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October 11, 2019

Mr. Tracy Smith Division of Environmental Remediation Remedial Bureau D New York State Department of Environmental Conservation 625 Broadway Albany, NY 12233-7013

Re: Semet Residue Ponds Site OU-2 Remedial Design Construction Work Plan Order on Consent: Index # R7-20190104-1 Site #734008

Dear Mr. Smith:

Enclosed is the Revised Semet Residue Ponds Site OU-2 Remedial Design Construction Work Plan, prepared by OBG, part of Ramboll on behalf of Honeywell. Please contact Brad Kubiak of OBG (<u>Brad.Kubiak@obg.com</u> or 315-956-6384) or me if you have any questions.

Sincerely,

Stephen J. Miller, P.E. Syracuse Remediation Program Manager

Attachments (1 copy, ec)

- cc: Robert Nunes USEPA (1 copy, ec) Tom Mongelli - USEPA (ec) Harry Warner - NYSDEC Region 7 (1 copy, ec) Mark Sergott – NYSDOH (1 copy, ec) Maureen Schuck - NYSDOH (ec) Margaret A. Sheen, Esq. - NYSDEC, Region 7 (ec) Argie Cirillo, Esq. - USEPA (ec) Brian D. Israel, Esq. - Arnold & Porter (ec) Joseph Heath, Esq. - (ec) Thane Joyal, Esq. - (1 copy, ec) Jeanne Shenandoah - Onondaga Nation (1 copy, ec) Hazel Powless - HETF (ec) Alma Lowry - (ec) Shane Blauvelt – Honeywell (ec)
- Maureen Markert OBG (ec) Tom Conklin – OBG (ec) Chris Calkins – OBG (ec) Paul Schultz – OBG (ec) Clare Leary – OBG (ec)

WORK PLAN

Semet Residue Ponds Site OU-2 Remedial Design Construction Work Plan Geddes, New York



August 2019 Revised October 2019





ENVIRONMENT & HEALTH

Below are the responses to New York State Department of Environmental Conservation (NYSDEC) comment letter dated September 9, 2019 regarding the Semet Residue Ponds OU-2 Remedial Design Construction Work Plan dated August 2, 2019.

Comment 1: Page 7, paragraph 5, Section 5.4. The last sentence in this paragraph should be revised to state "Through a request for re-use, the material in these stockpiles...." In addition, since a remedy has not been selected, Item 1 should be revised to state that "Material from either stockpile will remain on the Willis property and addressed in accordance with the remedy selected for the Willis Avenue Site." Item 2 should also be revised to state "Material from either stockpile would be hauled to the Site where it would be utilized for general subgrade material under areas receiving a 40- or 50-mil geomembrane."

Response: Comment noted. Text revised to reflect this change.

Comment 2: Appendix B, Specification 31 22 19. Please confirm seed mixes appropriate for the site (e.g., lawn areas, swales) are included in this specification. In several places there are references to the Wastebeds 1-8 IRM (e.g., Table 13, revetment, Ninemile Creek Seep Apron) and seeds and plants are discussed for wetland areas. Please revise as necessary.

Response: The seed mix to be utilized in the areas of vegetation is the successional old-field seed mix from Table 2 of the Technical Specifications. In areas of concentrated flow, the swale seed mix from Table 3 may be utilized.

Comment 3: Appendix C, CQAPP. In the Table of Contents, several page numbers are not included. Please revise.

Response: Comment noted. Page numbers have been added.

Comment 4: Appendix C, CQAPP, Sections 3.2.4 to 3.2.8. These sections should be revised to refer to the proper materials (all refer to geotextile separation fabric). In addition, please confirm the appropriate specifications are included/labeled in Appendix B (e.g., specification 30000 referenced in Section 3.2.8 is not included on the specification for Cetco Liquid Boot) and/or additional specifications do not need to be referenced (e.g., should Section 3.2.7 also reference specification 01 02 03 in addition to 01 73 19). Please revise as necessary.

Response: Comment noted. CQAPPP text and applicable Technical Specifications have been revised to address this comment.

SEMET RESIDUE PONDS SITE OU-2 REMEDIAL DESIGN | CONSTRUCTION WORK PLAN

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- C. Construction Quality Assurance Project Plan



1.0 INTRODUCTION

1.1 OVERVIEW

This Operable Unit (OU)-2 Phase 1 Construction Work Plan (CWP) for the Semet Residue Ponds Site (Site) has been prepared pursuant to the Operable Unit (OU)-2 Remedial Design/Remedial Action Work Plan (RDRA WP; OBG, 2019a). CWP presents the procedures to implement remedial design and remedial actions at the Site, and further details remedial actions discussed in the RD/RA WP. **Appendix A** contains the Design Drawings, **Appendix B** contains the Technical Specifications, and **Appendix C** contains the Construction Quality Assurance Project Plan (CQAPP).

Remedial objectives associated with *in situ* solidification/stabilization requirements were submitted in the Target Treatment Remedial Action Work Plan (TTWP) submitted by OBG, Part of Ramboll (OBG) on June 14, 2019 (OBG, 2019a). CWP focuses on the final cover systems components for OU-2, as shown on the Design Drawings included as **Appendix A**.

1.2 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) established for the remedy in the Semet Residue Ponds Operable Unit-2 Record of Decision (ROD; NYSDEC and USEPA 2019) are presented below:

- Prevent, or reduce to the extent practicable, ingestion of/direct contact with contaminated Solvay waste/soil/fill material to be protective under the current and reasonably anticipated future land uses.
- Prevent, or reduce to the extent practicable, inhalation of or exposure to contaminants volatilizing from contaminated Solvay waste/soil/fill material and groundwater, and unacceptable inhalation threat associated with soil vapor.
- Prevent, or reduce, to the extent practicable, the release of site-related contaminants to groundwater, surface water and sediment that may cause unacceptable adverse effects on shallow and intermediate groundwater, surface water or sediment quality in Tributary 5A and Onondaga Lake.

Furthermore, as stated in the ROD:

NYSDEC's SCOs have been identified as remediation goals for soil to attain these RAOs. SCOs are risk-based criteria that have been developed by the State following methods consistent with EPA's methods/protocols/guidance and they are set at levels consistent with EPA's acceptable levels of risk that are protective of human health, ecological exposure, or the groundwater depending upon the existing and anticipated future use of the Subsite. While the land use of the Subsite has historically been industrial, current and anticipated future uses of some areas could include commercial use or recreational uses.

Given the comingling of the shallow and intermediate groundwater outside of the hydraulic containment system with that of the adjacent Willis Avenue subsite groundwater, shallow and intermediate groundwater at and beyond the point of compliance (POC) will be addressed as part of the Willis Avenue subsite and therefore is not addressed in the remedy for this OU. Groundwater remedial goals are the New York State Ambient Water Quality Standards. Prior remedial activities and IRMs to address surface water and sediment have eliminated exposure to these media and maintenance of the remedial actions and IRMs are expected to achieve the RAO.

1.3 WORK PLAN ORGANIZATION

This WP is organized in the following sections.

- Introduction (Section 1)
- Project Background (Section 2)
- Health and Safety, Air Quality Monitoring, and Decontamination (Section 3)
- Construction Project Management (Section 4)



- Remedial Action (Section 5)
- Construction Quality Assurance/Construction Quality Control (Section 6)
- Construction Schedule (Section 7)

2.0 PROJECT BACKGROUND

2.1 SITE BACKGROUND

The Site comprises approximately 49.5 acres in the Town of Geddes, Onondaga County, New York. The Site Plan presented on Sheet C-101 in **Appendix A** includes the following approximate subareas of the Site:

- BCA (13.4 acres)
- Berm Area (1.9 acres)
- West of the BCA (28.4 acres)
- Western and Southern Berm Area (2.7 acres)
- Semet Lakeshore Area (3.1 acres)

2.2 REGULATORY BACKGROUND

Regulatory background and site history is discussed in depth in the RDRA WP (OBG, 2019a)

3.0 CONSTRUCTION PROJECT MANAGEMENT

Responsibilities and assignments of the project team are summarized in the descriptions below.

3.1 CONSTRUCTION PROJECT MANAGEMENT RESPONSIBILITIES

NYSDEC Project Manager

As the lead regulatory agency, the NYSDEC Project Manager's functions shall include the following functions:

- Review and approve designs
- Review project submittals for compliance with regulations
- Issue approval to construct the project once design has been approved
- Review and approve major design modifications or requests for variances from the regulatory conditions during construction.

Honeywell Design/Construction Manager

Honeywell is the responsible party. The Honeywell Design/Construction Manager will provide technical input and attend meetings with project staff and the NYSDEC. Honeywell has retained OBG as the remedial design and remedial action contractor, providing services as engineer-of-record. Remedial design and remedial action roles and responsibilities are identified below.

Site Lead

The role of the OBG Site Lead is to see that expectations for project quality, safety, schedule, and performance are met or exceeded. In addition, the Site Lead will periodically attend review meetings and will be available on an as-needed basis to the project team.



Design Lead

Design Lead will manage change throughout the course of construction to ensure RD objectives are met. This will include coordination with the Honeywell Design/Construction Manager, design team, and Construction Project Manager, establishing a work schedule, and control of work flow to achieve deliverable dates.

Construction Project Manager

Construction Project Manager will manage the procurement and construction phases of the project on a day-today basis, monitor and evaluate project controls throughout the phases of the project, and see that the technical and quality objectives established during the design phase of the project are realized throughout construction. The Construction Project Manager will serve as the primary contact between the Honeywell Design/Construction Manager, NYSDEC, design team, and construction project team during the RA phases of the project.

Construction Field Manager

The Construction Field Manager will be on-Site full time and will be qualified to supervise the work done. The Construction Manager will supervise the procurement and construction phases of the project on a day-to day basis, monitor and evaluate project controls throughout the project, and see that the technical and quality objectives are achieved.

Health and Safety Manager

The primary responsibilities of the Health and Safety Manager will be to develop, implement, and enforce the Site-Specific Health and Safety Plan for the project, submitted under separate cover.

3.2 PROJECT MANAGEMENT ASSIGNMENTS

NYSDEC Project Manager Tracy A. Smith, P.E.

Honeywell Design/Construction Manager Shane Blauvelt, P.E.

Remedial Design Design Lead: Brad Kubiak, P.E.

Remedial Action Construction Project Manager: David Edwards

Construction Field Manager: Michael Salvagno

Health and Safety Manager: Erin Visalli

4.0 HEALTH AND SAFETY, AIR QUALITY MONITORING, AND DECONTAMINATION

This section summarizes the proposed approach to health and safety, air quality monitoring, and general conditions.

4.1 HEALTH AND SAFETY

As with all OBG projects, safety will be a top priority. Health and safety excellence is a core value of both Honeywell and OBG. OBG believes that all injuries and occupational illnesses, as well as safety and environmental incidents, are preventable and will adhere to high standards for the safe execution of this project and the protection of the environment, employees and the people in the community.



OBG believes that with effective employee involvement, training, project planning and auditing that all accidents are preventable. Training and planning tools that will be implemented by OBG safety staff will include the following:

Project Health and Safety Plan

OBG developed a project-specific Health & Safety Plan (HASP) that utilizes the existing Honeywell Syracuse Portfolio Health & Safety Plan (HSP2) and will incorporate specific job safety analyses (JSA) for the scope of work associated with this project. The HASP will be reviewed as part of the site orientation training and all direct hire personnel/subcontractors will be required to follow the requirements of the HASP. This HASP is in accordance with HSP2 with the JSAs specifically identified for the project. JSAs include the following:

- A. Imported fill placement
- B. Excavation/Trenching
- C. Working Near Water
- D. Clearing of Trees and Brush
- E. Targeted Treatment
- F. Environmental Hazards
- G. Traffic Control
- H. Fuel Storage
- Onondaga Lake Sites Emergency Response Plan (ERP)

The ERP provides a plan for response in the event an incident occurs while implementing the remediation of Onondaga Lake and surrounding upland sites. The plan outlines emergency response protocols, required notifications, and available emergency equipment, and describes the Emergency Response Team (ERT), which is a specialized team trained in advanced first aid, spill response, water rescue, and certified in confined space rescue.

Subcontractor Safety Pre-Qualifications

Each subcontractor who will be working for OBG on this project will be required to submit a completed Honeywell Safety Questionnaire Form for approval by OBG and Honeywell prior to initiating work onsite. OBG holds subcontractors to the same safety standards to which OBG is held accountable.

Drug and Alcohol Testing

OBG believes in a drug and alcohol-free workplace. Drug and alcohol testing is a condition for work on Honeywell projects covered by the HSP2. All employees will participate in a pre-project drug screening prior to beginning work on the project. In addition, all employees will be subject to a random testing program.

Pre-Work Health and Safety Kickoff Meeting

A pre-work Health and Safety kickoff meeting will be scheduled with the project team.

Site Orientation Training

Personnel working on this project will be required to attend a site orientation training session administered by OBG's safety supervisor prior to engaging in any work activities and/or entering the work zone.



Daily Pre-Task Planners and Weekly Toolbox Safety Meetings

Daily safety talks will be documented utilizing a Daily Pre-Task Planner form found in the HSP2. Pre-Task Planners will be prepared on a daily basis and will be reviewed with the work crew focusing on any changes in equipment, tools, work methods, or Site conditions as well as key hazards and safety controls.

Project personnel must attend a project Weekly Toolbox Safety Meeting. These meetings are an opportunity to conduct field safety training, distribute key safety information, reinforce safety as a priority, and/or review recent inspection results directly with all project personnel.

Health and Safety Audits

The OBG safety supervisor and Construction Management (CM) team will conduct Site audits to verify compliance with the project-specific HASP as well as the HSP2.

OBG understands the chemical and physical properties of Site contaminants. Based on previous experiences with intrusive work at this Site, the work will likely be performed in modified Level D personal protective equipment. The actual level of protection used will be based on results of our air monitoring program.

Should conditions warrant, a three-zone approach will be used during site operations in order to contain the potential spread of contamination and control the flow of personnel, vehicles, and materials in and out of the work area. The zones include the exclusion zone, the contaminate reduction zone, and the support zone. The exclusion and contaminate reduction zones will be designated using temporary construction fence or hazard tape. Access to these zones will be limited to authorized individuals.

4.2 AIR QUALITY MONITORING

An employee work zone air monitoring program will be implemented during intrusive activities. These programs are detailed in the Community Air Monitoring Plan (CAMP) as appended to the RDRA WP (OBG, 2019a). Community air monitoring will be performed throughout the project in accordance with the requirements of the CAMP. Updates to this document will be tracked, as necessary, through progress meetings. Modifications thereto will be submitted to the NYSDEC for approval prior to implementation.

4.3 STORMWATER POLLUTION PREVENTION PLAN

A Stormwater Pollution Prevention Plan (SWPPP) has been prepared for work performed at the Site as appended to the RDRA WP (OBG, 2019a). This document describes actions to be taken in accordance with NYSDEC's State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activities, Permit No. GP-0-15-002 and Best Management Practices (BMPs) detailed in the New York State Stormwater Design Manual. SWPPP describes the erosion and sediment control practices during construction activities, offers protective measures to minimize sediment transport, and identifies potential sources of sediment that may affect the quality of stormwater discharges. SWPPP provisions and inspections will be performed until stabilized final surfaces are achieved.

4.4 DECONTAMINATION

Decontamination of equipment will be conducted as necessary. Material will be removed from the exterior of trucks and heavy equipment using a dry brush, prior to leaving the site, to prevent tracking of mud and dirt onto roadways. Further decontamination of equipment using spray wash will be conducted, as necessary. Collected decontamination water will be conveyed to the Willis Avenue Groundwater Treatment Plant (GWTP) for treatment where applicable.



5.0 **REMEDIAL ACTION**

As part of the proposed Remedial Action at the site, the following items will be addressed in this work plan:

- Site Preparation, Earthwork, and Grading
- Importation of Fill Materials
- Construction Water Management
- Access Roadways and Parking Area Construction
- Stormwater Infrastructure Construction
- Exterior Berm Construction
- Fencing and Guiderail Installation

5.1. SITE PREPARATION, EARTHWORK AND GRADING

5.1.1 Subgrade Preparation

Subgrade will be constructed with both onsite materials and offsite fill materials. Excavated material from the West of the BCA Area will be utilized as fill within that area and not relocated to other subareas of the Site. Stockpiling of removed material is not anticipated, as proposed excavations will be worked directly into site grading. Onsite fills will be installed in lifts not greater than 12-inches thick and compacted with a vibratory roller prior to installation of subsequent lifts. Imported general fill materials will be sufficient for subgrade construction and approved for use prior to acceptance. Material will generally be placed in lifts not larger than 12-inches in compacted thickness and will be tested for compaction in accordance with the appended Technical Specifications and CQAPP. Final subgrade surface will be fine graded, proof rolled, and made suitable for installation of geomembrane, where applicable.

5.1.2 Clearing and Grubbing

Work associated with removal of vegetation will only be performed at times approved by the Design Lead that are not hazardous to protected species. Material removed will be chipped and utilized as an erosion and sediment control mechanism or spoiled at an offsite location approved by the Team.

5.1.3 Existing Structure Decommissioning

Historic structures at the site associated with abandoned processes may be encountered. Many of these structures were decommissioned in the 1980's. Structures located within the scope of work will be opened and inspected. If not previously decommissioned, structures will be backfilled with NYSDOT Item 304.12, or with flowable fill. These modifications will be tracked and documented in the FER.

Historic groundwater monitoring wells that are no longer in use will be decommissioned in accordance with NYSDEC CP-43 by an external third party. Existing groundwater monitoring wells that require extension as a result of proposed final elevations will be addressed as depicted in the Design Drawings.

5.1.4. Select Fill Installation

Select fills to be utilized for the project as depicted in the Design Drawings will be preapproved, tested, and installed in accordance with the appended CQAPP and Technical Specifications.

5.2 IMPORTATION OF FILL MATERIALS

Prior to the installation of earthen materials, the supplier will be required to provide the following:

- Name and location of the material source
- Affidavit from the owner of the source for each type of borrow material to be imported to the Site



Laboratory analytic data for each material, as necessary

The affidavit from the owner of the source of each type of borrow material shall state that, to the best of his knowledge, the site of the source material was never used as a dump site for chemical, toxic, hazardous, or radioactive materials and it is not now nor ever has been listed as a suspected depository for chemical, toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.

Laboratory analytic data (or documentation of such data no older than one year from submittal) from an ELAPcertified laboratory will be provided for these soils for the compounds in Table 375-6.8(b) "Commercial Use Soil Cleanup Objectives" in NYSDEC Subpart 375. Sampling for 1,4-dioxane and polyfluroalkyl substances will be included, as required. Failure of a single compound test result will mean that the entire material batch will be rejected unless specifically accepted on a test-by-test basis and approved by NYSDEC.

Samples of imported fill materials will be collected from each new source and analyzed for geotechnical parameters, where applicable, as detailed in the Technical Specifications included as **Appendix B**. Imported fill materials will also be analyzed for chemical parameters, and will be sampled at the following frequency:

- One sample per 500 cubic yards (cy)
- One sample per 500 2,500 cy
- One sample per 2,500 5,000 cy
- One sample per 5,000 10,000 cy; and
- One sample per subsequent 10,000 cy

These frequencies are modified from DER-10 sampling requirements for analytical testing of imported fill and are proposed for the Site due to the large volume of material necessary.

5.3 CONSTRUCTION WATER MANAGEMENT

Management of construction water will be in accordance with the SWPPP as appended to the RDRA WP (OBG, 2019a), and as detailed in the Technical Specifications in Appendix B. Contact runoff will not be allowed to discharge from the Site. Bypass pumping and dewatering efforts will be employed as necessary to progress earthwork. Only clean stormwater will be discharged from the Site.

5.4 ACCESS ROADWAYS AND PARKING AREA CONSTRUCTION

The Site will have two points of access that will service three areas, as shown on Sheet C-102 in **Appendix A**. Primary site access will extend across the Willis Avenue property, ultimately connecting to Willis Avenue. This access road cross section will consist of geogrid atop the compacted subgrade, followed by 18 inches of compacted granular fill as the wear surface. All roadways are designed with 12-foot wide travel lanes in each direction, with 3-foot shoulders. As designed, large vehicles such as buses or emergency vehicles can navigate the access road and roadways across the Site. Immediately south of the primary Site access road will be a smaller Site access point that will be designated as a secondary point of egress for emergency vehicles.

Construction includes installation of the primary access roadway across the northern portion of the adjacent Willis Avenue property. The access roadway is positioned in the area of two soil stockpiles (SP1 and SP2) on the Willis property. Through a request for reuse, the material in these stockpiles will be relocated in one of two ways:

- 1) Material from either stockpile will remain on the Willis property and be addressed in accordance with the remedy selected for the Willis Avenue Site.
- 2) Material from either stockpile would be hauled to the Site where it would be utilized for general subgrade material under areas receiving a 40- or 50-mil geomembrane.



Areas anticipated for parking in the near term will consist of compacted granular fill. The BCA will have a minimum installed granular fill thickness of 1-foot, and West of the BCA Area will have a minimum of 18 inches of granular fill, installed in two lifts, as shown on the drawings included as **Appendix A** and detailed in the CQAPP included as **Appendix C**.

Access roadways will be bound by guiderail, where necessary, for safety. Fencing that matches existing onsite fencing will be installed along roadways wherever proximate to steeper slopes to deter trespass onto steeper areas. Gates will be installed at multiple locations across roadways for site security and to assist in the navigation of vehicles. Guiderails, fencing, gate locations, and details are included within the Design Drawings included as **Appendix A**. Guiderail to be supplied and installed in accordance with NYSDOT standards as detailed in Standard Sheets 606-07. Fencing to be installed per the Design Drawings, manufacturer's recommendations, and as detailed in the Technical Specifications included in **Appendix B**.

5.4.1 WOVEN GEOTEXTILE AND BIAXIAL GEOGRID

Woven geotextiles or biaxial geogrids will be utilized as a separation layer between the subgrade soils and the granular fill material utilized in roadway construction, and to add structural integrity to the wear surface, as shown on the drawings included as **Appendix A**. These materials will be visually inspected for damage upon receipt and installed in accordance with manufacturer's recommendations.

5.4.2 GRANULAR FILL

Access roadways and the West of BCA Area parking area will consist of 18 inches of compacted granular fill material as depicted in the Design Drawings. The BCA parking area will utilize 12 inches of granular fill. This material will adhere to the NYSDOT Item No. 304.12 Type II requirements and be installed in lifts as detailed in the CQAPP included in **Appendix C**.

