
PLAN
0' 25' 50' 100'
NOTE:
ALL EXISTING MONITORING WELLS WITHIN WORK LIMITS SHALL BE PROTECTED OR PROPERLY ABANDONED PER NYSDEC COMMISSIONER POLICY NO. 43 - MONITORING WELL DECOMMISSIONING (CP-43, 2009). FOR ADDITIONAL INFORMATION SEE SHEET 19 "PROPOSED MONITORING AND SAMPLING LOCATION PLAN".
VERIFY SCALE IF PLAN SHEET IS REDUCED
REV
DESCRIPTION
DRN
CHK
DATE (M/D/Y)
DRN BY:
DES BY:
CHK BY:
APP BY:
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NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN
SITE LAYOUT
PROJECT START DATE (M / Y)
NOVEMBER 2010
PROJECT NO.
106559
FILENAME
NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.
4
DRAWING NO.
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NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

EXCAVATION LAYOUT

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
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DRAWING NO.: 5

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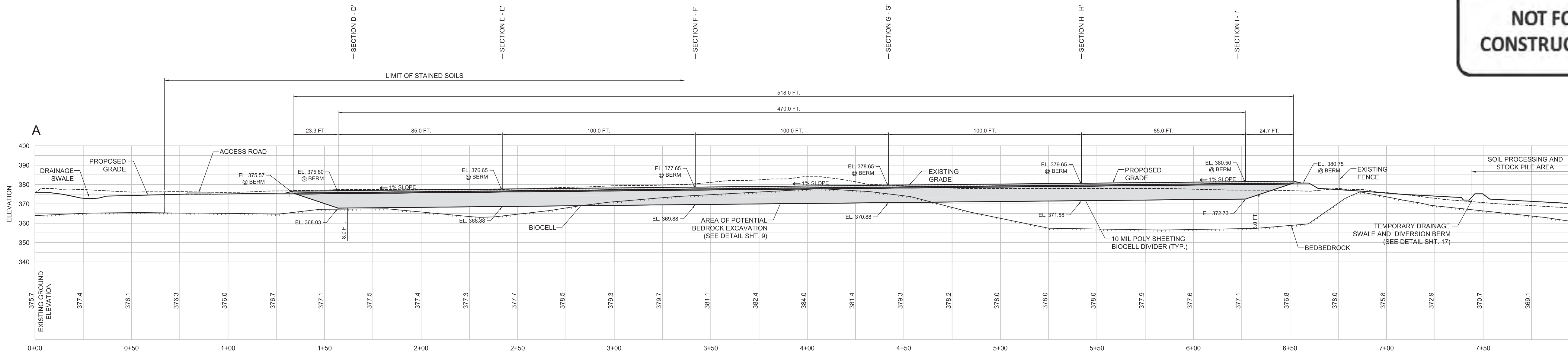
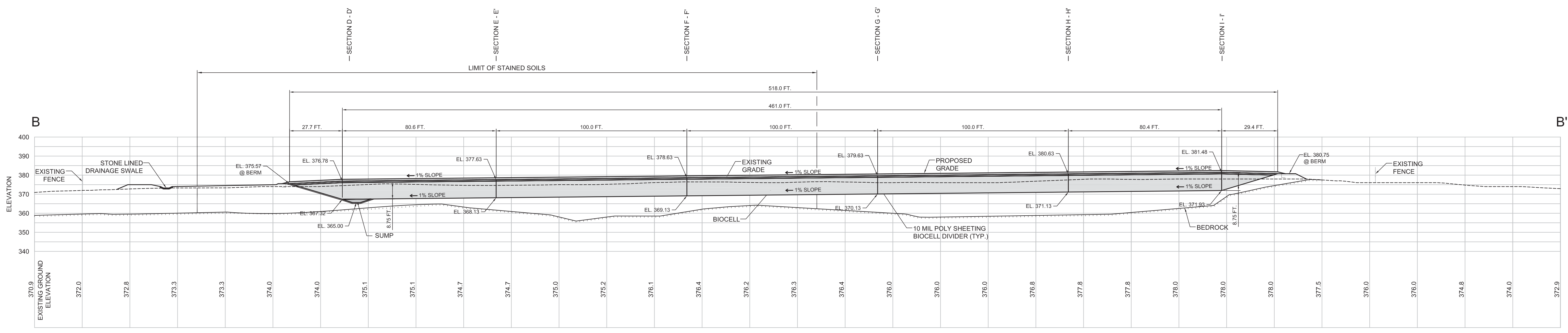


SECTION A - A'

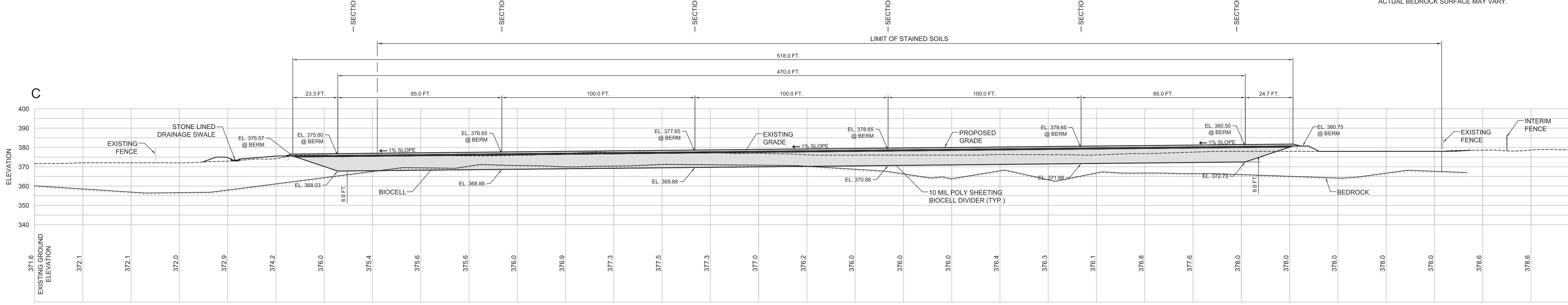


SECTION B - B'

NOTES:

1) LABELED ELEVATIONS INDICATE PROPOSED LINER AND CAP GRADES

2) BEDROCK SURFACE SHOWN IS TO BE CONSIDERED APPROXIMATE. ACTUAL BEDROCK SURFACE MAY VARY.



SECTION C - C'

HORIZ. 0' 15' 30' 60'

VERT. 0' 15' 30' 60'

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SECTIONS A-A', B-B' & C-C'

PROJECT START DATE (M / Y): NOVEMBER 2010

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SHEET NO.: 6

DRAWING NO.: 6

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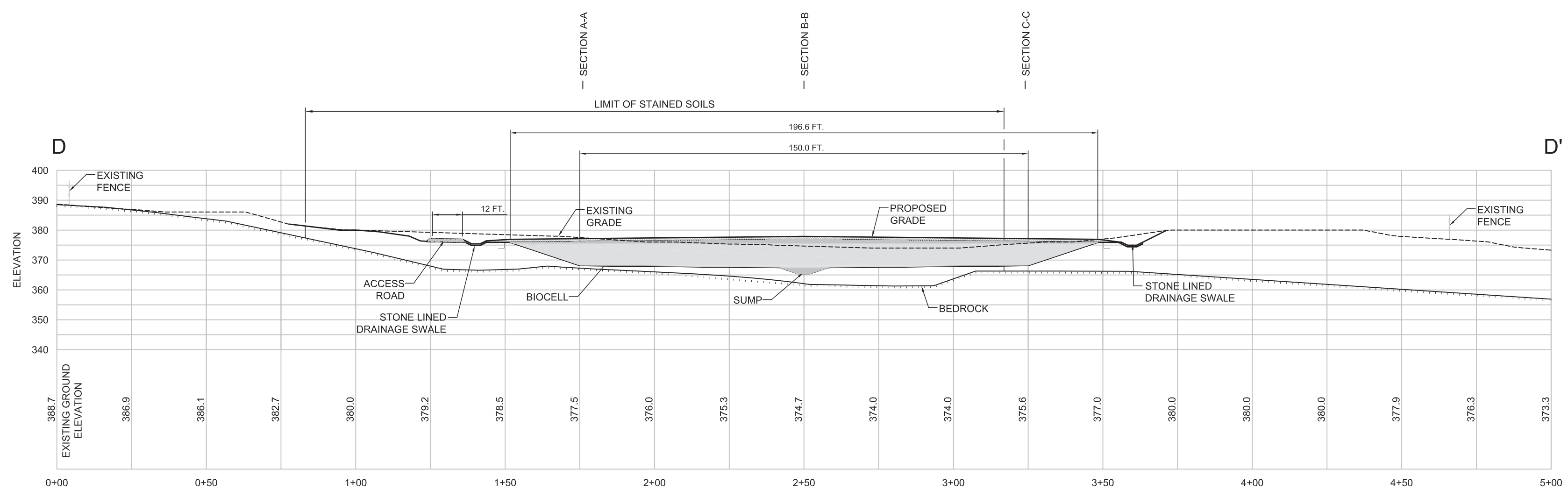
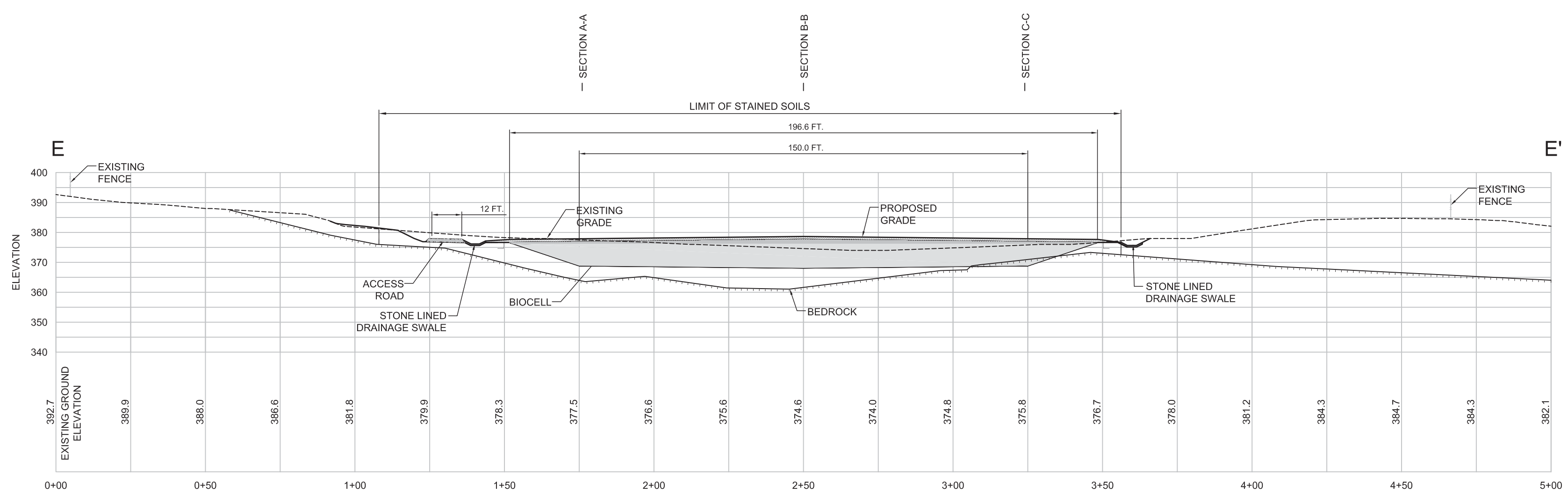
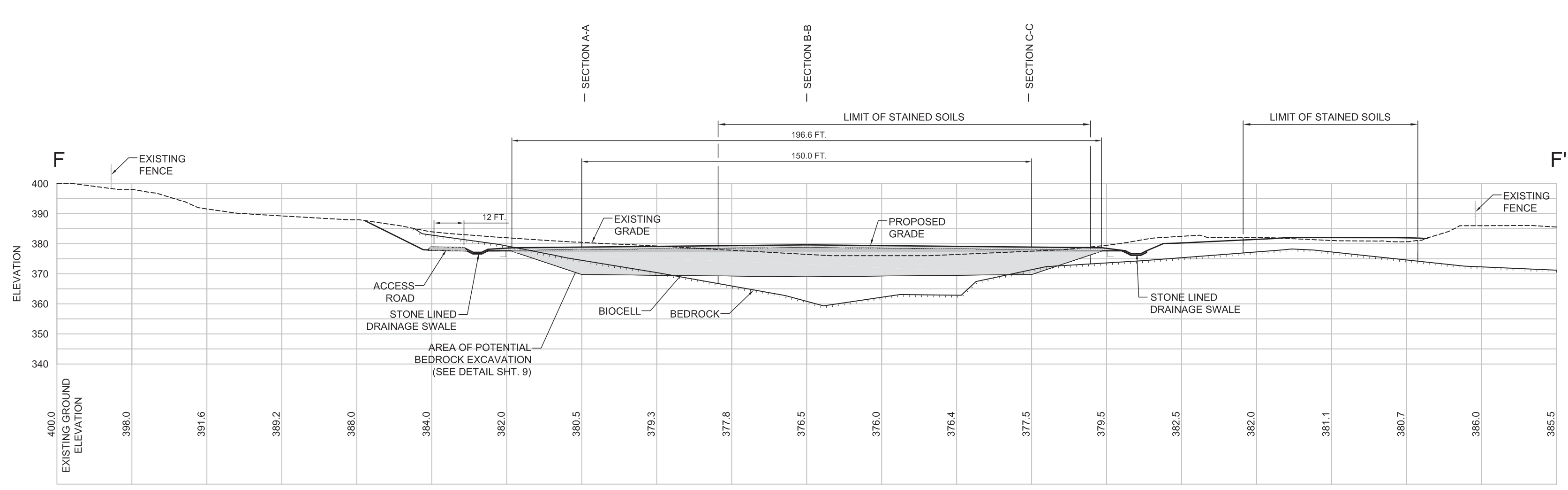


SECTION D - D'



SECTION E - E'



SECTION F - F'

NOTES:

1) LABELED ELEVATIONS INDICATE PROPOSED LINER AND CAP GRADES

2) BEDROCK SURFACE SHOWN IS TO BE CONSIDERED APPROXIMATE. ACTUAL BEDROCK SURFACE MAY VARY.

HORIZ. 0' 15' 30' 60'
VERT. 0' 15' 30' 60'

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
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SECTIONS D-D', E-E' & F-F'

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DRAWING NO.: 7

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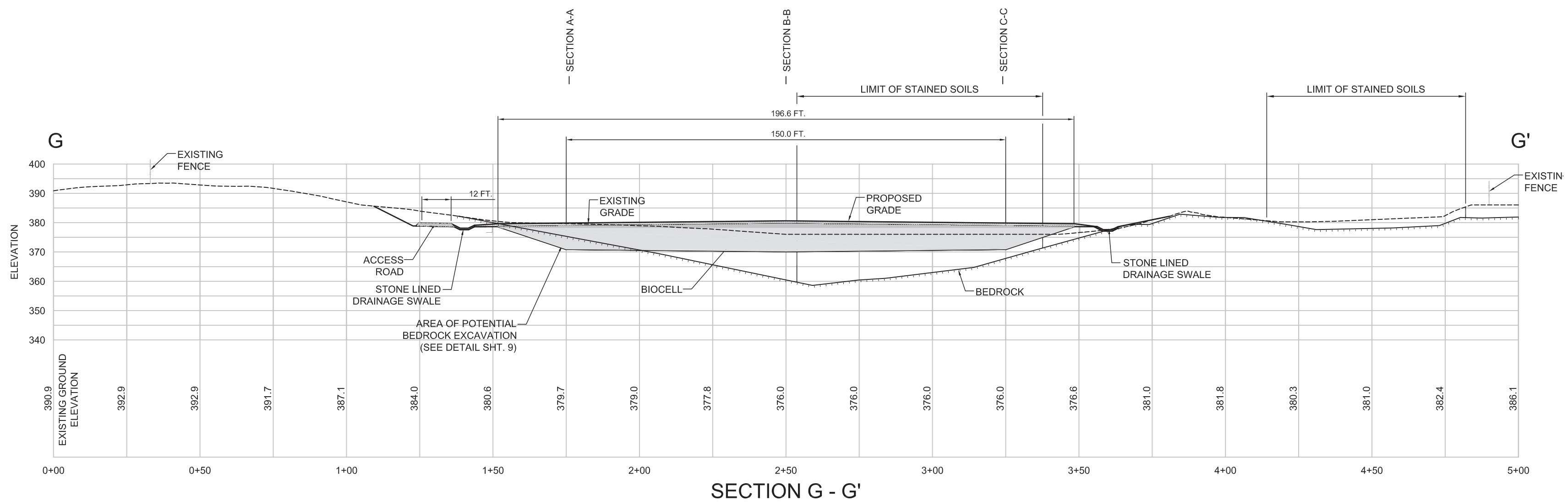
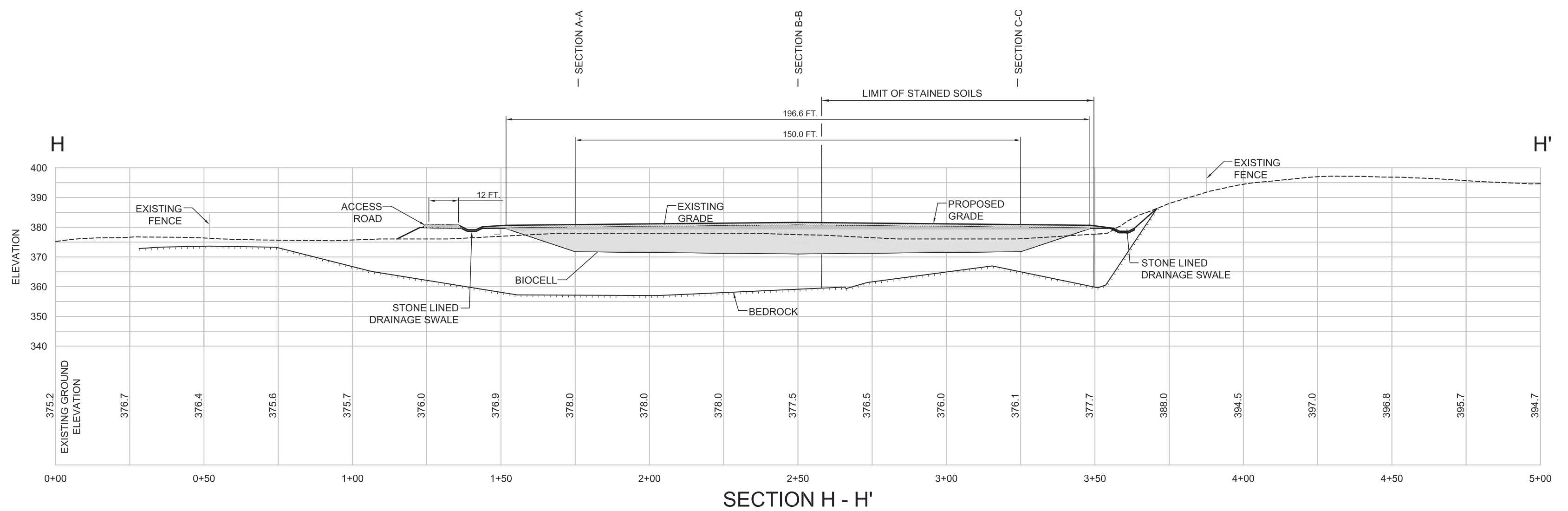


SECTION G - G'



SECTION H - H'

NOTES:

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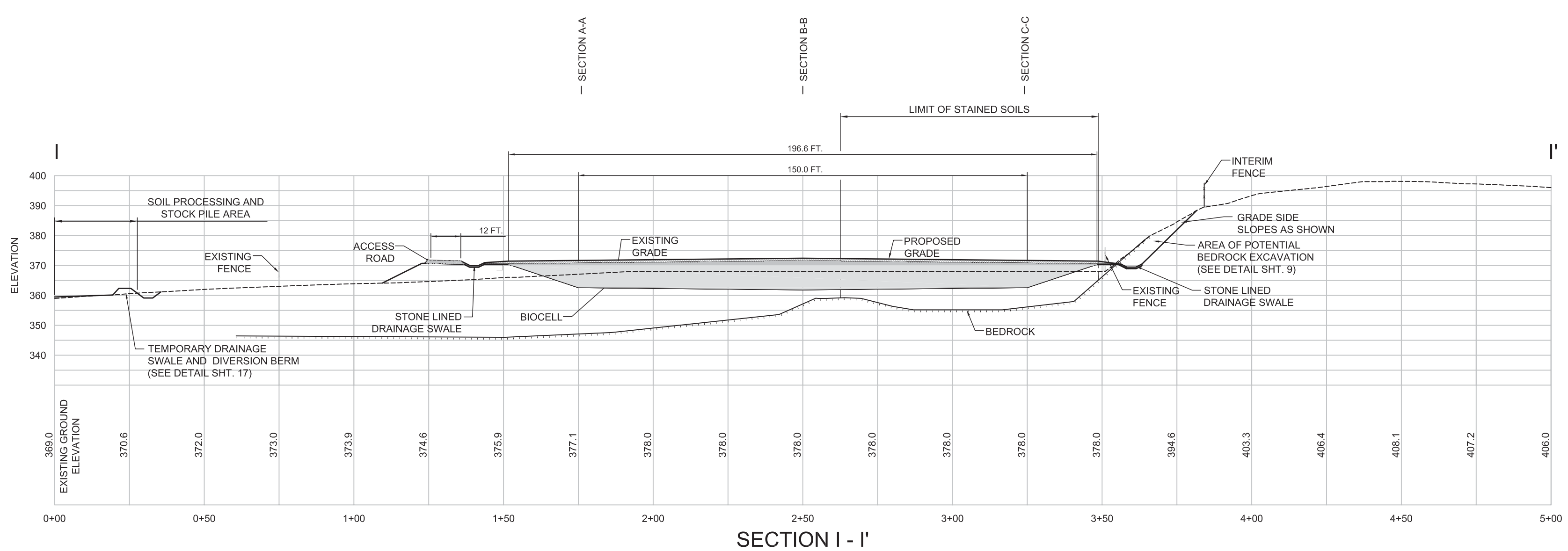
2) BEDROCK SURFACE SHOWN IS TO BE CONSIDERED APPROXIMATE. ACTUAL BEDROCK SURFACE MAY VARY.



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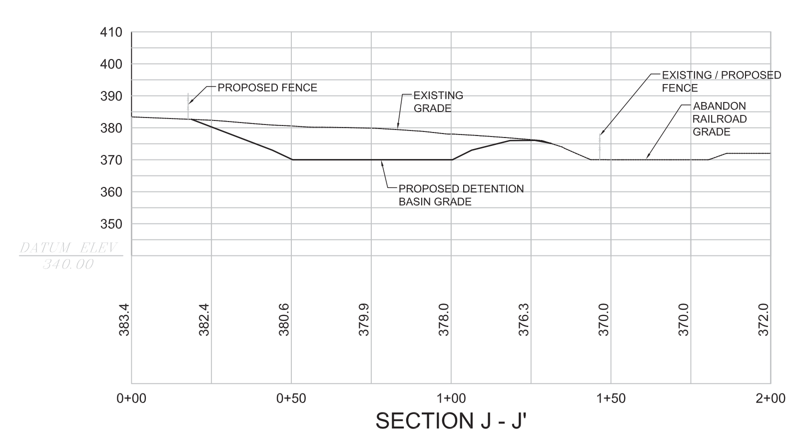

SECTION J - J'

HORIZ. 0' 15' 30' 60'
VERT. 0' 15' 30' 60'

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

SECTIONS G-G', H-H' & I-I'

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DRAWING NO.: 8

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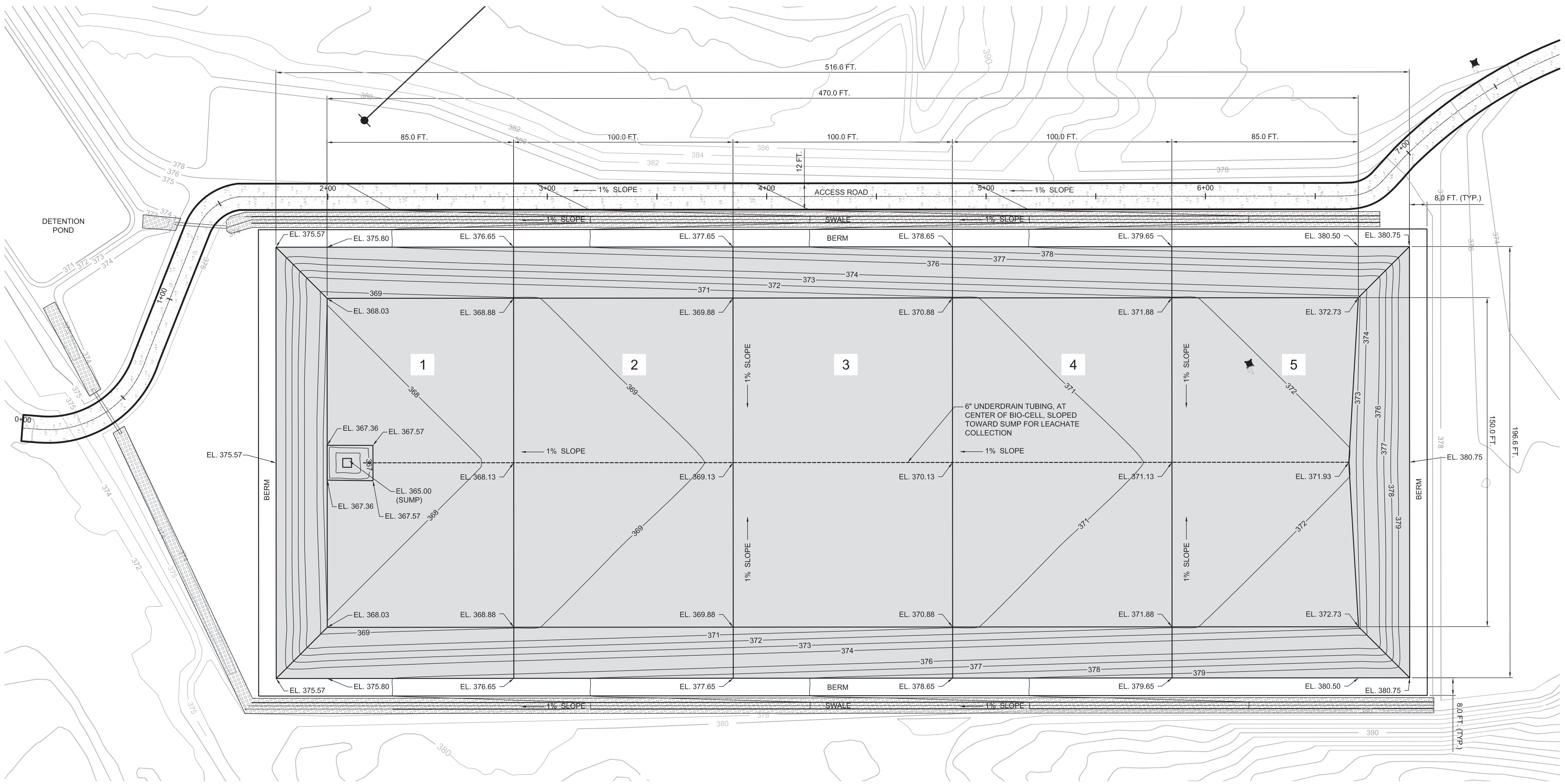
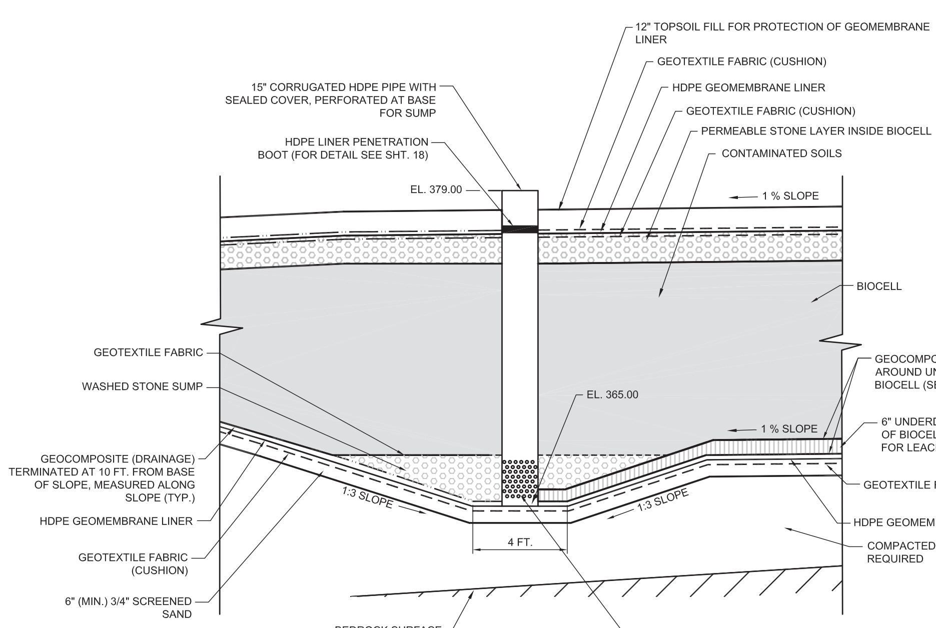