5.5 STORMWATER INFRASTRUCTURE CONSTRUCTION

Phase 1 includes the construction of Stormwater Basin #1 (SB1), multiple dry swales, a series of catch basins with conveyance piping, and a vegetated swale that feeds into a drop inlet/culvert structure prior to entering SB1. Phase 2 includes the construction of Stormwater Basin #2 (SB2) and Stormwater Basin #3 (SB3), a perimeter conveyance swale along the southern toe of the Western and Southern Berm Area, and construction of two stormwater flow weirs across Tributary 5A access roads. Construction of each infrastructure component is discussed below. Multiple geosynthetics are utilized in support of these items. Geosynthetics will be installed in accordance with the Technical Specifications and quality control procedures outlined in the CQAPP included as **Appendix C**.

5.5.1 STORMWATER BASINS

Stormwater is conveyed via surface runoff into each basin from the vegetated swale to the south, and from a network of dry swales and conveyance piping. The cross section of each stormwater basin will consist of:

- a) Prepared subgrade
- b) Cushion geotextile
- c) Geomembrane
- d) HydroTurf®

At SB1, geosynthetics will be anchored in trenches around the perimeter of the basin. For SB2 and SB3, the geomembrane will be installed such that no anchor trench is necessary in the areas of 40-mil LLDPE geomembrane. The LLDPE geomembrane will be extrusion welded at the top of the anchor trench to the 50-mil Super Gripnet® liner, where applicable.



Once the geomembranes are installed, basins will be hydrostatically tested in accordance with the Technical Specifications included as **Appendix B**. Basin outlet discharge structures will be constructed from HDPE materials, and a 6-inch diameter pipe will stub out into each basin to collect accumulated flows. This primary inlet will be wrapped in non-woven geotextile and further protected with clean washed stone to deter transmission of sediments and debris through the system, as depicted in the Design Drawings included as Appendix A. The base of each structure will be backfilled with stone to prevent overturning.

At SB1, the outlet will penetrate the geomembrane to the north prior to discharging into the existing drop inlet structure. The SB2 outlet will penetrate the berm to the west through conveyance piping where a velocity-controlling level spreader will dissipate flow prior to entering the roadway crossing weir. The SB3 outlet will penetrate the southern berm through conveyance piping and discharge into a lined swale proximate to the toe of the slope. The top of each outlet structure will incorporate grating that serves as an overflow device, and HDPE welding will be performed in accordance with the Technical Specifications included as **Appendix B**.

5.5.2 VEGETATED SWALE

The vegetated swale directs flow from the southern portion of Phase 1 into a drop-culvert structure that discharges into SB1. The cross-section of the vegetated swale is as follows from bottom to top;

- a) Prepared subgrade
- b) Cushion geotextile
- c) Geomembrane
- d) Composite geonet

Geosynthetics will terminate on the east and west sides of the vegetated swale in anchor trenches.

5.5.3 DRY SWALES AND STORMWATER CONVEYANCE INFRASTRUCTURE

Dry swales will be utilized to address water quality volume considerations in accordance with the Site-specific SWPPP, submitted as an attachment to the RDRA WP (OBG, 2019a). The cross-section of each dry swale is as follows from bottom to top;

- a) Prepared subgrade
- b) Cushion geotextile
- c) Geomembrane
- d) Cushion geotextile

Each dry swale will contain a 4-inch diameter HDPE perforated underdrain pipe to direct runoff into the stormwater conveyance system. One end of the underdrain pipe will terminate with a cleanout for maintenance activities and the other end will terminate in a catch basin. Solid wall HDPE piping will be utilized exclusively outside of the dry swale areas. Catch basins will be HDPE and will commingle dry swale flows through HDPE piping networks toward the stormwater basins. Each dry swale, catch basin, and conveyance piping section will be leakage tested as detailed in the Technical Specifications (Appendix B) and CQAPP (**Appendix C**).

Earthen materials within the dry swales will not be installed until they are verified to be in accordance with the imported fill requirements as detailed in **Section 5.2**, and with the NYSDOT specifications cited on the Design Drawings included as Appendix A and as detailed in **Section 5.1**.

5.5.4 STORMWATER BASIN #3 DISCHARGE SWALE AND ROADWAY WEIR CROSSINGS

SB3 discharges into a swale proximate to the toe of slope. The swale cross section will consist of prepared subgrade and the following geosynthetic cross-section is as follows from bottom to top;



- a) 50-mil LLDPE Super Gripnet
- b) HydroTurf®
- c) HydroBinder® Infill

The SB3 swale discharges into one of two roadway crossing weirs. The other weir is where the SB2 outlet structure discharges. These weirs allow for continued access to the roadway for maintenance vehicles while directing flow into Tributary 5A. Each geosynthetic material is to be installed and tested in accordance with the Technical Specifications (Appendix B) and the CQAPP (**Appendix C**).

5.6 WESTERN AND SOUTHERN BERM AREA CONSTRUCTION

The northern portion of the Western and Southern Berm Area will receive a 40-mil LLDPE geomembrane, cushion geotextile and earthen fill to sustain a vegetative appearance along the entirety of the north slope. The remainder of the Western and Southern Berm Area will receive a synthetic turf lining (HydroTurf®, or equal) system in lieu of a soil capping system. This system reduces maintenance on the slopes, prevents stormwater infiltration into the berm, and reduces rework associated with erosion and sediment buildup. The cross-section of the Western and Southern Berm Area is as follows:

- d) 50-mil LLDPE Super Gripnet
- e) HydroTurf®
- f) HydroBinder® Infill

Geosynthetics are anchored at the top of slope in a trench, and at the bottom of slope (or backside of SB3 discharge swale) as depicted in the Design Drawings included in Appendix A. Each geosynthetic material is to be installed and tested in accordance with the Technical Specifications and the CQAPP.

5.7 FENCING AND GUIDERAIL INSTALLATION

Fencing and guiderails will be installed as shown in the Design Drawings to promote traffic safety and Site security. Generally, guiderails are positioned atop slopes, and fencing is included around the perimeter of the Site. Installation parameters are specified in the Technical Specifications and Design Drawings. Prior to post installation for guiderail or fencing, geosynthetics will be cut in an "X" pattern to expose the subgrade surface. Once the post has been installed, a third-party geosynthetic installer will affix Liquid Boot at each penetration. Fence gates will be installed to further control traffic flows and secure the Site. Exact dimensions and types of gates are included in the Design Drawings.

5.8 MODIFICATIONS TO THE DESIGN DRAWINGS

Issued for Construction (IFC) drawings are inclusive of modifications to the 95% Design Drawings that were appended to the RDRA WP (OBG, 2019a). These modifications include the following:

- 1) Geogrid Location (multiple details): in areas where a liner system is present, the geogrid layer was relocated to the middle of the 18-inch granular fill layer
- 2) General Note (Sheet G-001): General Note 10 was added to address the decommissioning of existing structures, location of historic structures was added to the legend and shown on subsequent sheets
- 3) Hatching on Willis Property (Sheet C-102): Hatching and Note 3 were added to more accurately depict the bounds of restoration proximate to the primary access roadway
- 4) Catch Basin Network CB-1A through CB-1D (Sheet C-105): Exact locations of these structures were modified slightly. CB-1A was moved westward, the others were modified only slightly for enhanced constructability



- 5) Outlet Piping Size Transition from Stormwater Basin #2 and Stormwater Basin #3 (multiple sheets): Discharge piping was modified to remain at 18-inch diameter for the entire length
- 6) Welding of Pipe Boots (Sheet C-502): Note 2 was added to the Typical Pipe Penetration Detail stating that boots shall be welded and non-destructively tested, where applicable
- 7) Southeastern Sideslope Treatment Area Final Grades (multiple sheets): Proposed final contours in this subarea were regraded to a maximum slope of 3 horizontal to 1 vertical for enhanced constructability
- 8) Weir Flow Detail (Sheet C-506): Detail was modified to reflect the Hydroturf[®] cross section with rounded stone for enhanced constructability
- 9) Section: Northern Berm Area Restoration Detail (formally on Sheet C-506): Detail was removed from IFC set based on comments received on the RDRA WP (OBG, 2019a)

6.0 CONSTRUCTION QUALITY ASSURANCE / CONSTRUCTION QUALITY CONTROL

A CQAPP was prepared for the project and is attached as **Appendix B**. The CQAPP provides guidelines and procedures for Construction Quality Assurance and Construction Quality Control (CQA/CQC) that will be adhered to throughout construction.

Construction Quality Assurance (CQA) is a planned system of activities that provides assurance that the work is constructed as specified in the design. Construction Quality Control (CQC) is a planned system of inspections that are used to directly monitor and control the quality of the Construction Project. During construction, CQA/CQC activities will be conducted to document that the work was performed in accordance with the Design Drawings, Technical Specifications, and manufacturer's specifications. Technical Specifications included as Appendix B detail information such as field testing methods, sampling requirements for laboratory testing, testing procedures and equipment to be used, criteria for acceptance/failure, and a description of the corrective actions to be initiated upon a test failure.

The CQAPP provides the basis for CQA/CQC activities associated with the final cover systems installation only. CQC/CQA of targeted treatment is documented in the TTWP (OBG 2019b). Examples of CQA/CQC activities include:

- In-Place Density Test in accordance with ASTM Method D6398 or ASTM Method D1556
- Particle Size Analysis and Baseline Modified Proctor in accordance with ASTM D422 or C136 and ASTM D1557
- Obtaining imported select fill clean fill affidavits and laboratory analytical data
- Visual inspection of imported fill for consistency
- LLDPE liner testing performed by a third-party inspector that will be contracted to OBG

7.0 CONSTRUCTION SCHEDULE

A construction schedule is included as **Figure 1**. A detailed 2020 construction schedule will be submitted via addendum prior to commencement of work. A Final Engineering Report (FER) will be provided upon completion of construction.



REFERENCES

OBG 2019a. Semet Residue Ponds Targeted Treatment Remedial Action Work Plan. June 2019.

OBG 2019b. Operable Unit (OU)-2 Remedial Design/Remedial Action Work Plan. July 2019.

NYSDEC and USEPA 2019. Semet Residue Ponds Operable Unit-2 Record of Decision. March 2019.



Figure 1 Construction Schedule



ID	0	Task Mode	Task Name	Duration	Start	Finish	Predeo	Succes	Actual Start	Actual Finish	ruary Mar 2/10	ch April 3/10 4/7	May	June	Ju 6/3	ıly A 30 7/
1		-3	2019 Semet Phase I & II	424 days	Tue 3/13/18	Fri 10/25/19			Tue 3/13/18	NA=	2/10			072	0/5	
2			Regulatory Requirements	96 days	Tue 3/19/19	Wed 7/31/19			Tue 3/19/19	NA		1				—
3	~	*	Receive ROD	0 days	Tue 3/19/19	Tue 3/19/19			Tue 3/19/19	Tue 3/19/19	•	► 3/19				
4			Work Plans	65 days	Thu 5/2/19	Wed 7/31/19			Thu 5/2/19	NA						—
5	~	*	Submit RD/RA Work Plan	1 day	Mon 5/6/19	Mon 5/6/19		6	Mon 5/6/19	Mon 5/6/19						
6		*	Receive work Plan Approval	25 days	Thu 5/2/19	Wed 6/5/19	5	7	NA	NA				6/5		
7		*	Submit Construction Work Plan	1 day	Wed 6/26/19	Wed 6/26/19	6	8	NA	NA					1	
8		*	Receive Construction Work Plan app	rc25 days	Thu 6/27/19	Wed 7/31/19	7		NA	NA						
9			Procurement	70 days	Mon 2/25/19	Fri 5/31/19			Mon 2/25/19	NA				-		
10	~	-5	Source Heavy Equipment Rental	15 days	Mon 2/25/19	Fri 3/15/19		27	Mon 2/25/19	Fri 3/15/19						
11	~	-\$	Liner Package	60 days	Mon 3/11/1	EFri 5/31/19			Mon 3/11/19	Fri 5/31/19	l			1		
12	~	*	Liner Package Development	35 days	Mon 3/11/19	9Fri 4/26/19			Mon 3/11/19	Fri 4/26/19	-					
13	~	*	Liner RFQ to subs	10 days	Mon 4/29/19	9Fri 5/10/19			Mon 4/29/19	Fri 5/10/19		I				
14	~	*	Descope Meetings	3 days	Tue 5/21/19	Thu 5/23/19			Tue 5/21/19	Thu 5/23/19						
15	~	*	Contractor Selection	6 days	Fri 5/24/19	Fri 5/31/19			Fri 5/24/19	Fri 5/31/19				•		
16	~	-\$	Imported Materials	28 days	Wed 3/27/1	5 Fri 5/3/19			Wed 3/27/19	Fri 5/3/19			-1			
17	~	-5	Imported Material Supplier Review	21 days	Wed 3/27/19	Wed 4/24/19	25		Wed 3/27/19	Wed 4/24/19						
18	~	*	Analytical and Geotech testing	15 days	Thu 4/4/19	Wed 4/24/19			Thu 4/4/19	Wed 4/24/						
19	\checkmark	*	Provide PO For material	1 day	Fri 5/3/19	Fri 5/3/19			Fri 5/3/19	Fri 5/3/19						
20		-\$	Fence Package	15 days	Mon 4/15/1	5 Fri 5/3/19			Mon 4/15/19	NA			-1			
21		*	Fence Package Development	15 days	Mon 4/15/19	9 Fri 5/3/19			Mon 4/15/19	NA						
22			Guide rail package	30 days	Mon 4/15/1	Eri 5/24/19			Mon 4/15/19	NA			1			
23		*	Guide rail package development	15 days	Mon 4/15/19	9Fri 5/3/19		24	Mon 4/15/19	NA						
24		*	Guide rail package RFQ to subs	15 days	Mon 5/6/19	Fri 5/24/19	23		NA	NA						
25	~		H&S Supplies/Meters	13 days	Mon 2/25/19	Wed 3/13/19		17	Mon 2/25/19	Wed 3/13/19						
26			Mobilization/Site Prep	289 days	Tue 3/13/18	Fri 4/19/19			Tue 3/13/18	NA		Î				
			Tack		Project Summary	. I		l Inar	tive Milestone		 Ν/1-1	nual Summary P				adline
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			Summary		Inactive Task			Dur	ation-only		Fini	sh-only	С			- 0
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28			Equipr	nent Delivery		25 days	Mon 3/18/19	Fri 4/19/19	10		Mon 3/18/19	Fri 4/19/19	2/10	3/10	4/7		0/2		50 7728
		-5	2019 A	QM Equipment		288 days	5 Tue 3/13/18	5 Thu 4/18/19			Tue 3/13/18	NA			_				
29 📱		-5	2019	AQM Equipment Installed	1	4 days	Tue 3/13/18	Fri 3/16/18			NA	NA							
30	~	*	Relo	ocate Monitors SP,8, SP9	9 & SP10	1 day	Thu 4/18/19	Thu 4/18/19			Thu 4/18/19	Thu 4/18/19							
31	~	-5	Earthen	fill/debris removal		75 days	Mon 3/11/1	9 Fri 6/21/19			Mon 3/11/19	Fri 6/21/19							
32	~	*	Reloca	te Trib 5 soil pile from B	BCA	2.8 wks	Mon 3/11/1	9Thu 3/28/19		34	Mon 3/11/19	Thu 3/28/19)						
33	1	*	comm	ence using soil Pile 1 for	r pond cov	«2 wks	Mon 6/10/1	9 Fri 6/21/19		59	Mon 6/10/19	Fri 6/21/19						հ	
34	~	*	Remov equipr	ve steel/contaminated nent/debris from BCA		5 wks	Thu 5/16/19	Wed 6/19/19	32		Thu 5/16/19	Wed 6/19/19				1			
35		-5	Well Dec	ommisioning		67 days	Wed 4/10/1	SThu 7/11/19			Wed 4/10/19	NA	_				_		1
36	1	*	Compe	etitive Bid		6 days	Wed 4/10/1	9Wed 4/17/19			Wed 4/10/19	Wed 4/17/							
37		*	Field E	ffort		4 wks	Mon 6/3/19	Fri 6/28/19			Mon 6/3/19	NA					0		
38			Water	Transfer		59 days	Mon 4/22/1	SThu 7/11/19			Mon 4/22/19	NA			-		_		1
39	~	*	Che	ck Transfer System		5 days	Mon 4/22/1	9Fri 4/26/19		41FS+1	Mon 4/22/19	Fri 4/26/19							
40	1	*	Che	ck Pond pH		1 day	Wed 4/24/1	9Wed 4/24/19			Wed 4/24/19	Wed 4/24/			I				
41		*	Dew	vatering of Pond 4		50 days	Thu 4/25/19	Wed 7/3/19	39FS+	142FS-5	5 Thu 4/25/19	NA				,			
42		*	Trar	nsfer AQ water To Tank 2	2@ WWTF	P50 days	Thu 4/25/19	Wed 7/3/19	41FS-5	5	Thu 4/25/19	NA	L.						
43		*	Trar	nsfer Pond 1 to Pond 2		50 days	Wed 5/1/19	Tue 7/9/19			Wed 5/1/19	NA	L.		l				
44		*	Trar	nsfer Pond 2 water to EC	Q tanks	50 days	Fri 5/3/19	Thu 7/11/19			Fri 5/3/19	NA							I
45		-5	2019 Sen	net Residue TT		80 days	Mon 3/18/19	Fri 7/5/19			Mon 3/18/19	NA	L .						
46		-5	2019 S	emet Residue TT Ponds 2,	,3 & 4	16 wks	Mon 3/18/19	Fri 7/5/19		55,71F	Mon 3/18/19	NA	 \					Ŋ	
47		-5	Grading			138 days	6 Wed 4/17/1	9 Fri 10/25/19			Wed 4/17/19	NA			-				
48	1	*	BCA ac	ccess road construction		1 wk	Mon 4/29/1	9 Fri 5/3/19			Mon 4/29/19	Fri 5/3/19			ŀ				
49	1	*	BCA ro	ough Grading		8 days	Wed 4/17/1	9 Fri 4/26/19			Wed 4/17/19	Fri 4/26/19							
50	1	*	BCA su	Ibgrade		35 days	Thu 5/2/19	Wed 6/19/19		64FS+5	Thu 5/2/19	Wed 6/19/	1						
51		*	BCA Fi	nal Grade		25 days	Wed 6/5/19	Tue 7/9/19	50FF+:	1	NA	NA							ŀ
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*	Rough Grading Ponds 1,2,3 & 5 Subgrade Ponds 1,2,3,5 Fair Shut down	8 wks 25 days	Mon 7/15/19						2/10 3/10 4/7	5/5	
*	Subgrade Ponds 1,2,3,5 Fair Shut down	25 days		Fri 9/6/19	50	53 <i>,</i> 56	NA	NA			
-+ -+	Fair Shut down		Mon 9/9/19	Fri 10/11/19	52	62	NA	NA			
		2 wks	Wed 8/21/19	Tue 9/3/19			NA	NA			
	Backfill Pond 4	3 wks	Mon 7/8/19	Fri 7/26/19	46		NA	NA			
*	Rough grade Pond 4	4 wks	Mon 9/9/19	Fri 10/4/19	52	57	NA	NA			
*	Subgrade Pond 4	3 wks	Mon 10/7/19	Fri 10/25/19	56		NA	NA			
	Access Road construction	50 days	Mon 6/10/19	Fri 8/16/19			Mon 6/10/19	NA			I
*	Road construction	25 days	Mon 6/10/19	Fri 7/12/19	33	60FS+	Mon 6/10/19	NA			
*	install guide rails/fencing	5 wks	Mon 7/15/19	Fri 8/16/19	59FS+	5	NA	NA			
-5	Liner Prep and Install	66 days	Mon 7/15/19	Mon 10/14/19			NA	NA			
*	Ponds 1,2,3 & 5	6 wks	Tue 9/3/19	Mon 10/14/19	53		NA	NA			
*	Liner Install SW ponds	2 wks	Mon 7/15/19	Fri 7/26/19		65	NA	NA			
*	Liner install BCA	3 wks	Mon 7/15/19	Fri 8/2/19	50FS+	5	NA	NA			
*	Liner install Swales	1 wk	Mon 7/29/19	Fri 8/2/19	63	68FF	NA	NA			
	Retention Ponds and collection system	72 days	Thu 4/25/19	Fri 8/2/19			Thu 4/25/19	NA	1		
*	SW Pond 1 grade	2.4 wks	Thu 4/25/19	Fri 5/10/19			Thu 4/25/19	Fri 5/10/19			
*	Collection system install	2 wks	Mon 7/22/19	Fri 8/2/19	65FF	69FS-1	NA	NA			
*	Discharge system install	1 wk	Mon 7/15/19	Fri 7/19/19	68FS-1		NA	NA			
-4	Berm Work	75 days	Tue 7/9/19	Mon 10/21/19			NA	NA			
*	Clear West and South Berms	5 wks	Tue 7/9/19	Mon 8/12/19	46FS+	72	NA	NA			
*	Fill material install	25 days	Tue 8/13/19	Mon 9/16/19	71	73	NA	NA			
*	Install supergrip net	2 wks	Tue 9/17/19	Mon 9/30/19	72	74FS-5	NA	NA			
*	Install Hydroturf	2 wks	Tue 9/24/19	Mon 10/7/19	73FS-5	575	NA	NA			
	Install Hydrobinder	2 wks	Tue 10/8/19	Mon 10/21/19	74		NA	NA			
	× 二 ネ ネ ・ ネ ・ ネ ・ ネ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・	Subgrade Pond 4Access Road constructionRoad constructioninstall guide rails/fencingLiner Prep and InstallPonds 1,2,3 & 5Liner Install SW pondsLiner install BCALiner install SwalesRetention Ponds and collection systemSW Pond 1 gradeCollection system installDischarge system installBerm WorkFill material installInstall supergrip netInstall supergrip netInstall Hydroturf	Subgrade Pond 43 wksAccess Road construction50 daysRoad construction25 daysinstall guide rails/fencing5 wksPonds 1,2,3 & 56 wksLiner Prep and Install66 daysPonds 1,2,3 & 56 wksLiner Install SW ponds2 wksLiner Install BCA3 wksLiner install Swales1 wkRetention Ponds and collection system72 daysSW Pond 1 grade2.4 wksCollection system install2 wksDischarge system install1 wkBerm Work75 daysClear West and South Berms5 wksFill material install25 daysInstall supergrip net2 wksInstall Hydroturf2 wks	Subgrade Pond 43 wksMon 10/7/19Access Road construction50 daysMon 6/10/19Road 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daysThu 4/25/19 Fri 8/2/19SW Pond 1 grade2.4 wksThu 4/25/19 Fri 5/10/19SW Pond 1 grade2.4 wksThu 4/25/19 Fri 5/10/19Berm Work75 daysTue 7/9/19 Mon 10/21/19Fill material install25 wksTue 7/9/19 Mon 8/12/19Install supergrip net2 wksTue 9/17/19 Mon 9/30/19Install Hydroturf2 wksTue 9/17/19 Mon 10/7/19	Subgrade Pond 4 3 wks Mon 10/7/19 Fri 10/25/19 56 Access Road construction 50 days Mon 6/10/15 Fri 8/16/19 56 Road construction 25 days Mon 6/10/15 Fri 8/16/19 59FS+1 install guide rails/fencing 5 wks Mon 7/15/19 Fri 8/16/19 59FS+1 Liner Prep and Install 66 days Mon 7/15/19 Mon 10/14/19 53 Liner Install SW ponds 2 wks Mon 7/15/19 Fri 7/26/19 50FS+1 Liner Install BCA 3 wks Mon 7/15/19 Fri 8/2/19 63 Retention Ponds and collection system 72 days Thu 4/25/19 Fri 8/2/19 63 SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 8/2/19 63 SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 63 SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 63 SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 63 SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 63 Berm Work 75 days Tue 7/9/19 Mon 10/21/19 68 <tr< td=""><td>Subgrade Pond 4 3 wks Mon 10/7/19 Fri 10/25/19 56 Access Road construction 50 days Mon 6/10/19 Fri 7/12/19 33 60FS+1 Install guide rails/fencing 5 wks Mon 7/15/19 Fri 8/16/19 59FS+5 50 Install guide rails/fencing 5 wks Mon 7/15/19 Mon 10/14/19 59FS+5 50 Ponds 1,2,3 & 5 6 wks Tue 9/3/19 Mon 10/14/19 53 65 Liner Install SW ponds 2 wks Mon 7/15/19 Fri 7/26/19 65 65 Liner Install BCA 3 wks Mon 7/29/19 Fri 8/2/19 63 68FF Retention Ponds and collection system 72 days Thu 4/25/19 Fri 8/2/19 63 68FF SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 8/2/19 63 68FF SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 65FF 69FS-1 Discharge system install 1 wk Mon 7/15/19 Fri 7/19/19 68FS-1 Celert West and South Berms 5 wks Tue 7/9/19 Mon 10/21/19 Fill material install 2 wks Tue 7/9/19 Mon 9/16/19 71 Fill material install 2 wks</td><td>Subgrade Pond 43 wksMon 10/7/19 Fri 10/25/1956NAAccess Road construction50 daysMon 6/10/15Fri 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days Mon 6/10/19 Fri 8/16/19 33 60F5+5 Mon 6/10/19 NA NA install guide rails/fencing 5 wks Mon 7/15/19 Fri 8/16/19 59F5+5 NA NA NA Ponds 1,2,3 & 5 6 wks Tue 9/3/19 Mon 10/14/19 53 NA NA Liner Install SW ponds 2 wks Mon 7/15/19 Fri 7/26/19 65 NA NA Liner install BCA 3 wks Mon 7/15/19 Fri 8/2/19 50F5+5 NA NA SW Pond 1 grade 1 wk Mon 7/29/19 Fri 8/2/19 63 68FF NA NA SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 5/10/19 Fri 5/10/19 Thu 4/25/19 Fri 5/10/19 Collection system install 1 wk Mon 7/21/19 Fri 8/2/19 68F5-1 NA NA Discharge system install 1 wk</td><td>Subgrade Pond 4 3 wks Mon 30/7/19 Fr 10/25/19 56 NA NA Access Road construction 50 days Mon 6/10/19 Fr 7/12/19 33 60F5+! Mon 6/10/19 NA Road construction 25 days Mon 6/10/19 Fr 7/12/19 33 60F5+! Mon 6/10/19 NA Install guide rails/fencing 5 wks Mon 7/15/19 Fr 8/16/19 59F5+! NA NA Liner Prep and Install 66 days Mon 7/15/19 Mon 10/14/19 53 NA NA Ponds 1,2,3 & 5 6 wks Tue 9/3/19 Mon 10/14/19 53 NA NA Liner Install SW ponds 2 wks Mon 7/15/19 Fr 7/26/19 65 NA NA Liner Install BCA 3 wks Mon 7/15/19 Fr 7/26/19 56 NA NA Ketention Ponds and collection system 72 days Thu 4/25/19 Fri 8/2/19 63 68FF NA NA SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 5/10/19 Thu 4/25/19 Fri 5/10/19 SW Pond 1 grade 2.4 wks Tue 7/9/19 Mon</td><td>Subgrade Pond 43 wksMon 10///19 Fri 10/25/1956NANAAccess Road construction50 daysMon 6/10/19 Fri 7/12/193360F5+: Mon 6/10/19NARoad construction25 daysMon 6/10/19 Fri 7/12/193360F5+: Mon 6/10/19NAInstall guide rails/fencing5 wksMon 7/15/19 Fri 8/16/1959F5+:NANAUner Prep and Install66 daysMon 7/15/19 Fri 8/16/1959F5+:NANAPonds 1,2,3 & 56 wksTue 9/3/19Mon 10/14/1953NANAUner Install SW ponds2 wksMon 7/15/19 Fri 8/2/1950F5+:NANALiner install BCA3 wksMon 7/29/19 Fri 8/2/1950F5+:NANAKetention Ponds and collection system72 daysThu 4/25/19 Fri 8/2/196368F5-NANASW Pond 1 grade24 wksThu 4/25/19 Fri 8/2/196569F5-1NANACollection system install24 wksTue 7/9/19 Mon 10/2/1965F769F5-1NANAMon Starley System install1 wkMon 7/15/19/Fri 7/19/1968F5-1NANAMer Work75 daysTue 7/9/19 Mon 10/2/19Mon 10/2/19Fri 7/2NANAMarrier Install Supergrip net2 wksTue 9/3/19 Mon 9/16/197173NANAInstall Hydroturf2 wksTue 9/2/19 Mon 10/7/19725/57NANA</td></tr<>	Subgrade Pond 4 3 wks Mon 10/7/19 Fri 10/25/19 56 Access Road construction 50 days Mon 6/10/19 Fri 7/12/19 33 60FS+1 Install guide rails/fencing 5 wks Mon 7/15/19 Fri 8/16/19 59FS+5 50 Install guide rails/fencing 5 wks Mon 7/15/19 Mon 10/14/19 59FS+5 50 Ponds 1,2,3 & 5 6 wks Tue 9/3/19 Mon 10/14/19 53 65 Liner Install SW ponds 2 wks Mon 7/15/19 Fri 7/26/19 65 65 Liner Install BCA 3 wks Mon 7/29/19 Fri 8/2/19 63 68FF Retention Ponds and collection system 72 days Thu 4/25/19 Fri 8/2/19 63 68FF SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 8/2/19 63 68FF SW Pond 1 grade 2.4 wks Mon 7/15/19 Fri 8/2/19 65FF 69FS-1 Discharge system install 1 wk Mon 7/15/19 Fri 7/19/19 68FS-1 Celert West and South Berms 5 wks Tue 7/9/19 Mon 10/21/19 Fill material install 2 wks Tue 7/9/19 Mon 9/16/19 71 Fill material install 2 wks	Subgrade Pond 43 wksMon 10/7/19 Fri 10/25/1956NAAccess Road construction50 daysMon 6/10/15Fri 8/16/19Mon 6/10/19Road construction25 daysMon 7/15/193360FS+1 Mon 6/10/19install guide rails/fencing5 wksMon 7/15/19Fri 8/16/1959FS+1NALiner Prep and Install66 daysMon 7/15/19Mon 10/14/19S3NAPonds 1,2,3 & 56 wksTue 9/3/19Mon 10/14/19S3NALiner Install SW ponds2 wksMon 7/15/19Fri 8/2/1965NALiner install BCA3 wksMon 7/15/19Fri 8/2/196368FFNALiner install Swales1 wkMon 7/29/19Fri 8/2/196368FFNASW Pond 1 grade2.4 wksThu 4/25/19Fri 8/2/1965FF69FS-1NASW Pond 1 grade2 wksMon 7/15/19Fri 8/2/1965FF69FS-1NACollection system install1 wkMon 7/15/19Fri 8/2/1965FF69FS-1NASW Pond 1 grade2 wksTue 7/9/19Mon 10/21/19MANANACollection system install1 wkMon 7/15/19Fri 8/2/1965FF69FS-1NAClear West and South Berms5 wksTue 7/9/19Mon 9/16/197173NAInstall supergrip net2 wksTue 9/17/19Mon 9/16/197173NAInstall supergrip net2 wksTue 9/2/19Mon 10/7/1973FS-5	Subgrade Pond 4 3 wks Mon 10///19 Fri 10/25/19 56 NA NA Access Road construction 50 days Mon 6/10/19 Fri 8/16/19 NA Mon 6/10/19 NA Road construction 25 days Mon 6/10/19 Fri 8/16/19 33 60F5+5 Mon 6/10/19 NA NA install guide rails/fencing 5 wks Mon 7/15/19 Fri 8/16/19 59F5+5 NA NA NA Ponds 1,2,3 & 5 6 wks Tue 9/3/19 Mon 10/14/19 53 NA NA Liner Install SW ponds 2 wks Mon 7/15/19 Fri 7/26/19 65 NA NA Liner install BCA 3 wks Mon 7/15/19 Fri 8/2/19 50F5+5 NA NA SW Pond 1 grade 1 wk Mon 7/29/19 Fri 8/2/19 63 68FF NA NA SW Pond 1 grade 2.4 wks Thu 4/25/19 Fri 5/10/19 Fri 5/10/19 Thu 4/25/19 Fri 5/10/19 Collection system install 1 wk Mon 7/21/19 Fri 8/2/19 68F5-1 NA NA Discharge system install 1 wk	Subgrade Pond 4 3 wks Mon 30/7/19 Fr 10/25/19 56 NA NA Access Road construction 50 days Mon 6/10/19 Fr 7/12/19 33 60F5+! 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SEMET RESIDUE PONDS SITE OU-2 REMEDIAL DESIGN CONSTRUCTION WORK PLAN | APPENDIX

Appendices



Appendix A Design Drawings





SITE LOCATION MAP NOT TO SCALE

SEMET OU-2 REMEDIAL DESIGN

HONEYWELL INTERNATIONAL INC. **GEDDES, NEW YORK**

JULY 2019



O'BRIEN & GERE ENGINEERS, INC.

IT IS A VIOLATION OF LAW FOR ANY PERSON UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER TO ALTER THIS DOCUMENT.



INDEX TO DRAWINGS

	TITLE SHEET
G-001	GENERAL NOTES, LEGEND & ABBREVIATIONS
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C-102	OVERALL SITE LAYOUT PLAN
C-103	GENERAL SITE SUBGRADE GRADING PLAN
C-104	PHASE 1 - PARKING & RESTORATION SITE LAYOUT PLAN
C-105	PHASE 1 - FINAL SURFACE & STORMWATER MANAGEMENT PLAN
C-106	PHASE 2 - PARKING & RESTORATION SITE LAYOUT PLAN
C-107	PHASE 2 - FINAL SURFACE & STORMWATER MANAGEMENT PLAN
C-108	STORMWATER BASIN NO. 3 DISCHARGE SWALE PLAN & PROFILE
C-109	STORMWATER BASIN NO. 2 OUTFALL PLANS & PROFILES
C-110	STORMWATER BASIN NO. 3 OUTFALL PLAN & PROFILE
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C-112	PHASE 2 TEMPORARY EROSION & SEDIMENT CONTROL SITE PLAN
C-201	PHASE 1 - CENTERLINE ROAD 'A' PROFILES
C-202	PHASE 1 - CENTERLINE ROAD 'A' PROFILE
C-203	PHASE 2 - CENTERLINE ROAD 'B' & 'C' PROFILES
C-501	EROSION & SEDIMENT CONTROL DETAILS
C-502	MISCELLANEOUS DETAILS - 1
C-503	MISCELLANEOUS DETAILS - 2
C-504	MISCELLANEOUS DETAILS - 3
C-505	MISCELLANEOUS DETAILS - 4
C-506	MISCELLANEOUS DETAILS - 5

GENERAL NOTES:

- 1. VERIFY DIMENSIONS PERTINENT TO THE WORK OF THIS CONTRACT IN THE FIELD. PROPOSED CONTOURS AND ELEVATIONS SHOWN ARE SUBGRADE ELEVATIONS WHERE NOTED AND FINISHED ELEVATIONS. IF DISCREPANCIES ARE FOUND BETWEEN THE PLANS AND PHYSICAL CONDITIONS OF THE SITE, NOTIFY THE ENGINEER.
- 2. THESE DRAWINGS SHOW EXISTING AND PROPOSED CONTOURS AT A 1-FT INTERVAL
- 3. PROPOSED WORK IS SHOWN IN BOLD TEXT AND LINES.
- 4. CONSTRUCTION SHALL GENERALLY PROCEED ACCORDING TO THE SEQUENCE PROVIDED IN THE CONSTRUCTION WORK PLAN, TO BE SUBMITTED UNDER SEPARATE COVER.
- 5. MAINTAIN EXISTING DRAINAGE FACILITIES AND CHANNELS DURING PERFORMANCE OF WORK TO BE FREE OF DEBRIS AND FOREIGN MATTER AND OPERATIONAL. PROPER EROSION CONTROL TECHNIQUES (INCLUDING SILT FENCES AND STONE CHECK DAMS) SHALL BE IMPLEMENTED AS REQUIRED AND IN ACCORDANCE WITH THE SWPPP; PROVIDED WITH EACH CONSTRUCTION WORK PLAN.
- 6. EXCAVATE AND STAGE EXCESS MATERIALS RELATED TO THE CONSTRUCTION IN ACCORDANCE WITH TECHNICAL SPECIFICATION 01170 MATERIAL HANDLING AND DISPOSAL.
- 7. RESTORE DISTURBED AREAS IN ACCORDANCE WITH TECHNICAL SPECIFICATION 31 22 19 TOPSOIL SEEDING AND PLANTING.
- 8. CLEAN FILL BROUGHT ONTO THE SITE SHALL MEET DER-10 GUIDANCE AND NEW YORK STATE PART 375 REQUIREMENTS, OR AS APPROVED BY NYSDEC.
- 9. WORK SHALL BE PERFORMED IN SUBSTANTIVE COMPLIANCE WITH NYSDEC SPDES GP-0-15-002, SECTION 401 AND 404 OF THE CLEAN WATER ACT AND PURSUANT TO THE PROJECT STORMWATER POLLUTION PREVENTION PLAN (SWPPP) SUCH THAT PROJECT ACTIVITIES DO NOT RESULT IN SIGNIFICANT IMPACTS TO WATER QUALITY.
- 10. SHOULD HISTORIC STRUCTURES BE LOCATED PROXIMATE TO THE AREA OF WORK. THEY WILL BE DECOMMISSIONED IN ACCORDANCE WITH THE CONSTRUCTION WORK PLANS.

TOPOGRAPHIC SURVEY AND MAPPING:

- 1. SURVEY INFORMATION SHOWN ON THE CONTRACT DRAWINGS IS REFERENCED HORIZONTALLY TO THE NORTH AMERICAN DATUM OF 1983 (NAD83) AND PROJECTED TO THE STATE PLANE COORDINATE SYSTEM (CENTRAL ZONE) AND REFERENCED VERTICALLY TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). HORIZONTAL COORDINATES ARE REFERENCED TO THE GRID COORDINATE SYSTEM.
- 2. TOPOGRAPHIC SURVEY INFORMATION SHOWN ON THE CONTRACT DRAWINGS IS A COMPILATION OF MAPPING FROM THE FOLLOWING SOURCES:
 - THEW & ASSOCIATES DATED JUNE 20, 2011, SEPTEMBER 22, 2011, NOVEMBER 2, 2011, JANUARY 11, 2012, JUNE 2014, JANUARY 4, 2018 JULY 2, 2018, AND DECEMBER 19, 2018
 - O'BRIEN & GERE ENGINEERS, INC., "WILLIS AVENUE SEMET TAR BEDS SITE; GROUNDWATER TREATMENT PLANT EXPANSION", DATED 07/05/16
 - C.T. MALE ASSOCIATES "AS-BUILT", DATED 05/11/18, "WILLIS AVE 6-15-18", DATED 06/15/18, AND "BOUNDARY AND TOPOGRAPHIC SURVEY", DATED 12/12/18..

GENERAL UTILITY:

- 1. EXACT DIMENSIONS AND LOCATIONS OF STRUCTURES AND UTILITIES ARE CONSIDERED APPROXIMATE AND SHALL BE VERIFIED IN THE FIELD. IN ADDITION, OTHER UNDERGROUND PIPES, UTILITIES OR STRUCTURES NOT SHOWN ON THE DRAWINGS MAY EXIST.
- 2. CONTACT DIG SAFELY NEW YORK AND THE OWNER PRIOR TO INITIATION OF CONSTRUCTION ACTIVITIES. PROVIDE AT LEAST 72 HOURS (3 BUSINESS DAYS) NOTIFICATION.
- 3. COORDINATE WORK AFFECTING EXISTING UTILITIES WITH THE RESPECTIVE UTILITY COMPANY OWNER. DETAILS OF CONSTRUCTION AND/OR RELOCATION SHALL BE APPROVED BY THE UTILITY OWNERS AND OTHER APPROVING AGENCIES, IF REQUIRED.
- 4. PIPE ELEVATIONS GIVEN ARE INVERT ELEVATIONS, UNLESS SPECIFIED OTHERWISE.

PIPE SCHEDULE

SYSTEM	NOMINAL DIAMETER	MATERIAL
UNDERDRAIN PIPE (PERFORATED)	4" AND 6"	DR-17 IPS HDPE
STORMWATER PIPE	VARIES	DR-17 IPS HDPE

PIPE SCHEDULE NOTES:

PERFORATED HDPE PIPE SHALL HAVE 0.25" PERFORATIONS LOCATED IN A 0°, 90°, 180° AND 270° RING PATTERN. RINGS SHALL BE SPACED 6" APART.

UNLESS ACTING UNDER THE DIRECTION OF LICENSED ENGINEER, TO ALTER THIS DOCU	F A JMENT.	INACCURACIES WHEN DRAWING USE THE GRAPH DRAWING IS NO	IN THE STATED SCALE MAY BE INTRODUCED GS ARE REPRODUCED BY ANY MEANS. HIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. IT SCALABLE IF NO SCALE BAR IS PRESENT.	
IN CHARGE OF R. DUFF				
DESIGNED BY R. DUFF				
CHECKED BY R. DUFF				
 DRAWN BY S. JOHNSON	0 NO.	7/12/2019 DATE	ISSUED FOR CONSTRUCTION REVISION	RGD INT.

IT IS A VIOLATION OF LAW FOR ANY PERSON, THIS DRAWING WAS PREPARED AT THE SCALE INDICATED.

MONITORING WEI
SP-02A
SP-05A, B, C
SP-09A, B, C
SP-10D, BR
SP-03A, B, C
SP-04A, B, C
SP-06A, B, C
SP-07A, B, C
SP-08A, B, C
SP-11D, BR
WA-04-I, D, S
GM-01
GM-06
GM-07
GM-08
GM-09
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DECOMMISSION

ABBREV	IATIONS		LEGE	<u>ND</u>	
APPROX.	APPROXIMATE				
AVE BCA	AVENUE BRUSHY CLEARED AREA	COMM	EXISTING UNDERGROUND	369.5 X	PROPOSED SPOT ELEVATION
BLVD	BOULEVARD		COMMUNICATIONS (FIBER OPTIC)	ES-1	
BVCS BVCE	BEGINNING VERTICAL CURVE STATION BEGINNING VERTICAL CURVE ELEVATION		EXISTING SANITARY FORCEMAIN		PROPOSED STORMWATER PIPE WITH FLARED END SECTION
CB C					
ዊ CLF	CHAIN LINK FENCE	W	EXISTING WATER LINE	CB-1	PROPOSED CATCH BASIN
CONC.					
CSP	CORRUGATED STEEL PIPE	<u> </u>	EXISTING CONTOUR	•	
DIA. ELEV	DIAMETER ELEVATION			Ø	PROPOSED MANHOLE OR BASIN OUTLET STRUCTURE
EMH		GUY ——	EXISTING OVERHEAD GUT WIRE		
EVCS	END VERTICAL CURVE STATION END VERTICAL CURVE ELEVATION		EXISTING CHAIN LINK FENCE		RIP-RAP
EX./EXIST.	EXISTING	0 0			
GLM	GAS LINE MARKER	000	EXISTING GUIDE RAIL	<i>←</i>	
GV GW	GATE VALVE GROUND WATER				
HDPE	HIGH DENSITY POLYETHYLENE	• FOMKR	EXISTING FIBER OPTIC MARKER	265.93 (CM) N 62 09 17 W	BEARING & DISTANCE
HYD I	HYDRANT INTERSTATE			N 02 03 17 W	
ID		M	EXISTING MANHOLE	·····	
INC. INV	INVERT				AREA REQUIRING 40 MIL LLDPE GEOMEMBRANE
К	HORIZONTAL DISTANCE REQUIRED TO PRODUCE A 1%	0	EXISTING BOLLARD		
LLDPE	LINEAR LOW DENSITY POLYETHYLENE				
LVC MAX.	LENGTH OF VERTICAL CURVE MAXIMUM	S	EXISTING SANITARY MANHOLE		AREA REQUIRING HYDROTURF INSTALLATIONS
MH	MANHOLE				
MIL MIN.	MINIMUM	Emm	EXISTING VEGETATION		PHASE BOUNDARY LINE
MW					
OHE	OVERHEAD ELECTRIC				BEAWEST OF BEA BOONDART
PT PVI	POINT POINT OF VERTICAL INTERSECTION	GAS	EXISTING NATURAL GAS	770	
PVC	POLYVINYL CHLORIDE				PROPOSED CONTOUR
R RCP	RADIUS REINFORCED CONCRETE PIPE	UGE	EXISTING UNDERGROUND ELECTRIC		
S.S.	STAINLESS STEEL			— - <u>370</u> - —	PROPOSED SUBGRADE CONTOUR
SICPP	SHEET SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE	OHE	EXISTING OVERHEAD ELECTRIC		PROPERTY LINE
STA SWPPP	STATION STORM WATER POLICITION PREVENTION PLAN				
TP	TEST PIT		EXISTING RAILROAD TRACKS	• 0 0 0 0 0	PROPOSED GUIDERAIL
TRIB. TYP.	TYPICAL			D	PROPOSED TEMPORARY FENCING
UD. UGE		H	EXISTING ELECTRIC HANDHOLE		
UNK	UNKNOWN	WA-WA-04S 💌	EXISTING MONITORING WELL	- 0	PROPOSED PERMANENT FENCING
VERT. W	VERTICAL WATER OR WIDTH				
W/	WITH	WA-GM-47 🗙	EXISTING MONITORING WELL TO BE DECOMISSIONED		PROPOSED DRY SWALE
₩ ₩	NUMBER			· — · · · · I	
±	PLUS OR MINUS	P7-14	EXISTING PIEZOMETER LOCATION	·]	PROPOSED STORM WATER BASIN OUTLINE
		· / / · · ·			
			EXISTING RECOVERY WELL		PROPOSED CENTER OF ROAD
				<u> </u>	PROPOSED VEGETATED SWALE
		W19	EXISTING INCLINOMETER		
				UD UD	PROPOSED UNDERDRAIN
			EXISTING INCLINOMETER AND PIEZOMETER	SF	PROPOSED SILT FENCE
		$\chi^{\perp}\chi$	EXISTING LIGHT POLE		
		\sim		21.83	PROPOSED STONE CHECK DAM
			EXISTING HYDRANT		
		<u> </u>			
		\bigcirc	EXISTING UTILITY POLE		EXISTING STRUCTURE
				•	(TO BE INSPECTED)
		D	EXISTING STORM DRAIN MANHOLE		
			EXISTING CATCH BASIN		
			EXISTING CONIFEROUS TREE		
		ENENZ			
			EXISTING DECIDUOUS TREE/SHRUB		
			EXISTING SIGN		
		0			
			EXISTING ELECTRIC METER		
		ම	EXISTING GAS MARKER		
		O TEST	EXISTING GAS TEST		