BIO-CELL STAKE OUT INFORMATION

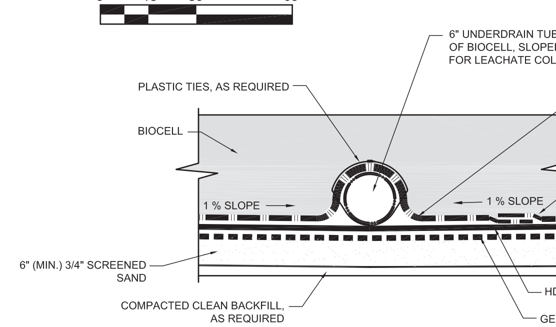
PNT.	NORTH	EAST	ELEVATION	DESCRIPTION
101	958455.1709	562461.5089	375.57	LINER
102	958417.4930	562560.9074	375.57	LINER
103	958379.8150	562660.3059	375.57	LINER
104	958459.8159	562471.8251	375.57	LINER
105	958424.9736	562563.7430	375.57	LINER
106	958390.1312	562655.6609	375.57	LINER
107	958473.3446	562501.8710	368.03	LINER
108	958453.6868	562566.1439	367.41	LINER
109	958448.0636	562580.9786	367.41	LINER
110	958420.1772	562642.1323	368.03	LINER
111	958469.0688	562571.9746	367.57	LINER
112	958463.3661	562587.0188	367.57	LINER
113	958454.0994	562572.6445	365.00	LINER
114	958452.6816	562576.3848	365.00	LINER
115	958457.8397	562574.0623	365.00	LINER
116	958456.4021	562577.8550	365.00	LINER
117	958563.9203	562502.7313	376.65	LINER
118	958561.0846	562510.2120	376.65	LINER
119	958552.8260	562531.9992	368.88	LINER
120	958526.2422	562602.1298	368.13	LINER
121	958499.6586	562672.2605	368.88	LINER
122	958491.3999	562694.0477	376.65	LINER
123	958488.5643	562701.5283	376.65	LINER
124	958657.4278	562538.1762	377.65	LINER
125	958654.5921	562545.6568	377.65	LINER
126	958646.3335	562567.4441	369.88	LINER
127	958619.7498	562637.5747	369.13	LINER
128	958593.1661	562707.7054	369.88	LINER
129	958584.9074	562729.4926	377.65	LINER
130	958582.0718	562736.9732	377.65	LINER
131	958750.9353	562573.6211	378.65	LINER
132	958748.0996	562581.1017	378.65	LINER
133	958739.8410	562602.8890	370.88	LINER
134	958713.2573	562673.0196	370.13	LINER
135	958686.6736	562743.1503	370.88	LINER
136	958678.4150	562764.9375	378.65	LINER
137	958675.5794	562772.4181	378.65	LINER
139	958844.4428	562609.0661	379.65	LINER
140	958841.6072	562616.5466	379.65	LINER
141	958833.3486	562638.3340	371.88	LINER
142	958806.7648	562708.4645	371.13	LINER
143	958780.1812	562778.5952	371.88	LINER
144	958771.9225	562800.3824	379.65	LINER
145	958769.0869	562807.8630	379.65	LINER
146	958912.8299	562668.4621	372.73	LINER
147	958882.1319	562737.0331	371.93	LINER
148	958859.6626	562808.7234	372.73	LINER
149	958942.8758	562654.9335	380.75	LINER
150	958908.0335	562746.8514	380.75	LINER
151	958873.1911	562838.7693	380.75	LINER
152	958953.1920	562650.2885	380.75	LINER
153	958915.5141	562749.6870	380.75	LINER
154	958877.8362	562849.0855	380.75	LINER

NOTES:
1) LABELED ELEVATIONS INDICATE PROPOSED LINER GRADES. FOR COVER INFORMATION SEE FINAL GRADING AND SITE RESTORATION PLAN.
2) PIPING NOT SHOWN FOR CLARITY. SEE TYPICAL BIOCELL PIPING AND MONITORING LAYOUT PLAN FOR INFORMATION.

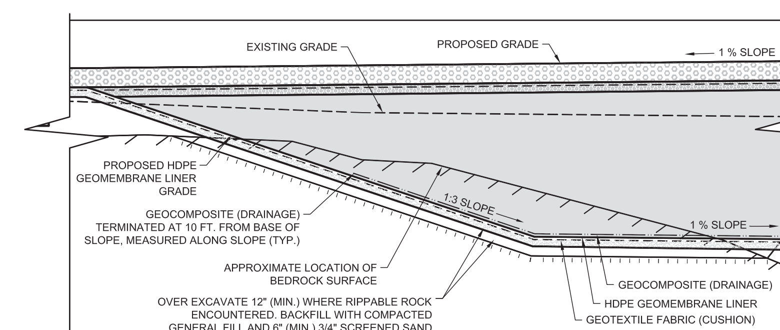
BIOCELL PLAN
0' 15' 30' 60'



BIOCELL SUMP DETAIL
NOT TO SCALE

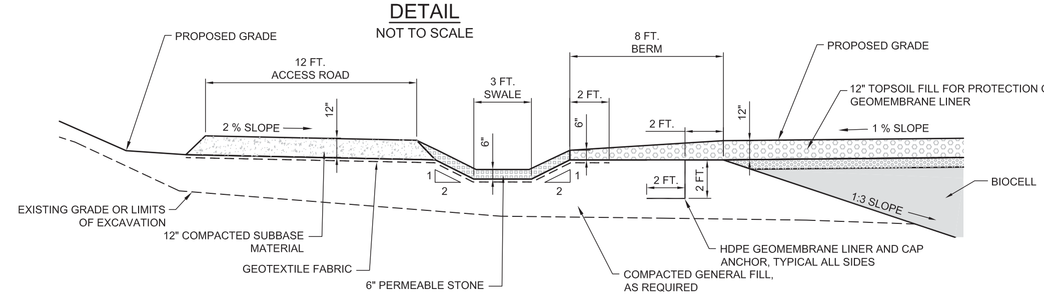


LEACHATE COLLECTION DETAIL
NOT TO SCALE



ROCK EXCAVATION DETAIL
NOT TO SCALE

ROCK EXCAVATION NOTE:
CONTRACTOR MAY ENCOUNTER WEATHERED OR UN-SOUND ROCK WHILE EXCAVATING FOR THE PROPOSED BIOCELL INSTALLATION. IF SOUND BEDROCK IS FOUND WITHIN THESE LIMITS, THE BIOCELL LINER INSTALLATION MAY BE MODIFIED ACCORDINGLY WHILE MAINTAINING DIRECTION AND MINIMUM PERCENT OF GRADE FOR SLOPES. ADDITIONALLY THE CONTRACTOR SHALL EXPOSE BEDROCK TO THE PROPOSED LIMITS OF EXCAVATION SHOWN AND PROVIDE A DETAILED SURVEY (TO THE ENGINEER) FOR ASSESSMENT FOR BIOCELL QUANTITY REDUCTION.



TYPICAL ACCESS ROAD AND LINER ANCHOR TRENCH DETAIL
NOT TO SCALE

NOT FOR CONSTRUCTION

VERIFY SCALE IF PLAN SHEET IS REDUCED
1-INCH

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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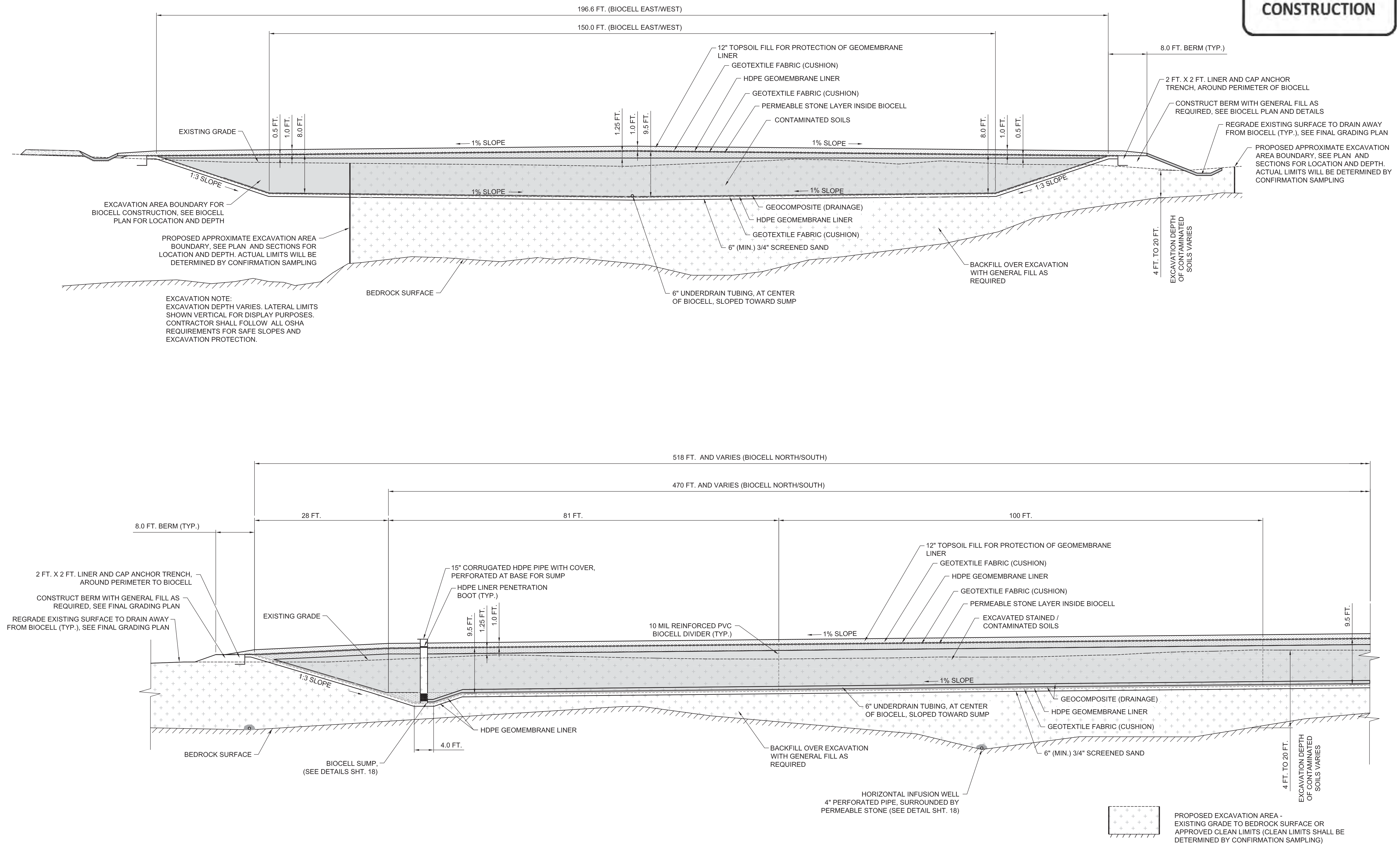
NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

BIOCELL PLAN
AND DETAILS

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 9
DRAWING NO.: 9

NOT FOR CONSTRUCTION



NOTE:
PIPING NOT SHOWN FOR CLARITY. SEE TYPICAL BIOCELL PIPING AND MONITORING LAYOUT PLAN.

TYPICAL BIOCELL SECTIONS

0' 5' 10' 20'

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

VERIFY SCALE IF PLAN SHEET IS REDUCED — 1-INCH

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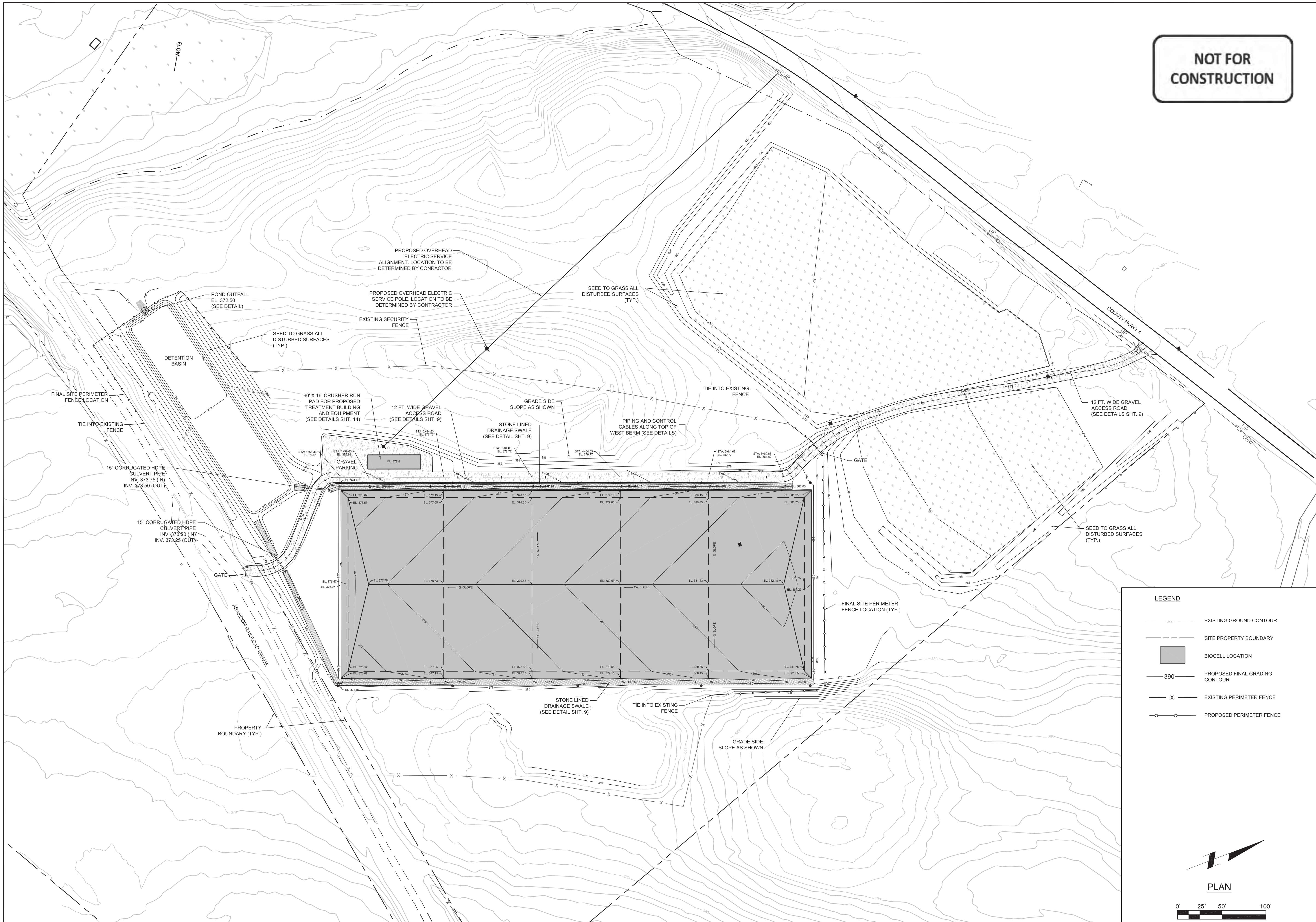
NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

BIOCELL TYPICAL SECTIONS

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 10
DRAWING NO.: 10

500444



VERIFY SCALE IF PLAN SHEET IS REDUCED 1-INCH

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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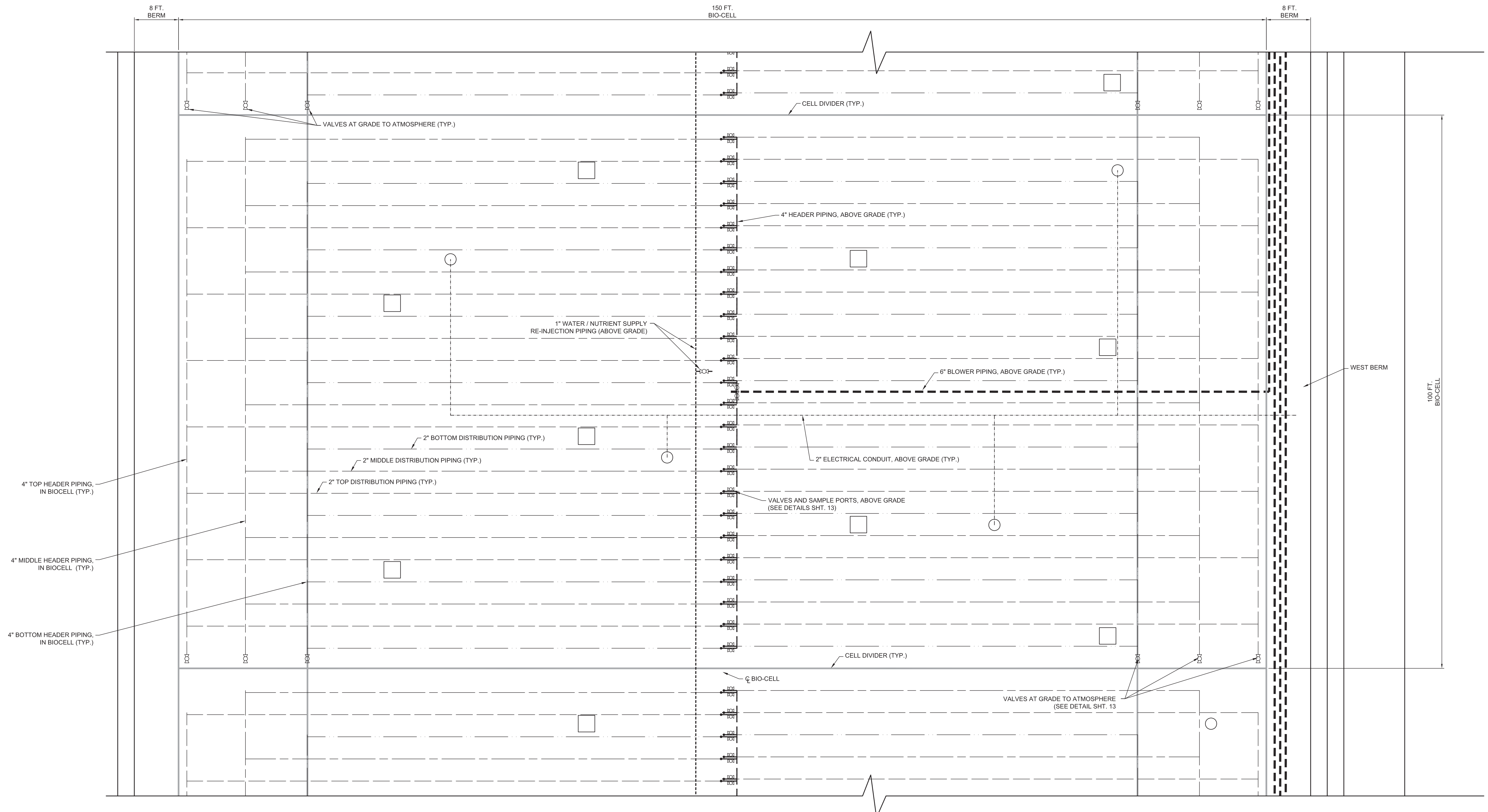
NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

POST-CONSTRUCTION GRADING AND SITE RESTORATION PLAN

PROJECT START DATE (M / Y) NOVEMBER 2010
PROJECT NO. 106559
FILENAME NEPERA_RDWP-DESIGN-1.dwg
SHEET NO. 11
DRAWING NO. 11

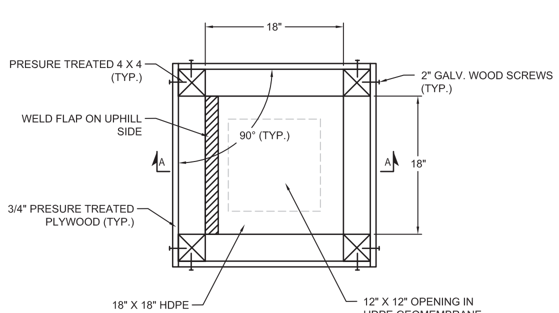
500445

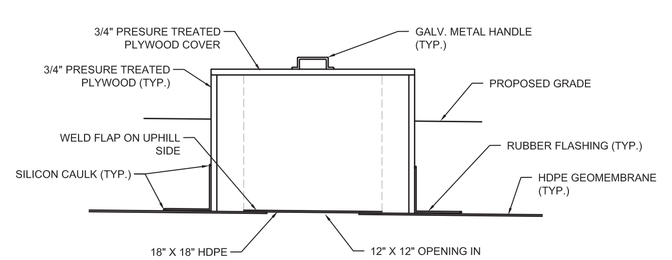


NOTE:
BIOCELL TWO SHOWN, OTHER BIOCELLS ARE SIMILAR

TYPICAL BIOCELL PIPING LAYOUT PLAN

0' 5' 10' 20'





TYPICAL SAMPLE PORT ACCESS WAY
NOT TO SCALE

LEGEND

6" BLOWER PIPING	2" MOISTURE / NUTRIENT RETURN PIPING
4" TOP HEADER PIPING (ABOVE GRADE & IN BIOCELL)	BALL VALVE
4" MIDDLE HEADER PIPING (ABOVE GRADE & IN BIOCELL)	SAMPLE PORT LOCATION (SEE DETAIL THIS SHT.)
4" BOTTOM HEADER PIPING (ABOVE GRADE & IN BIOCELL)	MONITORING PROBE LOCATION (SEE DETAIL SHT. 13)
2" TOP DISTRIBUTION PIING (IN BIOCELL)	
2" MIDDLE DISTRIBUTION PIPING (IN BIOCELL)	
2" BOTTOM DISTRIBUTION PIPING (IN BIOCELL)	