HONEYWELL INTERNATIONAL INC. SEMET OU-2 REMEDIAL DESIGN

O'BRIEN & GERE ENGINEERS, INC

SYRACUSE, NEW YORK

GENERAL	FILE NO.	
	1163.70277	
GENERAL NOTES, LEGEND &	DATE	G-001
ABBREVIATIONS	JULY 2019	



	GENERAL SITE PLAN LEGEND
	TRIBUTARY 5A
	6-INCH TOPSOIL
	1-FOOT ENGINEERED COVER (BRUSHY CLEARED AREA (BCA))
$\times \times$	1.5-FOOT LOW-PERMEABILITY ENGINEERED COVER (WEST OF THE BCA AREA)
	WESTERN AND SOUTHERN BERM AREA
	LINER; 40 MIL LLDPE
	BCA / WEST OF BCA BOUNDARY
	CONSTRUCTION PHASE LIMITS
₩A-04S 🕱	MONITORING WELL LOCATIONS
GM-47 🕱	MONITORING WELL LOCATIONS TO BE DECOMMISSIONED
	EXISTING GROUNDWATER COLLECTION TRENCH
	SEMET LAKESHORE AREA BOUNDARY

SHEET NOTES:

- 1. MONITORING WELLS TO BE DECOMMISSIONED IN ACCORDANCE WITH CP-43 GUIDANCE.
- 2. MONITORING WELLS TO BE MODIFIED FOR LOCKING, FLUSH MOUNT ACCESS. SEE DETAIL 'B', SHEET C-503.
- 3. CHLORINE DOSING MANHOLE TO BE MODIFIED TO BE FLUSH WITH FINAL ELEVATIONS.

CIVIL	FILE NO.	
	1163.70277	
	DATE	C-101
GENERAL SITE PLAN	JULY 2019	



			USE THE GRAP DRAWING IS NO	PHIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. OT SCALABLE IF NO SCALE BAR IS PRESENT.		
IN CHARGE OF	R. DUFF					
DESIGNED BY	R. DUFF					
CHECKED BY	R. DUFF					
DRAWN BY	S JOHNSON	0	7/12/2019	ISSUED FOR CONSTRUCTION	RGD	
	0.001110011	NO.	DATE	REVISION	INT.	





0 7/12/2019 ISSUED FOR CONSTRUCTION NO. DATE REVISION REVISION







DNEYWELL.1163/70277.SEMET-2018-OU-2\DOCS\DWG\SHEETS\95% SUBMITTAL\70277.C105.DW

VEGETATIVE COVER SEE DETAIL 'A' SHEET C-505 (TYP.) VEGETATIVE COVER SEE DETAIL 'A' SHEET C-505 (TYP.) VEGETATIVE COVER SHEET C-505 (TYP.) VEGETATIVE SHEET C-505 (TYP.) VEGETATIVE S	O+00B (16+27A) DOUBLE SWING GATE (TEMPORARY) TO BE REMOVED	
	FILE NO.	
PHASE 2	1163.70277	C_{-106}
PARKING & RESTORATION	DATE	0-100
SITE LAYOUT PLAN	JULY 2019	

DRAWING IS NOT SCALABLE IF NO SCALE BAR IS PRESENT.						
IN CHARGE OF	R. DUFF					
DESIGNED BY	R. DUFF					
CHECKED BY	R. DUFF					
		0	7/12/2019	ISSUED FOR CONSTRUCTION	RGD	
		NO.	DATE	REVISION	INT.	

SYRACUSE, NEW YORK

DISCHARGE SWALE PLAN & PROFILE

JULY 2019

Ľ	UNLESS ACTING LICENSED ENGIN	UNDER THE DIRECTION OF EER, TO ALTER THIS DOCU	A IMENT.	WHEN DRAWING USE THE GRAPH DRAWING IS NO	IN THE STATED SCALE MAY BE INTRODUCED GS ARE REPRODUCED BY ANY MEANS. HIC SCALE BAR TO DETERMINE THE ACTUAL SCALE. IT SCALABLE IF NO SCALE BAR IS PRESENT.	
	IN CHARGE OF	R. DUFF				
	DESIGNED BY	R. DUFF				
	CHECKED BY	R. DUFF				
_	DRAWN BY	S. JOHNSON	0 NO.	7/12/2019 DATE	ISSUED FOR CONSTRUCTION REVISION	RGD

CIVIL	FILE NO.	
	1163.70277	
RMWATER BASIN NO. 2 OUTFALL	DATE	C-109
PLANS & PROFILES	JULY 2019	

STORMWATER BASIN NO. 3 OUTFALL TO SOUTH BERM SWALE SCALE: 1"=20' 20' 0

CIVIL	FILE NO.	
	1163.70277	
		C-110
STONIVIATEN DASIN NO. 3	DATE	
OUTFALL PLAN & PROFILE	JULY 2019	
	-	







PHASE 2	FILE NO. 1163.70277	C 112
PORARY EROSION & SEDIMENT	DATE	0-112
CONTROL SITE PLAN	JULY 2019	





420 400 ____ 390 380 370 FILE NO. 1163.70277 C-201 DATE JULY 2019

SAVED: 6/21/19 12:07





NEYWELL.1163/70277.SEMET-2018-OU-2\DOCS\DWG\SHEETS\95% SUBMITTAL\70277.C202.DWG

ROAD A - CENTERLINE PROFILE: PHASE 1 SCALE: HORIZ. 1"=60' VERT. 1"=10' 60' 0 60' 0 60'

10' **0**

NOTE:

1. SEE SHEET C-102 FOR ROADWAY LOCATIONS.



HONEYWELL INTERNATIONAL INC. SEMET OU-2 REMEDIAL DESIGN

SYRACUSE, NEW YORK

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CIVIL	FILE NO. 1163.70277	C 202
PHASE 1	DATE	0-202
ENTERLINE ROAD 'A' PROFILE	JULY 2019	



SYRACUSE, NEW YORK

		BVCS: 15+91.92 BVCE: 398.97	PVI STA: 16+91 PVI ELEV: 398. K: 235.95 LVC: 200.00 OW PT. STA: 17+ LOW PT ELEV: 39 UN PT ELEV: 30 UN PT ELEV:	.92 33 43.22 6 5 8.49 5 ENCE: 10 140 15 80 10 10 10 10 10 10 10 10 10 10 10 10 10	430 420 420 410 			
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	DESIGNED BY	R. DUFF				
	CHECKED BY	R. DUFF				
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	24	12' MIN. PATHWAY
	PLAN VIEW	
2" STONE, OR	RECLAIMED OR RECYCLED CONCRE	ETE EQUIVALENT.
UIRED, BUT NC	OT LESS THAN 50 FEET.	





O'BRIEN & GERE ENGINEERS, INC

SYRACUSE, NEW YORK



MISCELLANEOUS DETAILS - 1

JULY 2019





REVISION

INT

CROSS SECTION -SIZE VARIES 8" (MAX.)



- 1. FLARED END SECTION SHALL BE HDPE. SIZE AND CONNECTION SHALL BE PER MANUFACTURER'S RECOMMENDATIONS FOR HDPE
- 2. END SECTIONS TO BE INSTALLED ON PROPOSED STORM SEWER INLETS AND OUTLETS, WHERE SHOWN ON PLANS.

DRY SWALE ID	DS-1A	DS-1B	DS-1C	DS-1D	DS-1E	DS-2A	DS-2B	DS-2C	DS-2D	DS-3A	DS-3B
TOP OF SWALE ELEV. 'A'	394	395	396	398	389	398	398.5	398.5	398.5	399.5	398.5
BOTTOM OF DRY SWALE ELEV. 'B'	392	393	394	396	387	396	396.5	396.5	396.5	397.5	396.5
4" UD ELEV. 'C'	389.58	390.58	391.58	393.58	384.58	393.58	394.08	394.08	394.08	395.08	394.08
DISCHARGE STRUCTURE ID	CB-1A	CB-1B	CB-1C	CB-1D	WEIR	CB-2A	CB-2B	CB-2C	CB-2D	WEIR	WEIR
DISCHARGE STRUCTURE RIM/BOTTOM OF WEIR ELEV.	393.5	394.5	395.5	397.5	388.5	397.5	398	398	398	399	398

O'BRIEN & GERE ENGINEERS, INC





SYRACUSE, NEW YORK









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IN CHARGE OF	R. DUFF				
DESIGNED BY	R. DUFF				
CHECKED BY	R. DUFF				
		0	7/12/2019	ISSUED FOR CONSTRUCTION	RGD
DRAWN BY	S. JUHNSUN	NO.	DATE	REVISION	INT.

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT. WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS.



HONEYWELL INTERNATIONAL INC. SEMET OU-2 REMEDIAL DESIGN	
SYRACUSE, NEW YORK	Ν



SEMET RESIDUE PONDS SITE OU-2 REMEDIAL DESIGN CONSTRUCTION WORK PLAN |APPENDIX B

Appendix B Specifications



Appendix B.1 General Specifications



Honeywell			0110 Spec. No	0 o.	
THE POWER OF CONNECTED		Latest Revision			
		JKM	July 2017	4	
Honeywell International, Inc.	Corporate USED DES Group	Ву	Date	No.	
115 Tabor Road	Corporate HSER, RES Group	Document Approval			
Morris Plains, NJ 07950	Remediation Specification	WJH By	July 20	17	

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ATTACHMENT 01100-7	BORING AND WELL CONSTRUCTION DATA ENTRY FORM

01100

Spec. No.

1 PROJECT ADMINISTRATION

1.1 SCOPE

1.1.1 Summary

- 1.1.1.1 The Remediation Construction and Operation, Maintenance, and Monitoring (OM&M) Requirements document summarizes Honeywell's typical requirements regarding Project Administration and Construction Management activities for Remedial Action Work performed for Honeywell.
- 1.1.1.2 This document is written for use under the Honeywell Fixed Price/Unit Price contract. It may also be applied to remedial construction projects led by an Alliance Partner (AP) using the Environmental, Remediation, Construction, and Procurement (ERCP) contract in which case the roles indicated in italics and parentheses shall apply.
- 1.1.1.3 In addition to the applicable requirements set forth in the other Contract Documents the Contractor (*Subcontractor*) shall adhere to the requirements listed in this document, unless otherwise specified.
- 1.1.1.4 This document is generic in nature and shall be used in conjunction with the Request for Proposal (RFP) (Sections 1.0 through 8.0) to determine which sections of this document are applicable to a given project. In some cases the Technical Specifications may conflict with this document based on project-specific requirements. In such cases, the project-specific Technical Specifications shall have precedence.
- 1.1.1.5 This document refers to various templates to manage construction information (request for information, change orders, etc.). Alternate forms may be used if approved by Honeywell (AP) prior to start of construction.
- 1.1.1.6 This document is for projects that are being contracted under the Honeywell's Standard RFP process. For contracts where the AP self-performs the work, the AP would be held to the same standards and requirements as specified in this specification section for the Contractor.
- 1.1.1.7 This document is arranged into nine sections and presents Honeywell's (*AP*'s) expectations regarding the work defined by each section, as may be applicable to the scope of work, as follows:
 - 1. Project Administration: Activities and deliverables that potentially impact all phases of the Work.
 - 2. Construction Site Management: Activities and deliverables for various post-contract award Work and ongoing field support activities.
 - 3. Pre-Construction Work: Work activities performed post-contract award and before mobilization is permitted.
 - 4. Construction Mobilization & Site Preparation: Activities to be completed before commencing field Construction Work.
 - 5. Construction Work: Activities and deliverables for Well Installation, Civil, Mechanical, and Electrical/Instrumentation/Control Construction Work.
 - 6. Construction Startup & Commissioning: Turnover requirements for process, monitoring, or other mechanical / electrical / control systems.
 - 7. Construction Site Restoration & Demobilization: Activities to be completed before Contract can be closed-out.
 - 8. Construction Contract Closeout: Final project activities and deliverables.

9. Operation, Maintenance, and Monitoring: Activities to support a final remedy following construction and commissioning or interim remedies or other non-final remedial operation directed as part of a contract, order or agreement with agencies.

1.1.2 Reference Documents

- 1.1.2.1 Unless otherwise stated in the Contract, the Request for Proposal (RFP) (Sections 1.0 through 8.0), plus the Bidders Proposal including Cost Proposal Breakdown, any design change bulletins (DCBs) and construction change orders (CCO), define the Project scope of work.
- 1.1.2.2 Existing topographic information and subsurface investigation data (e.g., soil boring logs) are for reference only. Actual topography and geologic conditions may vary. Verify actual topographic and subsurface information as necessary.

1.1.3 Definitions

1.1.3.1 Refer to RES-ADMIN-02 Definition and Acronyms Summary for common definitions and acronyms that are applicable to this Contract. These and other technical-specific terms and acronyms that may be defined in Technical Specifications (Section 4.0), shall have the same meaning throughout the Contract Documents.

1.2 CONSTRUCTION SCHEDULE

1.2.1 Construction Schedule Requirements

- 1.2.1.1 <u>Submit</u> and update and maintain itemized bar chart schedules as indicated below. Schedules shall include a Baseline Construction Schedule, Three-Week Look Ahead Schedules and Construction Progress Schedules. These shall be compliant with the project schedule construction milestones provided in **ATTACHMENT 01010-1** of Specification Section 01010 Summary of Work. General requirements include:
 - 1. Clearly indicate weekly manpower loading for direct, indirect, and subcontract labor and the scheduled start and completion dates for each task item.
 - 2. Schedule must allow for all Work activities, meetings, regulatory permit acquisition, review and comment on all submittals, daily site required permit acquisition (for operating facilities), incidental and temporary work activities.
 - 3. Schedule must allow for normal inclement weather at the job site location during the progress of the Work.
 - 4. Schedule tasks shall be itemized in sufficient detail to accurately track the Work as it progresses and shall directly correlate with Specification Section 01010 Summary of Work and Contractor's (*Subcontractor's*) Proposal (Section 1.0, Table 1-1).
 - 5. Each schedule task shall be named as indicated in Specification Section 01010 Summary of Work and shall also identify Honeywell's Code of Account (COA) designation(s).
 - 6. Schedule tasks or subtasks not specifically identified in Specification Section 01010 Summary of Work shall be named by Contractor (*Subcontractor*), shall be grouped under the appropriate Honeywell designated task and shall be assigned the same COA as the top level COA.
- 1.2.1.2 Honeywell (*AP*) reserves the right to accept or reject Contractor's (*Subcontractor's*) updated schedule.
- 1.2.1.3 Honeywell will not grant weather-related schedule extensions unless unusually abnormal weather occurs that can be documented. <u>Submit</u> historical weather data as supporting documentation.

1.2.2 Baseline Construction Schedule

1.2.2.1 An approved Baseline Construction Schedule developed pursuant to RES-CP-WPC-06 Schedule Development shall form the basis for the initial construction schedule and shall be modified in

consultation with the Contractor's (*Subcontractor's*) Construction Project Manager and Site Superintendent as field work progresses. Detailed Baseline Construction Schedule shall:

- 1. Itemize major Work items consistent with Contractor's (Subcontractor's) proposal.
- 2. Establish baseline milestone dates for completion of major Work items.
- 3. Be submitted within five workdays of award of contract.
- 1.2.2.2 Refer to RES-CP-WPC-06 Schedule Development for Baseline Construction Schedule development requirements.

1.2.3 Three-Week Look Ahead Schedule Requirements

- 1.2.3.1 <u>Submit</u> a three-week look ahead schedule with the following:
 - 1. Indicate the planned work activities for each day over the next three weeks including major milestones and project deliverables.
 - 2. Identify coordination items with AP, Honeywell, or others.
 - 3. <u>Submit</u> updated schedule for each construction progress meeting. See the attached example schedule (ATTACHMENT 01100-2) for format.

1.2.4 Construction Progress Schedules

- 1.2.4.1 <u>Submit</u> to Honeywell for approval, progress schedule that may adversely impact key milestone dates or the previously accepted completion date prior to implementing the new schedule.
- 1.2.4.2 <u>Submit</u> updated Construction Progress schedule at each billing cycle to support the monthly reporting requirements in RES-CP-DC-05 Monthly Project Report Preparation.

1.2.5 Work Hours

- 1.2.5.1 Work schedules shall be based on five 8-hour days 40 hours per week unless otherwise noted in the Technical Specifications (Section 4.0). Alternate straight-time work hours (e.g. four 10-hour days or working six-days per week) are subject to Honeywell's written acceptance.
- 1.2.5.2 Contractor (*Subcontractor*) wishing to Work overtime or on a modified workday schedule on its own account (at no additional cost to Honeywell), must obtain Honeywell Construction Representative's or AP Construction Manager's (CM's) written approval. <u>Submit</u> written request for overtime at least three workdays prior to performing such Work.
- 1.2.5.3 Short unscheduled overtime will be left to the Honeywell Construction Representative's or AP CM's discretion and approval.
- 1.2.5.4 Overtime: If the Contractor (*Subcontractor*) is in default on any contract provisions and Honeywell determines items such as additional labor, expediting, overtime, second shift or holiday and weekend work are required to maintain satisfactory work progress, these efforts shall be provided by Contractor (*Subcontractor*) at no cost to Honeywell. If the Contractor (*Subcontractor*) is not in default, Honeywell shall pay the Contractor (*Subcontractor*) actual overtime, when requested and authorized in writing by Honeywell for the purposes of schedule acceleration. Contractor (*Subcontractor*) will be reimbursed on a unit price basis with an agreed upon not to exceed cap or as otherwise mutually agreed to in writing in accordance with Change Order procedures for the work contemplated. All such costs shall be substantiated by invoices and time slips checked and approved on a daily basis by Honeywell or AP. Honeywell will reimburse Contractor (*Subcontractor*) for only the overtime portion of the direct labor costs. General and Administrative (G&A), overhead indirect costs and labor associated with these tasks, and inefficiencies or loss of productivity, unless otherwise agreed upon, will not be reimbursed by Honeywell.

01100

Spec. No.

1.3 FINANCIAL

1.3.1 Contract Base Price

1.3.1.1 Contract Base price shall be the amount indicated in the executed Contract (Section 2.0) between Contractor (*Subcontractor*) and Honeywell (*AP*).

1.3.2 Billing Schedule

- 1.3.2.1 Prepare an earned value estimate that indicates Contractor's (*Subcontractor's*) estimated progress billings during the entire Project duration, itemized for each billing cycle.
- 1.3.2.2 <u>Submit</u> preliminary Billing Schedule with Proposal (See Section 1.0, Attachment 1-1).
- 1.3.2.3 <u>Submit</u> revised Billing Schedule to Honeywell at Kickoff Meeting then monthly thereafter with invoice showing incremental and total quantity of work performed and percent completed at end of billing cycle.
- 1.3.2.4 On large projects, Contractor *(Subcontractor)* may be required to prepare a cash flow analysis for cost control. RES-CP-DC-05 Monthly Project Report Preparation and RES-CP-WPC-09 Schedule and Cost Control will be attached to this specification for contracts that the Contractor *(Subcontractor)* is required to perform these responsibilities.

1.3.3 Invoicing

- 1.3.3.1 Invoice format shall follow the breakdown in the Line Item Cost Proposal Breakdown of Contractor's (Subcontractor's) Proposal, Table 1-1. Invoices for Original Contract work shall be presented with the following information:
 - Total Work Completed, which means physical completion and acceptance by Honeywell as being correct and proper. Material and/or equipment delivered and not installed does not constitute completion.
 - Less Retention
 - Net Invoice to Date
 - Less Previous Billing (Net)
 - Due This Invoice (Original Contract)
 - Change Orders to be included in a separate section, with a brief description of each Change Order, and all the above breakdown described above for Original Contract work
 - Grand Total Due for Original Contract plus all CCO work to-date.
- 1.3.3.2 <u>Submit</u> two copies of all Invoices to Honeywell's (*AP's*) Designee. Electronic submissions may be acceptable on a project-specific basis.
- 1.3.3.3 <u>Submit</u> updated Construction Progress Schedule (See Paragraph 1.2.4) with monthly invoice. <u>Submit</u> Monthly Project Report (see Paragraph 1.4.1.3) with monthly invoice.
- 1.3.3.4 <u>Submit</u> the requisite Release of Lien Waivers documentation per the executed Agreement.
- 1.3.3.5 Any invoice received without the Construction Progress Schedule, requisite Release of Lien Waivers or Monthly Project Report will be rejected and returned to Contractor *(Subcontractor).*
- 1.3.3.6 Invoices that do not comply with these requirements may result in a delay of payment or return of Invoice to Contractor (*Subcontractor*) for resubmission.