NOT FOR CONSTRUCTION

VERIFY SCALE IF PLAN SHEET IS REDUCED — 1-INCH

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

TYPICAL BIO-CELL PIPING AND MONITORING LAYOUT PLAN

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 12
DRAWING NO.: 12

500446

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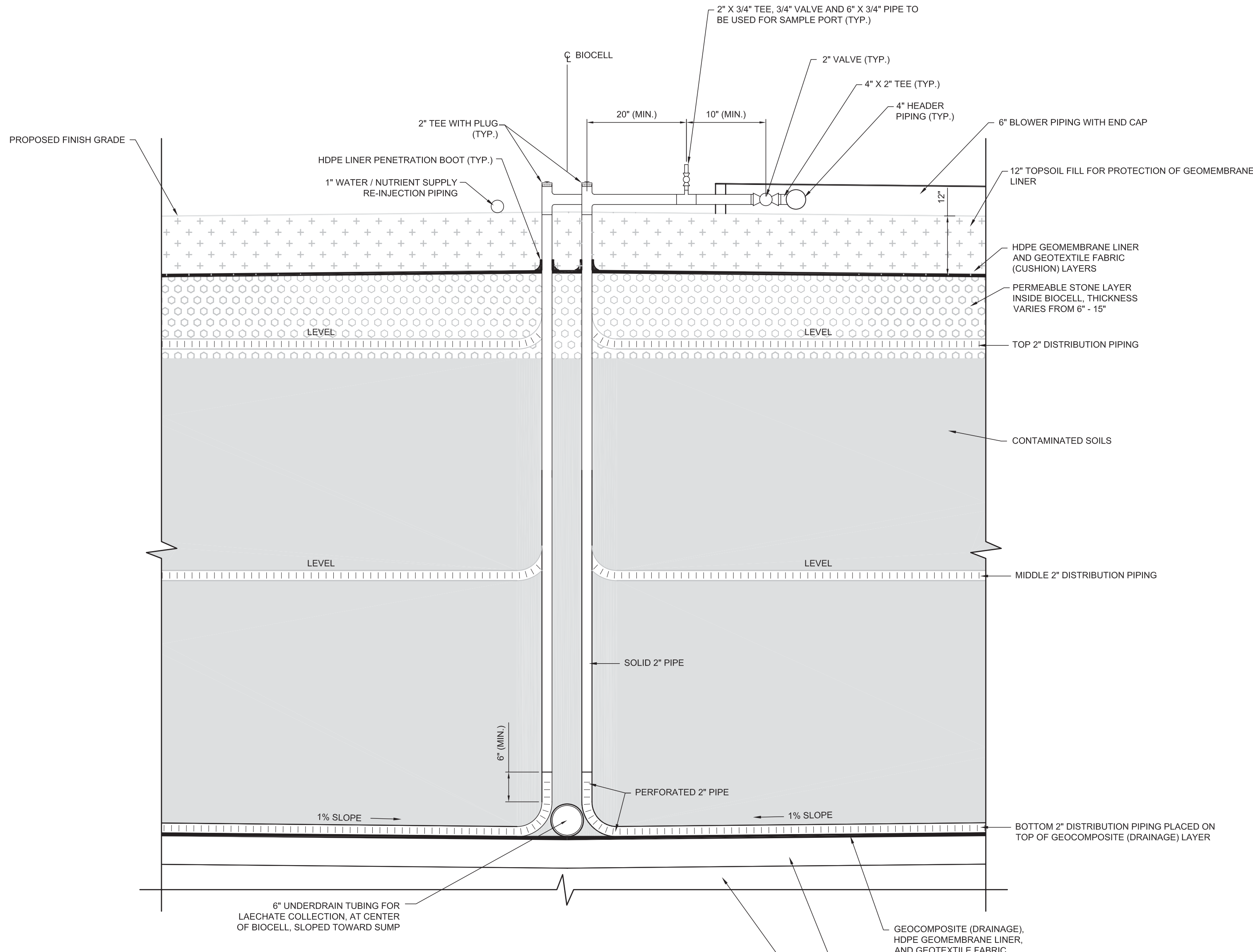
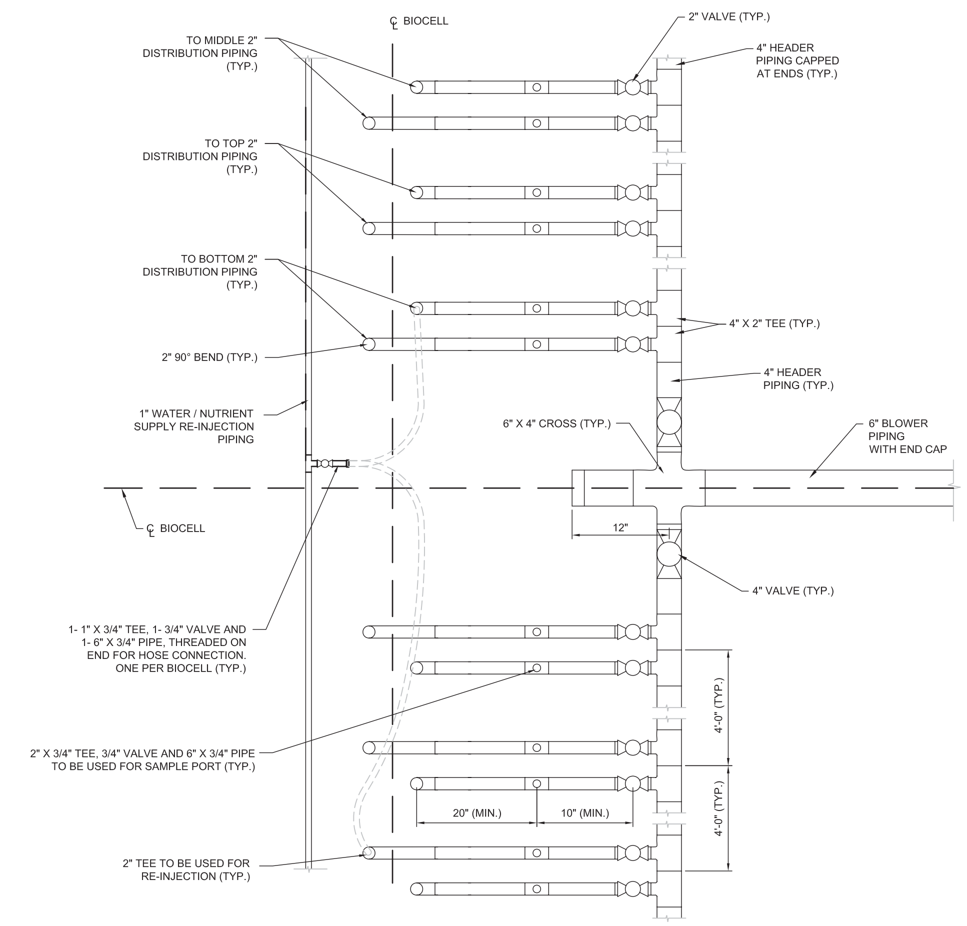
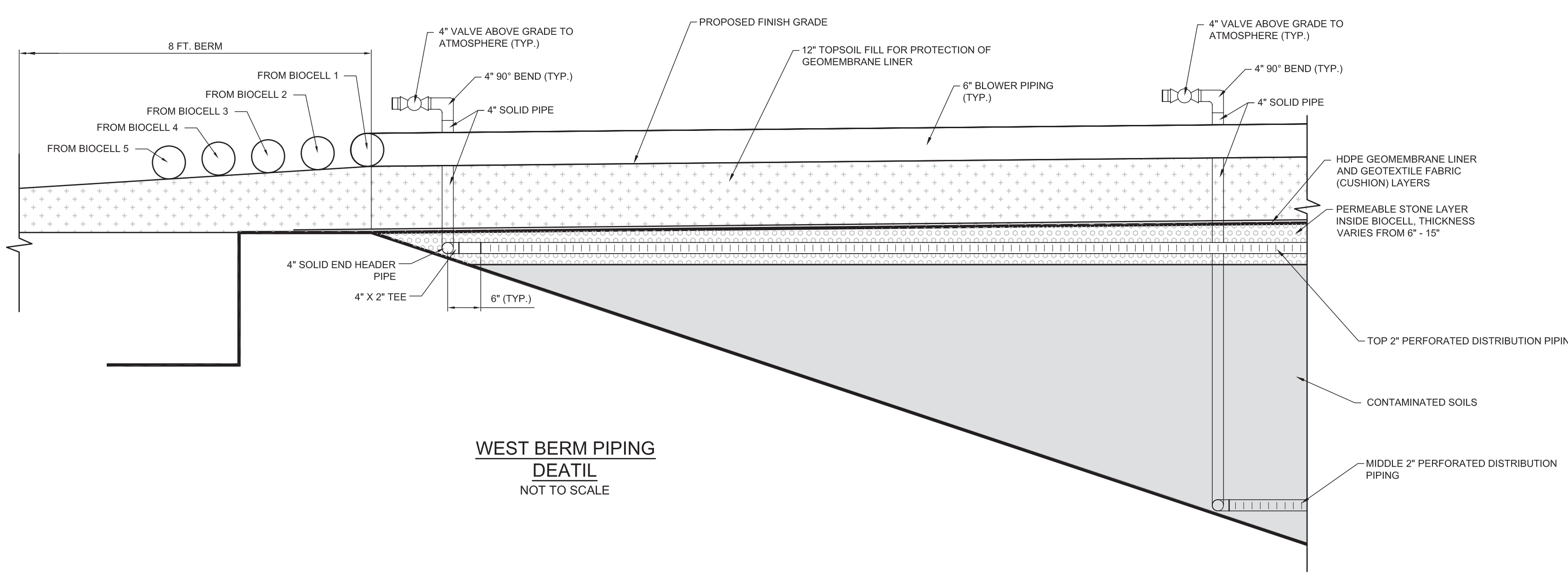


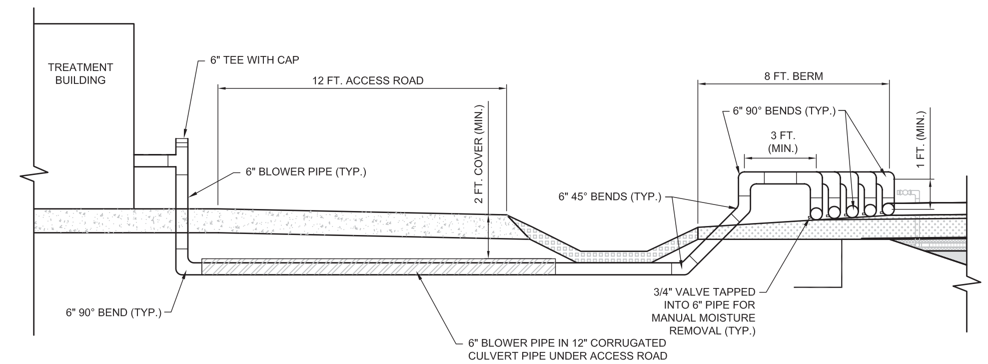
TYPICAL BIOCELL PIPING CONNECTION SECTION
NOT TO SCALE



TYPICAL BIOCELL MANIFOLD PIPING DETAIL
NOT TO SCALE



WEST BERM PIPING DEATIL
NOT TO SCALE



PIPE CROSSING DEATIL
NOT TO SCALE

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

VERIFY SCALE IF PLAN SHEET IS REDUCED
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NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

BIOCELL PIPING
SECTIONS AND DETAILS

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 13
DRAWING NO.: 13

500447

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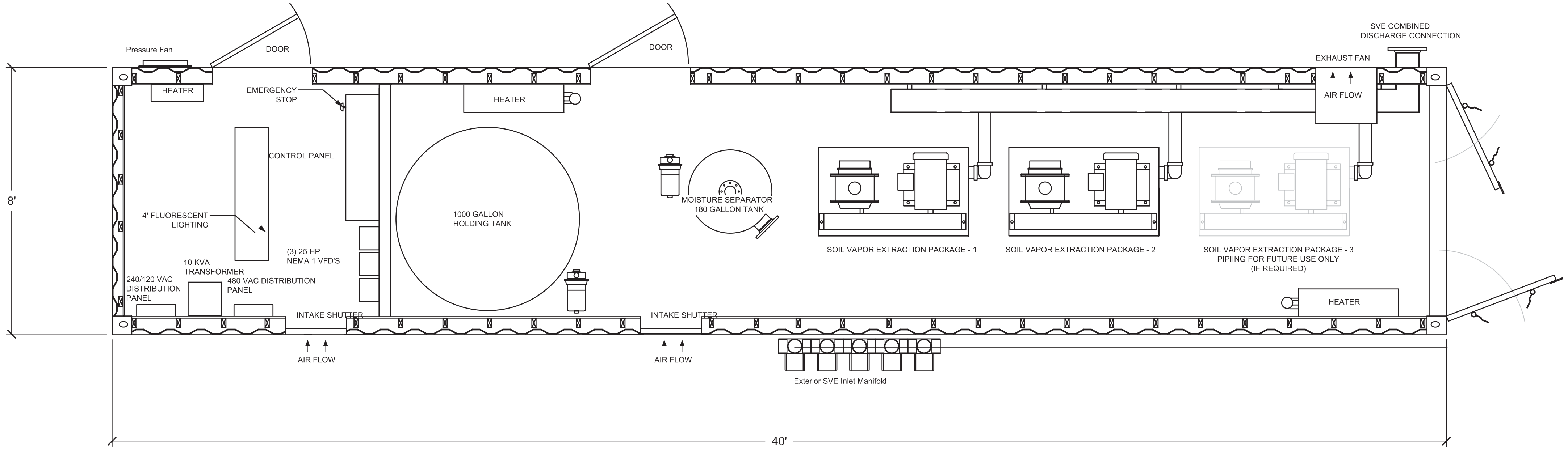
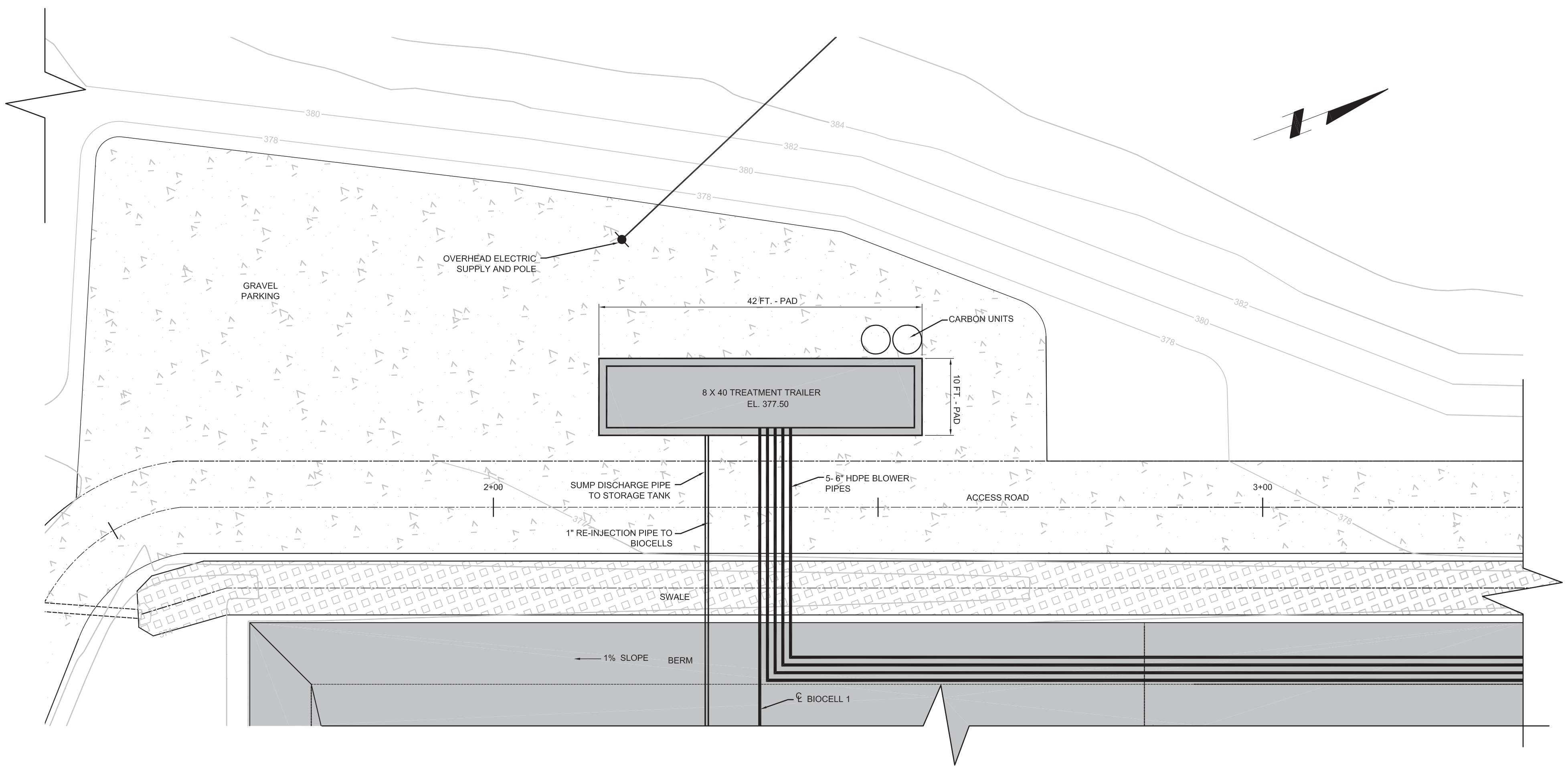


TREATMENT TRAILER PLAN
NOT TO SCALE



TREATMENT PLANT LAYOUT PLAN
NOT TO SCALE

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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WORK PLAN

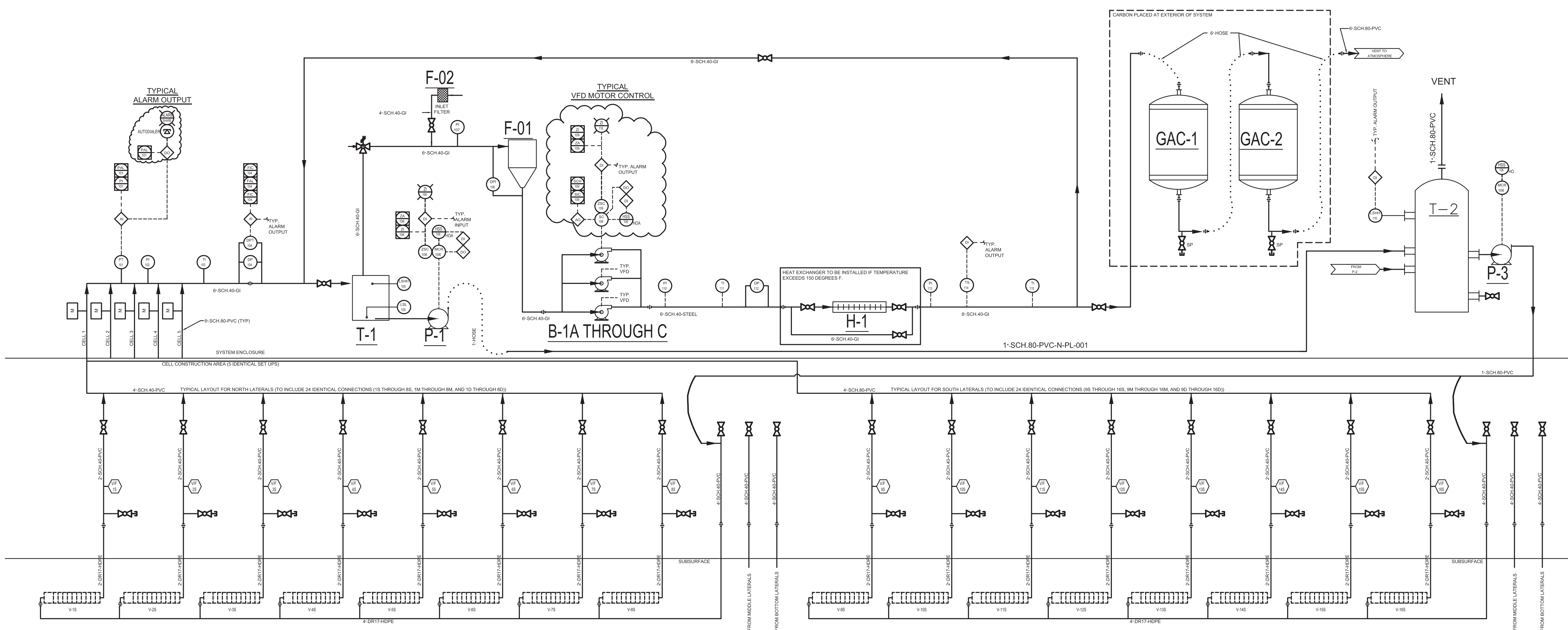
TREATMENT PLANT LAYOUT
AND DETAILS

PROJECT START DATE (M / Y)
NOVEMBER 2010
PROJECT NO.
106559
FILENAME
NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.
14
DRAWING NO.
14

500448

NOT FOR CONSTRUCTION

T-1	P-1	F-01	F-02	B-1A THROUGH C	H-1	GAC-1&2	T-2	P-2	P-3
MOISTURE KNOCKOUT 100 GAL CARBON STEEL	MOISTURE KNOCKOUT PUMP 10 GPM @ 25' TDH 240/480V / 60Hz 3Ø / 1/2 Hp	INLET FILTER W/FILTER ELEMENT	IN-LINE AIR FILTER W/FILTER ELEMENT	SVE BLOWER 500 SCFM @ 6 IHg 240/480V / 60Hz 3Ø / 25 Hp	HEAT EXCHANGER CARBON STEEL (IF NECESSARY)	GRANULAR ACTIVATED CARBON 2,000 LB. / CARBON STEEL 4'-0"DIA / 10PSI	OVERFLOW STORAGE TANK 1,000 GAL POLY TANK	SUMP PUMP 10 GPM @ 25' TDH 240/480V / 60Hz 3Ø / 1/2 Hp	MOISTURE KNOCKOUT PUMP 10 GPM @ 25' TDH 240/480V / 60Hz 3Ø / 3/4 Hp



NOTE: THE VACUUM SIDE OF EACH LATERAL WILL EXIT
THE PILE AND CONNECT TO ONE OF TWO HEADERS (NORTH OR SOUTH).
THE AMBIENT AIR INTAKE SIDE OF EACH LATERAL WILL BE T'D TOGETHER
BASED ON DEPTH (TOP, MIDDLE BOTTOM) AND COMBINE WITH A SEPARATE HEADER
WHICH WILL EXIT THE PILE AND BE VALVED SEPARATELY.

INSTRUMENT LEGEND

First-Letter	Initiating or Measured Variable *2	Primary Element	Transmitters: Indicator	Transmitters: Blind	Readout Devices: Recordor	Readout Devices: Indicator	Readout Devices: Integrating Indicator	Controllers: Recordor	Controllers: Indicator	Controllers: Blind	Alarm Devices: HIGH	Alarm Devices: LOW	Alarm Devices: HIGH & LOW	Control Valve	Self Actuated Control Valve	Switch
A	Analysis (*3)	AE	AIT	AT	AR	AI		ARC	AIC	AC	AAH	AAL	AAHL			AS
B	Burner/Combustion	BE	BIT	BT	BR	BI		BRC	BIC	BC	BAH	BAL	BAHL			BS
C	User's Choice															
D	User's Choise															
E	Voltage	EE	EIT	ET	ER	EI		ERC	EIC	EC	EAH	EAL	EAHL			ES
F	Flow Rate	FE	FIT	FT	FR	FI	FQI	FRC	FIC	FC	FAH	FAL	FAHL	FV	FCV	FS
G	User's Choice															
H	Hand								HIC	HC			HA	HV		HS
I	Current	IE	IIT	IT	IR	II	IQI	IRC	IIC		IAH	IAL	IAHL			IS
J	Power	JE	JIT	JT	JR	JI	JQI	JRC	JIC		JAH	JAL	JAHL			JS
K	Time	KE	KIT	KT	KR	KI	KQI	KRC	KIC	KC	KAH	KAL	KAHL		KCV	KS
L	Level	LE	LIT	LT	LR	LI		LRC	LIC	LC	LAH	LAL	LAHL	LV	LCV	LS
M	TORQUE	ME	MI	MT	MR	MI		MRC	MIC	MC	MAH	MAL	MAHL			
N	User's Choice															
O	User's Choice															
P	Pressure or Vacuum	PE	PIT	PT	PR	PI		PRC	PIC	PC	PAH	PAL	PAHL	PV	PCV	PS
Q	Quantity or Event	QE	QIT	QT	QR	QI	QQI	QRC	QIC		QAH	QAL	QAHL			QS
R	Radiation	RE	RIT	RT	RR	RI		RRC	RIC	RC	RAH	RAL	RAHL			RS
S	Speed or Frequency	SE	SIT	ST	SR	SI	SQI	SRC	SIC	SC	SAH	SAL	SSHL		SCV	SS
T	Temperature	TE	TIT	TT	TR	TI		TRC	TIC	TC	TAH	TAL	TAHL	TV	TCV	TS
U	Multivariable				UR	UI										
V	Vibration/Mach. Anal	VE	VIT	VT	VRC	VI					VAH	VAL	VAHL			VS
W	Weight or Force	WE	WIT	WT	WR	WI	WQI	WRC	WIC	WC	WAH	WAL	WAHL		WCV	WS
X	Unclassified															
Y	Event State Presence	YE		YT	YR	YI			YIC	YC	YAH	YAL		YZ		YS
Z	Position or Dimension	ZE	ZIT	ZT	ZR	ZI		ZRC	ZIC	ZC	ZAH	ZAL	ZAHL		ZCV	ZS

SPECIAL NOTES:

1. **Process equipment symbols may vary to show a better resemblance to equipment being used.**
2. **To simplify routing of process flow lines, some pieces of equipment may appear in more than one place on the flow diagram. Equipment so duplicated will be indicated by dashed lines.**

*NOTES:

* NOTES:

1. The instrument legend is based on ISA STANDARD S5.1-1984
2. Any "First Letter" may be modified by the following letters,

D=	Differential	PD=	Pressure Differential
J=	Scan	TJR=	Scanning Temperature Recorder
Q=	Integrate or Totalize	FQI=	Flow Integrating Indicator
A=	Auto Mode	FO=	Flow Restriction Orifice
FF=	Flow Ratio	FFC=	Flow Ratio Controller
SS=	Speed Ratio	SSC=	Speed Ratio Controller
LL=	Level Ratio		

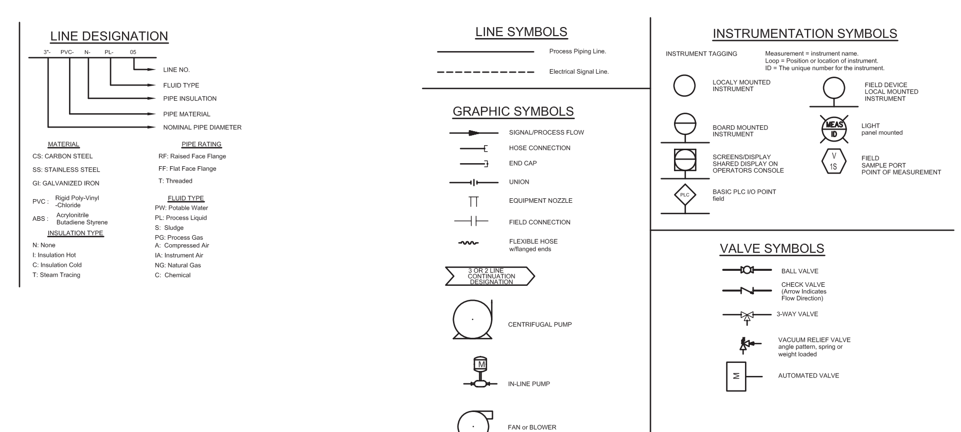
3. The letter "A" is to be used for all analysis variables. The following terms are placed outside the instrument circle of a loop to denote the specific variable.