1.3.4 Retention

1.3.4.1 Amount of the Total Contract Price (Base Price plus cost of any CCOs or minus any Credits owed Honeywell) retained by Honeywell (*AP*) until the Work is complete and accepted by Honeywell.

1.3.4.2 Retention percentage of the total contract price shall be as specified in the Contract (Section 2.0).

1.3.5 **Progress Payments**

1.3.5.1 Progress payments shall be applicable to projects with a scheduled Work duration of longer than six weeks.

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- 1.3.5.2 Submit monthly invoices to Honeywell (AP), when progress payments are applicable.
- 1.3.5.3 See Measurement and Payments, Paragraph 2.6.

1.3.6 **Contract Price Changes**

1.3.6.1 See Honeywell procedure RES-CP-WPC-08 Contractor Change Order Procedure for CCOs.

1.3.7 **Final Payment**

- 1.3.7.1 Submit final invoice to Honeywell (AP) after Contract Closeout Meeting is complete.
- 1.3.7.2 Retention will be released for payment when all punch list items are complete and any outstanding warranty claims are resolved and accepted in writing by Honeywell.
- 1.3.7.3 Retention will also be released for payment upon Honeywell's receipt of the Contractor's (Subcontractor's) Final Release and Waiver of Claims Form included in Section 2.0 of the Construction Documents.

1.4 **GENERAL ADMINISTRATION**

1.4.1 **Progress Reporting & Tracking**

- 1.4.1.1 **Daily Activity Report**
 - 1. Prepare Daily Construction Reports in accordance with Honeywell procedure RES-CP-DC-03 Daily Construction Report Preparation.
- 1.4.1.2 Weekly Construction Report
 - 1. Prepare and submit a Weekly Construction Report in accordance with Honeywell procedure RES-CP-DC-04 Weekly Construction Report Preparation.
- 1.4.1.3 Monthly Project Report
 - 1. Prepare and submit Monthly Project Report in accordance with Honeywell procedure RES-CP-DC-05 Monthly Project Report Preparation.

1.4.2 **Alternate Approaches & Substitutions**

- 1.4.2.1 All requests for Alternate Approaches and Substitutions (hereafter referred to as Substitutions) shall comply with this section.
- 1.4.2.2 Obtain Honeywell's (AP's) authorization for substitution of any product or construction method that is prescribed when a particular product or method is specified as "or equal" before the Work shall be allowed to proceed.
- 1.4.2.3 Substitutions that also require Regulatory Agency review and approval are at the risk of the Contractor.
- 1.4.2.4 **Requests for Substitution**
 - 1. <u>Submit</u> three copies or electronic copy (in Portable Document Format [PDF]) of written requests for substitution within ten workdays of Contract execution.
 - 2. After this period, requests for substitution will only be considered for conditions beyond Contractor (Subcontractor) control.

- 3. After the Contract is executed, limit each request to one proposed substitution (e.g., each substitution should be for a discrete item and not lumped into one larger related item such as a liner material and source of the liner material if both involve substitutions).
- 4. For products, include the following in the request:
 - Product identification, including make, model, manufacturer's name and address.
 - Manufacturer's product literature, shop drawings, certified performance / test data, and reference standards.
 - Samples, if appropriate.
- 5. For construction methods, (when prescribed) include the following in the request:
 - Detailed description of proposed method.
 - Drawings illustrating method.
 - Other data Honeywell (*AP*) required to establish that proposed method is equal.
- 1.4.2.5 Honeywell (*AP*) may request the name of references, address and date of installation for similar projects where the proposed product or construction method was successfully used.
- 1.4.2.6 Proposed Substitutions will not be accepted if:
 - 1. Substantial revision of Contract Documents will be required, as determined by Honeywell (*AP*).
 - 2. Completion of any Work will be delayed.
 - 3. Substitutions are not administratively complete and not specifically identified by a formal request for substitution.
- 1.4.2.7 Honeywell (*AP*) will notify Contractor (*Subcontractor*) in writing of decision to accept or reject request for substitution.
- 1.4.2.8 If Honeywell (*AP*) determines that a proposed substitute is not equal to that specified, Contractor (*Subcontractor*) shall furnish the product, manufacturer, or method originally specified.

1.4.3 Requests for Information

- 1.4.3.1 Contractor (*Subcontractor*) may <u>submit</u> Requests for Information (RFIs) to clarify or to request to deviate from design requirements following these procedures:
 - 1. Use RFI Form (**ATTACHMENT 01100-3**) available from Honeywell (*AP*) in Word (.doc) format.
 - 2. Initiate an RFI by completing the "General Information" section (except "Date Information Provided" and "RFI Results in a DCB" boxes) and the "Request" section.
 - 3. Submit to Honeywell (*AP*) to complete the "Date Information Provided", "RFI Results in a DCB" boxes as well as the "Response" section.
 - 4. Honeywell (*AP*) completes remaining sections, prints, signs, scans and distributes back to Contractor (*Subcontractor*) within five work days unless unusual circumstances warrant a mutually agreed upon longer period of time.

1.4.4 Change Management

- 1.4.4.1 Changes to the original scope of work can be made by:
 - 1. Addenda issued in numerical order prior to award.
 - 2. DCBs issued in numerical order after award.
 - 3. CCOs.
- 1.4.4.2 Work beyond the original scope of the contract shall not proceed without written authorization by Honeywell (*AP*).
- 1.4.4.3 Design Change Bulletins

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- 1. Honeywell (*AP*) reserves the right to issue a DCB at any time during the contract as a result of the submittal process, RFIs, progress meeting discussions or other activity where a change in design is desired.
- 2. Honeywell (AP) prepares the DCB form for Contractor's (*Subcontractor's*) review and signature. Sample DCB Form (**ATTACHMENT 01100-4**) is attached.
- 3. Contractor (*Subcontractor*) shall return DCB form within five workdays after receipt indicating in the signature box if there is an impact on contract price, which would require initiating a CCO.
- 4. Unless Contractor (*Subcontractor*) believes a CCO is required, Contractor (*Subcontractor*) shall immediately proceed with performing the requested change in Work.
- 5. If CCO is required, Contractor (*Subcontractor*) shall NOT execute changes until receipt of an executed CCO or upon further instruction from Honeywell (*AP*) in accordance with Honeywell Construction Change Order procedures referenced below.
- 1.4.4.4 Construction Change Orders
 - 1. CCOs shall be administered in accordance with the Honeywell procedure RES-CP-WPC-08 Contractor Change Order Procedure.
- 1.4.4.5 Minor Modifications / Deviations in Work
 - 1. The Construction Representative (*QA/QC Engineer*) has the authority to authorize Contractor (*Subcontractor*) to deviate from the Work specified in the Contract Documents, without the initiation of the RFI, DCB or CCO process, if:
 - the work deviation does not alter the performance or aesthetics of the design;
 - the deviation does not affect a quantity for a unit price pay item; and
 - Contractor (*Subcontractor*) agrees that the Work does not change the cost or schedule of the Work and forfeits any later request to initiate a CCO for this deviation.
 - 2. The Construction Representative (*QA/QC Engineer*) shall record deviations in a Deviation Summary Log and present at the Weekly Project Planning and Progress Meeting.
 - 3. Contractor (*Subcontractor*) shall document minor modifications / deviations in the Work that were approved by the Construction Representative (*QA/QC Engineer*) by:
 - Reviewing the Deviations Summary Log prepared and presented at the Weekly Project Planning and Progress Meeting by the Construction Representative (QA/QC Engineer) and agreeing that no CCO is required.
 - Indicating the change by redline in the Record Documents maintained at the job site; and
 - Reporting a description of the change in the Weekly Construction Report.

1.4.5 Acceptance of Work

- 1.4.5.1 Honeywell will accept all Work in writing.
- 1.4.5.2 All accepted areas shall be complete and ready for start-up operations.
- 1.4.5.3 Refer to Paragraphs 6.0 Commissioning, Start-up and Prove-Out, 7.0 Site Restoration & Demobilization and 8.0 Contract Closeout for requirements relating to final Acceptance of Work. A checklist of actions required for Final Acceptance of Work is attached for reference (ATTACHMENT 01100-5).

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1.5 COMMUNICATION

1.5.1 Electronic Data / Documentation Requirements

- 1.5.1.1 If requested to be in electronic editable format, the following data / document types shall be compatible with the listed electronic file formats and versions listed (earlier versions and formats will be accepted):
 - 1. Calendar: Microsoft Outlook 2003
 - 2. Databases: Microsoft Access 2003
 - 3. Drawings, Construction: AutoCAD 2009
 - 4. e-mail: Microsoft Outlook 2003
 - 5. Graphics, Miscellaneous: Visio Standard 5.0 2003.
 - 6. Photographs, Digital: ".jpg" file format
 - 7. Videos: DVD or ".mpg" format
 - 8. Presentations: Microsoft PowerPoint 2003
 - 9. Schedules: Microsoft Project 2003
 - 10. Spreadsheets: Microsoft Excel 2003
 - 11. Text Documents: Microsoft Word 2003

1.5.2 Photographs & Video Recordings

- 1.5.2.1 <u>Furnish</u> copies of all photographs or video recordings documenting Work progress to Honeywell (*AP*).
- 1.5.2.2 Photographs or video recordings are only permitted at inactive (no longer in operation) Honeywell sites with verbal approval from Honeywell.
- 1.5.2.3 Photographs or video recordings are only permitted at active (in operating mode) Honeywell sites with written approval from Honeywell.
- 1.5.2.4 Electronic photograph/video file names shall describe the picture.
- 1.5.2.5 At a minimum, pictures shall be taken prior to mobilization, during construction (as part of weekly progress reports), and as a record of completed conditions at the site, adjacent properties, access roads, etc. Additional video recordings or other site-specific documentation of pre-work conditions may be required if specified in the Technical Specifications (Section 4.0) of the RFP.
- 1.5.2.6 Digital media shall be date and time stamped.
- 1.5.2.7 Refer to Honeywell procedure RES-CP-DC-09 Photo Documentation for minimum requirements for construction management personnel to document work activities and associated progress with photographs.

1.5.3 Contractor (Subcontractor) Submittals

- 1.5.3.1 Submittals that are to be included as part of the Contractor's (*Subcontractor's*) Scope of Work are summarized in the Recurring Reporting Schedule included as **ATTACHMENT 01010-2** of Specification Section 01010 Summary of Work.
- 1.5.3.2 Contractor (*Subcontractor*) Submittal Requirements
 - 1. A transmittal letter must accompany all submittals.
 - 2. The transmittal letter shall indicate:
 - Purpose of submittal
 - Type of submittal (Approval, Comment, Record, Certified, As-Built, etc.)
 - Desired return date of submittal
 - Name and telephone number of the person to whom any questions can be directed.

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- 3. Honeywell (AP) review time will vary depending on scope.
- 4. Allow a minimum of five workdays for Honeywell (AP) review of any submittal.
- 5. Contractor (*Subcontractor*) submittals, as required in the Contract Documents, shall consist of the following:
 - Drawings (Shop Drawings, Progress Drawings, As-Built Drawings, etc.)
 - Specifications (for Products furnished, Concrete Design Mix, etc.)
 - Technical Data (Manufacturer Cut Sheets and Performance Information)
 - Calculations
 - Procedures (Rigging, Lifting, Welding, Construction Methods, etc.)

1.5.3.3 Shop Drawings

- 1. Shop Drawings for Contractor (*Subcontractor*) supplied machinery or fabricated components shall include the following, as may be applicable:
 - All dimensions and other information necessary for lifting, rigging, handling, storage, arrangement, clearances, installation, anchoring and assembly;
 - Tie-ins, hook-ups, utility requirements
 - <u>Provide</u> schedule of shop drawings.
- 2. <u>Submit</u> three plotted sets or one electronic (PDF) of "Review Set" Shop Drawings to Honeywell (*AP*) and obtain authorization to proceed from Honeywell or Engineer prior to fabrication.
- 3. Honeywell or Engineer will review, comment or authorize fabrication within ten workdays of receipt of Review Shop Drawings.
- 4. <u>Submit</u> at least three plotted sets or one electronic (PDF) of manufacturer's Certified Shop Drawings prior to installation.

1.5.3.4 Construction Progress Drawings

- 1. Construction Progress Drawing markups shall include:
 - All dimensions and other relevant information, which document the construction work performed and how the progress relates to the original contract documents.
 - Relevant information shall include, but not be limited to, scope changes, previously undocumented underground and above-ground conditions, location, arrangement, orientation, elevation, distance, size, area, volume, etc.
- 2. A set of unmarked Contract Drawings will be provided to the Contractor (*Subcontractor*) if requested.
- 3. The drawings shall be continually marked-up to document field changes as the Work progresses.
- 1.5.3.5 Record Drawings
 - 1. Record Drawings shall be a clearly marked-up set of Contract Drawings and shall illustrate:
 - Construction Progress Drawing information.
 - All field changes, additions, deletions, substitutions, or corrections.
 - All CCO Work must be shown on the Record Drawings.
 - 2. Include supplemental Contractor (Subcontractor) Record sketches as required.
 - 3. <u>Submit</u> Record Drawings and records within ten workdays of completion of the Work. Record drawings must be prepared in compliance with Honeywell survey procedures as detailed in RES-CP-WPC-11 Survey Control and Digitization and be in accordance with the specific requirements contained in the Technical Specifications (Section 4.0) of the RFP.

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1.5.4 Correspondence

- 1.5.4.1 Correspondence Requirements
 - 1. <u>Submit</u> three paper copies or electronic copy (PDF) of all correspondence to Honeywell (AP).
- 1.5.4.2 Prior to Contract Award
 - 1. <u>Submit</u> all formal correspondence prior to Contract award to Honeywell's Supply Manager (*AP's CM*).
 - 2. All correspondence shall include the Honeywell RFP number, project name and number, and related subject as applicable.
 - 3. All questions concerning commercial documents shall be directed as indicated in the Instructions to Bidders.
 - 4. All technical questions shall be directed as indicated in the Instructions to Bidders.

1.5.4.3 After Contract Award

- 1. <u>Submit</u> all formal correspondence and questions after Contract award to Honeywell's Construction Representative (*AP's CM*).
- 2. All correspondence shall include Honeywell's (*AP's*) purchase order number, project name and number, job site location, and related subject, as applicable.

1.5.5 Meetings

- 1.5.5.1 Meeting Requirements
 - 1. The following is a list of typical meetings:
 - Pre-Bid Meeting
 - Kickoff Meeting
 - Project Planning, Progress Meetings, and Schedules
 - Safety Meetings
 - Contract Closeout Meetings
 - 2. The following is a list of possible meetings depending on Project requirements:
 - Pre-Installation Meeting
 - Problem or Work Deficiency Meeting
 - 3. The Honeywell Construction Representative or the CM, at their discretion, will hold meetings, not otherwise specified as the need arises, during the contract.

1.5.5.2 Meeting Agenda

- 1. The meeting organizer shall prepare and distribute a meeting agenda to all invited attendees at least one workday prior to meeting.
- 2. Weekly Progress Meeting agenda shall follow the general content of the Weekly Construction Report as detailed in Honeywell procedure RES-CP-DC-04 Weekly Construction Report Preparation. Some topics may not be applicable to a particular project, but the general topics should be followed where pertinent.
- 3. The agenda for all other meetings shall incorporate the following minimum requirements:
 - Safety: Relevant safety issues for Work planned or in progress. Any staff changes since the previous meeting.
 - Purpose: What the meeting is trying to accomplish.
 - Agenda: The steps to achieve the purpose. Include action items from last meeting, next steps, and agenda for next meeting.

- Code of Conduct: Treat others with respect, build on other's ideas, make decisions and resolve conflict. Information pertaining the Work shall be treated as confidential property as stated in the Contract (Section 2.0 of the RFP).
- Expectations: Determine if agenda meets the group's expectations. Modify agenda as necessary.
- Roles: Assign roles to keep meeting on track and on schedule (e.g., Leader, Moderator Time Keeper, and Scribe).

1.5.5.3 Meeting Attendance

- 1. The following groups or individuals shall be represented at meetings by persons familiar with the project and authorized to conclude matters relating to the project, as may be required:
 - Honeywell
 - Contractor (*or AP*)
 - Each major subcontractor
 - Supplier(s)
 - Agency Representative(s)
 - Others having relevant business with the Project Work.
- 1.5.5.4 Meeting Minutes
 - 1. Meeting organizer shall ensure that meeting minutes are prepared, reviewed, and distributed within 5 working days after meeting to all participants, and those affected by decisions made.
 - 2. Preparation and distribution requirements, sample meeting attendance sheet, meeting minute outline, and action item log are contained within the Honeywell procedure RES-CP-DC-02 Meeting Minutes Preparation.

1.5.6 Work Plans

- 1.5.6.1 Work Plans
 - 1. Work Plan(s) must be agreed to prior to initiating site work.
 - 2. <u>Submit</u> Work Plan to Honeywell (AP) within ten workdays of contract award.
 - 3. Honeywell (*AP*) will review and provide written comments for Work Plan within five workdays from receipt.
 - 4. <u>Submit</u> revised Work Plan within five workdays of receipt of Honeywell's (*AP*'s) written comments.
 - 5. Work Plan tasks shall correlate with Specification Section 01010 Summary of Work and Contractor's (*Subcontractor's*) Bid tasks.
 - 6. Work Plan shall include at a minimum the following items.
 - Full detail for all phases of Contractor's (Subcontractor's) Work
 - Project Directory
 - Organization chart with the names and authority levels
 - Honeywell's Remediation Manager, Design and Construction Manager, Supply Manger, Construction Representative, QA/QC Engineer (*and AP's Project Manager, Construction Manager, and QA/QC Engineer*)
 - Contractor's (*Subcontractor's*) Construction Project Manager, Site Superintendent, Site Health & Safety Representative
 - Subcontractor's Representative(s)
 - Contingency Plan

- Quality Assurance / Quality Control Plan
- Health and Safety Plan
- 7. Refer to the Technical Specifications (Section 4.0) for content requirements for other activityspecific Work Plans that may be required for the project.

1.5.6.2 Contingency Plan

- 1. Contingency plan shall include detailed procedures for dealing with:
 - Emergency or spill when loading, transferring or transporting of hazardous or TSCA waste, fuel, oil and lubricants (if applicable)
 - Excavated or detected subsurface waste containers or gas cylinders (if applicable).
 - Health and Safety incidents
 - Regulatory inspections
 - Major weather events
 - Other incidents requiring immediate work stoppage
 - Technical contingency plans for managing water, waste, or obstructions
- 1.5.6.3 Quality Assurance / Quality Control Plan (QAP)
 - 1. Quality Assurance/Quality Control Plan (QAP)
 - All required sample collection, inspection and test requirements and methods
 - Projects not requiring a project specific QAP will have all inspections listed as part of the respective Technical Specifications (Section 4.0).

1.5.6.4 Health & Safety Plan (HASP)

1. Prepare and comply with Health & Safety Plan as per Specification 01620.

1.5.7 Operation, Maintenance and Monitoring Plan and/or Manual

- 1.5.7.1 This paragraph is limited to projects where OM&M activities are part of the Contractor's (*Subcontractor's*) Scope of Work. Construction of most systems will make these activities applicable. It is also applicable for construction work requiring long-term maintenance such as mowing of a capped area.
- 1.5.7.2 Unless otherwise specified in the Technical Specifications (Section 4.0), Contractor (*Subcontractor*) shall prepare portions of the OM&M Manual as described in RES-OP-01, OM&M Manual and Plan Requirements.

1.5.8 Commissioning Plan

- 1.5.8.1 This paragraph is limited to projects that include process systems (see definition in RES-CP-WPC-04 Commissioning Plan) as part of the Contractor's (*Subcontractor's*) Scope of Work. Construction of most systems will make these activities applicable.
- 1.5.8.2 Unless otherwise specified in the Technical Specifications (Section 4.0), Engineer shall prepare the Commissioning Plan as described in RES-CP-WPC-04 Commissioning Plan.

1.5 MATERIALS MANAGEMENT

1.6.1 Procurement

- 1.6.1.1 Contractor (*Subcontractor*) supplied materials shall be ordered after Contract award or as authorized by Honeywell (*AP*) in writing.
- 1.6.1.2 <u>Submit</u> copies of Purchase Orders (PO) [less pricing] within fifteen workdays after Contract award to Honeywell Construction Representative (*Construction Manager*) for critical path items

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and major products when such items are critical to the successful on-time completion of the Work. Purchase Orders shall show promised delivery dates.

- 1.6.1.3 Immediately indicate long delivery items that will adversely affect project schedule.
- 1.6.1.4 Furnish all materials other than those specifically indicated as supplied by Honeywell (*or AP*) in the Contract Documents.

1.6.2 Warranties

- 1.6.2.1 Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- 1.6.2.2 Insert duplicate executed (and notarized if required by the technical specifications) copies of all warranties into OM&M Manual, if Manuals are being provided, or otherwise <u>submit</u> for Honeywell's (*AP's*) review to be turned over to Honeywell as part of Final Submittals.
- 1.6.2.3 For items of Work delayed beyond date of Substantial Completion, <u>provide</u> updated submittal within ten workdays after acceptance, listing date of acceptance as start of warranty period.

1.6.3 Compliance with Regulations

- 1.6.3.1 Obtain required certifications, permits and inspections and comply with all federal, state, local, regulations governing transportation, handling, storage and use of products.
- 1.6.3.2 <u>Submit</u> Safety Data Sheets (SDSs) to Honeywell Construction Representative (*Construction Manager*) for all products having SDSs ten workdays prior to delivery of such Product to the site.
- 1.6.3.3 SDS(s) and chemical list/inventory must be maintained and readily available at all times for onsite use.

1.6.4 Transportation and Handling

1.6.4.1 Transport and handle products in accordance with federal, state and local regulations, SDS, manufacturer's instructions and Honeywell (*and AP*) requirements.

1.6.5 Receiving

- 1.6.5.1 Receive and off-load all Products supplied by Honeywell (*or AP*).
- 1.6.5.2 <u>Submit</u> off-loading procedure(s) at least ten workdays prior to lift for Honeywell's (*AP*'s) review.
- 1.6.5.3 The Honeywell Construction Representative (*Construction Manager*) must authorize Contractor's (*Subcontractor's*) off-loading procedures for all major products supplied by Honeywell (*or AP*).
- 1.6.5.4 Upon receipt of Honeywell (*or AP*) or Contractor (*Subcontractor*) supplied Products, <u>IMMEDIATELY</u> inspect for damage, confirm quantities and verify for compliance with specifications.
- 1.6.5.5 Notify Honeywell Construction Representative (*Construction Manager*) and transporter immediately, in writing, any shortages, damage or irregularities in shipment.
- 1.6.5.6 Photograph product damage or irregularities from shipment.
- 1.6.5.7 <u>Submit</u> copy of completed Receiving and Inspection Report to Honeywell (*and AP*) in accordance with the procedure RES-CP-WPC-05 Receiving Inspection Procedure General Goods.
- 1.6.5.8 Maintain copies of all report forms at the Project site.
- 1.6.5.9 Provide equipment and personnel to unload and handle Products.
- 1.6.5.10 Prevent damage and defacement of Products.