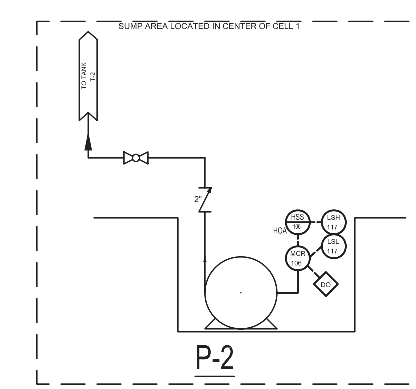
CO	Carbon Monoxide	H_2S	Hydrogen Sulfide
CO_2	Carbon Dixoide	O_2	Gaseous Oxygen
Comb	Combustible	pH	pH
OP	Opacity	Smoke	Smoke Density
		FID	Flame Ionization Detector

TAG CONSTRUCTION

T I R C A

1st letter always meas type
2nd 3rd 4th etc.
modify meas to show rq'd functions





VERIFY SCALE IF PLAN SHEET IS REDUCED

1-INCH

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NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

PIPING & INSTRUMENTATION DIAGRAM

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 15
DRAWING NO.: 15

500449

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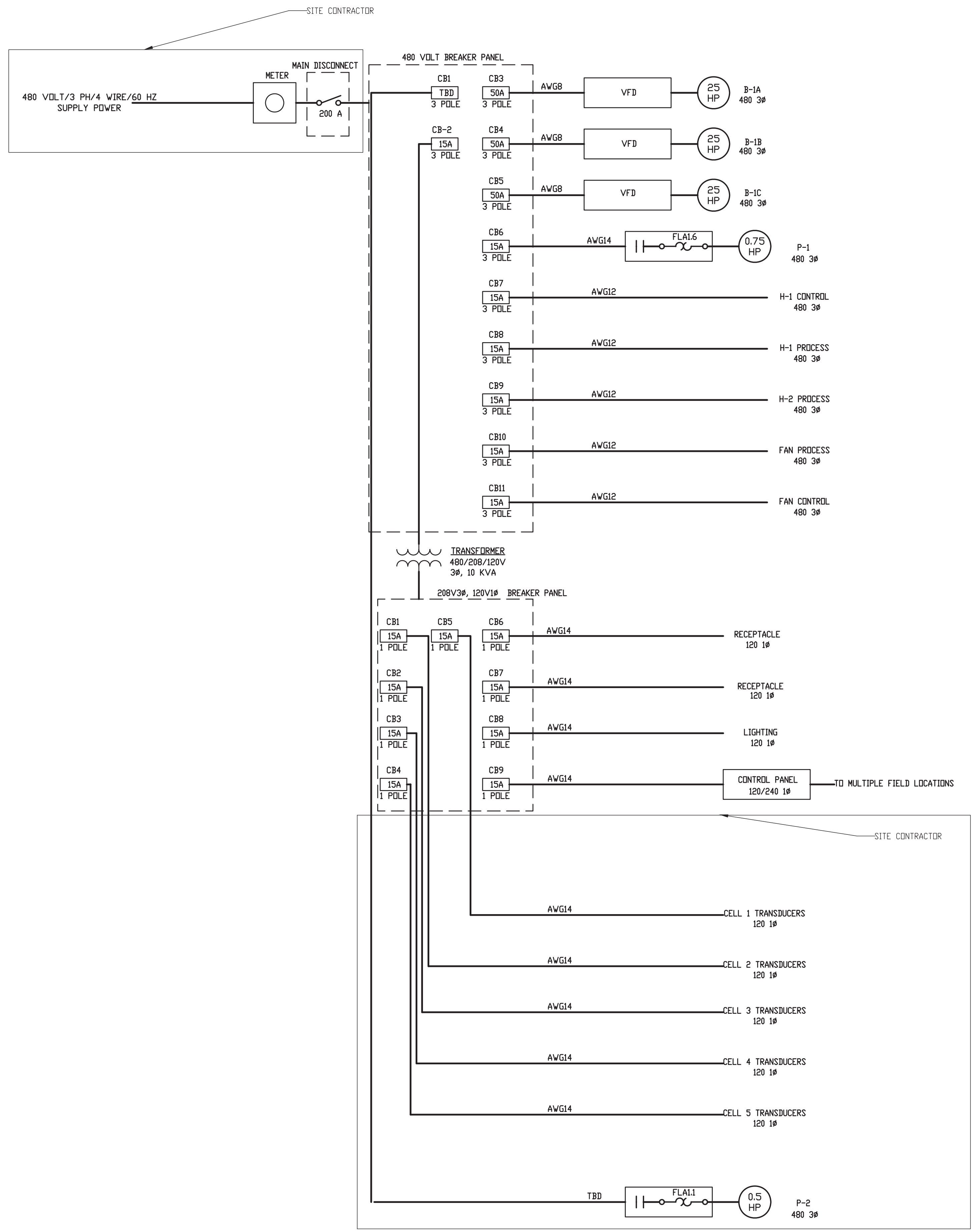

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

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1-INCH

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NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

ELECTRIC 1-LINE PLAN

PROJECT START DATE (M / Y) NOVEMBER 2010

PROJECT NO. 106559

FILENAME NEPERA_RDWP-DESIGN-1.dwg

SHEET NO. 16

DRAWING NO. 16

500450

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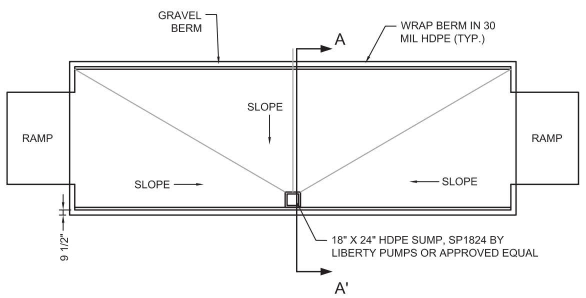
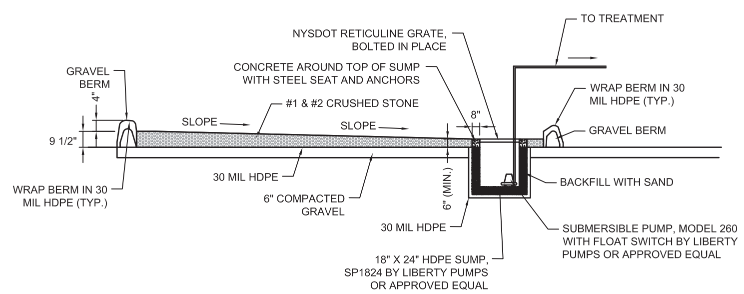


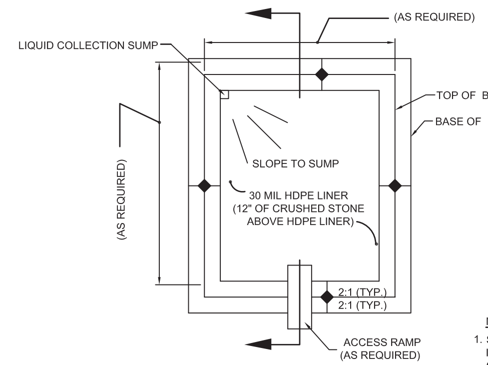
PLAN



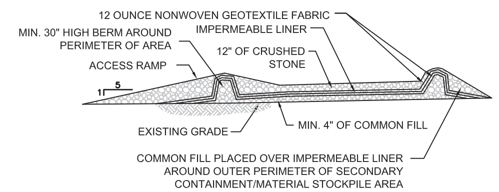
SECTION A - A'

DECONTAMINATION PAD DETAILS

(NOT TO SCALE)



PLAN



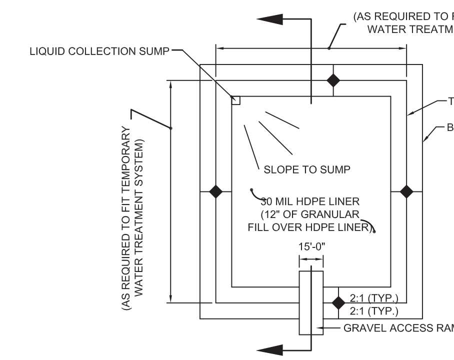
SECTION

NOTES:

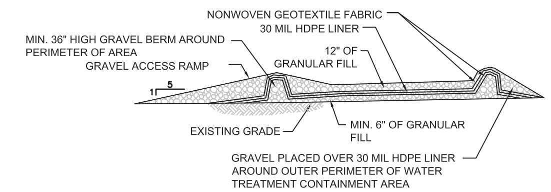
1. SECONDARY CONTAINMENT/MATERIAL STOCKPILE AREA TO INCLUDE AN IMPERMEABLE LINER AND BE SLOPED TO A SUMP. A CUSHION LAYER OF 12 OUNCE NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED ABOVE AND BELOW THE IMPERMEABLE LINER.
2. CONTRACTOR SHALL ADD COMMON FILL MATERIAL AS NEEDED OR AT DIRECTION OF ENGINEER TO PROVIDE FOR SEPARATION BETWEEN WASTE MATERIALS AND/OR AND LINER SYSTEM.
3. CONTRACTOR RESPONSIBLE FOR CHARACTERIZATION, PROPER TRANSPORTATION AND OFF-SITE DISPOSAL OF ALL MATERIALS USED IN CONSTRUCTION OF SECONDARY CONTAINMENT/MATERIAL STOCKPILE AREA.

SECONDARY CONTAINMENT/MATERIAL STOCKPILE AREA DETAIL

(NOT TO SCALE)



PLAN



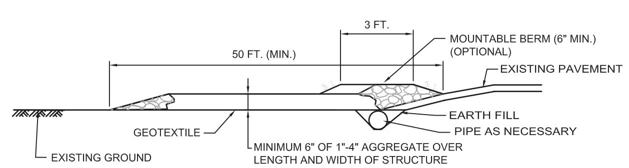
SECTION

NOTES:

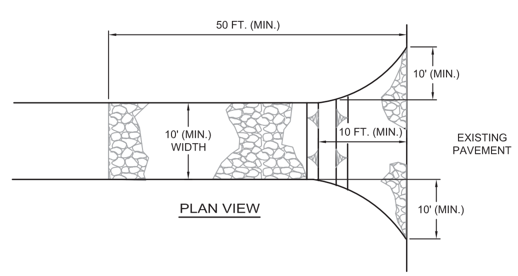
1. WATER TREATMENT SYSTEM CONTAINMENT AREA TO INCLUDE AN IMPERMEABLE LINER (30 MIL HDPE) AND BE SLOPED TO A SUMP.
2. CONTRACTOR SHALL ADD GRANULAR FILL MATERIAL AS NEEDED OR AT DIRECTION OF ENGINEER TO PROVIDE FOR SEPARATION BETWEEN WASTE MATERIALS AND LINER SYSTEM.
3. CONTRACTOR RESPONSIBLE FOR CHARACTERIZATION, PROPER TRANSPORTATION AND OFF-SITE DISPOSAL OF ALL MATERIALS USED IN CONSTRUCTION OF WATER TREATMENT SYSTEM CONTAINMENT AREA.

WATER TREATMENT SYSTEM CONTAINMENT AREA DETAIL

(NOT TO SCALE)



PROFILE



PLAN VIEW

STABILIZED CONSTRUCTION ENTRANCE

(NOT TO SCALE)

STABILIZED CONSTRUCTION ENTRANCE NOTES:

1) STONE SIZE - USE 1 - 4 INCH STONE, OR RECLAIMED OR RECYCLED CONCRETE

2) LENGTH - NOT LESS THAN 50 FT.

3) THICKNESS - NOT LESS THAN 6 INCHES.

4) WIDTH - 12 FT. MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS, 24 FOOT MINIMUM IF SINGLE ENTRANCE TO SITE.

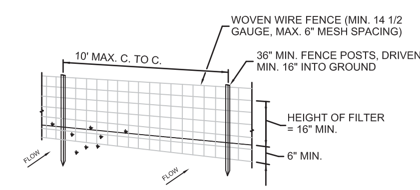
5) GEOTEXTILE - WILL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING STONE.

6) SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPE WILL BE PERMITTED.

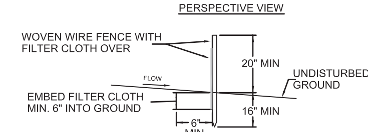
7) MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO THE PUBLIC RIGHTS-OF-WAY, ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.

8) WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.

9) PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN EVENT.



PERSPECTIVE VIEW



SECTION

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

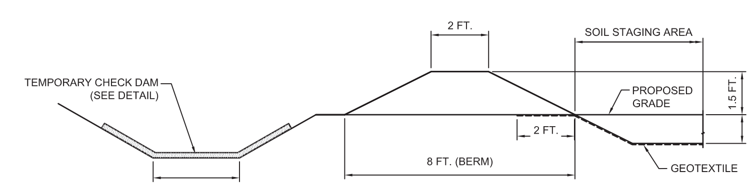
1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS:
2" HARDWOOD.

FENCE:
WOVEN WIRE, 14 1/2 GA.
6" MAX. MESH OPENING.

FILTER CLOTH:
FILTER X. MIRAFI 100X.
STABILINKA T140N OR APPROVED EQUAL.

SILT FENCE DETAILS

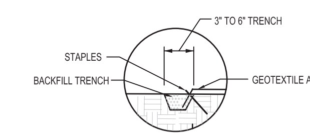


DRAINAGE SWALE AND DIVERSION BERM DETAIL

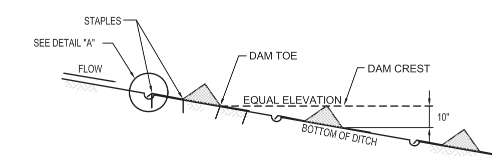
(NOT TO SCALE)

NOTES:

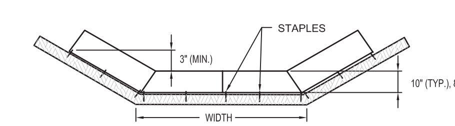
1. CONTRACTOR SHALL CONSTRUCT RIDGE TO SPECIFICATIONS SHOWN ALLOWING 10% FOR SETTLING.
2. CONTRACTOR SHALL ENSURE THAT THE TOP OF THE DIVERSION IS ON DESIGN GRADE OR HIGHER AT ALL TIMES.
3. GEOTEXTILE FABRIC SHALL BE INSTALLED BY CONTRACTOR AS SHOWN AND SHALL BE HELD IN PLACE BY METAL PINS.



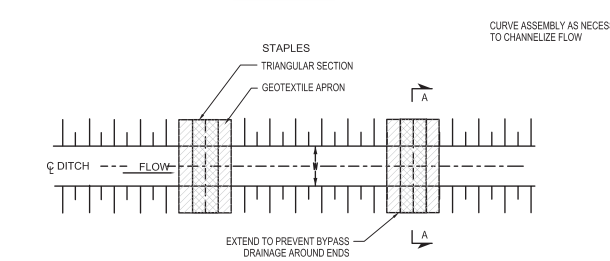
DETAIL "A"



PROFILE



SECTION A-A



PLAN

TEMPORARY CHECK DAM

(NOT TO SCALE)

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

VERIFY SCALE IF PLAN SHEET IS REDUCED — 1-INCH

DRN BY: ---
DES BY: ---
CHK BY: ---
APP BY: ---

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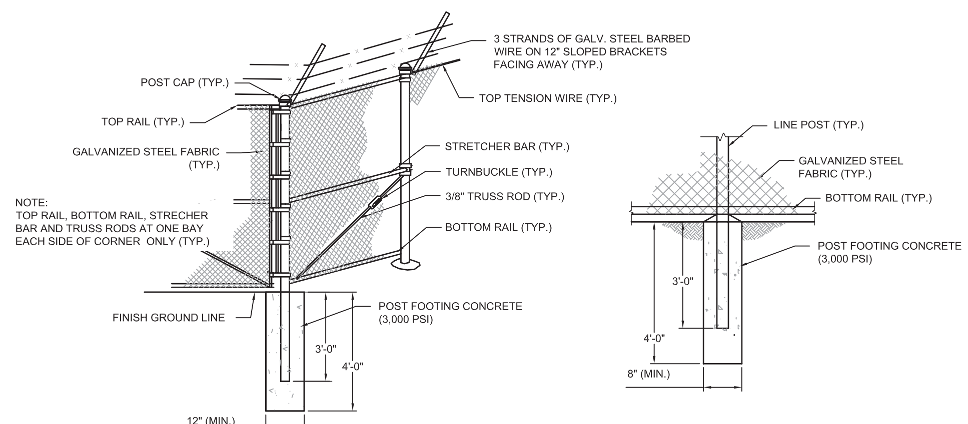
NEPERA CHEMICAL SUPERFUND SITE
DRAFT FINAL REMEDIAL DESIGN
WORK PLAN

TYPICAL DETAILS 1 OF 2

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 17
DRAWING NO.: 17

500451



CORNER AND
PULL POST DETAILS

LINE POST DETAILS

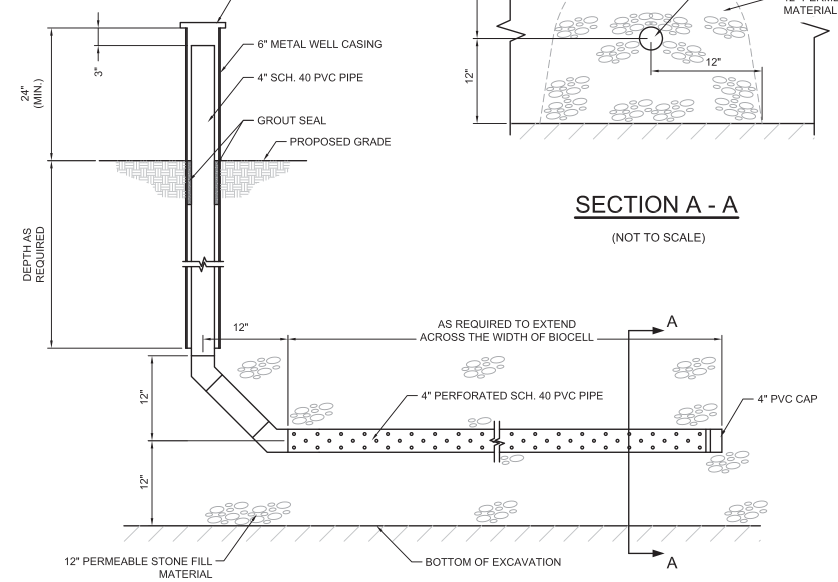
NOTE:
ALL FENCING AND FENCING COMPONENTS SHALL BE INSTALLED IN ACCORDANCE WITH NYSDOT SECTION 607-3.03

PERMANENT 6 FT. CHAIN LINK FENCE DETAILS

(NOT TO SCALE)

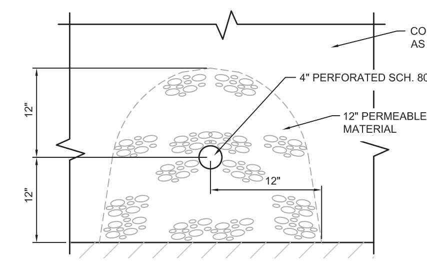
CHAIN LINK FENCE NOTES:

1. FENCE AND GATES THAT ARE DISTURBED BY THE REMEDIAL EXCAVATION SHALL BE REPLACED IN THE SAME LOCATIONS AND ALIGNMENT OR IN THE PROPOSED LOCATIONS SHOWN ON THE PLANS.
2. ALL MATERIALS SHALL COMPLY WITH CHAIN LINK MANUFACTURING INSTITUTE (CLFMI) CLF 2445, "PRODUCT MANUAL", TYPE STANDARD INDUSTRIAL.
3. FABRIC SIZE AND TYPE SHALL MATCH EXISTING CHAIN LINK FENCE FABRIC AND SHALL BE GALVANIZED STEEL IN ACCORDANCE WITH ASTM A123/A AT 1.7 OZ./SQ. FT.
4. POSTS AND ALL OTHER FENCE COMPONENTS SHALL BE GALVANIZED STEEL IN ACCORDANCE WITH ASTM A491.
5. LINE POSTS SHALL BE 2 1/2" DIAMETER, SCHEDULE 40 GALVANIZED STEEL, SPACING TO BE THE SAME AS EXISTING FENCE SPACING.
6. PULL AND CORNER POSTS SHALL BE 3" DIAMETER, SCHEDULE 40 GALVANIZED STEEL.
7. MANUAL GATES POSTS SHALL BE 4" DIAMETER, SCHEDULE 40 GALVANIZED STEEL.
8. MANUAL GATE FRAMING SHALL BE 2" DIAMETER, SCHEDULE 40 GALVANIZED STEEL.



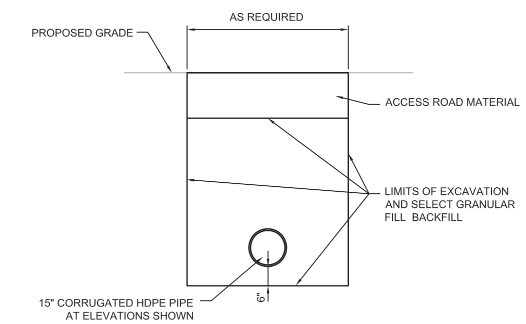
GROUNDWATER INFUSION WELL DETAIL

(NOT TO SCALE)



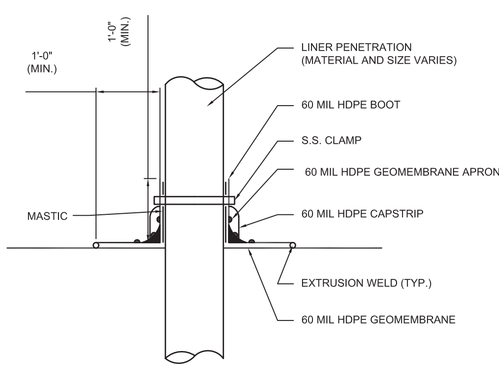
SECTION A - A

(NOT TO SCALE)



TYPICAL PIPE TRENCH DETAIL

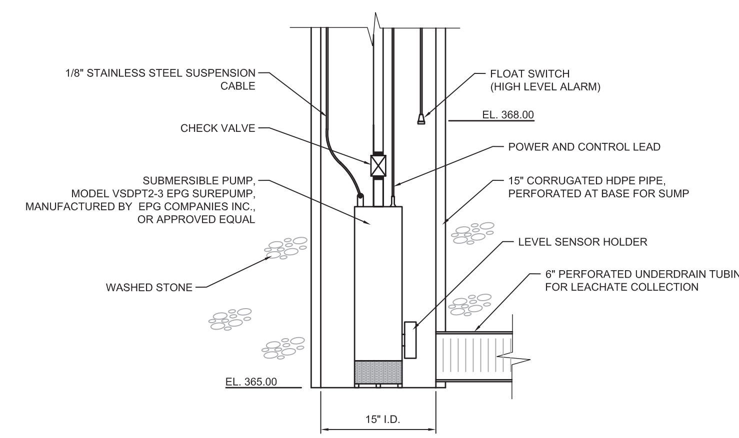
(NOT TO SCALE)



HDPE LINER PENETRATION DETAIL

(NOT TO SCALE)

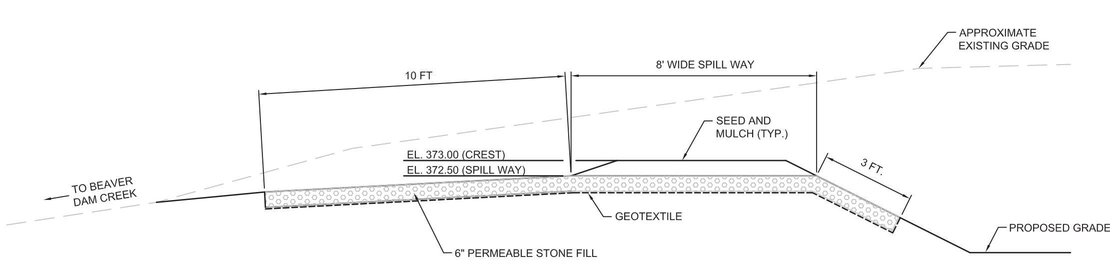
NOTE:
HDPE LINER PENETRATION DETAIL SHOWN FOR SUMP PENETRATION ONLY. CONTRACTOR SHALL PROPOSE ALL OTHER LINER PENETRATION SEALS TO THE ENGINEER FOR APPROVAL.



SUMP PUMP DETAIL

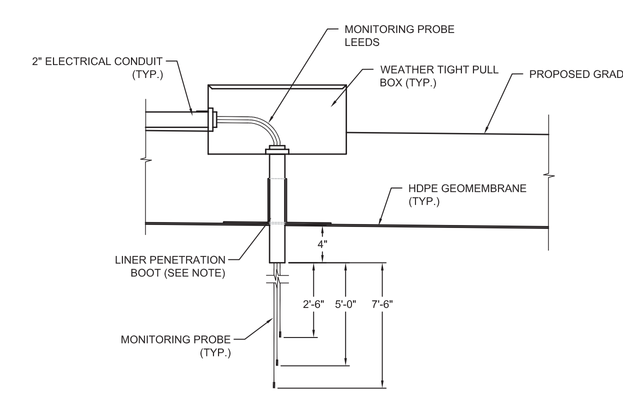
(NOT TO SCALE)

NOT FOR CONSTRUCTION



DETENTION BASIN SPILLWAY DETAIL

(NOT TO SCALE)



MONITORING PROBE DETAIL

VERIFY SCALE IF PLAN SHEET IS REDUCED
1-INCH

REV	DESCRIPTION	DRN	CHK	DATE (M/D/Y)

DRN BY: --
DES BY: --
CHK BY: --
APP BY: --

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NEPERA CHEMICAL SUPERFUND SITE DRAFT FINAL REMEDIAL DESIGN WORK PLAN

TYPICAL DETAILS 2 OF 2

PROJECT START DATE (M / Y): NOVEMBER 2010
PROJECT NO.: 106559
FILENAME: NEPERA_RDWP-DESIGN-1.dwg
SHEET NO.: 18
DRAWING NO.: 18

Attachment B

Specifications

SPECIFICATION 0001

TEMPORARY WASTE WATER TREATMENT SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR shall furnish all labor, equipment, and materials necessary to provide, construct, operate, monitor, and maintain the temporary waste water treatment system. The treatment system shall treat all water collected, extracted, or otherwise accumulated during the implementation of this Project (e.g., water generated from groundwater extraction within the excavation areas; dewatering of excavated stockpiled materials; equipment/personnel decontamination; and rainfall accumulation within the excavation, contaminated material staging, and containment areas). The treatment system shall be located within the Project Work Limits. The CONTRACTOR shall be responsible for obtaining and/or meeting the requirements of a State Pollutant Discharge Elimination System (SPDES) Permit prior to beginning work. Treated waters shall be discharged to the Beaver Dam Brook in accordance with the site SPDES Permit.

B. The CONTRACTOR is responsible for all costs and fees related to the operation and maintenance of the water treatment system (e.g., media change-out, system repairs, etc.).