1.7 QUALITY

1.7.1 References and Standards

- 1.7.1.1 All products and workmanship shall be in accordance with the latest versions and amendments of all applicable codes and standards specified in the Contract Documents that are in current use by the authorities having jurisdiction, as well as any applicable federal, state, and local codes, ordinances, and regulations.
- 1.7.1.2 For products or workmanship specified by association, trade or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- 1.7.1.3 Where various specified requirements conflict, the more stringent quality standards or more precise workmanship requirements shall govern.
- 1.7.1.4 Should manufacturers' instructions conflict with Contract Documents, request clarification from Honeywell before proceeding.

1.7.2 Products

- 1.7.2.1 Use only new and unused products in good condition and as specified in the Contract Documents for the execution of the Work.
- 1.7.2.2 Materials or products removed from existing premises shall only be reused as specifically permitted by the Contract Documents.
- 1.7.2.3 Use only products specified when a specific product name, manufacturer, supplier, model, or catalog number is identified in the Contract Documents or when specifications state that no substitution are permitted.
- 1.7.2.4 Select product that is compatible with other similar products already installed or where multiple Product options are specified.
- 1.7.2.5 To the maximum extent practicable, provide products of the same kind and from a single source.
- 1.7.2.6 Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- 1.7.2.7 Maintain test certificates for soils, crushed rock or gravel from off-site sources showing composition and material is contaminant-free on site, accessible for use at all times.
- 1.7.2.8 <u>Submit</u> copies of test certificates for soils, crushed rock or gravel from off-site sources showing composition and material is contaminant-free to the Honeywell Construction Representative (*Construction Manager*) daily, or as otherwise specified in the Technical Specifications (Section 4.0) of the RFP.

1.7.3 Workmanship

- 1.7.3.1 Product and workmanship quality shall comply with applicable industry standards or manufacturer recommendations and these Contract Documents as a minimum.
- 1.7.3.2 Work is to be performed by persons qualified through training and experience to produce required or specified quality.

1.7.4 Preparation

- 1.7.4.1 Verify that existing site conditions and substrate are capable of structural support or attachment of new Work being applied or attached or otherwise acceptable for subsequent Work.
- 1.7.4.2 Verify any conditions specifically described in the specifications.
- 1.7.4.3 Verify that utility services and tie-ins are available, of the correct characteristics, and in the correct locations.

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- 1.7.4.4 Verify that field measurements are as indicated on construction drawings, shop drawings or as instructed by the manufacturer.
- 1.7.4.5 Clean and prepare anchorage or mating surfaces.
- 1.7.4.6 Beginning new Work in an area indicates acceptance of existing known conditions of that area by Contractor.

1.7.5 Installation

- 1.7.5.1 Comply with manufacturers' instructions; adhere to each step in sequence.
- 1.7.5.2 Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Honeywell (*AP*) before proceeding.
- 1.7.5.3 Adjust products to appropriate dimensions, tolerance, position, orientation and alignment before securing Products in place.
- 1.7.5.4 Immediately report any deviation from manufacturers' written instructions to Honeywell (AP).

1.7.6 Inspection, Testing and Sampling

- 1.7.6.1 All material and workmanship is subject to Honeywell's (*and AP*'s) inspection and acceptance at any location where investigation, excavation, fabrication, installation or erection is performed.
- 1.7.6.2 Coordinate with Honeywell (*AP*) required project inspections, testing and sampling including, but not limited to, Machinery, construction, operations, permits, work conditions, health, safety environment, work in progress, completed work, etc. throughout the duration of the project.
- 1.7.6.3 Fully assist the Honeywell Construction Representative (*Construction Manager*) with tools, scaffolding, labor, etc., as may be required for inspections.
- 1.7.6.4 Permit access to Honeywell (*and AP*) or its' designee and officials having jurisdiction for inspection, testing and sampling.
- 1.7.6.5 Notify Honeywell Construction Representative (*Construction Manager*) at least two workdays before performing any scheduled tests or inspections.
- 1.7.6.6 All tests and inspections required by the Contract Documents shall be made by a technician qualified by training and experience or testing laboratory and shall be carried out in the presence of the Honeywell Construction Representative (*Construction Manager*) or designee.
- 1.7.6.7 Reports shall document test results, inspection observations, indicate compliance status and shall identify for which Specification the tests or inspection was performed.
- 1.7.6.8 The Contractor (*Subcontractor*) and Honeywell Construction Representative (*Construction Manager*) or designee must cosign all test reports.
- 1.7.6.9 Measuring, inspection, and testing equipment
 - 1. Measuring, inspection, and testing equipment will be calibrated as required by the specifications and, when applicable, industry standards or the authorities having jurisdiction.
 - 2. Where no calibration standards exist, the basis used for calibration shall be noted.
 - 3. A documented procedure is required for all equipment that is to be calibrated.
 - 4. All calibrated equipment shall be in good condition and shall be labeled or tagged indicating the current status and identifying who performed the calibration and the date.
 - 5. <u>Provide</u> copy of calibration certificate when required by the specifications or requested by Honeywell Construction Representative (*Construction Manager*).
 - 6. Any environmental limitations shall be noted and strictly followed.
 - 7. Unauthorized adjustment of calibrated equipment is not permitted.
 - 8. Immediately notify Honeywell Construction Representative (*Construction Manager*) when testing equipment used on the project is out of calibration.

1.7.6.10 When specified in the Contract Documents, Honeywell (*AP*) will appoint, employ and pay for specified services of an independent inspection or sampling firm.

- 1. The independent firm will perform inspections and other services specified in the specifications and as required by Honeywell.
- 2. Inspecting may occur on or off the project site as required by Honeywell (AP).
- 3. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access and assistance by incidental labor as requested.
- 4. Notify Honeywell (*AP*) ten workdays in advance for Work requiring independent inspection or sampling services.

1.7.7 Analytical Services

- 1.7.7.1 Honeywell (*AP*) shall arrange for analytical laboratory services, except when required for Contractor's (*Subcontractor's*) use or if otherwise indicated in the Contract Documents. Contractor (*Subcontractor*) shall utilize Honeywell approved laboratories when providing analytical services.
- 1.7.7.2 Coordinate any analytical services required for the remediation and Contractor's operations including scheduling, bottle delivery, sample collection, labeling, documentation, sample shipment, data evaluation and data summary.
- 1.7.7.3 Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- 1.7.7.4 The same independent firm shall perform re-testing due to Contractor (*Subcontractor*) controlled non-conformance issues as directed by Honeywell. Contractor (*Subcontractor*) will be responsible for the re-testing costs.

1.7.8 Nonconforming Conditions

- 1.7.8.1 Nonconforming conditions are those that cannot be resolved within the scope of existing specifications and will also include design errors.
- 1.7.8.2 Report all nonconforming conditions to the Honeywell Construction Representative (*Construction Manager*) in writing unless otherwise instructed in writing by Honeywell.
- 1.7.8.3 Prepare and maintain a non-conformance report which lists and describes the nonconforming conditions, identifies recommendations, assigns responsibility, assigns due date, and tracks status. Update and review the nonconformance reports as part of weekly status reports. An example Nonconforming Conditions Report (**ATTACHMENT 01100-6**) is available from Honeywell (*AP*) in Excel (.xls) format.
- 1.7.8.4
- 1.7.8.5 Where possible, the affected item or area will be segregated, labeled or otherwise marked denoting nonconforming condition.
- 1.7.8.6 No further work may continue on the affected item or area without written consent from Honeywell.

1.8 RISK MANAGEMENT

1.8.1 General

1.8.1.1 For other than ERCP Contracts, the Risk Management Plan developed as part of the Basis of Cost and Schedule Report shall be reviewed and updated by the Contractor in the course of construction activities. Refer to RES-CP-WPC-07 Cost Estimating Development for specific requirements.

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1.8.2 Environmental

- Continually monitor Work area for appearance, discoloration and odors. Use field screening 1.8.2.1 instruments as needed to determine presence of contamination, as may be specified in the Technical Specifications (Section 4.0) of the RFP.
- Minimize and monitor for air emissions including fugitive dusts, volatile organic compounds, smoke 1.8.2.2 and odors as detailed in the Contractor's (Subcontractor's) Health and Safety Plan and as may be specified in the Technical Specifications (Section 4.0) of the RFP.
- Minimize wind and water erosion, contact with storm water and spillage when handling all soils, 1.8.2.3 sediments, debris, and construction materials.
- Store contaminated equipment and materials in designated lay-down or holding areas only. 1.8.2.4

1.8.3 Health & Safety

1.8.2.1 Health and Safety requirements are provided in Specification Section 01620 General Requirements Safety, Health, and Emergency Response.

Permits & Other Permissions 1.8.4

- Permits obtained by Honeywell (or AP) are listed in ATTACHMENT 01010-3 of Specification 1.8.4.1 Section 01010 Summary of Work.
- 1.8.4.2 Obtain all construction licenses, plan reviews and permits in connection with the work unless otherwise stated in Specification Section 01010 Summary of Work.
- Contractor (Subcontractor) shall immediately notify Honeywell (and AP) in writing of violation of 1.8.4.3 any ordinance, law or code.
- Honeywell (and AP) shall review permit applications prepared by Contractor (Subcontractor) prior 1.8.4.4 to submitting application to authorities having jurisdiction for approval.
- Copies of all approved permits shall be given to Honeywell Construction Representative 1.8.4.5 (Construction Manager).
- 1.8.4.6 Access agreements that are obtained by Honeywell or Contractor (Subcontractor) for all affected properties with all affected property owners must be in place prior to Contractor (Subcontractor) commencing work.

1.8.5 **Building Code Compliance**

- Apply for and procure all necessary Building Code and other locally required permits. 1.8.5.1 permissions and approvals necessary to perform the work, from the appropriate authorities having jurisdiction.
- Honeywell (AP) will provide Construction Drawings as included in the Contract Documents that 1.8.5.2 may be used to obtain building permits. Additional drawings (stamped, if required) that may be needed for permits are the responsibility of the Contractor (Subcontractor) unless specific additional drawings are identified and requested as part the Contractor's (Subcontractor's) proposal and agreed to by Honeywell (AP).
- Administer all Code required inspections throughout all phases of Construction including 1.8.5.3 Certificate of Occupancy, as may be required.
- Submit to Honeywell's Construction Representative (Construction Manager) copies of all 1.8.5.4 Inspection Reports, including final acceptance inspection forms by federal, state, local or other governmental authorities.

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2 SITE MANAGEMENT

2.1 SITE ACCESS & SECURITY

- 2.1.1Only personnel in the employ of Honeywell or its Contractors, Subcontractors, or Suppliers shall be allowed on site. No other personnel are allowed on site without the express written approval of Honeywell.
- 2.1.2 Only vehicles authorized by the Honeywell Construction Representative (Construction Manager) shall be allowed onsite. All others must remain in designated areas, parking areas or off site.
- 2.1.3 The Contractor's (Subcontractor's) employees shall access the site via agreed to point of entry.
- 2.1.4 Maintain a sign-in / sign-out log(s) for the duration of the site activities.
- 2.1.5 All personnel must sign-in upon site entry and sign-out upon site exit.
- 2.1.6 For projects requiring badges, all personnel must wear ID badges in a visible and conspicuous location at all times while on site. Badge visibility may not always be practical at all times when wearing Tyvek or other PPE levels as approved by the Honeywell Construction Representative (Construction Manager).
- 2.1.7 Administer the distribution and return of Worker and visitor ID badges.
- 2.1.8 Replace lost or stolen ID badges within 24 hours of loss.
- 2.1.9 Contractor (Subcontractor) is solely responsible for security of Contractor (Subcontractor) Work, equipment and Products, and any Products supplied by Honeywell (or AP) to Contractor (Subcontractor), until final acceptance by Honeywell (and the AP). Honeywell (or AP), may provide security (e.g., quards, fencing) for non-work hours, but does not absolve Contractor (Subcontractor) of responsibility.

2.2 **EXECUTION, COORDINATION OF WORK, AND ROLES AND RESPONSIBILITIES**

2.2.1 Contractor (Subcontractor)

- 2.2.1.1 Contractor (Subcontractor) shall:
 - 1. Provide specific attention to the execution of this Contract and assure there is full-time supervision throughout the entire contract duration.
 - 2. Assure that Contractor's (Subcontractor's) Construction Project Manager, Site Superintendent, Site Health and Safety Representative, workers and all Subcontractors fully comply with all of the Construction Document requirements.
 - 3. Direct the Work of Contractor's (Subcontractor's) workers and Subcontractors.
 - 4. Address worker or Subcontractor questions regarding the Work.
 - 5. Utilize recognized engineering and survey practices to:
 - Establish elevations, lines, levels and utility locations, slopes, and invert elevations;
 - Locate and lay out construction features including necessary stakes for cut, fill, placement and grading operations;
 - Verify set-backs and easements.
 - 6. Confirm drawing dimensions and elevations.
 - 7. Verify locations and elevations of existing utilities at point of connection with new services well in advance of new construction.
 - Notify Honeywell (AP) of potential conflicts between new or existing utilities or construction before installing the particular item of work.



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- Employ responsible and competent Construction Project Manager qualified by experience and training to capably supervise all phases of the work. This experience must include:
 - Commitment to safety procedures and their enforcement -
 - Job planning, forecasting, and scheduling
 - Utilization of effective manpower, equipment, and material control techniques
 - Construction change estimating ability and execution authority
 - Ability to manage and interface with all Subcontractors -
 - Administrative organization and execution of all contract requirements
- 8. Submit resume (including work experience and safety record) of the proposed Construction Project Manager with Contractor's Bid Proposal.
- 9. Authorization by Honeywell shall be required prior to the assignment, transfer or dismissal of the Construction Project Manager.
- 10. When, in the opinion of Honeywell Construction Representative (Construction Manager), the Construction Project Manager is insufficiently qualified or fails to meet the Contract requirements, the Contractor (Subcontractor) shall immediately remedy the situation to Honeywell's (AP's) satisfaction.
- 11. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- 12. Conduct all Work in accordance with Contractor's Work Plan, Contractor's Health and Safety Plan (HASP), applicable federal, state, and local laws, statutes, or codes and Honeywell policies.
- 13. Provide written verification that equipment is properly installed.
- 14. Provide written documentation of testing.
- 15. Meet with the Honeywell Construction Representative (Construction Manager) prior to construction start.
- 16. Accommodate special site safety requirements.
- 17. Coordinate, conduct and document any on-site and off-site project meetings as specified herein.
- 18. Provide information regarding all project Work aspects, schedules and submittals for Honevwell review and comment.
- 19. Incorporate or otherwise respond to Honeywell (AP) submittal comments or reported deficiency observations.
- 20. Coordinate Work of various crafts having interdependent responsibilities for installing. connecting to and placing Systems into service.
- 21. Coordinate space requirements, supports and installation of mechanical and electrical Work, which are either indicated on Drawings or are called for in the Specifications.
- 22. Coordinate locations of fixtures and outlets with finish elements.
- 23. Coordinate completion and clean up of Work areas as the Work progresses in preparation for Substantial Completion or as may be designated for Honeywell's occupancy.
- 2.2.1.2 Equipment, Tools and Supplies
 - 1. Provide all equipment, tools and supplies necessary to perform the required work described by the Contract Documents.
 - 2. All tools and equipment must be maintained in a safe condition.

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3. All equipment, tools and supplies shall be of sufficient quantity to assure the successful completion of the work in accordance with the Contract schedule.

2.2.1.3 Contractor (*Subcontractor*) On-Site Resources

- 1. The Contractor (Subcontractor) shall:
 - Mobilize equipment, materials, labor and any other resources, of appropriate capability and size, and only as necessary, to productively perform the Work items for which these resources are required.
 - Demobilize equipment, materials, labor and other resources immediately after the Work items for which these resources are required are complete or when the Work cannot be productively performed.
 - Provide equipment that is appropriately sized and suitable for the intended Work. Equipment shall be neither oversized (beyond recommended factor of safety) nor undersized (below recommended factor of safety). Equipment shall only be used for its intended use. Equipment shall be operated, inspected and maintained in accordance with applicable OSHA, manufacturer and industrial standards.
 - In instances where Honeywell (*or AP*) may be responsible to cover the costs for Contractor's (*Subcontractor's*) on-site resources, such as during periods of down time created or directed by Honeywell (*or AP*), the Contractor (*Subcontractor*) shall mitigate the costs for these resources to the maximum extent possible. Contractor (*Subcontractor*) and Honeywell (*AP*) shall evaluate potential alternatives such as demobilizing equipment, suspending labor resources, etc. Failure to meet these obligations, depending on the severity, may result in Honeywell's (*AP's*) reduction in or suspension of Contractor's Scope of Work or termination of the Contract.

2.2.2 Honeywell (*AP*)

- 2.2.2.1 Honeywell Construction Representative (Construction Manager) will:
 - 1. Address Contractor questions regarding the Work.
 - 2. Not direct the Work of Contractor's workers or Subcontractors.
 - 3. Only address issues regarding the Work with Contractor's Construction Project Manager or other designated representative(s).
 - 4. Stop work whenever such stoppage may be necessary to ensure the proper and safe execution of the work.
 - 5. Define any special work and specific site safety requirements (for Operating Facility).
 - 6. Make periodic inspections of work in progress.
 - 7. Participate in all on-site and off-site project coordination meetings.
 - 8. Review and comment on all project Work aspects, schedules, and submittals, and will inform Contractor of any observed deficiencies to ensure compliance with Contract Documents.
 - 9. Act as the point of contact for site activities.

2.2.3 Lower Tier Subcontractors

- 2.2.3.1 All lower tier subcontractors are required to be qualified through ISNetworld[®] (ISN) and Honeywell approval prior to conducting any work on site.
- 2.2.3.2 ISN qualification shall be obtained or information for listing shall be initiated for all major subcontractors prior to the Bid proposal (Section 1.0 of the RFP).
- 2.2.3.3 Contractor (*Subcontractor*) shall compile and indicate on the bid form all Major Subcontractor Contractor ISN status. Confirmation of ISN qualification and Honeywell approval of major subcontractors is required prior to contract award.

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2.2.3.4 After award, Contractor (subcontractor) shall compile a listing of minor subcontractors and ISN status and facilitate ISN qualification and Honeywell approval prior to conducting any work onsite. Additional or new Subcontractors (major or minor) must obtain ISN qualification in accordance with the RFP (Section 1.0) and be agreed to by Honeywell (*and the AP*) prior to their initiating site Work.

2.3 CONSTRUCTION MEETINGS

2.3.1 Project Planning and Progress Meetings

- 2.3.1.1 The Contractor's Construction Project Manager (*Construction Manager*) shall hold regularly scheduled on site Project Planning and Progress Meetings with all subcontractors and Honeywell.
- 2.3.1.2 Meeting shall be held weekly unless otherwise agreed to by Honeywell.
- 2.3.1.3 Contractor (*AP*) will notify Honeywell of meeting location, date and time.

2.3.2 Safety Meetings

2.3.2.1 Conduct Daily and Weekly Safety meetings in accordance with the requirements of Specification Section 01620 General Requirements Safety, Health, and Emergency Response. Weekly safety meetings may be combined with weekly project progress meetings.

2.3.3 Pre-installation Meeting

- 2.3.3.1 The Contractor's Construction Project Manager (*Construction Manager*) shall hold a preinstallation meeting at the site prior to commencing work when required in the Specifications.
- 2.3.3.2 Notify Honeywell's Construction Representative, Remediation Manager, Design and Construction Manager and Supply Manager at least four workdays in advance of the proposed meeting date.
- 2.3.3.3 Prepare agenda and preside at meeting.
- 2.3.3.4 Review conditions of installation, preparation and installation procedures.
- 2.3.3.5 Review coordination requirements for other Work or for ongoing facilities operations.

2.3.4 Problem or Work Deficiency Meeting

- 2.3.4.1 Either Contractor (*Subcontractor*) or Honeywell (*AP*) shall initiate a meeting when and if a problem or deficiency is present or likely to occur.
- 2.3.4.2 The meeting shall define and resolve the problem or work deficiency.

2.3.5 Agenda and Minutes

2.3.5.1 Refer to Subparagraph 1.5.5 "Meetings" under Paragraph 1.5 "Communication" for minimum requirements for meeting agenda and minutes.

2.4 UTILITY HAZARDS

- 2.4.1 Before starting work in any area, locate and identify any active or inactive underground or overhead utilities that could present a hazard. If utilities are to remain in place, provide adequate means of protection during construction activities.
- 2.4.2 Contractor (*Subcontractor*) shall obtain all "Dig Safe" permits prior to commencement of any invasive subsurface activities unless otherwise indicated in **ATTACHMENT 01010-4 Permit Schedule** of Specification Section 01010 Summary of Work.
- 2.4.2.1 Coordinate with Operating Facility to locate on-site underground utilities before attempting excavation work or other invasive work. Refer to Paragraph 2.5 Working in Operating Facilities for coordination with the facility to locate on-site utilities (i.e., possible geophysics, test pitting etc.).
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- 2.4.2.2 Should uncharted, or incorrectly charted piping or other utilities be encountered during excavation, consult the Utility Owner immediately for directions. Cooperate with Honeywell and utility companies in keeping respective services and facilities in operation.
- 2.4.2.3 Do not interrupt existing utilities serving facilities occupied and used by Honeywell or others, except when permitted in writing and then only after acceptable temporary utility services have been provided.