C. The water treatment system shall be constructed within a containment area to collect miscellaneous water that may leak/leave the water treatment system prior to treatment (e.g., leaks in hose or pipe connections). The containment area shall be constructed in accordance with the Design Drawings. Accumulated water within the containment area will be collected and subject to treatment.

D. Water that accumulates within excavation areas will be collected and subject to on-site treatment. Water being discharged will be subject to visual inspection by the Engineer. If any sheens or odors are observed in the discharge water, discharging of the water will be discontinued and the water will be retreated using the water treatment system.

E. The CONTRACTOR shall provide a water treatment system capable of handling and treating a continuous flow rate of up to 50 gallons per minute (gpm) against the actual system pressure losses.

F. The CONTRACTOR shall provide, operate, monitor, and maintain a treatment system that is likely to handle water containing the following constituents:

1. Suspended and dissolved solids.
2. Volatile organic compounds.
3. Semivolatile organic compounds.
4. Inorganics.

Information regarding site hydrogeological conditions and groundwater quality data from select wells within the Project Work Limits is provided in the Remedial Design. This information identifies the type and general range of constituents that may be present in the water subject to treatment.

G. Treatment/Discharge Requirements

The CONTRACTOR is required to meet the requirements of a SPDES Permit and will operate the water treatment system in accordance with that permit and all applicable local, state, and federal regulations.

H. The water treatment system shall be constructed within a containment area and include the following components/processes:

1. Influent Holding Tank(s).
2. Solids filtration/removal.
3. Granular activated carbon (GAC) vessels.
4. System controls.
5. Effluent Holding Tank(s).
6. Piping, pumps, controls, gauges, re-pressurization tanks (as needed) etc. to convey all Project-related waters from various points of collection to and through the water treatment system, and to the discharge location.

Figure 1 (attached at the end of this Section) provides a generalized process flow diagram to assist the CONTRACTOR in understanding the primary components of the water treatment system and requirements of this Section.

1.02 SUBMITTALS

A. The CONTRACTOR shall submit the following information related to the water treatment system:

1. Overall system layout (process flow diagram).
2. Technical details relating to the construction and maintenance of the containment area(s).
3. Equipment size, dimensions, and materials of construction for all system components.
4. Pumping and piping types, sizes, and connections.
5. Electrical requirements and service connections.
6. Monitoring and maintenance requirements for system components.
7. Location of system components within Project Work Limits.
8. Material Safety Data Sheets (MSDs).

B. The CONTRACTOR shall submit the following as part of the CONTRACTOR's Technical Execution Plan (TEP):

1. Location(s) of groundwater extraction points, type and size/depth of installation (well, caisson, etc.), and anticipated extraction rate (per location and in total).
2. Pumps(s), piping, appurtenances to be used to extract groundwater, including numbers, size, fuel source, etc.
3. CONTRACTOR's anticipated operation of the extraction system, including monitoring, coordination with other Project activities (e.g., excavation), etc.

C. The CONTRACTOR shall maintain (throughout the course of the Project) a written record of the operation and maintenance activities associated with the water treatment system. Such information shall be tabulated, updated daily, and submitted on a weekly basis to the Engineer for review. At minimum, the summary shall include the following information (for each day):

1. Hours of operation.
2. Volume of water extracted, treated, and discharged.
3. Mode of discharge (i.e., batch or continuous).
4. Type and frequency of monitoring and maintenance activities (if any).
5. Other information relevant to the operation, monitoring, and maintenance of the water treatment system.

1.03 QUALITY ASSURANCE/QUALITY CONTROL:

A. Materials and methods shall comply with relevant standards, as well as any other standards, codes, or specifications applicable to the design, construction, operation, and maintenance of the water treatment system.

PART 2 PRODUCTS

2.01 INFLUENT HOLDING TANKS AND INFLUENT PUMP

A. The Influent Holding Tanks shall be constructed of materials compatible with the constituents that may be present in the water subject to treatment. The tanks shall provide a common collection point for waters generated as part of the Project.

B. The CONTRACTOR shall provide two weir storage tanks that can each accommodate a volume of approximately 18,000 gallons during initial start-up activities. The tanks shall be equipped with valving, piping, etc., as needed to receive extracted groundwater (and other liquids generated during the Project) for subsequent transfer through the treatment system. Additional Influent Holding Tanks may be necessary based on Project and Site conditions. The CONTRACTOR shall be capable of providing a minimum of three additional Influent Holding Tanks to the Site within 96 hours of Owner/Engineer request. Following start-up activities, the CONTRACTOR may reduce the number of Influent Holding Tanks to one as approved by the Engineer. The CONTRACTOR shall be responsible for any additional costs associated with reducing the number of Influent Holding Tanks to one.

C. The influent pump(s) shall be of sufficient size, operation, and construction to provide a nominal flow rate of 50 gpm through the water treatment system against the actual system pressure losses.

2.02 SOLIDS FILTRATOIN

A. Solids filtration shall be accomplished by carbon steel filter housings and filter bags, or equal.

B. Four units total:

   1. Rated at 50 gpm (per unit).
   2. Housing rated 125 pounds per square inch (psi) (per unit).

C. The bag filter units shall be assembled in two separate filter trains; each train shall be composed of two bag filter units arranged in series (i.e., lead and lag arrangement).

D. The filter trains shall be assembled to accommodate the following flow scenarios:

1. Operation in an alternating mode of operation (i.e., one train active, one train in standby mode).
2. Operation of the filter trains concurrently (i.e., each train accommodates one-half of the total influent flow).

E. Filter bag size:

1. Lead bag size of 25 microns; CONTRACTOR to supply bags.
2. Lag bag size of 10 microns; CONTRACTOR to supply bags.

F. Spare parts to support routine operations per manufacturer's recommendation.

2.03 GAC VESSELS

A. The GAC vessels shall be capable of being backflushed by CONTRACTOR using treated effluent as water supply (backflush water to be routed to Influent Holding Tanks).

B. Vessels shall be arranged in series (i.e., lead and lag arrangement). When the GAC in the primary (lead) vessel becomes spent (i.e., one or more of the constituents listed in the SPDES permit are detected in a sample collected from between the GAC vessels), the CONTRACTOR shall change out the GAC in the primary vessel and move the primary vessel to a secondary (lag) position. The secondary vessel will then become the new primary vessel.

C. Each vessel shall be filled with 2,000 pounds (lbs) of liquid phase GAC (4,000 lbs total) above the lateral injection piping.

1. Iodine Number (mgl/g): 900 (typ.)
2. Mesh size (U.S.):8x30
3. Moisture as Packed (wt.%): 2% (max)
4. Apparent Density (g/cm3): 0.46 – 0.54

D. Minimum flow rate capacity of 50 gpm (per vessel).

E. Minimum pressure rating of 75 psi (per vessel).

F. Spare parts to support routine operations/maintenance per manufacturer's recommendation.

2.04 EFFLUENT HOLDING TANKS AND DISCHARGE

A. The Effluent Holding Tank(s) shall be constructed of materials compatible with the constituents that may be present in the water subject to treatment.

B. The CONTRACTOR shall provide two 20,000 gallon storage tanks (Effluent Holding Tanks) to collect treated water for sampling, testing, and discharge during initial start-up activities. The tanks shall be piped and operated such that the treated effluent from the water treatment system can be routed on an alternating basis between the two tanks (i.e., one tank will be in standby mode while the other tank receives treated effluent). The CONTRACTOR will coordinate the sampling of treated effluent water. The Engineer will provide direction to the CONTRACTOR regarding disposition of the water based on analytical laboratory results (e.g., discharge, re-treat, use as system backwash). Following start-up activities, the CONTRACTOR may reduce the number of Effluent Holding Tanks to one as approved by the Engineer. The CONTRACTOR shall be responsible for any additional costs associated with reducing the number of Effluent Holding Tanks to one.

C. CONTRACTOR shall pump discharge treated effluent, when directed by the Engineer upon verification of meeting the requirements of the SPDES Permit, to the Beaver Dam Brook. Method of discharge (i.e., gravity versus pressure flow) shall be identified by the CONTRACTOR in consideration of the location of the Effluent Holding Tanks and the Beaver Dam Brook.

PART 3 EXECUTION

3.01 EXCAVATION AREA DEWATERING

The CONTRACTOR's TEP shall describe the proposed methods for dewatering the excavation areas (i.e., the lowering of the water table elevation), and subsequent dewatering to maintain the depressed water table elevation during active soil removal and related activities.

In preparing the TEP, the CONTRACTOR shall incorporate the following conditions:

A. Dewatering activities shall be coordinated with the CONTRACTOR's overall approach for executing the excavation activities. Considerations for the dewatering location(s), excavation sequencing and timing, performance of survey confirmation, and placement/compaction of backfill should be incorporated into the development of the TEP, especially with respect to the placement of extraction points within the excavation areas.

B. Water that accumulates within excavation areas shall be removed. The CONTRACTOR shall take precautions to minimize the solids in water extracted from the excavation areas, such as constructing a sump and keeping the intake of the pump off the bottom and away from the sidewalls of the area being dewatered.

C. To assess the performance of the groundwater extraction system, the CONTRACTOR shall conduct initial system start-up activities (in conjunction with the start-up activities associated with the water treatment system, discussed in Part 3.02A below). These activities are intended to demonstrate and troubleshoot, as necessary, system operations and to provide panning-level information regarding subsequent operations related to extraction rates/timing and other related operations. Start-up testing shall occur one week (minimum) prior to removal of materials from below the normal water table elevation and once the extraction and treatment system components have been installed and individually tested, as appropriate. The results of the extraction system start-up activities may provide additional information related to extraction rates and timing.

D. Groundwater extraction shall occur at a location(s) that is offset (horizontally and vertically) from the immediate vicinity of active soil disturbance/removal (to reduce the potential for excessive mixing of these materials and groundwater during excavation). The method of extraction shall include one or more extraction wells, caissons, well points, or similar applications located within each excavation area that are appropriately sized and positioned.

E. The following details (specific to this Section) shall be provided in the CONTRACTOR's RAWP:

1. Location of extraction points, type and size/depth of installation well, caisson, etc.) and extraction rate (per location and in total).

2. Pump(s), piping, appurtenances to be used to extract groundwater, including numbers, size, fuel source, etc.
3. CONTRACTOR's anticipated operation of the extraction system including monitoring and coordination with other Project activities (e.g., excavation).

3.02 SYSTEM START-UP AND MONITORING REQUIREMENTS

A. Initial Start-Up Testing – The CONTRACTOR shall conduct initial system start-up activities to assess the individual and combined performance of the groundwater extraction system and water treatment system. These activities are intended to demonstrate and troubleshoot system operations, and to provide planning-level information regarding subsequent operations related to extraction rate/timing and other related operations. Start-up testing shall occur one week (minimum) prior to removal of materials from below the normal water table elevation and once the extraction system and treatment system components have been installed and individually tested. As part of these initial start-up activities, the CONTRACTOR shall extract groundwater from the first excavation area. The initial extraction volume (i.e., initial "batch") will be approximately 20,000 gallons or equal to the quantity of groundwater extracted of a 10-hour pumping period (whichever occurs first). The water will be treated and stored in the Effluent Holding Tanks. The CONTRACTOR will then collect a representative sample from the treated water and submit the sample for laboratory analysis in accordance with the Site SPDES Permit. The analytical results will be compared to the discharge criteria presented in the Site SPDES permit. If analytical results are below criteria, the Engineer will direct the CONTRACTOR to discharge the treated water to the Beaver Dam Brook in accordance with the information provided herein. If the analytical results exceed one or more of the discharge criteria, the CONTRACTOR shall investigate the potential cause(s), modify the system (if necessary and in consultation with the Engineer), and re-treat the water within that tank. The CONTRACTOR will collect a sample from the re-treated water and submit that sample for the appropriate laboratory analysis. The above process will be repeated until two consecutive "batches" have undergone successful treatment. The results of the extraction system start-up activities may provide additional information related to extraction rates and timing. In addition, the information obtained as a result of the treatment system start-up activities will be reviewed by the Engineer and may result in modifications to the water treatment system design and operation. The CONTRACTOR shall assume that the review process will occur over a one-week timeframe, and shall accommodate the time in his planning/schedule.

B. Excavation Area Dewatering – Following completion of the initial start-up activities described above, the CONTRACTOR shall continue dewatering the excavation area. Excavation dewatering activities are anticipated to be conducted during Site preparation activities and during the excavation of materials above the normal water table elevation. During these activities, the CONTRACTOR shall directly discharge treated water to the Beaver Dam Brook. The CONTRACTOR will collect samples of the treated effluent water at a frequency of one sample per week or as required by the SPDES permit. If an exceedance of the discharge criteria is detected at any time during continuous discharging activities, the CONTRACTOR will stop discharge/treatment activities and will notify NYSDEC of the exceedances. The CONTRACTOR shall evaluate potential causes for the exceedance of the discharge criteria and make adjustments/modifications (as appropriate and in consultation with the Engineer) to the water treatment system.

C. Excavation Below the Normal Water Table Elevation – Once excavation activities below the normal water table elevation commence, monitoring activities will follow the initial start-up testing outlined above. The re-performance of these start-up activities is due to the potential change in influent water conditions. Water collected during this time will be generated during excavation below the normal water table elevation and during material dewatering activities and thus have the potential to contain a higher solids content than initial water subject to treatment. Similar to initial system start-up activities, an initial batch of water of approximately 20,000 gallons or quantity generated over a 10-hour pumping period (whichever occurs first) will be collected, treated, and sampled as indicated above. The analytical results will then be compared to the discharge criteria and provided to NYSDEC. If the analytical results are below the discharge criteria, the Engineer will direct the CONTRACTOR to discharge the treated water to the Beaver Dam Brook in accordance with the information provided herein. If the analytical results are above one or more of the discharge criteria, the CONTRACTOR shall investigate the potential cause(s), modify the system (if necessary and in consultation with the Engineer), and retreat the water within the tank. The CONTRACTOR will collect a sample from the retreated water and submit that sample for the appropriate laboratory analysis. Following confirmation that the discharge criteria have been met for two consecutive batches, the Engineer will direct the CONTRACTOR to directly discharge future treated water to the Beaver Dam Brook for the remainder of the project. Sampling of effluent water will be conducted by the CONTRACTOR at a frequency of one sample per week. Any exceedances detected during continuous discharging activities will be handled as identified above. During the course of the Project, the Engineer may require the CONTRACTOR to modify the mode of discharge (i.e., batch or continuous) based on Project/Site conditions.

D. The CONTRACTOR will collect representative samples for laboratory analysis from the Influent Holding Tank and the Effluent Holding Tank, at the Engineer’s request, to determine the effectiveness of the water treatment system and compliance with the applicable discharge criteria. Once laboratory results are obtained, the Engineer will provide direction regarding the disposition of the treated water (e.g., discharge to the Beaver Dam Brook). The CONTRACTOR will also periodically collect samples from between the GAC vessels to monitor for breakthrough as required by the Engineer.

3.03 WATER TREATMENT SYSTEM OPERATION, MONITORING, AND MAINTENANCE

A. The CONTRACTOR shall continuously monitor the operation of the treatment system and at no time leave the system operating without qualified attending personnel present within the Project Work Limits. During the initial dewatering activities, the CONTRACTOR may elect to operate the extraction system and water treatment system on a continuous basis during non-working hours. Such a plan must be formally communicated (in writing) to the Owner and Engineer for review and approval.

B. As required, the CONTRACTOR shall perform routine maintenance of the treatment system including, but not limited to, change-out of bag filters, back flushing of the GAC vessels, and GAC change-out.

C. Following conclusion of the water treatment system operations, the CONTRACTOR shall clean and decontaminate all equipment in accordance with the provisions of the Remedial Design.

END OF SECTION

SPECIFICATION 0002

BULKING AGENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Bulking agent for use in increasing the porosity of soils within the biocell.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to mixing of bulking agent:
   1. Origin (supplier's name and production plant) of bulking agent.
   2. Proposed method and percentage of mixing bulking agent and soils.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Protect bulking agent from excessive heat, cold, moisture, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Storage and Protection:
   1. Protect bulking agent from excessive water and other sources of damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. The bulking agent shall consist of organic shavings, mulch, or chips harvested from initial clearing and grubbing activities onsite or imported from an approved supplier.

B. The bulking agent shall be free of all metal, plastic, waste, ect.

PART 3 EXECUTION

3.02 PREPARATION

A. CONTRACTOR shall visually inspect bulking agent for excessive moisture prior to mixing with soils.

3.03 INSTALLATION

A. CONTRACTOR shall physically mix bulking agent into soils according to the CONTRACTOR'S proposed mixing plan at a mix ratio of 1 part bulking agent to 25 parts soil by volume.

3.04 FIELD QUALITY CONTROL

A. The CONTRACTOR shall provide visual inspection and photographic documentation that the bulking agent has been properly mixed with the soils.

END OF SECTION

SPECIFICATION 0003

FERTILIZER

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fertilizer used to stimulate microbial activity in soils.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to mixing of bulking agent:
   1. Origin (supplier's name and production plant) of each fertilizer.
   2. Material Safety Data Sheets of each proposed fertilizer.
   3. Proposed mix ratio of each fertilizer and soil.
   4. Proposed method of mixing fertilizers and soils.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Protect fertilizer from excessive heat, cold, moisture, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Storage and Protection:
   1. Protect fertilizer from excessive water and other sources of damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. The fertilizer mixture shall consist of nitrogen and phosphorus products derived from (not inclusive):
   1. Urea solutions
   2. Ammonium solutions
   3. Phosphate solutions

B. The fertilizer shall be furnished from a local supplier. Should a local supplier not exist or prove uneconomical, the fertilizer shall be furnished from the nearest source available.

C. Fertilizer will be chosen with the intent of providing a 100:10:1 - Carbon, Nitrogen, Phosphorus ratio within the soils.

PART 3 EXECUTION

3.02 PREPARATION

A. CONTRACTOR shall visually inspect fertilizer for excessive moisture prior to mixing with soils.

3.03 INSTALLATION

A. CONTRACTOR shall physically mix fertilizer into soils according to the CONTRACTOR'S proposed mixing plan and at a minimum ratio of 5.24 pounds of Nitrogen per cubic yard of soils and 0.524 pounds of Phosphorous per cubic yard of soils.

3.04 FIELD QUALITY CONTROL

A. The CONTRACTOR shall provide visual inspection and documentation that the fertilizer has been properly mixed with the soils.

END OF SECTION

SPECIFICATION 0004

NONWOVEN GEOTEXTILE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Nonwoven Geotextile for use as a protective layer for a geomembrane.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to geotextile deployment:
   1. Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geotextile.
   2. Copies of dated quality control certificates issued by resin supplier.
   3. Results of tests conducted by geotextile manufacturer to verify that resin used to manufacture geotextile meets Specifications.
   4. List of materials which comprise geotextile, handling and storage procedures.
   6. Manufacturer's specification for geotextile which includes properties listed and measured using appropriate test methods.
   7. Written certification that minimum values given in manufacturer's specification are guaranteed by geotextile manufacturer.
   8. Quality control certificates, signed by geotextile manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
   9. Field panel layout and identification code including dimensions and details.
   10. Qualifications of Installer and designated Construction Quality Officer.
   11. Warranty statements: the Manufacturer shall warranty the material for a period of 5 years; the Installer shall warranty the installation for a period of 3 years.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.
   2. Material and Installation Warranty from manufacturer.

1.03 REFERENCES:

A. "Drop in Specifications for Nonwoven Geotextiles," GSE, http://www.gseworld.com/products/drainage/geotextiles/nonwoven-geotextile.html

1.04 QUALIFICATIONS:

A. Manufacturer:
   1. Manufacturer shall have minimum 5 yrs continuous experience in manufacture of geotextiles or experience totaling 2,000,000 sq ft of manufactured geotextiles for minimum of 10 completed facilities.

B. Installer:

1. Installer shall have minimum 5 yrs continuous experience in installation of geotextile or experience totaling 2,000,000 sq ft of installed geotextile for minimum of 10 completed facilities.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Manufacturer shall identify each roll delivered to site with following:
      a. Manufacturer's name.
      b. Product Identification.
      c. Thickness.
      d. Roll number.
      e. Roll dimensions.

   2. Protect geotextile from excessive heat, cold, UV light, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Acceptance at Site:
   1. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
   2. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
   3. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

C. Storage and Protection:
   1. Protect geotextile from dirt, water, UV light, and other sources of damage.
   2. Preserve integrity and readability of geotextile roll labels.
   3. Rolls which do not have proper identification at delivery will not be accepted.
   4. Contractor should prepare set down area. Any damage to rolls at time of unloading should be documented by the Installer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Geotextile Properties:

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE NW4	NW6	NW8	NW10	NW12	NW16
AASHTO M288 Class			3	2	1	>1	>>1	>>>1
Mass per Unit Area, oz/yd2 (g/m^2)	ASTM D 5261	90,000 ft^2	4 (135)	6 (200)	8 (270)	10 (335)	12 (405)	16 (540)
Grab Tensile Strength, lb (N)	ASTM D 4632	90,000 ft^2	120 (530)	160 (710)	220 (975)	260 (1,155)	320 (1,420)	390 (1,735)
Grab Elongation, %	ASTM D 4632	90,000 ft^2	50	50	50	50	50	50
Puncture Strength, lb (N)	ASTM D 4833	90,000 ft^2	60 (265)	90 (395)	120 (525)	165 (725)	190 (835)	240 (1,055)
Trapezoidal Tear Strength, lb (N)	ASTM D 4533	90,000 ft^2	50 (220)	65 (290)	90 (395)	100 (445)	125 (555)	150 (665)
Apparent Opening Size, Sieve No. (mm)	ASTM D 4751	540,000 ft^2	70 (0.212)	70 (0.212)	80 (0.180)	100 (0.150)	100 (0.150)	100 (0.150)
Permittivity, sec~'	ASTM D 4491	540,000 ft^2	1.80	1.50	1.30	1.00	0.80	0.60
Water Flow Rate, gpm/ft^2 (l/min/m^2)	ASTM D 4491	540,000 ft^2	135 (5,495)	110 (4,480)	95 (3,865)	75 (3,050)	60 (2,440)	45 (1,830)
UV Resistance (% retained after 500 hours)	ASTM D 4355	per formulation	70	70	70	70	70	70
NOMINAL ROLL DIMENSIONS								
Roll Length[1], ft (m)			600 (182)	850 (259)	600 (182)	500 (152)	400 (122)	300 (91)
Roll Width[1], ft (m)			15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)
Roll Area, ft^2 (m^2)			9,000 (836)	12,750 (1,185)	9,000 (836)	7,500 (698)	6,000 (557)	4,500 (418)

NOTE:
[1]Roll lengths and widths have a tolerance of ±1%.

B. Geotextile shall be manufactured from new polymer. Geotextile manufactured from non-complying polymer shall be rejected.

C. Geotextile shall be able to withstand direct UV exposure for a minimum of 30 days without noticeable effect on performance properties.

2.03 SOURCE QUALITY CONTROL

A. Tests, Inspections shall be performed by geotextile manufacturer as follows:
   1. Test geotextile to demonstrate that resin meets this Specification.
   2. Continuously monitor geotextile during manufacturing process for inclusions, bubbles, or other defects. Geotextiles which exhibit defects shall not be acceptable for installation.

3. Monitor thickness continuously during manufacturing process.
4. Tests shall be conducted for the following properties in accordance with test methods specified.

    a. Mass per Unit Area.
    b. Grab Tensile Strength.
    c. Grab Elongation.
    d. Puncture Strength.
    e. Trapezoidal Tear Strength.
    f. Permittivity.
    g. Water Flow Rate.
    h. UV Resistance.

    Perform these tests on geotextile materials, minimum of once every 50,000 ft^2. Samples not complying with Specifications shall result in rejection of rolls. At geotextile manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls. Certified test results should be submitted for review/approval.

PART 3 EXECUTION

3.02 PREPARATION

A. Surface Preparation:
  1. After prepared surface has been accepted by the Installer, report to Director’s Representative any change in supporting surface condition that may require repair work. Maintain prepared surface.
  2. Repair damage to prepared surface caused by installation activities at CONTRACTOR'S expense.

3.03 INSTALLATION

A. Panel Nomenclature:
  1. Field panel is defined as a roll or portion of roll cut and placed in field, excluding patches and cap strips.
  2. Identify each field panel with identification code (number or letter-number) consistent with CONTRACTOR'S layout plan. Only authorized personnel shall be permitted to write on liner.

B. Protection:
  1. Do not use equipment which damages geotextile. Equipment shall be less than 5 psi unless a lower requirement is specified by the Manufacturer.
  2. Ensure prepared surface underlying geotextile has not deteriorated since previous acceptance, and remains acceptable immediately prior to geotextile deployment.
  3. Keep geosynthetic elements immediately underlying geotextile clean and free of debris.
  4. Do not permit personnel to smoke or wear shoes that can damage the underlying Geomembrane while working on geotextile.

5. Unroll panels in manner which does not cause excessive scratches or crimps in geotextile and does not damage supporting geomembrane. All material deployment shall be conducted under the supervision of the Construction Quality Officer.
6. Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
7. Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g., sandbags, tires) that shall not damage geotextile. In case of high winds, continuous loading is recommended along panel edges.
8. Protect geotextile in areas where excessive traffic is expected with geotextiles or other suitable materials.

C. Field Panel Deployment:
1. Install field panels at locations indicated on CONTRACTOR'S layout plan.
2. Remove damaged panels or portions of damaged panels which have been rejected from work area.
3. Do not proceed with deployment at ambient temperature below 32ºF (0ºC) or above 104ºF (40ºC) unless otherwise authorized, in writing, by the Director.
4. Do not deploy during precipitation, in presence of excessive moisture, (fog, dew), in area of ponded water or in presence of excessive winds.
5. Cover with approved material within 15 days of installation.

D. Seam Layout:
1. When possible, orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope.
2. When possible, no horizontal seam shall be less than 5 ft (1.5 m) from toe of slope.
3. In general, maximize lengths of field panels and minimize number of field seams.
4. Adjoining geotextile rolls shall be overlapped a minimum of 2 feet.

H. Repair Procedures:

1. Repair portions of geotextile exhibiting flaw or damage from construction.
2. Damaged areas will be removed and patched. The patch shall overlap the original area by a minimum of 3 feet on each side.