2.5 WORKING IN OPERATING FACILITIES

2.5.1 Compliance with Operating Facility General Rules and Practices

- 2.5.1.1 Refer to Paragraph 1.1.3 for Definition of an Operating Facility.
- 2.5.1.2 Contractor (*Subcontractor*) is responsible for the costs for complying with Operating Facility rules and practices.
- 2.5.1.3 Never interfere with the ongoing operations unless otherwise permitted in Contract Documents or as agreed to in advance in writing by Honeywell.
- 2.5.1.4 Coordinate with Operating Facility prior to commencing construction to review the proposed work and review potentially applicable Operating Facility procedures and requirements. Review, discuss and comply with:
 - 1. Applicable site established General SOPs such as Work Permitting, Lockout and Tag-out procedures, Decommissioning and Commissioning procedures
 - 2. Union/non-union worker environment (ensure labor harmony)
 - 3. Contractor parking restrictions
 - 4. Vehicular access and speed limit restrictions
 - 5. Temporary storage restrictions
 - 6. Temporary Facility restrictions
 - Construction Trailers
 - Toilet Facilities
 - Utilities
 - Drinking water
 - 7. Temporary fence requirements
 - 8. Construction gate requirements and any labor action concerns.
 - 9. Housekeeping requirements
 - 10. Waste management requirements and coordination needs
 - 11. Management of Change requirements and facility involvement in changes)
 - 12. Communication requirements
 - Facility management
 - Discrete operational areas
 - Functional leaders
 - Public relations
 - Regulators
 - Code enforcement officials
 - First responders
 - Other officials
 - Other third-parties
 - 13. Work logistics, planning and coordination with facility
 - 14. Work permit requirements
 - 15. Work hour restrictions
 - 16. Work area restrictions
 - 17. Open excavations near working areas (passer-bys)

- 2.5.1.5 Coordinate with Operating Facility to locate on-site underground utilities before attempting excavation work. Work may entail performing a thorough underground search using noninvasive geophysical surveys and / or test pitting where indicated on the Contract Drawings or Technical Specifications. An Excavation Permit may be required before any excavation can be performed.
- 2.5.1.6 Do not operate any existing Facility valves, gates, switches, instrumentation, controls, and other items of equipment or utilities required for execution of Contractor's (*Subcontractor's*) Work without Facility Operation's expressed written permission.
- 2.5.1.7 All Work shall be complete, tested and ready for commissioning prior to "Transfer of Care, Custody and Control" to Honeywell.
- 2.5.1.8 Obtain a properly executed Work Permit (General, Hazardous or Hot Work) as required.

2.5.2 **Compliance with Operating Facility Security Requirements.**

- 2.5.2.1 Coordinate with Operating Facility prior to commencing construction to review the proposed work with respect to the Facility security requirements. Review, discuss and comply with:
 - 1. Background Checks, if required, before any work commences.
 - 2. Restricted access to certain areas.
 - 3. Involved/restrictive facility required badge process.
 - 4. Sign-in/out process for site and/or various areas.
 - 5. Use of Cameras (typically restricted or prohibited entirely).
 - 6. Surrendering of cameras and picture phones at the gate.
 - 7. Emergency Contact requirements.
 - 8. Facility security is not responsible for providing Contractor (Subcontractor) required security for their employees, materials or work area.

2.5.3 **Compliance with Operating Facility Health, Safety and Environmental Requirements.**

- 2.5.3.1 Coordinate with Operating Facility prior to commencing construction to review the proposed work with respect to the Facility Health, Safety and Environmental requirements. Review, discuss and comply with:
 - 1. Facility specific Health, Safety and Environmental SOPs
 - 2. Informing the facility of all planned activities well in advance especially:
 - Crane work, critical lifts
 - Excavation and Trenching (barricade / road plate)
 - Lock out / Tag out Zero Energy
 - Fall protection
 - Confined space entry
 - 3. Facility Operating Permits
 - Air Emissions
 - Liquid waste discharge/disposal
 - Solid waste storage/handling and disposal (Large quantity generator)
 - Any special facility specific regulatory requirements (DOE, NRC, etc.)
 - 4. Keeping facility workers, visitors and trespassers safe for every task during normal work hours and leaving the site properly secured against hazards at the end of every day.
 - 5. Informing the facility how RES work may affect their SOPs related to permits, regulatory compliance, or other Facility activities.

2.5.4 **Connection to Existing Facilities**

2.5.4.1 All Work shall be tested, calibrated, inspected and in working condition before final tie-ins are made to an existing Facility.

- 2.5.4.2 Prior to making any tie-ins or hot taps to existing electric, water, sewer, air, steam or process piping systems, Contractor (*Subcontractor*) must receive Facility approval and obtain all applicable Work Permits
- 2.5.4.3 Temporary connections shall be made permanent at the next scheduled Facility outage or sooner as may be practicable.
- 2.5.4.4 All permanent connections must meet applicable Specification, Facility, regulatory and other compliance requirements.

2.5.5 **Coordination with Facility Operations**

- 2.5.5.1 Schedule and execute operations so as to avoid interference with the operations of the existing facilities and Work of others.
 - 1. <u>Submit</u> to Honeywell (*and AP*) and Facility Operations written notice and itemized Work schedule at least ten workdays before commencement of Work that may affect the operations of the Facility, such as shutdowns, tie-ins, process bypass loops and modification to existing electrical, control, safety or security systems.
 - 2. Unscheduled interruptions resulting from remedial work under the Contractor's (*Subcontractor's*) responsibility must be returned at once to normalcy through temporary or permanent means.
 - 3. Interruption of service to Operating facilities exceeding eight hours in any 24-hour period is not allowed unless specifically accepted in writing by Facility Operations management.

2.6 MEASUREMENT & PAYMENT

2.6.1 Measurement & Payment Requirements

- 2.6.1.1 Refer to Section 01010 for Bid Items and Section 2.0 (Contract) of the RFP for payment terms and conditions.
- 2.6.1.2 Tolerance shall be ± 0.01 foot for field measurements, unless otherwise specified herein and within RES-CP-WPC-11 Survey Control and Digitalization or within the Technical Specifications (Section 4.0).
- 2.6.1.3 When using surveys for measurement and payment:
 - 1. Site Superintendent shall sign Surveyor's field notes.
 - 2. Keep duplicate field notes on file and <u>provide</u> copy to Honeywell Construction Representative (*Construction Manager*).
 - 3. Certify digitally calculated quantities for payment purposes.
- 2.6.1.4 Reconciliation of any additional as-built quantities shall be done in accordance with Honeywell's CCO procedure.

2.6.2 Lump Sum / Unit Rate Bid Items

- 2.6.2.1 Each lump sum task will be paid at 100% of the proposal bid price, on a per task basis, when the actual work performed is within plus or minus 5% of the estimated bid quantity.
- 2.6.2.2 Any actual quantities in excess of 105% of the estimated bid quantities that may result in an extra cost to Honeywell will require the Contractor to request a CCO before performing such extra work.
- 2.6.2.3 Any actual quantities below 95% of the estimated bid quantities shall result in an automatic credit to Honeywell.
- 2.6.2.4 The Contractors bid proposal unit rates shall be equally applied to extra costs (above 105%) or credits (below 95%) to determine the actual cost or credit of the task.

2.6.3 Lump Sum Basis

- 2.6.3.1 Lump sum items with no unit rate specified shall be measured as a single item. Unless otherwise specified, lump sum items will be paid when the work is 100% complete and ready for its intended use or the next phase of construction.
- 2.6.3.2 Lump sum items with unit rate specified shall be measured on a unit rate basis as per the Contractors proposal. Payments will be made in accordance with the progress payment provisions specified.

2.6.4 Length Basis

2.6.4.1 Length basis items shall be measured along the item's centerline in accordance with the Contract Documents. Payments will be made in accordance with the progress payment provisions specified.

2.6.5 Area Basis

- 2.6.5.1 Area basis items shall be measured to a sufficient accuracy to calculate the actual surface area within limits specified in the Contract Documents. Payments will be made in accordance with the progress payment provisions specified.
- 2.6.5.2 For areas of a regular geometric nature, the minimum measurements required to perform such calculations are acceptable.
- 2.6.5.3 For areas of complex configuration, area shall be calculated using appropriate surveying or similar techniques.
- 2.6.5.4 Calculate areas to $\pm 1/10$ square foot or $\pm 1/100$ square yard as may be appropriate.

2.6.6 Volume Basis

- 2.6.6.1 Volume basis items shall be measured to a sufficient accuracy to calculate the actual volume within limits specified in the Contract Documents and as further defined below. Payments will be made in accordance with the progress payment provisions specified.
- 2.6.6.2 Excavation & Backfill
 - 1. For excavation of impacted material (e.g., soil):
 - After clearing and grubbing and before commencing excavation, survey ground surface elevations and establish ground surface area as excavation datum for excavation volume calculation unless otherwise specified in Specification Section 01010 Summary of Work, Bid Item 7.6.
 - As the work progresses and as may be required to determine bottom area and full depth of excavation, <u>survey</u> bottom of excavation surface elevations and area to determine excavation terminus.
 - Excavation beyond the specified boundary limits, including but not limited to, materials excavated for slope stability, safety or other construction facilitation are considered over excavation and shall be excluded from the volume calculations for excavation payment purposes.
 - 2. For backfill using on-site fill material:
 - Use excavation survey information if available, unless otherwise specified in Specification Section 01010 Summary of Work, specific Bid Item.
 - If excavation survey information is not available, survey bottom of excavation surface elevations and area to determine excavation datum for backfill volume calculation.
 - After on-site backfill material is placed and compacted, survey ground surface elevations and establish top of backfill surface area as backfill terminus.

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- If on-site fill material (or topsoil, as the case may be) is brought to finished grade, use final grade measurements as backfill terminus.
- 3. For backfill using imported fill material or topsoil:
 - Unless otherwise specified, utilize all available on-site fill material and topsoil first as may be practicable.
 - Follow similar procedure as outlined for using on-site fill material, except use top of placed and compacted fill from on-site sources as the datum as may be applicable.
 - <u>Submit</u> copies of all Bills of Lading, certified weigh tickets and material quality certifications to the Honeywell Construction Representative (*Construction Manager*) daily for all imported fill material and topsoil.
- 4. Use datum and terminus survey measurements to calculate in-situ volume of material excavated or backfill placed to \pm 1/100 of a cubic yard.

2.6.6.3 Cast-in-Place Concrete

- 1. The volume shall be calculated using the dimensions of the finished concrete construction as shown on the Construction Drawings.
- 2. Where field conditions necessitate a deviation from the Construction Drawings that will significantly add to the cast-in-place concrete volume (>5% total increase), Contractor shall follow the CCO Process.
- 3. Contractor shall markup Construction Drawings with deviations noted and <u>furnish</u> copies to Honeywell Construction Representative (*Construction Manager*) with an RFI or CCO request, as applicable.
- 4. Calculate cast-in-place concrete volume to \pm 1/100 of a cubic yard.

2.6.7 Weight Basis

- 2.6.7.1 Items specified as measured on a weight basis shall be measured using a certified scale in accordance with the manufacturer's recommendations and applicable agencies having jurisdiction.
- 2.6.7.2 <u>Submit</u> copies of all Bills of Lading (if applicable) and certified weigh tickets to the Honeywell Construction Representative (*Construction Manager*) daily.
- 2.6.7.3 Using the data collected from the certified weight tickets calculate the weight of material to \pm 20 pound or \pm 1/1000 of a ton. Payments will be made in accordance with the progress payment provisions specified.

2.7 ENGINEERING & SURVEY SERVICES

2.7.1 Qualification Requirements

- 2.7.1.1 <u>Submit</u> Engineer and Land Surveyor statement of qualifications to Honeywell (*AP*) for review and acceptance before commencing any Work requiring these services as defined below.
- 2.7.1.2 Any special survey requirements and deliverables such as global positioning system, data management, formatted drawings and figures, etc., will be stipulated in the Technical Specifications (Section 4.0) of the RFP and shall be in conformance with RES-CP-WPC-11 Survey Control and Digitization. Contractor (*Subcontractor*) shall verify surveying subcontractor meets all the requirements stipulated in this section, and in the Technical Specifications (Section 4.0) of the RFP.

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2.7.2 Engineering

2.7.2.1 Professional Engineer, when required per the Technical Specifications (Section 4.0) of the RFP for the successful completion of the work, must be licensed in the State where the Work will take place and the appropriate discipline for the service provided.

2.7.3 Surveying

- 2.7.3.1 All surveying work shall be in conformance with RES-CP-WPC-11 –Survey Control and Digitization. The following paragraphs summarize some minimum requirements.
- 2.7.3.2 Land Surveyor, when needed for the successful completion of the work or for measurement payment purposes, must be registered in the State where the Work will take place.
- 2.7.3.3 Sequence surveying in each designated area as may be appropriate for Work or as otherwise directed by the Honeywell Construction Representative (Construction Manager).
- 2.7.3.4 Submit for Honeywell's (AP's) written approval at least ten workdays in advance of survey work, survey methods and equipment to be used. Work done using methods or equipment not agreed to by Honeywell (AP) shall be subject to removal and replacement.
- 2.7.3.5 Notify Honeywell (AP) at least two working days in advance of survey activities planned.
- 2.7.3.6Submit related surveyor information, calibration certificates, field notes and record drawings.

2.7.4 **Survey Control Points**

- 2.7.4.1 **Survey Control Point Requirements**
 - 1. Establish survey control reference points prior to starting work.
 - 2. Use appropriate offset staking method for grade markers and other construction control points that interfere with the Work.
 - 3. Protect and preserve survey control points during construction.
 - 4. Site reference points shall not be relocated without Honeywell's (AP's) prior written approval.
 - 5. Report dislocated, damaged or destroyed reference point to Honeywell (AP) promptly.
 - 6. Replace dislocated, damaged or destroyed survey control points as per original survey.
- 2.7.4.2 Survey Monuments
 - 1. Off-site control monuments shall be used as a reference for on-site monuments (when specified), as on-site monuments are expected to settle during construction.
 - 2. The horizontal control datum shall be as indicated on the Construction Drawings, typically state plane coordinates, U.S. foot (North American Datum 1983 [NAD83]), unless otherwise indicated.
 - 3. The vertical control datum shall be as indicated on the Construction Drawings, typically the National Geodetic Vertical Datum 1927 (NGVD27), unless otherwise indicated.
 - 4. On-site monuments (when specified) shall be checked not less than monthly against off-site monuments until job completion.
 - 5. Reference site survey and reference points to off-site control monuments and record locations of all survey control points, using the Control Datum, on Record Drawings.

2.8 **TEMPORARY FACILITIES**

2.8.1 **Temporary Facility Requirements**

2.8.1.1 Furnish, when appropriate, sufficient temporary facilities for field office, sanitary, construction and drinking water, storage, telephone, fax machine, health, safety or other facilities required to successfully complete the work in hot, cold, wet or other inclement weather.

- 2.8.1.2 The Honeywell Construction Representative (*Construction Manager*) will designate areas for construction trailers or offices, parking, lay-down, and storage of Products and equipment.
- 2.8.1.3 Electrical power, water, gas and other utility connections available on site are defined within the Contract Documents
- 2.8.1.4 Utility connections to existing sources are subject to Honeywell authorization.

2.8.2 **Potable Water**

2.8.2.1 Provide and maintain an adequate supply of clean potable water for construction, testing, decontamination, cleanup, dust control, safety, equipment and domestic consumption, and any facilities needed to convey or store the water.

2.8.3 Sanitary Facilities

2.8.3.1 Provide and maintain an adequate number of sanitary, chemical type, temporary toilets for the use of personnel employed by the Contractor (*Subcontractor*), Subcontractors, Honeywell (and *AP*) and authorized visitors. These facilities shall conform to the requirements of all state, county and local ordinances and shall be kept clean and maintained in good working order at all times.

2.8.4 Storage

- 2.8.4.1 Furnish, as necessary, temporary buildings or trailers required for the storage and protection of Honeywell (*or AP*) or Contractor (*Subcontractor*) supplied Products.
- 2.8.4.2 All Products shall be stored neatly and in such a way to allow for Contractor's (*Subcontractor's*) Work, activities of the Operating Facility and others authorized to access the site to proceed in a safe and orderly manner.
- 2.8.4.3 Provide facilities to store and protect Products received on site.
 - 1. Maintain adequate cover and other protection in accordance with industry best practice, SDS or manufacturer's guidelines, as may be applicable.
 - 2. Store sensitive Products in weather tight, climate controlled enclosures.
 - 3. Maintain Product with documentation, SDS, seals, nameplates, match marks and labels intact and legible.
- 2.8.4.4 Establish adequate exterior storage (lay-down) area as may be applicable for efficient materials handling throughout project duration.
- 2.8.4.5 Cover with impermeable sheet covering, provide ventilation to prevent condensation and prevent contact with ground for:
 - 1. Products subject to degradation or weather / moisture damage.
 - 2. Fabricated Products stored outside.
- 2.8.4.6 Store materials on solid flat surfaces in a well-drained area.
 - 1. Prevent mixing with foreign matter.
 - 2. Keep covered with impermeable sheeting if weather impacts are a concern.
 - 3. Control storm water runoff and run-on.
- 2.8.4.7 Provide off-site storage and protection when site does not permit adequate on-site storage or protection.
- 2.8.4.8 Machinery stored for three months or more shall be maintained in accordance with industry best practices and manufacturer guidelines.
 - 1. Maintenance shall include, but is not limited to:
 - Lubrication of non-painted or exposed carbon steel surfaces
 - Lubrication of bearings and shaft rotation
 - 2. Maintain a moisture and dirt free environment for air movers, compressors, pumps, etc.

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- 3. Include necessary details for these machinery maintenance items in the construction Work Plan.
- 4. Record all maintenance activities on monthly inspection log.
- 2.8.4.9 Inspect to verify Products are undamaged and in acceptable condition at least monthly.
 - 1. Maintain detailed Inspection Log for all Products.
 - 2. <u>Submit</u> copies of inspection log entries to the Honeywell Construction Representative (*Construction Manager*) monthly.

2.9 **PROTECTION OF WORK**

- 2.9.1 Protect and preserve all Products and Work that has been or will be performed by Contractor (*Subcontractor*), Subcontractors, Honeywell, or others from Contractor's (*Subcontractor*'s) operations, the actions of others working in the same areas, loss, damage, weather affects or tidal fluctuations.
- 2.9.2 Immediately notify the Honeywell Construction Representative (*Construction Manager*) of any lost, damaged, deteriorated or otherwise defective Product or Work.
- 2.9.3 Exercise extreme care to prevent damage to existing telephone lines, power lines, water mains, sewer or gas lines, and other above ground or below ground structures.
- 2.9.4 Immediately notify the Honeywell Construction Representative (*Construction Manager*) of any damage to existing aboveground or below ground structures, as well as the utility or third parties having jurisdiction over the damaged facilities.
- 2.9.5 Replace all missing items.
- 2.9.6 Replace any damaged or defective Products or Work to the condition required by the appropriate specification.
- 2.9.7 Alternately, the Contractor (*Subcontractor*) may petition the Honeywell Construction Representative (*Construction Manager*) for written permission to repair, clean or restore any damaged or defective Products or Work to the condition required by the appropriate specification.
- 2.9.8 Obtain approval from the Construction Representative (*Construction Manager*) for all materials, methods and procedures used to repair, clean, or restore damaged Products and Work.

2.10 MANUFACTURERS' FIELD SERVICES

- 2.10.1 When specified in the Contract Documents, provide services of an authorized Vendor technical representative to:
 - 1. Supervise the field construction activities, installation, adjustment and testing.
 - 2. Monitor and instruct for quality and workmanship for the Product supplied.
 - 3. Inspect, check and agree to installation prior to start-up.
 - 4. Instruct operations and maintenance personnel.
- 2.10.2 Vendor's technician is subject to Honeywell (*AP*) approval.
- 2.10.3 <u>Submit</u> technician qualifications ten workdays in advance of such Work.

2.11 HOUSEKEEPING

- 2.11.1 Keep the Site neat at all times and free of accumulation of scrap, trash, rubbish and debris related to site work.
- 2.11.2 Maintain all parking areas, roadways and traffic areas impacted by site work free of spilled materials, tracked soil and debris on a daily basis.
- 2.11.3 Maintain work areas, passageways and stairs in and around buildings or other structures in a clear, unobstructed and orderly manner.

- 2.11.4 Soil, rubbish, debris, waste material, etc. on rights-of-way, roadways, railways and in support areas must be collected and placed in a designated area within the work zone each day.
- 2.11.5 Site Superintendent shall inspect such Work areas daily before Work begins, as the workday ends and whenever working conditions change to ensure housekeeping practices are observed.
- 2.11.6 Debris shall be promptly removed from Work Areas during the course of construction as it is generated.
- 2.11.7 Immediately clean up any spillage and return to its originally intended use, if appropriate, or dispose of in accordance with the Contract Documents.

2.12 MANAGING WASTE MATERIAL

2.12.1 Managing Waste Material Requirements

- 2.12.1.1 Manage all handling, segregation, construction water, stabilization, containerizing, storage and loading for transportation all waste materials resulting from the performance of the Work. Manage all waste material in accordance with RES-CP-WPC-12 Waste Management Procedure.
- 2.12.1.2 Transportation and disposal responsibilities of hazardous and TSCA waste shall be as defined in Specification Section 01010 Summary of Work.

2.13 **PROHIBITIONS**

- 2.13.1 Prohibited construction practices include, but are not limited to, the following:
- 2.13.1.1 For any stream corridor, wetland, surface water or unspecified location:
 - 1. Dumping of spoil material
 - 2. Indiscriminate, arbitrary, or capricious operation of equipment
 - 3. Pumping of silt-laden water from trenches or other excavations
 - 4. Disposal of trees, brush, and other debris
- 2.13.1.2 Permanent or unspecified alteration of the flow line of any stream.
- 2.13.1.3 Dynamite or other explosive blasting.
- 2.13.1.4 Open burning of construction project debris.
- 2.13.1.5 Disposal of de-watering fluids without authorization.

2.14 STANDBY TIME (DELAY TIME)

- 2.14.1 Standby time is defined as time that Contractor (*Subcontractor*) is not permitted to conduct scheduled productive work tasks for influences outside the control of the Contractor (*Subcontractor*) and not discussed or presented in the Specification Section 01010 Summary of Work or any other part of the Contract Documents.
- 2.14.2 Standby time does not apply to those items specifically defined as being included in Specification Section 01010 Summary of Work. Standby time likewise does not apply to work items that are considered incidental to the Work as defined by the Contract Documents.
- 2.14.3 Standby time will apply to those tasks, as approved in writing by Honeywell (*and the AP*), that are delayed or otherwise interrupted by the following:
- 2.14.3.1 Change in the Scope of Work as initiated by other parties other than the Contractor (*Subcontractor*) or their designees,
- 2.14.3.2 Change in the design as initiated by parties other than the Contractor (*Subcontractor*) or their designees,
- 2.14.3.3 Changes in site conditions,
- 2.14.3.4 Work stoppage for the convenience of Honeywell.