3.04 FIELD QUALITY CONTROL

A. Visual Inspection:
1. The Director's Representative will examine seam and non-seam areas of geotextile for identification of defects, holes, blisters, nondispersed raw materials, and any sign of contamination by foreign matter.
2. Clean and wash geotextile surface if the Director's Representative determines that amount of dust or mud inhibits examination.
3. Do not tie any geotextile panels that have not been examined for flaws by the Director's Representative

E. Repair Verification:
1. GEOTEXTILE QAC ENGINEER shall observe number and log each repair.

END OF SECTION

SPECIFICATION 0005

HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Textured high density polyethylene (HDPE) geomembrane for lining systems.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to geomembrane deployment:
   1. Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geomembrane.
   2. Copies of dated quality control certificates issued by resin supplier.
   3. Results of tests conducted by geomembrane manufacturer to verify that resin used to manufacture geomembrane meets Specifications.
   4. Statement that amount of reclaimed polymer added to resin during manufacturing did not exceed 2% by weight.
   5. List of materials which comprise geomembrane, expressed in following categories as percent by weight: polyethylene, carbon black, other additives.
   6. Manufacturer's specification for geomembrane which includes properties listed and measured using appropriate test methods.
   7. Written certification that minimum values given in manufacturer's specification are guaranteed by geomembrane manufacturer.
   8. Quality control certificates, signed by geomembrane manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
   9. Field panel layout and identification code including dimensions and details.
   10. Certificate that extrudate to be used is comprised of same resin as geomembrane to be used.
   11. List of seaming devices with identification numbers.
   12. Qualifications of Installer and designated Construction Quality Officer.
   13. Warranty statements: the Manufacturer shall warranty the material for a period of 5 years; the Installer shall warranty the installation for a period of 3 years.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.
   2. Subbase surface acceptance certificates signed by the Engineer for each area that will be covered directly by geomembrane. Submit prior to geomembrane deployment.
   3. Deployment of geomembrane will be considered acceptance of subgrade if certificate is not submitted.
   4. Material and Installation Warranty from manufacturer.

1.03 QUALIFICATIONS:

A. Manufacturer:

1. Manufacturer shall have minimum 5 yrs continuous experience in manufacture of HDPE geomembrane or experience totaling 2,000,000 sq ft of manufactured HDPE geomembrane for minimum of 10 completed facilities.

B. Installer:

1. Installer shall have minimum 5 yrs continuous experience in installation of HDPE geomembrane or experience totaling 2,000,000 sq ft of installed HDPE geomembrane for minimum of 10 completed facilities.
2. Personnel performing seaming operations shall be qualified by experience or successfully passing seaming tests. Minimum of one seamer shall have experience seaming minimum 100,000 sq ft of HDPE geomembrane using same type of seaming apparatus in use at site. Most experienced seamer, "master seamer," shall provide direct supervision, as required, over less experienced seamers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Manufacturer shall identify each roll delivered to site with following:
   a. Manufacturer's name.
   b. Product Identification.
   c. Thickness.
   d. Roll number.
   e. Roll dimensions.

2. Protect geomembrane from excessive heat, cold, UV light, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Acceptance at Site:

1. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
2. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
3. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

C. Storage and Protection:

1. Protect geomembrane from dirt, water, UV light and other sources of damage.
2. Preserve integrity and readability of geomembrane roll labels.
3. Rolls which do not have proper identification at delivery will not be accepted.
4. Contractor should prepare set down area. Any damage to rolls at time of unloading should be documented by the Installer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Textured Polyethylene Geomembrane Properties:

PROPERTY	METHOD	VALUE
Thickness	**ASTM D5199**	
	mils min. average	60
	mils min. reading	36
Modifications to ASTM D751: Measure thickness at 1-ft intervals across width of roll (perpendicular to machine direction) and report average, standard deviation, and lowest individual readings.		
Density (geomembrane)	ASTM D1505 g/cc min.	0.940
Melt Index (resin)	ASTM D1238 (Condition 190/2.16) g per 10 minutes, max.	1.0
Tensile Properties: (each direction)	**ASTM D638**	
	Yield strength (ppi min.)	88
	Break strength (ppi min.)	88
	Elongation at yield (%min.)	12
	Elongation at break (% min.)	200
Modifications to ASTM D638: Type IV Die. ASTM D638 test specimen shall be used. Grip separation shall be 2.5 in. Rate of grip separation will be 2 in. per minute. Gauge length of 1.3 in. for yield values, and 2.0 in. for break values may be used to calculate elongation from grip movement.		
Tear Strength	ASTM D1004	28 lbs min.
Puncture Resistance	ASTM D4833	72 lbs min.
Low Temperature	ASTM D746	-60ºC max.
Carbon Black Content	ASTM D1603	2.0 to 3.0%
Carbon Black Dispersion	ASTM D2663	A-1 or A-2
Modifications to ASTM D2663: Prepare sample using microtome to produce thin section of geomembrane no thicker than 20 microns. Examine thin section at 100 times magnification.		
Dimensional Stability (each direction)	ASTM D1204	2.0% max. change
Modification to ASTM D1204: 100 C for 1 hr.		
Environmental Stress Crack	GRI GM-5b	100 hrs min.
Test method GM-5 modified as follows: Test shall be discontinued upon failure of first specimen or when test duration exceeds specified value.		
Multi-axial Elongation	GRI GM-4	20% min.

C. Geomembrane shall be manufactured from new polyethylene resin. Geomembrane manufactured from non-complying resin shall be rejected.

D. Geomembrane Characteristics:

1. Contain maximum of 1% by weight of additives, fillers or extenders (not including carbon black).
2. Contain between 2% and 3% by weight of carbon black for ultraviolet light resistance.
3. No pinholes, bubbles or other surface features that compromise geomembrane integrity. Free of blisters, nondispersed raw materials, or other signs of contamination by foreign matter.

2.02 SEAMING AND TESTING EQUIPMENT

A. Welding:
1. Maintain on-site minimum of 1 spare operable seaming apparatus, unless otherwise agreed upon at pre-construction meeting.
2. Seaming equipment shall not damage geomembrane.
3. Use extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus, or utilize hand-held gauges to measure extrudate temperatures.
4. Use fusion-welding apparatus which are self-propelled devices equipped with following:
   a. Gauge indicating temperature of heating element.
   b. Method of monitoring relative pressure applied to geomembrane.
5. Place electric generator on smooth base such that no damage occurs to geomembrane.

B. Vacuum Testing Equipment:
1. Vacuum box assembly consisting of: rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.
2. Pump assembly equipped with pressure controller and pipe connections.
3. Pressure/vacuum rubber hose with fittings and connections.
4. Soapy solution to wet test area.
5. Means of applying soapy solution.

C. Air Pressure Testing Equipment:
1. Air pump (manual or motor driven), equipped with pressure ga, capable of generating, sustaining, and measuring pressure between 24 and 35 psi (160 and 240 kPa), and mounted on cushion to protect geomembrane.
2. Rubber hose with fittings and connections.
3. Sharp hollow needle, or other approved pressure feed device.
4. Air pressure monitoring device.

D. Tensiometer Testing Equipment:
1. Tensiometer shall be capable of maintaining constant jaw separation rate of 2 in. per min, and shall be calibrated, with certificate of calibration less than 1 yr old kept with tensiometer.

2.03 SOURCE QUALITY CONTROL

A. Tests, Inspections shall be performed by geomembrane manufacturer as follows:
1. Test geomembranes to demonstrate that resin meets this Specification.

2. Continuously monitor geomembrane during manufacturing process for inclusions, bubbles, or other defects. Geomembranes which exhibit defects shall not be acceptable for installation.
3. Monitor thickness continuously during manufacturing process.
4. Tests shall be conducted for following properties in accordance with test methods specified.
   a. Density.
   b. Carbon black content.
   c. Carbon black dispersion.
   d. Thickness.
   e. Tensile properties.
   f. Tear strength.
   g. Puncture resistance.

   Perform these tests on geomembrane, minimum of once every 40,000 ft^2. Samples not complying with Specifications shall result in rejection of rolls. At geomembrane manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls.
5. Perform environmental stress crack resistance test on geomembrane at minimum of once every resin lot (typically equivalent to one rail car or 180,000 lbs).
6. Geomembrane manufacturer shall certify that following tests have been performed for each resin used to manufacture rolls for Project in accordance with test methods specified.
   a. Dimensional stability.
   b. Low temperature brittleness.
   c. Multi-axial elongation.

PART 3 EXECUTION

3.01 QUALITY CONTROL SAMPLING

A. CONTRACTOR shall make rolls available and assist the Engineer in obtaining material inventory and material samples.
   1. Samples shall be tested in accordance with the test methods specified at frequency of one per 100,000 sq ft.
      a. Density
      b. Carbon black content
      c. Carbon black dispersion
      d. Thickness
      e. Tensile properties

B. Rolls represented by quality assurance testing shall be rejected if test failure. CONTRACTOR may at their expense request additional testing to validate individual rolls. Rolls bracketed by passing tests will be allowed to be deployed and seamed.

3.02 PREPARATION

A. Surface Preparation:
   1. After prepared surface has been accepted, report to Engineer any change in supporting surface condition that may require repair work. Maintain prepared surface.

2. Do not place geomembrane onto area which has become softened by precipitation or cracked due to desiccation. Observe and report surface condition daily to evaluate degree of softening and desiccation cracking.
3. Repair damage to prepared surface caused by installation activities at CONTRACTOR'S expense.

3.03 INSTALLATION

A. Panel Nomenclature:
1. Field panel is defined as a roll or portion of roll cut and seamed in field, excluding patches and cap strips.
2. Identify each field panel with identification code (number or letter-number) consistent with CONTRACTOR'S layout plan. Only authorized personnel shall be permitted to write on liner.

B. Protection:
1. Do not use equipment which damages geomembrane.
2. Ensure prepared surface underlying geomembrane has not deteriorated since previous acceptance, and remains acceptable immediately prior to geomembrane deployment.
3. Keep geosynthetic elements immediately underlying geomembrane clean and free of debris.
4. Do not permit personnel to smoke or wear shoes that can damage geomembrane while working on geomembrane. Personnel shall not bring glass bottles on geomembrane.
5. Unroll panels in manner which does not cause excessive scratches or crimps in geomembrane and does not damage supporting soil.
6. Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
7. Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g., sandbags, tires) that shall not damage geomembrane. In case of high winds, continuous loading is recommended along panel edges.
8. Protect geomembrane in areas where excessive traffic is expected with geotextiles, extra geomembrane, or other suitable materials.

C. Field Panel Deployment:
1. Install field panels at locations indicated on CONTRACTOR'S layout plan.
2. Remove damaged panels or portions of damaged panels which have been rejected from work area.
3. Do not proceed with deployment at ambient temperature below 32ºF (0ºC) or above 104ºF (40ºC) unless otherwise authorized, in writing, by the Director.
4. Do not deploy during precipitation, in presence of excessive moisture, (fog, dew), in area of ponded water or in presence of excessive winds.
5. Do not undertake deployment if weather conditions will preclude material seaming on same day as deployment.
6. Do not deploy more geomembrane field panels in one day than can be seamed during that day.

D. Seam Layout:
1. When possible, orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope.

2. When possible, no horizontal seam shall be less than 5 ft (1.5 m) from toe of slope.
3. In general, maximize lengths of field panels and minimize number of field seams.
4. Align geomembrane panels to have nominal overlap of 3 in. (75 mm) for extrusion welding and 4 to 6 in. (100 mm to 150 mm) for fusion welding. Final overlap shall be sufficient to allow peel tests to be performed on seam.

E. Temporary Bonding:
1. Hot air device (Liester) may be used to temporarily bond geomembrane panels to be extrusion welded.
2. Do not damage geomembrane when temporarily bonding adjacent panels. Apply minimal amount of heat to lightly tack geomembrane panels together. Control temperature of hot air at nozzle of any temporary welding apparatus to prevent damage to geomembrane.
3. Do not use solvent or adhesive.

F. Seaming Methods:
1. Approved processes for field seaming are extrusion fillet welding and fusion welding. Proposed alternate processes shall be documented and submitted to OWNER for approval. Alternate procedures shall be used only after being approved in writing by OWNER.
2. Seams shall meet following requirements:

POLYETHYLENE SEAM PROPERTIES

<table>
<tr><th>PROPERTY</th><th>METHOD</th><th colspan="3">SPECIFIED VALUE</th></tr>
<tr><td></td><td>MATERIAL THICKNESS</td><td>40</td><td>60</td><td>80</td></tr>
<tr><td>Bonded Seam Strength</td><td>ASTM D4437, ppi min</td><td colspan="3">132</td></tr>
<tr><td>Peel Adhesion:
Fusion
Extrusion</td><td>ASTM D4437, ppi min.
ASTM D4437, ppi min.</td><td colspan="3">90
78</td></tr>
<tr><td colspan="5">Modifications to ASTM D4437: For shear tests, sheet shall yield before failure of seam. For peel adhesion, seam separation shall not extend more than 50 percent of seam width into seam. For either test, testing shall be discontinued when sample has visually yielded. For all tests 4 of 5 samples shall pass for seam to qualify and all shall have a strength value.</td></tr>
</table>

3. Use double-fusion welding as primary method of seaming adjacent field panels.
   a. For cross seam tees, associated with fusion welding, extrusion weld to minimum distance of 4 in. (100 mm) on each side of tee.
   b. Place welder on protective pad to prevent geomembrane damage between seaming.
   c. When subgrade conditions dictate, use movable protective layer (e.g. extra piece of geomembrane) directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between sheets and prevent debris from collecting around pressure rollers.
4. Use extrusion fillet welding as secondary method for seaming between adjacent panels and as primary method of welding for detail and repair work.
   a. Purge heat-degraded extrudate from barrel of extruder under following conditions:
      1) Prior to beginning seam.
      2) Whenever extruder has been inactive.

b. Place smooth insulating plate or fabric beneath hot welding apparatus after usage.

c. Use clean and dry welding rods or extrudate pellets.

d. Complete grinding process without damaging geomembrane within 1 hr of seaming operation.

e. Minimize exposed grinding marks adjacent to extrusion weld. Do not allow exposed grinding marks to extend more than 1/4 in. outside finished seam area.

f. Grind perpendicular to seam.

G. Seaming Procedures:

1. General Seaming Procedures: (Ambient temperature between 32ºF (0ºC) and 104ºF (40ºC)).

a. Do not field seam without master seamer being present.

b. Dry conditions, i.e., no precipitation nor other excessive moisture, such as fog or dew.

c. No excessive winds.

d. If required, provide firm substrate by using extra piece of geomembrane, or similar hard surface directly under seam overlap to achieve proper support for seaming apparatus.

e. Align seams with fewest possible number of wrinkles and fishmouths.

f. Extend seams to outside edge of panels placed in anchor trench.

g. Prior to seaming, ensure that seam area is clean and free of moisture, dust, dirt, debris or foreign material.

h. Fishmouths or wrinkles at seam overlaps shall be cut along ridge of wrinkle in order to achieve flat overlap. Cut fishmouths or wrinkles shall be seamed and any portion where overlap is inadequate shall be patched with an oval or round patch of same geomembrane extending minimum of 6 in. (150 mm) beyond cut in each direction.

i. Deploy and seam geomembrane to minimize bridging due to temperature changes that could result in failure of liner.

2. Cold Weather Seaming Procedures (ambient temperature is below 32ºF (0ºC)).

a. No seaming of geomembrane is permitted unless demonstrated to OWNER ENGINEER that geomembrane seam quality will not be compromised.

b. GEOMEMBRANE QAC ENGINEER shall determine geomembrane surface temperatures at intervals of at least once per 100 ft of seam length to determine if preheating is required. For extrusion welding, preheating required if surface temperature of geomembrane below 32ºF (0ºC).

c. Preheating may be waived by OWNER based on recommendation from GEOMEMBRANE QAC ENGINEER, if demonstrated to GEOMEMBRANE QAC'S ENGINEER'S satisfaction that welds of equivalent quality may be obtained without preheating at expected temperature of installation.

d. If preheating is required, GEOMEMBRANE QAC ENGINEER shall observe areas of geomembrane that have been preheated by hot air device prior to seaming, to ensure they have not been subjected to excessive melting.

e. GEOMEMBRANE QAC ENGINEER shall confirm that surface temperatures not lowered below minimum surface temperatures specified for welding due to winds or other adverse conditions. It may be necessary to provide wind protection for seam area.

f. Preheating devices used shall be pre-approved by OWNER prior to use.

g. Additional destructive seam tests may be taken at interval between 500 ft and 250 ft of seam length, at GEOMEMBRANE QAC'S ENGINEER'S discretion.

h. Sheet grinding may be performed before preheating, if applicable.
i. Trial seaming shall be conducted under same ambient temperature and preheating conditions as actual seams. New trial seams shall be conducted if ambient temperature drops by more than 10ºF (3ºC) from initial trial seam test conditions. New trial seams shall be conducted upon completion of seams in progress during temperature drop.

3. Warm Weather Procedures (ambient temperature is above 104ºF (40ºC)).
   a. No seaming of geomembrane is permitted unless demonstrated to OWNER ENGINEER that geomembrane seam quality will not be compromised.
   b. Trial seaming shall be conducted under same ambient temperature conditions as actual seams. New trial seams shall be conducted if ambient temperature rises by more than 5ºF (3ºC) from initial trial seam test conditions. Such new trial seams shall be conducted upon completion of seams in progress during temperature rise.
   c. At option of GEOMEMBRANE QAC ENGINEER, additional destructive seam tests may be required for any suspect areas.

H. Repair Procedures:

1. Repair portions of geomembrane exhibiting flaw, or failing destructive or nondestructive test.
2. Final decision as to repair procedure shall be agreed upon between OWNER, CONTRACTOR, and GEOMEMBRANE QAC ENGINEER.
3. Acceptable repair procedures include following:
   a. Patching: Piece of same geomembrane material extrusion welded into place. Use to repair large holes, tears, nondispersed raw materials, and contamination by foreign matter.
   b. Spot welding or seaming: Bead of molten extrudate placed on flaw. Use to repair pinholes, or other minor, localized flaws.
   c. Capping: Strip of same geomembrane material extrusion welded into place over inadequate seam. Use to repair large lengths of failed seams.
   d. Extrusion welding flap: Bead of molten extrudate placed on exposed flap of fusion weld. Use to repair areas of inadequate fusion seams, which have exposed edge. Repairs of this type shall be approved by GEOMEMBRANE QAC ENGINEER and shall not exceed 100 ft (30 m) in length.
   e. Removal and replacement: Remove bad seam and replace with strip of same geomembrane material welded into place. Use to repair large lengths of failed seams.
4. For each repair method:
   a. Ensure surfaces are clean, dry, and prepared in accordance with specified seaming process.
   b. Ensure seaming equipment used in repairing procedures meet requirements of this Specification.
   c. Extend patches or caps at least 6 in. (150 mm) beyond edge of defect. Round corners of patches with radius of approximately 3 in. (75 mm).
5. Do not place overlying layers over locations which have been repaired until appropriate acceptable nondestructive and destructive (laboratory) test results are obtained.

3.04 FIELD QUALITY CONTROL

A. Visual Inspection:
   1. The Engineer will examine seam and non-seam areas of geomembrane for identification of defects, holes, blisters, nondispersed raw materials, and any sign of contamination by foreign matter.
   2. Clean and wash geomembrane surface if the Engineer determines that amount of dust or mud inhibits examination.
   3. Do not seam any geomembrane panels that have not been examined for flaws by the Engineer
   4. Nondestructively test seams and any non-seam areas identified by the Engineer.

B. Trial Seams:
   1. Make trial seams on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming.
   2. Make trial seams at beginning of each seaming period, and at least once each 5 hrs, for each production seaming apparatus used that day. Each seamer shall make at least one trial seam each day.
   3. Make trial seams under same conditions as actual seams.
   4. Make trial seams only under observation of the Engineer.
   5. Seam overlap shall be as indicated for finished seam.
   6. Make trial seam sample shall be at least 5 ft (1.6 m) long by 1 ft (0.3 m) wide (after seaming) with seam centered lengthwise.
   7. Cut 3 specimens from sample with 1 in. (25 mm) wide die. These specimen locations shall be selected randomly along trial seam sample by the Engineer. Test specimens in peel using field tensiometer. Samples shall fail in sheet or exceed the specified peel criteria stated in this Specification.
   8. If specimen fails, entire trial seam operation shall be repeated. If additional specimen fails, do not use seaming apparatus and seamer until deficiencies are corrected and 2 consecutive successful trial welds are achieved.

C. Nondestructive Seam Testing:
   1. General:
      a. Purpose of nondestructive tests is to check continuity of seams. It will not provide quantitative information on seam strength.
      b. Nondestructively test field seams over their full length using vacuum test for extrusion seams, air pressure for double-fusion seams or other approved method. Document results.
      c. Perform nondestructive testing as seaming work progresses.
   2. Vacuum Testing for extrusion seam:
      a. Energize vacuum pump and reduce tank pressure to approximately 5 psi (10 in. of Hg) (35 kPa) gauge pressure.
      b. Wet strip of geomembrane approximately 12 in. by 48 in. (0.3 m by 1.2 m) with soapy solution.
      c. Place box over wetted area.
      d. Close bleed valve and open vacuum valve.
      e. Ensure that leak-tight seal is created.
      f. For minimum of 10 sec, apply vacuum and examine geomembrane through viewing window for presence of soap bubbles.

g. If no bubbles appear within 10 sec, close vacuum valve and open bleed valve, move box over to next adjoining area with minimum 3 in. (75 mm) overlap and repeat process.
h. Mark and repair areas where soap bubbles appear.

3. Air Pressure Testing for double-fusion seam:
   a. Seal both ends of seam to be tested.
   b. Insert needle or other approved pressure feed device into air channel created by fusion weld.
   c. Insert protective cushion between air pump and geomembrane.
   d. Pressurize air channel to pressure of approximately 30 psi (200 kPa). Close valve and allow pressure to stabilize for approximately 2 min.
   e. Observe air pressure 5 min after initial 2 min stabilization period ends. If pressure loss exceeds Maximum Permissible Pressure Differential or pressure does not stabilize, locate faulty area and repair.

MAXIMUM PERMISSIBLE PRESSURE DIFFERENTIAL AFTER 5 MINUTES

Material (mil)	Pressure Diff. (psi)
40	4
60	3
80	2
100	2

   f. Cut opposite end of tested seam area once testing is completed to verify continuity of air channel. If air does not escape, locate blockage and retest unpressurized area. Repair cut end of air channel.
   g. Remove needle or other approved pressure feed device and repair hole in geomembrane.
4. Inaccessible Seams:
   a. Cap-strip seams that cannot be nondestructively tested.
   b. Cap-strip material shall be composed of same type and thickness geomembrane as geomembrane to be capped.

D. Destructive Seam Testing:
1. General:
   a. Purpose of destructive seam testing to evaluate seam strength.
   b. Perform destructive seam test as seaming progresses.
   c. Failed destructive seam sample shall result if grips of testing machine cannot be closed on sample test flap (available flap is 1/2 in. long or less) due to excessive temporary welding.
2. Location and frequency:
   a. Test at minimum frequency of one test location per 500 ft (150 m) of seam length performed by each welding machine. This minimum frequency to be determined as average taken throughout entire facility.
   b. Test locations shall be determined during seaming, at Engineer's discretion.
   c. CONTRACTOR will not be informed in advance of locations where seam samples will be taken.
   d. The Engineer reserves right to increase frequency of testing in accordance with performance results of samples previously tested.
3. Sampling Procedures:

a. Cut samples at locations chosen by the Engineer.
b. CONTRACTOR shall number each sample and record sample number and location in panel layout drawing.
c. Repair holes in geomembrane resulting from destructive seam sampling immediately in accordance with repair procedures described in this Specification.
d. Continuity of repair and seams shall be tested in accordance with vacuum testing requirements.

4. Sample Dimensions: Take two 1 in. wide samples for field testing prior to cutting full laboratory sample.
   a. Field Testing: Cut 1 in. (25 mm) wide samples, 8 in. long with seam centered parallel to width. Distance between these 2 samples shall be 42 in. (1.1 m). Test both samples on field tensiometer in peel. If both samples pass field test, take sample for laboratory testing.
   b. Laboratory Testing: Take laboratory test sample from between samples taken for field testing. Cut sample for laboratory testing 12 in. (0.3 m) wide by 42 in. (1.1 m) long with seam centered lengthwise. Cut this sample into three parts. GEOMEMBRANE QAC ENGINEER shall distribute parts as follows:
      1) One part to CONTRACTOR for optional laboratory testing, 12 in. by 12 in. (0.3 m by 0.3 m).
      2) One part to Geomembrane Quality Assurance Laboratory (QAL) for testing, 12 in. by 18 in. (0.3 m by 0.5 m).
      3) One part to OWNER for archive storage, 12 in. by 12 in. (0.3 m by 0.3 m).
   c. Final determination of sample sizes shall be agreed upon at pre-construction meeting.
   d. Submit laboratory sample for quantitative testing
5. Destructive Test Failure Procedures: When sample fails destructive testing, whether test is conducted by Geomembrane QAL or by field tensiometer, CONTRACTOR has following options:
   a. Repair seam between any 2 passing destructive test locations.
   b. Trace welding path to intermediate point (10 ft (3 m) minimum from point of failed test in each direction) and take small sample with 1 in. (25 mm) wide die for an additional field test at each location. If these additional samples pass test, then take full laboratory samples. If these laboratory samples pass tests, repair seam between these locations. If either sample fails, repeat process to establish zone in which seam should be repaired.
   c. Acceptable repaired seams shall be bound by 2 locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft (50 m) of repaired seam, Geosythetic QAC may have CONTRACTOR destructive test repair seam.
   d. When sample fails, OWNER may require additional testing of seams that were welded by same welder and/or welding apparatus during same time shift.
   e. Passing laboratory destructive tests of trail seam samples taken as indicated in Section 3.04, B, may be used as boundry for failing seam.

E. Repair Verification:
1. GEOMEMBRANE QAC ENGINEER shall observe number and log each repair.
2. Nondestructively test each repair.
3. Nondestructive test results that pass shall indicate adequate repair.
4. Repairs more than 150 ft long , may require destructive test sampling.

5. Failed destructive or nondestructive tests indicate that repair shall be redone and retested until passing test results.

F. Large Wrinkles: Wrinkle is considered to be large when geomembrane can be folded over onto itself.

1. When seaming of geomembrane is completed, and prior to placing overlying materials, GEOMEMBRANE QAC shall identify large geomembrane wrinkles which should be cut and reseamed.
2. Cut and reseam wrinkles identified by GEOMEMBRANE QAC. Seams produced while repairing wrinkles shall be nondestructively tested.
3. Repair wrinkles identified by GEOMEMBRANE QAC. Repair during coldest part of installation period.

END OF SECTION

SPECIFICATION 0006

GEOCOMPOSITE DRAINAGE LAYER

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Geocomposite Drainage Layer for inclusion as part of a liner system.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to geocomposite deployment:
   1. Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geocomposite.
   2. Copies of dated quality control certificates issued by resin supplier.
   3. Results of tests conducted by geocomposite manufacturer to verify that resin used to manufacture geocomposite meets Specifications.
   4. List of materials which comprise geocomposite and handling and storage procedures.
   6. Manufacturer's specification for geocomposite which includes properties listed and measured using appropriate test methods.
   7. Written certification that minimum values given in manufacturer's specification are guaranteed by geocomposite manufacturer.
   8. Quality control certificates, signed by geocomposite manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
   9. Field panel layout and identification code including dimensions and details.
   10. Qualifications of Installer and designated Construction Quality Officer.
   11. Warranty statements: the Manufacturer shall warranty the material for a period of 5 years; the Installer shall warranty the installation for a period of 3 years.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.
   2. Material and Installation Warranty from manufacturer.

1.03 REFERENCES:

A. "Drop in Specifications for Geocomposites," GSE, http://www.gseworld.com/products/drainage/geocomposite.html

1.04 QUALIFICATIONS:

A. Manufacturer:
   1. Manufacturer shall have minimum 5 yrs continuous experience in manufacture of geocomposites or experience totaling 2,000,000 sq ft of manufactured geocomposites for minimum of 10 completed facilities.

B. Installer:

1. Installer shall have minimum 5 yrs continuous experience in installation of geocomposite or experience totaling 2,000,000 sq ft of installed geocomposite for minimum of 10 completed facilities.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Manufacturer shall identify each roll delivered to site with following:
      a. Manufacturer's name.
      b. Product Identification.
      c. Thickness.
      d. Roll number.
      e. Roll dimensions.

   2. Protect geocomposite from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Acceptance at Site:
   1. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
   2. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
   3. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

C. Storage and Protection:
   1. Protect geocomposite from dirt, water, UV light, and other sources of damage.
   2. Preserve integrity and readability of geocomposite roll labels.
   3. Rolls which do not have proper identification at delivery will not be accepted.
   4. Contractor should prepare set down area. Any damage to rolls at time of unloading should be documented by the Installer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Geocomposite Properties:

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE[1]		
Geocomposite			**6 oz/yd^2**	**8 oz/yd^2**	**10 oz/yd^2**
Transmissivity[2], gal/min/ft (m^2/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft^2	 0.48 (1 x 10^{-4}) 4.83 (1 x 10^{-3})	 0.48 (1 x 10^{-4}) 4.83 (1 x 10^{-3})	 0.43 (9 x 10^{-5}) 4.34 (9 x 10^{-4})
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft^2	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core[3] - GSE HyperNet					
Transmissivity[2], gal/min/ft (m^2/sec)	ASTM D 4716		9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})	9.66 (2 x 10^{-3})
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft^2	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft^2	2.0	2.0	2.0
Geotextile[3,4]					
Mass per Unit Area, oz/yd^2(g/m^2)	ASTM D 5261	1/90,000 ft^2	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft^2	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft^2	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft^2	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec^{-2})	ASTM D 4491	1/540,000 ft^2	1.5	1.3	1.0
Flow Rate, gpm/ft^2 (lpm/m^2)	ASTM D 4491	1/540,000 ft^2	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft^2	200 (5)	200 (5)	200 (5)
Roll Width[5], ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length[5], ft (m)	Double-Sided Composite Single-Sided Composite		270 (82.3) 300 (91.4)	260 (79.2) 310 (94.5)	230 (70.1) 290 (88.4)
Roll Area, ft^2 (m^2)	Double-Sided Composite Single-Sided Composite		3,915 (364) 4,350 (404)	3,770 (350) 4,495 (418)	3,335 (310) 4,205 (391)

NOTES:

- [1]AOS in mm is a maximum value.
- [2]Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3]Component properties prior to lamination.
- [4]Refer to geotextile product data sheet for additional specifications.
- [5]Roll widths and lengths have a tolerance of ±1%.
- *Modified.

B. Geocomposite shall be manufactured from new polyethylene resin. Geocomposite manufactured from non-complying resin shall be rejected.

C. Geocomposite shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure with a non-woven geotextile bonded to one or both sides.

2.03 SOURCE QUALITY CONTROL

A. Tests, Inspections shall be performed by geocomposite manufacturer as follows:

1. Test geocomposite to demonstrate that resin meets this Specification.

2. Continuously monitor geocomposite during manufacturing process for inclusions, bubbles, or other defects. Geocomposites which exhibit defects shall not be acceptable for installation.
3. Monitor thickness continuously during manufacturing process.
4. Tests shall be conducted for the following properties in accordance with test methods specified.

   I. Resin
      a. Polymer Density.
      b. Melt Flow Index.
   II. Geonet
      a. Carbon black content.
      b. Tensile Strength, MD.
      c. Density.
   III. Geotextile
      a. Mass per Unit Area.
      b. Grab Tensile.
      c. Puncture Resistance.
      d. AOS, US Sieve.
      e. Water Flow Rate
      f. UV Resistance
   IV. Geocomposite
      a. Ply Adhesion
      b. Transmissivity

   Perform these tests on geocomposite materials, minimum of once every 50,000 ft^2. Samples not complying with Specifications shall result in rejection of rolls. At geocomposite manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls. Certified test results should b submitted for review/approval.

PART 3 EXECUTION

3.02 PREPARATION

A. Surface Preparation:
   1. After prepared surface has been accepted by the Installer, report to Director's Representative any change in supporting surface condition that may require repair work. Maintain prepared surface.
   2. Repair damage to prepared surface caused by installation activities at CONTRACTOR'S expense.

3.03 INSTALLATION

A. Panel Nomenclature:
   1. Field panel is defined as a roll or portion of roll cut and placed in field, excluding patches and cap strips.
   2. Identify each field panel with identification code (number or letter-number) consistent with CONTRACTOR'S layout plan. Only authorized personnel shall be permitted to write on liner.

B. Protection:
   1. Do not use equipment which damages geocomposite. Equipment shall be less than 5 psi unless a lower requirements is specified by the Manufacturer.
   2. Ensure prepared surface underlying geocomposite has not deteriorated since previous acceptance, and remains acceptable immediately prior to geocomposite deployment.
   3. Keep geosynthetic elements immediately underlying geocomposite clean and free of debris.
   4. Do not permit personnel to smoke or wear shoes that can damage the underlying Geomembrane while working on geocomposite.
   5. Unroll panels in manner which does not cause excessive scratches or crimps in geocomposite and does not damage supporting geomembrane. All material deployment shall be conducted under the supervision of the Construction Quality Officer.
   6. Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
   7. Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g., sandbags, tires) that shall not damage geocomposite. In case of high winds, continuous loading is recommended along panel edges.
   8. Protect geocomposite in areas where excessive traffic is expected with geotextiles, extra geocomposite, or other suitable materials.

C. Field Panel Deployment:
   1. Install field panels at locations indicated on CONTRACTOR'S layout plan.
   2. Remove damaged panels or portions of damaged panels which have been rejected from work area.
   3. Do not proceed with deployment at ambient temperature below 32ºF (0ºC) or above 104ºF (40ºC) unless otherwise authorized, in writing, by the Director.
   4. Do not deploy during precipitation, in presence of excessive moisture, (fog, dew), in area of ponded water or in presence of excessive winds.
   5. Do not deploy more geocomposite field panels in one day than can be tied during that day.
   6. Cover with approved materials within 10days after installation.

D. Seam Layout:
   1. When possible, orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope.
   2. When possible, no horizontal seam shall be less than 5 ft (1.5 m) from toe of slope.
   3. In general, maximize lengths of field panels and minimize number of field seams.
   4. Adjacent edges of the geonet along the length of the geocomposite roll shall be placed with the edges of each geonet butted against each other.
   5. Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of 12 inches across the roll width.

E. Seaming Methods:
   1. The overlaps shall be joined by tying the geonet structure with cable ties.
   2. Cable ties shall be spaced a minimum of every 5 feet along the roll length and a minimum of every 6 inches within the anchor trench as applicable or as directed by the Engineer.

H. Repair Procedures:

1. Repair portions of geocomposite exhibiting flaw or damage from construction.
2. Damaged areas will be removed and patched. The patch shall be secured to the original geonet by tying every 6 inches with cable ties.

3.04 FIELD QUALITY CONTROL

A. Visual Inspection:

1. The Director’s Representative will examine seam and non-seam areas of geocomposite for identification of defects, holes, blisters, nondispersed raw materials, and any sign of contamination by foreign matter.
2. Clean and wash geocomposite surface if the Director’s Representative determines that amount of dust or mud inhibits examination.
3. Do not tie any geocomposite panels that have not been examined for flaws by the Director’s Representative

E. Repair Verification:

1. GEOMEMBRANE QAC ENGINEER shall observe number and log each repair.

END OF SECTION

SPECIFICATION 0007

HYDROSEEDING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Erosion Control, soil stabilization, and biocell cap protection through the use of Hydroseeding.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to application of Hydroseeding:
   1. Origin (supplier's name and production plant) of all slurry mix materials described in Section 2.1.
   2. Proposed method and rate of slurry mix material application.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Protect slurry materials from excessive heat, cold, moisture, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Storage and Protection:
   1. Protect slurry materials from excessive water and other sources of damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. The slurry mix shall consist of the following materials:
   a. Cellulose fiber mulch;
   b. Fertilizers;
   c. Organic tackifier; and
   d. Hydroseed mix.

B. Hydroseed mix shall consist of an appropriate mixture as defined in the table below.

Type	Application rate (lbs./1000 sq. ft.)
Birdsfoot trefoil **OR** Common white clover	0.20 0.20
AND	
Tall fescue	0.45
AND	
Redtop **OR** Rygrass	0.05 0.10

C. Fertilizer shall consist of 10-10-10 or equivilant.

2.02 EQUIPMENT

A. Equipment shall consist of a built in agitation system with the ability to agitate, suspend, and homogeneously mix by mechanical means a slurry containing not less than 44 lbs. of slurry mix per 100 gallons of water.

PART 3 EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall visually inspect soils for conditions that may hinder hydroseeding operations prior to application of slurry mixture. The CONTRACTOR shall notify the Engineer of any known conditions that may hinder hydroseeding operations or intended outcome prior to application of slurry mixture.

B. CONTRACTOR shall water soils 24 hours in advance of slurry mix application.

3.03 INSTALLATION

A. CONTRACTOR shall apply the slurry mix uniformly over the soils taking care to allow for mixing of the soils and slurry mix and in accordance with all manufacturer specifications.
B. All slurry mixtures shall be applied within two hours of mixing in the hydroseeding equipment or shall be disposed of offsite at the CONTRACTORS expense.
C. Do not apply the slurry mixture during extreme moisture conditions (excessive wet or dry soils).
D. The Engineer will have the final determination if conditions are acceptable for hydroseeding application.

3.04 FIELD QUALITY CONTROL

A. The CONTRACTOR shall provide visual inspection and photographic documentation that the slurry mixture has been properly applied to and mixed with the soils.

END OF SECTION

SPECIFICATION 0008

MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- **A.** Scope
- **B.** References
- **C.** Submittals
- **D.** Materials
- **E.** Product Requirements
- **F.** Equipment
- **G.** Piping

1.02 SCOPE:

A. Furnish, store, and install mechanical components and piping to meet the performance requirements in the contract documents in completing the remediation system installation.

B. Coordinate installation among subcontractors, especially piping and electrical equipment installation.

C. Provide Engineer with submittals as required.

1.03 REFERENCES:

A. Process Piping ASME B31.3

B. HDPE Pipe ASTM D3350 and D1603

C. Poly-vinyl chloride (PVC) Pipe ASTM D1785

D. Manufacturer’s Recommendations for specified Equipment and Materials

1.04 SUBMITTALS:

A. Materials and Equipment: Submit manufacturer's product data in accordance with the Products subsection of this section. Provide configurations, ratings, and dimensions for equipment and products, including location and size/capacity of each connection required for installation. Shop Drawings need to be submitted for approval by the Engineer. Operation and Maintenance Manual to be submitted to the Engineer at the time of shipping.

B. Warranties and Spare Parts: Provide manufacturer's warranties, the installation warranty shall guaranty the installation is free of “workmanship or material” defects for a minimum of 1 year.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Furnish, store, place, and install the following mechanical components per manufacturer's recommendations and related detail design Drawings.

1. Transducer Panels (Cell 1 through Cell 5)

a. Contractor to provide NEMA 4 weather resistant control panels provided by Campbell Scientific (ENC14/16-DC-NM #18819-30) or approved equivalent. Five separate panels, each shall be provided with the following equipment included within. (Parts obtained from Campbell Scientific, Inc. with standard warranty unless noted otherwise)

i. (1) 12 Volt Power Supply w/Charging regulator (Model: PS100-SW #17252-16)

ii. (1) Wall Charger 18 VAC 1.2 AMP Output, 110 VAC input, with 6 feet of cable (Model: PS100-SW #9591)

iii. (1) RS-485 Multidrop Interface with ST Tested -25 to + 50 deg C (Model: MD485-ST-SW #16685-5)

iv. (1) Measurement and Control Datalogger which shall be ST Tested -25 to + 50 deg C (Model: CR1000-ST-SW-NC #16130-23)

v. (1) 32 Channel Relay Mulitplexer which shall be ST rated -25 to + 50 deg C (Model: AM16/32B-ST-SW #19232-5)

vi. (12) Water Content Reflectometers with 75 feet of cable for each (Model: CS616-L75 #13932-32)

vii. (12) Soil Oxygen Probes (SO-111) with 75 feet of cable for each. *Obtained from Apogee Instruments*.

2. Cellular Data transmission station

a. The following Cellular data transmission equipment shall be provided and installed with the Cell 5 transducer panel.

i. (1) Airlink CDMA Cellular Digital Modem for Verizon (Model: RAVENXTV #21830)

ii. (1) Raven and Redwing Mounting Kit (#14394)

iii. (1) Data Cable Null Modem DB9 Male to Male 1 foot long (#18663)

iv. (1) 800 Mhz 1dBd Omni Cellular Antenna with N female & CSI Mounting Hardware (#18285)

v. (1) Cellular Phone Antenna with 12 feet N Male to SMA cable (#21847)

vi. (1) Datalogger Support Software Package (Model: Loggernet #16344)

3. Supports for Transducer Panels (5 set ups, Contractor to provide 1 for each transducer panel). The transducer panel at Cell 5 will house the cellular data transmission equipment and transducer equipment.

a. 6 inch thick concrete pads of 4 feet × 4 feet, 6 inches into the top soil cover installed for mounting of each panel.

b. Provide Control panel stands appropriately sized and rated for mounting of each panel at the locations shown on the drawings. Stands shall be sized appropriately to support the panel at a height of approximately 4 feet above grade.

c. 4000 psi concrete

4. Sump Pump Vault Package (P-2)

a. (VSDPT2-3) EPG SurePump patented, vertical, stainless steel sump drainer with a ½ HP 480 VAC 3 phase motor, capable of 10 GPM @ 25 feet of total dynamic head (TDH).

i. Include 25 feet of 14 AWG jacketed motor lead.

ii. A submersible level sensor with 25 feet lead.

iii. A 25 feet length of 1/8-inch stainless steel suspension cable with clamps.

iv. To include drilled check valve.

b. (L925PT) EPG PumpMaster Control Panel in NEMA 4 Enclosure to operate the VSDPT2-3 pump.

i. Include levelMaster level control meter and simulator

ii. A tank full pass along shut off

iii. A top mounted common alarm light

c. (BJBP500) EPG Breakout Box for the VSDPT2-3 motor

i. Nema 4X non-metallic enclosure with

ii. connection terminals for the VSDPT2-3 motor

d. (BJBL600BVA) EPG Breakout Box for the level sensor

i. Nema 4X non-metallic enclosure with

ii. Includes desicant dryer, bellows and connection terminals.

5. Prefab Remediation System Enclosure

a. SVE Blower Packages Provided by vendor Based on AECOM separate specification. Fully integrated package ready for operation includes (see NES quotation and Design Drawings for Details):

i. (2) 25 Hp / 480 VAC/ 3 PH/ TEFC Positive Displacement blowers capable of creating 500 scfm @ 6 inches of Hg.

ii. Inline Air Filter with Differential Pressure Indicator

iii. Discharge Silencer package

iv. V-belt Drive set-up

v. Discharge Check Valve

vi. Inlet and Discharge Isolation Valves

vii. Vacuum Relief Valve (@ 9 inches Hg Vacuum)

viii. Discharge Pressure Indicator

ix. Discharge Temperature Indicator

x. Flex connector

b. Moisture Separator

i. (1) 180 Gallon Moisture Separator

ii. ¾ HP / 480 VAC / 3PH/ TEFC transfer pump capable of 5 GPM @ a discharge pressure of 30 psig

iii. 3 position Level Switch

iv. Site glass

v. Manual Drain Valve

vi. Side clean out

vii. 6-inch inlet isolation butterfly valve

viii. Dilution valve with intake filter/silencer

c. Moisture Separator Condensate Holding Tank

i. 1,000 gallon Polyethylene tank, approximately 64-inches in diameter and 80-inche high

ii. 16-inch top access man way

iii. Holding Tank High and High/High Level Switches, Gems Model MGRE40T

iv. Holding Tank bulkhead fittings with cord grips for level switches

v. Holding Tank Drain Valves

vi. ¾ HP / 480 VAC / 3 PH / TEFC Transfer Pump capable of 5 GPM @ discharge pressure of 30 psi

d. 5 Leg SVE Inlet Manifold – Exterior Installation

i. 6 inch PVC Headers with five 6-inchPVC legs

ii. Five 6-inch Butterfly Vales with NEMA 4 Actuators

iii. Temperature Indicator

iv. Pressure Indicator

SVE Inlet Manifold – Interior Installation

v. Vacuum Transmitter

vi. Flow Transmitter with 6-inch averaging pitot tube

e. Control Panel & Power Distribution System

i. UL Listed EOS Pro Control-Based Control System capable of controlling (3) SVE Blowers, (1) Moisture Separator Effluent Pump, (1) Holding Tank Effluent Pump and (5) SVE Motor Operated Valves (MOVs)

ii. Alarms with programmed reset for moisture separator emergency high sump level, SVE system high discharge temperature, SVE system low vacuum, VFD 1 fault, VFD 2 fault, Emergency Stop Active, Holding Tank emergency high level, and Floor Sump emergency high level

iii. Circuit breakers, motor starters, overloads, external pilot lights, and selector switches

iv. Controls housed in NEMA 4 weather-tight enclosure to be placed in a non-hazardous location as defined bt NEC

v. (5) Two channel digital 7 day/24 hour timers for solenoid valves and motors

vi. (5) Selector switches for motor operated valve control

vii. (2) hour meters

viii. EOS Research Pro Control Type A2

ix. Analog outputs for controlling VFD speeds remotely

x. (2) Motor Starters for transfer pumps (with plastic cover for 480 V personnel protection)

xi. (2) 25 HP AC-Tech M34250 Variable Frequency Drives

xii. Externally mounted 480 VAC Fused Disconnect

xiii. 480 V Power Distribution Panel with three phase, 200 amp, NEMA 1 rating, main breaker and breakers for all motors, heaters, and transformer

xiv. 10 KVA Step Down Transformer with NEMA 3R rating and single phase (480 V input, 120/240 output) configuration

xv. 240 V Distribution panel with single phase, 100 amp, NEMA 3R rating, main breaker and breakers for control power, receptacle, lighting, and exhaust fan

xvi. A surge suppressor for protection of all electronic components on secondary (120/240 V) side of transformer

f. System Enclosure

i. Steel 8 feet by 40 feet by 9.5 feet high Cargo Container with separate entry control and process rooms

ii. External Electrical and Mechanical tie points for site contractor connection of integrated equipment to site work

Process Room

iii. Designed to meet Class 1 Division 2 NEC requirements to house the moisture separator, transfer pumps, holding tank, and SVE blowers

iv. (2) Explosion proof heaters with remote thermostat

v. (1) Explosion proof exhaust fan with remote thermostat

vi. (5) Class 1 Division 2 lights with switches located near the side entrance

vii. R-11 Insulation & Plywood interior finish

viii. Intake air shutter

ix. Floor Sump with Level Switch

Control Room

x. Designed as non-classified to contain the system control panel(s), transformer, and distribution panels

xi. (1) Non Classified heater with remote thermostat

xii. (1) Non Classified Pressure fan with remote thermostat

xiii. (1) Fluorescent light with light switch located near the side entrance

xiv. R-11 Insulation and Plywood interior finish

xv. Intake air shutter

B. Pipe, Fittings, Valves

1. High Density Polyethylene (HDPE) Pipe

a. Piping perforated sections and risers within each cell will consist of appropriately sized SDR-17 HDPE pipe as shown on the drawing 13 of Final Design Report.

i. Screen sections will be 2-inch in diameter

ii. Riser pipes extending screens above grade on the applied vacuum side will be 2-inch in diameter

iii. Vacuum headers will consist of ten (2 per cell) 4" manufactured SDR-17 HDPE headers will be manufactured and shipped to the site as four (20 foot long) pieces each. These will be 4" headers with 24 1' long 2" pipe extensions on a single plane. Six extensions per 20 foot long piece.

iv. The 4-inch vacuum headers for each cell will T together and connect to a 6-inch main vacuum line which extends from each cell to the pre-fab remediation system enclosure.

v. The single pipe and fittings which extend the ambient air intake of the screen sections above grade will be 4-inch in diameter

b. HDPE pipe shall be solid wall plastic pipe manufactured as specified in ASTM D3035.

c. The 2-inch perorated HDPE pipe will be in 40 foot lengths and will have 1/8-inch perforations, 6-inches on center and at 120 degree separation on the pipe circumference.

d. All pipes shall be HDPE SDR-17.

e. Fittings shall be fusion weld style T's, 45's, 90's, and PVC adapters approved for use with SDR-17 pipe and meeting the pressure ratings of the pipe itself.

2. Polyvinyl Chloride Pipe

a. The following pipe will be schedule 40 PVC:

i. Above grade piping on the ambient air intake side of the cell will be 4-inch diameter

ii. Piping from Sump Pump outlet to 1000 gal poly tank to be 1½ -inch diameter

iii. Piping from Pre-fab remediation system enclosure moisture knock-out pump effluent to 1000 gal poly tank is to be 1-inch diameter

iv. Piping from P-3 1000 gal poly tank (T-2) discharge pump to ambient air inlet piping to be 1-inch PVC, and 1-inch hose as shown on the drawings

v. Piping from Pre-Fab remediation system enclosure SVE effluent to Vapor Phase Carbon is to be 6-inch

3. Valves and Fittings

a. Valves will be installed in line as shown on the drawings by utilizing a fusion weld HDPE by by male NPT fitting, on each side of any valve.

b. At the system enclosure five male NPT by HDPE fittings will be utilized to connect between the engineer provided manifold and the contractor provided and installed piping.

c. All PVC fittings shall be schedule 40 PVC non drainage type fittings.

a. All HDPE type fittings shall be SDR-17 rated for up to 100 PSI.

b. All valves shall be appropriately sized to the pipes where they are connected and shall be schedule 40 type PVC true union type valves with option NPT or socket weld connection.

C. Storage

1. Contractor is responsible for the condition of all equipment until the completion of the project. At each stage of work, equipment must be protected from

weather, mechanical damage, theft, and from inappropriate handling or installation.

a. Cover all openings to prevent entry by dirt, dust, or debris, pests, or water.

b. Store on skids or pallets as appropriate to prevent similar damage.

c. Protect sensitive materials from exposure to sunlight.

2.02 PRODUCT REQUIREMENTS:

A. Identify, furnish, and install all necessary equipment as indicated herein and in the Drawings. Unless noted as provided by AECOM

PART 3 – EXECUTION

3.01 EQUIPMENT:

A. Installation of each item shall be in accordance with manufacturer's recommended methods, materials, and procedures. Notify Engineer immediately if conflicts or interferences with other work are discovered.

B. Locations, elevations and dimensions for site features shown on the Drawings are from recent surveys of visible/accessible site features or have been approximated. There may be abandoned or active subsurface piping or utilities in the work area that are not identified on the Drawings. The Contractor is responsible for verifying the location, dimensions and potential hazards of any existing facilities at the site while conducting this work.

C. Arrange installation with ample space for building entry and equipment servicing and maintenance. Coordinate with electrical work to provide space for location of panels, conduit, switches, and similar appurtenances.

D. Contractor may sequence the work as necessary to optimize site activities.

E. Contractor to furnish, store, place, and install the following mechanical components listed herein, except where specifically stated otherwise.

1. Transducer Panels (Cell 1 through Cell 5 and Cellular Data Transmission Station, and Sump Pump Control Panel)

d. CONTRACTOR is to install a 4 feet by 4 feet by 6 inch thick concrete pad with anchor bolts for the control panel in the area of the of each cell as shown on the drawings.

i. Cast four hot dipped galvanized steel, 5/8 inch coarse thread by 4 inches long “J” bolts into the pad using a template made directly from the control panel stand for each panel.

ii. Protect bolt stubs from damage as necessary until panel is ready to be installed

iii. Cables for individual transducers installed during civil work will be connected to the appropriate panel inputs

iv. Cellular antenna to be anchored to one of the Cellular Data Transmission Station pad and erected per the manufacturer's recommendations.

2. Sump Pump Vault Package (P-2)

a. Installed in the cell #1 as shown on the drawings

b. Fitted with 1.5-inch diameter pipe

c. Control panel installed and anchored as indicated for panels associated with Transducer Panels, and Cellular Data Transmission panel.

3. Prefab Remediation System Enclosure

a. Fully integrated package ready for operation (See Design Drawings for Details):

i. Install Enclosure at location shown on the Drawings.

ii. Contractor responsible for rigging of components into place from delivery truck.

iii. Prepare a crushed gravel layer as shown on the drawings.

iv. Install Vendor Supplied unistrut frames and solenoid valve manifold to outside of building. All materials are provided by vendor. Contractor must only provide labor to mount.

v. Connect 6-inch PVC main vacuum lines to vendor provided manifold as specified by the Engineer.

vi. Electrical connections to be completed to the containers locally mounted panel as indicated in Specification 0009 — Electric.

vii. Complete SVE blower discharge piping from pre-fab remediation enclosure to AECOM provided vapor phase carbon vessles.

viii. Complete PVC piping connections from sump pump (P-2) to influent of tank T-2 and (P-3) to ambient air intake piping. These pipes will be supplied and labeled on the outside of the engineer provided Pre-fab remediation system enclosure (site contractor not expected to make building penetrations).

F. Pipe, Fittings, Valves, and Insulation

1. HDPE , and PVC Piping

a. Piping is to be pressure tested prior to start up.

b. Pipe runs of over 10 feet are to be placed on unistrut and secured in place with appropriately sized unistrut clamps. The maximum distance between clamps shall be 8 feet.

c. Install HDPE piping as specified in ASTM D2321.

d. HDPE pipe connections shall be fusion welded.

e. PVC pipe threaded or solvent welded at all fixed connections as shown on the drawings.

f. All connections to vessels and other pipe materials via ANSI 150# flanges

g. Use Teflon® tape and pipe sealant for all threaded joints.

2. Valves

a. Valves shall be installed as shown on the drawings.

b. To be tested to insure that the valve is operable after gluing in place.

G. Installed pressure-rated pipe shall be pressure tested at 50 psig. Fully assembled sections may be pressure tested prior to installation, however no fittings or pipe sections may be added to a tested pipe run for the test to remain valid (i.e. changes to tested piping requires a retest of the newly formed pipe section). The Contractor shall provide all fittings and test plugs necessary to complete the pressure testing. This shall include well head plugs, and insertion bladder such that the pipeline may be pressure tested after connection to the well.

END OF SECTION

PRESSURE TESTING FORM FOLLOWS

PIPING PRESSURE TEST PROCEDURE

Test Number:__________ Length Tested:_________ Date Tested:__________
Line ID:_________________ Test By:__________________ Approval: ____________

STEP ACTION	NOTES	INITIAL

Notes:

All piping, especially joints, should be exposed for visual inspection of potential leaks.

Connect the test assembly at the most suitable end of the piping run.

Remove and cap any pressure or safety relief devices including rupture discs, relief valves, or vacuum gauges not rated for test pressure.

Fill the entire line with air (via air compressor) to the appropriate test pressure for the line.

Close off the pressure source from the line being tested and note the time and pressure in the "Notes" column to the right.

Soap all exposed joints and fittings for leaks. Tag any leaks and ensure that these are repaired upon depressurization

If there are no visible leaks, and the pressure has remained within 5% of the initial pressure, note the final pressure in the "Notes" column and approve the line tested.

SPECIFICATION 0009

ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 General

A. Furnish all labor, materials, tools, equipment, and appurtenances as required to provide a complete and operable electrical installation and, as needed, to meet the requirements of the Contract Documents. The Division 1 Specification Sections apply to the work of this Section.

1.02 SCOPE OF WORK

A. Contractor to supply an electrical service drop of 480 VAC 3ϕ to a 200 ampere service. The service will require cable, conduit, utility meter box, and proper grounding; all to be installed on an OWNER provided pre-fab building which will be delivered with external disconnect.

B. Furnish and install conduits and wiring which will be utilized to provide 120 VAC power from the Owner provided 120 VAC breaker panel to OWNER provided transducer panels located as shown on the drawings.

C. Provide power and instrumentation conduit, cable and fittings as needed to make connections to the OWNER provided ½ Horse Power, 480 VAC 3ϕ Sump Pump (P-2) from the Owner provided breaker and control panel.

D. The work included in this section consists of furnishing all labor, materials, and all appurtenant work in connection with the installation of the electrical service connection. That includes, but is not limited to:

1. Any and all required permitting
2. Generation of an as-built plan and elevation drawing of the connection to the local electrical service provider
    - i. A mark-up of approved construction drawings with final dimensions is acceptable
    - ii. For buried services (if necessary) provide an as-built survey by a New York licensed surveyor including at least entry, exit and any bends for the buried service
3. Connection to local utilities step down transformer
4. Provide and install conduit as necessary to protect cable as required by local code and NEC
5. Conductors and cables

6. Conductor connections
7. Device boxes and conduits
8. Pull and junction boxes
9. Switches and receptacles
10. Miscellaneous equipment

1.03 HAZARDOUS AREA CLASSIFICATIONS

A. Outdoor areas are considered suitable for general purpose electrical installations.

B. Enclosed areas such as the interior of the OWNER provided pre-fab building are considered Class 1 Division 2 per NEC.

C. Subsurface areas and sumps within the OWNERS area of construction are considered Class 1 Division 1 per NEC.

1.04 REFERENCES

A. National Electrical Code, 2008

B. Permit for service entry

C. ISA S20, Instrumentation Symbols and nomenclature

D. Drawing set for this design.

1.05 SUBMITTALS

A. The design package provides site layout drawings and a schematic one-line drawings for power distribution. Contractor is to provide the Engineer with a detailed plan of execution for review and approval prior to construction. Design provided by the Contractor shall detail the local provider's requirements for the specified power drop, including all mechanical support structures (masts, etc.), meters, wiring, connectors, and all other required materials as necessary per NEC, local code, and the local service provider.

B. Submit shop drawings for all field wiring, control panels and other switch and instrument enclosures to the Engineer for approval prior to ordering. Submittals to include:

1. Detailed shop drawings: Including all mechanical support structures, wiring connectors, and overall layout and dimensions of provided materials.
2. Specifications: List of materials with manufacturer's catalog cut sheets when applicable.

3. Catalog "cuts" and data sheets containing physical and dimensioned information, performance data, electrical characteristics, and any information necessary to verify conformance to the specifications or applicable codes for all contractor provided field-mounted equipment.

4. Permit for work with anticipated schedule for final delivery by the local service provider.

C. Submit, upon completion of the work, complete as-built drawing for all electrical connections, interconnecting diagrams, control diagrams with appropriate wire, terminal numbers, and verification of the inspection by licensed electrical inspector to the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Materials: Materials shall be new and shall be delivered to the job site in the original packaging.

B. Material shall be securely stored to prevent damage from theft, weather, impacts, vermin, or vandalism.

PART 2 - PRODUCTS

2.01 METER BOX

A. NEMA 3R or better enclosure

B. As required per NEC, local code and local service provider

2.02 CONDUIT

A. Approximate locations for conduit runs and tie points are shown on the Drawings where noted. Contractor must confirm locations and conduct site reconnaissance in order to ensure the proper delivery of power to the Main Disconnect, contractor provided distribution equipment, and all OWNER provided field equipment per NEC and all local requirements. Conduit runs expected to include:

1. Necessary conduit to complete main service entry

2. Conduit to feed from Contractor provided 120 VAC distribution panel to five separate OWNER provided transducer panels

3. Conduit to feed from OWNER provided 480 VAC distribution panel to Owner provided sump pump (P-2) panel.

B. Each new length of conduit shall bear the UL label and be a minimum size of ¾ inch, unless noted otherwise. Elbows shall be standard radius sweeps meeting the requirements of the NEC.

C. Galvanized steel conduit shall be schedule 40 full weight. Pipe size shall conform to ANSI C80.5 and UL.

D. Insulating Bushings: Threaded malleable iron with thermoplastic liner.

E. Insulated Grounding Bushings: Threaded malleable iron body with insulated thermoplastic liner throat and "lay-in" ground lug with compression screw.

F. Insulated Metallic Bushings: Threaded malleable iron body with plastic insulated throat.

G. Running threads are not acceptable.

H. Where applicable PVC conduit is to be schedule 40 PVC electrical conduit with glued fittings.

I. Liquid Tight Flexible Metallic Conduit:

1. Conduit: Conduit shall be liquid tight and shall have an interlocking flexible galvanized steel core with permanently bonded continuous exterior gray polyvinyl chloride jacket. Exterior jacket shall be moisture and oil proof, and UV protected. A copper bonding conductor shall be included between the segments. Interior surfaces shall be smooth and offer minimum drag to pulling conductors;

2. To be used in general purpose areas for connections to motors and movable instruments.

3. Fittings: Connectors shall be the screw clamp or screw-in (Jake) variety with cast malleable iron bodies and threaded male hubs with insulated throats or insulated bushings. Liquid-tight fittings shall be of cadmium plated cast malleable iron, with insulated throat, with provisions for grounding.

2.03 CONDUCTORS AND CABLE

A. Conductors: Unless otherwise noted on the Drawings, Conductors for power feeders, power circuits, lighting feeders, lighting circuits, and control circuits shall be stranded copper, rated 600 volt, with 75 C THWN insulation, UL approved, for installation underground, in concrete, in masonry, or in wet locations. All conductors shall be new, and properly labeled indicating wire size, voltage rating, insulation designation, and manufacturer name permanently marked on outer covering at regular intervals. Minimum conductor size shall be #12 AWG.

B. Shielded cable: Shielded cable shall consist of #16 AWG, stranded, tinned-copper conductors, individually insulated with 25 mils of polyethylene and 100 percent aluminum foil tape with wire drain. Unless otherwise shown on the Drawings, shielded cable shall be used for 4-20 ma signal. Belden 8760/9460 for twisted pairs or 8770 for three conductors, or equal.

C. Color Coding: System conductors shall be factory color coded by integral pigmentation with a separate color for each phase and neutral, or by an approved colored marking tape. Each voltage system shall have a color-coded system and shall have it maintained throughout. Approved colored marking tape is as follows:

1. 115/230VAC 1ϕ

    a. L1 - Black
    b. L2 - Red
    c. Neutral - White
    d. Ground - Green

2. 460 VAC 3 phase

    a. L1 - Yellow
    b. L2 - Blue
    c. L3 - Red
    d. Ground - Green

2.04 CONDUCTOR CONNECTORS

A. Conductor Joints: Conductors, in sizes from #12 to #8 AWG, shall be joined with electrical spring connectors of three-part construction incorporating a non-restricted, zinc-coated steel spring enclosed in a steel shell with an outer jacket of vinyl plastic with a flexible insulating skirt.

B. Conductor sizes #6 AWG and larger shall be joined with solid copper split-bolt connectors torqued to the proper value and taped, or with properly insulated copper compression connectors installed according to the manufacturer's instructions.

2.05 GROUNDING

A. General: Show grounding on the Drawings and in accordance with National Electrical Code, latest edition. Grounding cable shall be copper and sized in accordance with NEC requirement when sizes are not specifically shown on the Drawings.

B. Grounding Rods: Grounding rod shall conform to ANSI/UL 467 and shall be 5/8-inch minimum diameter, minimum 8-feet long, and constructed of copper-clad steel. Rods shall be located adjacent to the new lift station. Attach grounding conductors to rods with Bundy "GAR" type grounding clamp. Grounding rods shall be manufactured by Copperweld, Blackburn, or equal.

2.06 MISCELLANEOUS ELECTRICAL EQUIPMENT

A. Concrete Anchors: Use stainless steel expansion anchors (wedge or sleeve) for mounting all electrical conduit, boxes, and equipment. No type of explosion anchor will be permitted.

B. Unistrut: Unless otherwise specified, Unistrut channel shall be single strut type, 1-1/2 inch x 1-1/2 inch, 12 gauge hot dipped galvanized steel channel with 17/32 inch diameter bolt holes on 1-1/2 inch centers.

C. Nameplates: Nameplates shall be provided for all electrical stations and equipment furnished by the Contractor. Nameplates shall be engraved laminated plastic, with 1/8-inch white lettering on black background. Nameplates shall indicate equipment and its function. They shall be fastened with stainless steel drive screws or escutcheon pins.

D. Conductor and Terminal Markers: Conductor and terminal markers shall be self-adhering, pre-printed cloth or vinyl.

2.07 ENCLOSURES, JUNCTION BOXES, AND FITTINGS:

A. Local control or instrument enclosures shall be provided with/installed in NEMA 4 enclosures. Connections are to be made through the bottom of enclosures when possible, but must always maintain NEMA requirements.

B. Enclosures, junction boxes, and conduit are not to be supported by process vessels or piping. Separate supports may be required and may require concrete footings.

PART 3 – EXECUTION

3.01 METER BOX (MAIN SERVICE CONNECTION)

A. All poles, conduit, wiring, masts etc necessary to be installed per NEC and local requirements as necessary to provide separately metered 480 VAC 3ϕ phase power to the OWNER provided 200 AMP 3 Pole disconnect.

B. If service is provided overhead than poles and wiring shall be set such that the service lines remain a minimum of 20’ above ground level at all locations.

C. If a subsurface service is required than the Contractor will be required to excavate and install the conduits sufficiently deep to be protected from large construction vehicle traffic.

3.02 SUMP PUMP (P-2)

A. PVC conduit to be extended above grade from the location of the OWNER provided 480 VAC distribution panel over ground to the location of the OWNER provided sump pump control panel.

B. Rigid Conduit connection shall be made directly to the sump pumps panel.

C. Contractor to install properly sized wires within the conduit to feed both power and controls from the sump pump panel to the OWNER provided pre-fab building.

3.03 TRANSDUCER PANELS (CELL 1 THROUGH CELL 5)

A. PVC conduit is to be extended above grade from the location of the Contractor provided 120 VAC distribution panel over ground one to each of the OWNER provided transducer panels.

B. Common PVC conduit is to be extended above grade between each of the transducer panels and connected to each panel with 1 penetration.

C. Contractor to install properly sized wires within the conduit to feed power and controls from the the OWNER provided pre-fab building to the OWNER provided transducer panels.

D. Contractor to install a 3 conductor 22 AWG cable within the common conduit to transmit data between from Cell 1 to Cell 2, from Cell 2 to Cell 3, from Cell 3 to Cell 4, from Cell 4 to Cell 5 and from Cell 5 to the cellular transmitter station and connect to Engineer provided equipment as specified.

3.04 CONDUIT INSTALLATION

A. Install conduit and electrical equipment in locations that will cause minimal interference with the maintenance and removal of mechanical equipment.

B. Run conduit in a neat manner parallel or perpendicular to walls and slabs and, wherever possible, installed together in parallel runs supported with unistrut type support system. All conduits shall be installed straight and true with reference to the adjacent work.

C. Unless noted otherwise, conceal conduits in walls or in poured-in-place concrete slabs. Concealed conduits shall be run in as direct a route as possible and with bends of large radii. Make floor and wall penetrations only at specific approved locations. Conduits shall be rigidly secured in position by means of approved clamps.

D. Locations of conduit runs shall be planned in advance of the installation and coordinated with the piping installation, shall not unnecessarily cross other conduits or pipe, nor prevent removal of, nor block access to, mechanical or electrical equipment.

E. Unless noted otherwise, buried conduit shall be installed with a minimum of 24-inch cover. Buried conduit shall be installed using NEC approved plastic cradles, properly supported/anchored and of sufficient numbers to prevent movement during backfill operations. Warning tape is to be installed within fill and directly over conduit runs.

F. Conduits stubbed through slabs, or exposed above grade (except as noted) shall transition to rigid galvanized a minimum of 6” below grade.

G. Appropriately sized PVC conduits may be used for wiring between the Owner provided 120 VAC distribution panel and the OWNER provided transducer panels, and between the OWNER provided 480 VAC distribution panel and the OWNER provided sump pump panel.

H. Exposed conduit shall be supported with unistrut supports at a maximum spacing of 8 feet 0 inches and within 18 inches of couplings, boxes, etc., unless otherwise shown.

I. All conduits shall be tightly sealed during construction by use of conduit plugs or "pennies" set under bushings. All conduit in which moisture or any foreign matter has collected before pulling conductors shall be cleaned to the satisfaction of the Engineer.

J. Liquid-tite Flexible Metallic Conduit: Liquid-tight conduit shall be installed in all locations for connections to all motors, solenoid valves, and similar devices.

K. Prior to installation of conductors in underground conduits, a testing mandrel not less than six (6) inches long and with a diameter 1/4 inch less than the conduit diameter shall be drawn through, after which a stiff bristle brush of the proper size for the conduits shall be drawn through until the conduits are free of all sand and gravel.

L. Penetrations to NEMA 4 panels must be made in accordance with NEMA requirements to maintain the panel rating.

M. Penetrations to all NEMA 4 panels are to be made through the underside of the panel where at all possible. Exceptions must be approved by the ENGINEER.

3.05 SUPPORTS

A. Conduit shall be supported off walls, ground and ceiling with unistrut supports spaced not more than 8 feet apart.

3.06 TERMINATION AND JOINTS

A. Conduits shall be securely fastened to cabinets, boxes, and gutters using locknuts (one inside and one outside enclosure for rigid conduit) and an insulating bushing or specified insulated connectors. Grounding bushings or bonding jumpers shall be installed on all conduits terminating at concentric knockouts.

B. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using approved connectors and hubs.

C. Expansion couplings shall be installed where any conduit crosses a building separation or expansion joint, including joints of footings and grade beams.

D. Approved cable-sealing bushings shall be installed on all conduits originating from roof and terminating in switchgear, cabinets, or gutters inside the building.

E. Conduit bodies (condulets) are not acceptable as enclosures for splices.

F. Connection methods must allow for the Enclosure ratings to be maintained.

G. For outdoor enclosures all conduit penetrations must come to the underside of the enclosure.

3.07 WIRING AND CABLE INSTALLATION

A. Conductors shall not be installed in conduit runs until all work is completed for each individual conduit run. Care shall be taken in pulling conductors such that insulation is not damaged. UL-approved pulling compounds shall be used.

B. All cables shall be installed and tested in accordance with manufacturer's requirements and warranty.

C. Splicing and Terminating

1. All aspects of splicing and terminating shall be in accordance with cable manufacturer's published procedures.

2. All splices in outlet boxes with connectors as specified herein shall be made up with separate tails of correct color. At least six (6) inches of tails packed in box after splice is made up shall be provided.

3. No splices or junction boxes are allowed below ground surface.

D. All conductor and cable in panels, control centers, and equipment enclosures shall be bundled and clamped.

E. Joints in Conductors in Dry Locations, Copper Conductors

1. #8 AWG and smaller: Conductors shall be twisted and secured with cap or twist-on, expandable spring type solderless connectors.

2. #6 AWG and larger: Conductor shall be joined with split bolt connectors or compression sleeves. Joints shall be insulated with rubber tape and protected with half-lapped layers of vinyl plastic electrical tape. Insulation may also be provided by UL listed pre-manufactured components such as heat-shrink or cold-shrink devices.

F. Joints in Conductors in Moist Locations, Copper Conductors

1. #8 AWG and smaller: Conductor shall be securely joined as specified above, then encapsulated in epoxy (Scotchcast or approved equal).

2. #6 AWG and larger shall be joined as specified above, and suitably water treated.

3.08 IDENTIFICATION

A. All branch-circuits shall be securely tagged, noting the purpose of each. Conductors shall be marked with vinyl wrap-around markers. Where more than two conductors run through a single outlet, each circuit shall be marked with the corresponding circuit number at the panelboard.

B. Conductors size #6 AWG and larger shall be color coded using specified phase color markers and identification tags.

C. All terminal strips shall have each individual terminal identified with specified vinyl markers.

D. The panel and circuit numbers and the voltage contained in each junction box shall be identified via felt-tip pen or decal label on the inside of the cover.

E. All receptacles and switches shall be decal labeled on the plate, denoting the panel and circuit number.

F. Connections to Circuit Breakers, Switches, and Terminal Strips; Stranded Copper Conductors:

1. #12 through 8 AWG: Conductor shall be terminated in locking tongue style, pressure type, compression lugs, unless clamp type connection for stranded conductor is provided with device.

2. #6 AWG and larger: Conductor shall be terminated in one-hole flat-tongue style, compression type lugs, or by connectors supplied by the manufacturer.

3.09 GROUNDING

A. Enclosures of equipment, raceways, and fixtures shall be permanently and effectively grounded. A code-sized, copper, insulated green equipment ground shall be provided for all branch circuit and feeder runs. Equipment ground shall originate at panelboard ground bus and shall be bonded to all switch and receptacle boxes and electrical equipment enclosures. Ground terminals on receptacles shall be connected to the equipment grounding conductor by an insulated copper conductor.

3.10 SIGNAL WIRING

A. Conductor used for alarm and control signal applications shall be identified at both ends and referenced to appropriate as-built drawings. Control wiring shall be numerically or otherwise coded in accordance with as-built control diagrams.

3.11 INSTALLATION OF BOXES AND WIRING DEVICES

A. All outlets shall be surface mounted on walls, ceilings, and floors, except where specified to be finish flush.

B. No unused openings shall be left in any box. Close-up plugs shall be installed as required to seal openings.

C. Exposed outlet boxes and boxes in damp and wet locations shall be provided with gasketted cast metal cover plates.

3.12 BOX LAYOUT

A. Outlet boxes shall be installed at the locations and elevations shown on the Drawings or specified herein. Adjustments to locations shall be made as required by structural conditions and to suit coordination requirements of other trades.

3.13 INSTALLATION OF CONTROL PANELS AND PANELBOARD

A. Free-standing switchboards, distribution panels, etc., shall be accurately aligned, leveled, and bolted in place on full-length channels securely fastened to the floor with stainless steel wedge anchors per manufacturer's recommendations.

B. Interior wiring shall be bundled and clamped using specified plastic conductor wraps.

C. Nameplates, legend plates, and panel directories as specified herein shall be installed.

3.14 PROTECTION

A. Conduits, junction boxes, outlet boxes, and other openings shall be kept closed and/or locked to prevent entry of foreign matter.

B. Fixtures, equipment, and apparatus shall be covered and protected against dirt, paint, water, chemical or mechanical damage, before and during the construction period. Damaged fixtures, apparatus, or equipment shall be restored to original condition prior to final acceptance, including restoration of damaged shop coats of paint. Brightly finished surfaces and similar items shall be protected until in service. No rust or damage will be permitted.

3.15 WORKMANSHIP

A. Preparation, handling, and installation shall be in accordance with manufacturer's written instructions and technical data particular to the product specified and/or approved, except as otherwise specified.

B. Work shall be furnished and placed in coordination and cooperation with other trades.

C. Work shall conform to the National Electrical Contractor's Association Standard of Installation for general installation practice.

END OF SECTION

SPECIFICATION 0010

SELECT FILL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. General Fill to be used to backfill open excavations outside the biocell area.
   2. Permeable Stone Fill to be used in areas surrounding piping below grade and outside the biocell area and as the top layer within the biocell.
   3. Topsoil Fill to be used to support vegetative growth.
   4. Drainage Stone Fill to be used in site grading.

1.02 SUBMITTALS

A. Pre-installation: Submit prior to use onsite:
   1. Origin (supplier's name and production plant) of select fill.
   2. Proposed means and methods of placing and compacting select fill.
   3. Select Fill Gradation – ASTM C 136.
   4. Analytical Results of each Select Fill (sampled for VOCs, SVOCs, PCBs, Pesticides, Herbicides, and Metals) when applicable.

B. Installation: Submit as installation proceeds.
   1. Quality control documentation recorded during installation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:
   1. Protect select fill from excessive moisture or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Storage and Protection:
   1. Protect select fill from water and other sources of damage.
   2. Protect select fill from contaminated soils or water, as applicable.

PART 2 PRODUCTS

2.01 MATERIALS

A. General Fill
   a. General Fill will consist of clean onsite materials as approved by the Engineer or imported materials from a facility approved by the Engineer.
   b. Imported fill will meet New York State Department of Environmental Conservation Part 375 Soil Reuse Criteria for Unrestricted Reuse.
   c. General Fill shall be free of metal, plastic, waste, and other debris.

B. Permeable Stone Fill
   a. Permeable Stone Fill will consist of gravel\stone imported from a facility approved by the Engineer.

b. Permeable Stone Fill will consist of gravel\stone with a gradation of less than 70% passing through a 150 mm sieve, less than 25% passing through a 50 mm sieve, and will contain less than 10% fines by mass.
c. Permeable Stone Fill shall be free of all organic material and other debris.

C. Topsoil Fill
a. Topsoil Fill will consist of soils capable of supporting vegetative growth.
b. Topsoil Fill will consist of clean onsite materials as approved by the Engineer or imported materials from a facility approved by the Engineer.
c. Topsoil Fill will be placed a minimum of 12 inches across the entire site as indicated by the design drawings.
d. Topsoil Fill shall be free of metal, plastic, waste, and other debris.

D. Drainage Stone Fill
a. Drainage Stone Fill will consist of gravel\stone imported from a facility approved by the Engineer.
b. Drainage Stone Fill will consist of angular gravel\stone with a gradation of less than 50% passing through a 150 mm sieve and will contain less than 10% fines by mass.
c. Drainage Stone Fill shall be free of all organic material and other debris.

PART 3 EXECUTION

3.01 PREPARATION

A. CONTRACTOR shall visually inspect select fill for excessive moisture prior to installation.

3.02 INSTALLATION

A. General Fill
a. General Fill below the proposed biocell limits or detention pond spillway will be placed in horizontal layers no more than 12 inches thick and will be compacted to obtain 95 percent maximum density by Standard Proctor Test ASTM D698-07e1.
b. General Fill outside the limits of the proposed biocell or detention pond spillway may be placed at the CONTRACTOR’s discretion. The CONTRACTOR shall be responsible for repairs of any areas impacted by settlement for a period of one year following construction completion.

B. Permeable Stone Fill
a. Permeable Stone Fill will be placed surrounding all drainage pipes as indicated in the design drawings.
b. Permeable Stone Fill will be placed in such a matter as to not damage the pipe. The CONTRACTOR shall be responsible for repairing any pipe damaged as a result of installation at no cost to the Client.
c. Permeable Stone Fill will be placed within the biocell as shown in the design drawings.

C. Topsoil Fill
a. Topsoil Fill above the proposed biocell limits will be placed using low pressure equipment that will exert no more than 50 psi on the biocell top liner. The CONTRACTOR will be responsible for any repairs to the biocell cap as a result of placement of Topsoil Fill.

b. Topsoil Fill outside the proposed biocell limits will be placed at the CONTRACTOR'S discretion with Engineer's approval. The CONTRACTOR shall be responsible for repairs of any areas impacted by settlement for a period of one year following construction completion.

D. Drainage Stone Fill
   a. Drainage Stone Fill will be placed in all drainage swales as indicated in the design drawings.

3.03 FIELD QUALITY CONTROL

A. A minimum of three samples shall be taken from each imported fill source at the Engineer's discretion. The CONTRACTOR shall be responsible for the following tests on each sample:
   a. Gradation – ASTM C 136
   b. Soil Analytical Results in accordance with NYSDEC TAGM 4046 when applicable

B. The CONTRACTOR shall provide an approved laboratory with a minimum of three samples of onsite soils for the purpose of determining onsite soils Standard Proctor Density (ASTM D698-07e1). The CONTRACTOR shall provide the results of the tests to the Engineer prior to backfilling.

C. The CONTRACTOR shall provide visual inspection and photographic documentation that the Select Fill has been properly installed.

D. The CONTRACTOR shall provide written documentation that the Select Fill was compacted as required by this specification.

END OF SECTION