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- 2.14.4 The following provisions will be included as further definition and applicability of Contractor standby time:
- 2.14.4.1 Obtain Honeywell (and AP) agreement in writing for all labor and equipment standby costs.
- 2.14.4.2 Contractor (*Subcontractor*) shall specify all requirements with itemized and total costs associated with overtime, weekend or holiday standby requirements. Honeywell (*and AP*) acceptance of these requests shall be obtained in writing.
- 2.14.4.3 Honeywell (*AP*) will not provide standby compensation to the Contractor (*Subcontractor*) for any equipment or labor that is on site for the Contractor's (*Subcontractor's*) convenience and is not necessary for the work that is impacted by standby activities
- 2.14.4.4 Honeywell (*AP*) will not provide standby compensation to the Contractor (*Subcontractor*) for any equipment or labor that was not scheduled to be used on the day that Honeywell (*or the AP*) initiated the action for the standby time. Likewise, if the action occurred on a weekend or holiday, compensation will not be made for any equipment or labor that is on site the first work day following the off-hour event.
- 2.14.4.5 A standby event does not necessarily impact the entire project. If other productive tasks can be performed during the time when one or more discrete work tasks are impacted by the delay, the Contractor (*Subcontractor*) shall redirect resources to other work activities to mitigate the requirement for standby time.
- 2.14.4.6 Honeywell (*AP*) will not pay standby time for any equipment or labor that can be or is used productively for other work tasks.
- 2.14.4.7 No standby time will be paid for weekends or Federal Holidays.
- 2.14.5 Honeywell (*AP*) will expect to develop a cost basis for Contractor (*Subcontractor*) standby time for each Contract and further break down the cost structure to capture the costs required for each work item included in Specification Section 01010 Summary of Work. The costs for standby time will be developed with the following provisions:
- 2.14.5.1 Standby for equipment will be paid based upon the lesser of the following:
 - 1. A prorated amount of the daily rate for equipment on site three workdays or less, or,
 - 2. A prorated amount of the weekly rate for equipment on site three workdays or more, or,
 - 3. A prorated amount of the monthly rate for equipment on site for 14 workdays or more, including mobilization, demobilization and standby time.
 - 4. All prorated amounts shall be on an hourly basis not to exceed 8 hours per workday.
- 2.14.5.2 Standby for labor will be paid on the following basis:
 - 1. Straight time hourly rate.
 - 2. On the day that a standby is initiated, if Honeywell (*or AP*) announces standby before 10:00 a.m., all employees scheduled to work that day and were on site for their scheduled work, will be paid for up to 4 hours of work. If Honeywell (*or AP*) announces standby after 10:00 a.m., all employees scheduled to work that day and were on site for their scheduled work will be paid for up to 8 hours of work.
 - 3. Only those employees that are necessary to be on site for health, safety, environmental and security reasons, as accepted by Honeywell (*and the AP*) in writing, will be paid for 8 hours per workday for the duration of the standby event. Contractor (*Subcontractor*) shall not be compensated for any employees not accepted by Honeywell (*and the AP*) as necessary for a standby event.

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3 PRE-CONSTRUCTION WORK

3.1 APPROVAL SUBMITTAL(S)

3.1.1 Refer to Paragraph 1.2.1 Construction Schedule Requirements for Baseline Construction Schedule submittal requirements.

3.2 KICKOFF MEETING

- 3.2.1 The Honeywell Construction Representative (*Construction Manager*) will schedule a preconstruction kickoff meeting at the site or other convenient location before Work starts.
- 3.2.2 The meeting will provide an overview of the following project requirements:
- 3.2.2.1 Project Scope, Schedule, Invoicing Procedure, CCO Procedure, Contractor Submittals, Working in Operating Facilities, Site Access and Security, Health and Safety, Temporary Facilities, Coordination of Work, Permit Requirements, Materials Management, QA/QC, Managing Waste.

4 MOBILIZATION & SITE PREPARATION

4.1 MOBILIZATION

- 4.1.1 Provide and setup field office(s), office supplies, sanitary facilities, change trailers, First Aid and PPE supplies, temporary power, small tools and equipment.
- 4.1.2 Coordinate with Honeywell (*AP*) the following mobilization activities:
- 4.1.2.1 Location of field offices, sanitary facilities, lay-down areas and temporary storage facilities.
- 4.1.2.2 The agreed to location for construction field offices, storage, site access, parking and employee entry to Facility shall be as identified in the Construction Documents and will be reaffirmed at the kickoff meeting.

4.2 LAYOUT OF WORK AND SITE CONDITIONS

- 4.2.1 Within ten workdays after moving onto the job site, inspect any previous work performed by others (e.g., foundations, anchor bolts, pipe stub ups, valve locations) upon which Contractor's subsequent work will depend.
- 4.2.2 Accept, reject or note exceptions to all such previous work through written notification to the Honeywell Construction Representative (*Construction Manager*).
- 4.2.3 Verify the existence of any overhead or underground obstructions.

5 CONSTRUCTION WORK

5.1 GENERAL

5.1.1 Paragraph 5 provides minimum requirements for projects having minor site, mechanical or electrical scope and where more detailed technical specifications are not provided. For more complex construction work and when detailed technical specifications are provided, refer to the Technical Specifications (Section 4.0) of the Contract. If there is a conflict between these general requirements and the technical specifications, the technical specifications shall govern.

5.2 WELL INSTALLATION

- 5.2.1 Obtain required permits unless indicated as provided by others in Specification Section 01010 Summary of Work.
- 5.2.2 Decontaminate all rigs and equipment between each borehole and upon completion of work.
- 5.2.3 Borings not completed as wells shall be backfilled with neat cement grout or equivalent.

- 5.2.4 Develop each installed well per direction of Honeywell's *(AP's)* representative or as otherwise specified in the Technical Specifications (Section 4.0) of the RFP.
- 5.2.5 Manage soil cuttings, development water, decontamination water and other waste residuals as indicated in RES-CP-WPC-12 Waste Management Procedure and the Technical Specifications (Section 4.0) of the RFP.
- 5.2.6 <u>Provide</u> boring and well construction logs for all installed wells. A template for also recording pertinent information to streamline information download into Honeywell's Environmental Management database, is available from Honeywell (*AP*) in Excel (.xls) format (**ATTACHMENT 01100-7**).
- 5.2.7 At a minimum, well / boring locations shall be surveyed for record drawing submission.
- 5.2.8 Refer to the Technical Specifications for additional well submittal and installation requirements.

5.3 CIVIL WORK

5.3.1 Storm Water Management, Soil Erosion and Sedimentation Control

- 5.3.1.1 When required by the Specification Section 01010 Summary of Work or the Technical Specifications (Section 4.0) of the RFP, provide necessary Storm Water, Erosion Control, and Sedimentation Control Plan and measures.
- 5.3.1.2 Storm Water Management, Soil Erosion and Sedimentation Control Plan
 - 1. <u>Submit</u> to Honeywell (*AP*) a detailed Storm Water Management, Soil Erosion and Sedimentation Control Plan for construction and the one-year post-construction guarantee period. Plan should be submitted prior to construction activities for Honeywell (*AP*) review and approval.
 - 2. Maintain copy of this plan at the site
 - 3. At a minimum, the plan shall include:
 - Chronological completion dates for each temporary (and permanent) measure for controlling erosion and sediment.
 - Location, type and purpose for each temporary measure to be undertaken.
 - Dates when those temporary measures will be removed.
 - Materials to be used.
- 5.3.1.3 Storm Water Control Requirements
 - 1. Provide storm water runoff control, treatment and disposal measures in accordance with the approved plan.
 - 2. Address any deficiencies noted by Honeywell (AP) or regulatory agencies.
- 5.3.1.4 Soil Erosion Control and Sedimentation Control Requirements:
 - 1. Install erosion and sedimentation control measures prior to all construction activities.
 - 2. Maintain control measures during earthwork activities.
 - 3. Keep land disturbance to a minimum and schedule re-stabilization immediately after any disturbance, as is practicable.
 - 4. Inspect all control measures weekly, immediately after each rainfall of greater than 1/2 inch in any given week and at least daily during prolonged rainfall.
 - 5. Repair any failed control measure immediately. Perform maintenance as needed.
 - 6. Remove all sedimentation and erosion control barriers after completion of construction and permanent control measures are installed.

- 7. Conform to all State, County and Local erosion and sedimentation control measures and (if applicable) as specified in the Storm Water Management, Soil Erosion, and Sedimentation Control Plan (or equivalent plans).
- 8. Immediately adjust or institute additional control measures if planned control measures are not effective or satisfactory to the regulatory agencies having jurisdiction.
- 5.3.1.5 Soil Erosion Control Measures: Measures shall include temporary berms, diversions or other barriers including hay or straw bales, stone, silt fences or other agreed to materials that are constructed to retain sediment on-site by retarding and filtering storm runoff and prevent migration of silts and sediment to receiving waters. Unless otherwise shown on the drawings or detailed in the Technical Specifications (Section 4.0) of the RFP:
 - 1. Anchor all topsoil stockpiles with straw mulch and encircle with hay bales.
 - 2. Silt fences or hay bales shall be installed at the toe of all critical cut and fill slopes.
 - 3. Protect catch basins (sumps) with silt fences, hay bales or other approved means throughout or until all disturbed areas are stabilized.
 - 4. Grade surfaces per the Contract Documents and manufacturer guidelines, prior to installation of erosion control fabric.
 - 5. Diversion terraces shall be installed on the uphill side of disturbed areas to divert surface runoff away from unstable slopes and the project area, as may be required.
 - 6. Interceptor channels shall be used across disturbed areas where the slope is running parallel to direction of trenches to divert runoff to outlets on lower side of disturbed area and shall be arranged to minimize erosion impact, as may be required.
 - 7. Trench barriers of earth-filled sacks or piled stone, stacked to top of trench shall be constructed to prevent trench washout after installation of piping, if backfill operations are delayed, as may be required. Trench shall be sloped in the direction of piping.
 - 8. Tie hay/straw bales securely. Unless otherwise specified, utilize two #3 concrete reinforcing bars or two 2" x 2" hardwood stakes for each hay/straw bale to secure to the ground.
- 5.3.1.6 Sediment Control Measures
 - 1. Periodically remove sediment from temporary control structures and permanent drainage facilities as needed.
 - 2. Dispose of sediment per the Contract Documents. Prevent additional erosion or pollution.
 - 3. Sediment barriers shall be constructed at storm drain sumps, across minor swales / ditches and other low-strength temporary applications, as may be required.
 - 4. Unless otherwise specified, construct silt fences using reinforcement geotextile prefabricated to 24" height units with 4' stake spacing.
 - 5. Unless otherwise specified, install 2" x 2" x 36" hardwood post or standard T or U section steel posts (1.33 #/lf min.) for silt fences.

5.3.2 Earthwork

- 5.3.2.1 Conduct all earthwork activities to mitigate dispersion of volatile organic emissions and fugitive dust beyond the Work Area.
- 5.3.2.2 Comply with all requirements of the Storm Water Management, Soil Erosion and Sedimentation Control Plan for the duration specified in the Plan.

5.4 MECHANICAL WORK

5.4.1 Equipment

5.4.1.1 Installation of Machinery and materials

- 1. Use certified shop drawings, installation drawings and manufacturer instructions when installing Machinery.
- 2. Mechanics shall be competent, experienced and skilled in handling, setting, aligning, leveling and adjusting the Products and shall install Products in accordance with manufacturer recommendations.
- 3. Use proper tools, equipment and materials to rig and assemble Products to prevent deforming or marring the surface of shafts, drive components, mating surfaces, threaded parts, etc.
- 4. Furnish all fasteners, supports, brackets, bracing and other appurtenances required for a complete installation.
- 5. Do not force or drive couplings, gears, sheaves, etc. on machinery shafts nor subject them to an open flame or torch. Use only oil bath heater or similar method.
- 6. Apply a molybdenum disulphide anti-seize compound to all threads in mechanical connections such as bolts, studs, cap screws, tubing, etc. unless otherwise indicated.
- 7. Products shall not be altered or repaired, and no burning or welding will be permitted on any parts having machined surfaces, except by written permission of Honeywell (*AP*).
- 8. No rigging shall be done from any structure without the permission of Honeywell.
- 9. Furnish and install appropriate fittings or plugs in lubrication holes to prevent entry of moisture or foreign material.
- 5.4.1.2 Alignment & Leveling of Equipment

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- 1. Equipment shall be carefully set and aligned on foundations to proper orientation and elevation and shimmed to true level.
- 2. Equipment baseframe shall be tightened to bear against shims.
- 3. Equipment shall be checked after securing to foundations and, after confirmation of level and elevation, shall be grouted in place.
- 4. Rotating equipment shall be initially aligned using stainless steel shims while equipment is free from any external loads.
- 5. Correctly align piping to associated equipment to prevent stress at pipe connections. Springing of pipe to align with mating equipment flanges is not permitted.
- 6. Misaligned holes shall be reamed. "Driving" of fasteners or keys is not permitted.
- 7. Check rotating equipment angular and parallel alignment and adjust to manufacturer's specifications before testing or placing any Machinery into service.
- 8. <u>Submit</u> actual alignment data records to Honeywell (AP).
- 5.4.1.3 Equipment: Anchor, Shim and Grout
 - 1. Furnish anchor or expansion bolts, as specified or otherwise required.
 - 2. Use expansion bolts only where shown or agreed to by Honeywell (AP).
 - 3. Anchor and expansion bolts shall be of specified materials with heavy hex head nuts.
 - 4. Anchorage items shall conform to Contract Document requirements.
 - 5. Provide all steel shims, grout packing or other materials necessary to properly level and secure equipment in place.
 - 6. Wedging is not permitted.
 - 7. Use least number of flat shims possible in leveling equipment.
 - 8. Shims shall be clean and free of slag.
 - 9. When requested by Honeywell (*AP*), demonstrate that all elements so required are level and plumb.

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10. Grouting shall conform to Contract Document requirements.

5.4.2 **Piping and Pressure Bearing Systems**

- 5.4.2.1 Follow routing shown for pipes, ducts and conduit as closely as practicable; place runs parallel with lines of building.
- 5.4.2.2 Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.
- 5.4.2.3 In finished areas (except as otherwise indicated), conceal pipes, ducts and wiring within the construction.
- 5.4.2.4 Furnish all fasteners, gaskets, lubricants, sealants, hangers, supports, brackets, braces, bracing and other appurtenances required for a complete installation.
- Tighten connections requiring gaskets evenly all around to ensure uniform stress over the entire 5.4.2.5 gasket area.
- 5.4.2.6 Pressure test all piping and pressure bearing Systems in compliance with American Society of Mechanical Engineers, American Petroleum Institute or other relevant industrial standards.
- 5.4.2.7 Maintain all Pressure Test Reports on site and accessible at all times.
- 5.4.2.8 Submit copy of Pressure Test Report to the QA/QC Engineer immediately following test.

5.5 ELECTRICAL, INSTRUMENTATION, AND CONTROL WORK

- 5.5.1 Use certified shop drawings, installation drawings and manufacturer instructions when installing electrical and instrumentation equipment.
- 5.5.2 Electricians shall be competent, experienced and licensed (as indicated in the Technical Specifications [Section 4.0] of the RFP and in accordance with state and local regulations). For instrumentation work, they shall be skilled in adjusting and troubleshooting the Products and shall install Products in accordance with manufacturer recommendations.
- 5.5.3 Comply with the following codes, standards, regulations and specifications:
- 5.5.3.1 National Electrical Code (NFPA No. 70 - most recent edition)
- 5.5.3.2 Life Safety Code (NFPA No. 101 - most recent edition)
- 5.5.3.3 Electrical Safety in the Workplace (NFPA No. 70E - most recent edition)
- 5.5.3.4 National Electric Safety Code (NESC - most recent edition)
- 5.5.3.5 Occupational Safety and Health Act (OSHA) - regarding construction practices
- 5.5.3.6 Utility Company standards, specifications and requirements
- 5.5.3.7 State and local electrical codes, building codes and fire codes for the locale where the work is to be performed.
- 5.5.3.8 Underwriters Laboratory, Inc. (UL)
- 5.5.3.9 National Electrical Manufacturers Association (NEMA)
- 5.5.3.10 American National Standards Institute (ANSI)
- 5.5.3.11 National Electrical Contractors Association (NECA) 1 – Good Workmanship in Electrical Construction
- 5.5.4 Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and as required by the National Electrical Code. All mounting heights shall comply with latest Applicable Codes. All work shall comply with NECA 1.
- 5.5.5 Panelboards, cabinets, large pull boxes, large junction boxes, cable support boxes and starters shall be secured to structural members of walls, ceiling and the floor slab, as applicable and not supported from conduits suspended ceilings or other light construction. Small panelboards may

be supported on drywall or similar wall construction. Racks for support of conduit and heavy electrical equipment shall be secured to building construction by substantial structural supports. All work shall comply with NECA 1.

- 5.5.6 All distribution equipment (substations, switchboards, motor control centers, distribution panel boards, transformers, transfer switches, disconnects, starters, control panels, etc.), switchboard and distribution panel over current devices, motor control center devices, individually mounted motor controllers, disconnect switches, bus plugs, control devices, etc., shall have an engraved lamacoid tag, mounted adjacent to the manufacturer's nameplate, indicating the equipment's designation and identification number per the Contract Documents or site standards.
- 5.5.7 All equipment shall be labeled in accordance with OSHA, NFPA and code requirements.
- 5.5.8 For all feeder wiring rated 600 volts or less, provide 1,000 volt insulation resistance test prior to energizing feeders. Use a motor driven equipment for all tests. Test voltage shall be applied until readings reach a constant value and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum reading shall be 45 megohms for feeder conductors. Document test results and <u>submit</u> for approval prior to energizing conductors.
- 5.5.9 Install, wire, configure and test all instrumentation. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

Device / Equipment	Height (in)				
Toggle switches (up position "on")					
Receptacle outlets (long dimension vertical, ground pole nearest floor)	18				
Receptacle outlets, above baseboard heaters	30				
Receptacle outlets, hazardous areas	48				
Receptacle outlets, weatherproof, above grade	24				
Telephone outlets					
Telephone outlets, wall mounted					
Fire alarm manual station					
Fire alarm audio/visual station	90				
Branch circuit panelboards, to top of backbox	72				
Distribution panelboards, to top of backbox	72				
Terminal cabinets, control cabinets, annunciator panels, to top of backbox	72				
Disconnect switches, motor starters, enclosed circuit breakers	48				

- 5.5.10 Locate devices / equipment in locations shown on the drawings or in accessible areas acceptable to Honeywell (*AP*). Where structural or other interferences prevent compliance with mounting heights listed above, consult Honeywell (*AP*) to change location before installation.
- 5.5.11 Conduits:
- 5.5.11.1 Generally conceal throughout except where exposure is permitted by Honeywell (*AP*) or shown exposed on the Drawings.
- 5.5.11.2 Install exposed conduits either parallel or perpendicular to structural members and group together where possible.
- 5.5.11.3 Install conduits supported from building walls with at least 1/4-in. clearance from the wall to prevent accumulation of dirt and moisture behind the conduit.
- 5.5.11.4 Support long "drops" of small conduit by structure or several drops tied together to provide rigid, straight, plumb and neat appearing installation.

- 5.5.12 After the Instrumentation and Process Control System is completed, or when otherwise requested by Honeywell (*AP*), demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as requested by Honeywell (*AP*).
- 5.5.13 All systems shall be adjusted, tested, inspected and turned over to Honeywell in final working order acceptable to Honeywell (*AP*).
- 5.5.14 Contractor (*Subcontractor*) shall implement Honeywell's Lock-Out Tag-Out Safety Procedures specified in HSEMS 301, Lock, Tag, Try for all electrical work.

6 COMMISSIONING, STARTUP, AND PROVE-OUT

6.1 **APPLICABILITY**

6.1.1 Commissioning/Startup and prove-out applies to process systems (see definition in RES-CP-WPC-04 Commissioning Plan).

6.2 COMMISSIONING/STARTUP PREPARATION REQUIREMENTS

- 6.2.1 A Draft OM&M Manual and Commissioning Plan shall be submitted and approved by Honeywell prior to initiation of commissioning and startup activities (see Paragraphs 1.5.7 and 1.5.8). See RES-OP-01 OM&M Manual and Plan Requirements, and RES-CP-WPC-04 Commissioning Plan for Submittal timeframe requirements for these plans.
- 6.2.2 Coordinate the schedule/sequencing of all start-up activities of various Systems included in the project.
- 6.2.3 Notify Honeywell (AP) at least ten workdays prior to commissioning/start-up of each System.

6.3 COMMISSIONING/STARTUP IMPLEMENTATION

- 6.3.1 Implement the commissioning steps and complete the checklists as detailed in the approved Commissioning Plan.
- 6.3.2 Include the process system operators, whether staffed by the Contractor (Subcontractor) or other party in the commissioning process
- 6.3.3 Commissioning may consist of the following typical steps:
- 6.3.3.1 Completion of construction/installation checklists to verify the physical installation such as:
 - 1. Installation complies with the requirements of applicable manufacturer's instructions.
 - 2. Wiring and support components for equipment are complete and tested.
- 6.3.3.2 Completion of functional checklists to verify motor and instrument functionality such as:
 - 1. Each piece of Machinery or System has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
 - 2. Tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- 6.3.3.3 Completion of operational checklists to verify individual system and overall system such as:
 - 1. Adjustments have been operating equipment to ensure smooth and unhindered operation.
 - 2. Operating parameters have been compared to design and manufacturer expected values and are within expected ranges.
- 6.3.3.4 Completion of vendor/supplier inspection/certification for equipment identified in the technical specifications
- 6.3.3.5 Completion of operator training
 - 1. Unless otherwise specified, training time shall be a minimum of one eight-hour workday.

- 2. Utilize OM&M Manuals as basis for instruction. Review contents of manual with Honeywell (*and/or AP*) in detail to explain all aspects of operation and maintenance.
- 3. Demonstrate operation and maintenance of Products to Honeywell and OM&M Contractor (if applicable) (*and AP*) at least ten workdays prior to date of final inspection.
- 4. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of Machinery.
- 5. Demonstrate seasonal requirements for Machinery or Systems requiring seasonal operation.
- 6.3.3.6 Provide written certification of O&M Training in Final "As-Built" OM&M Manuals to be submitted within ten workdays after final inspection.

6.4 COMMISSIONING/STARTUP DOCUMENTATION

- 6.4.1 <u>Submit</u> a Commissioning Report in accordance with RES-CP-WPC-04 Commissioning Plan to document completed commissioning activities. The commissioning shall include completed checklists, warranties, manufacturer's certifications, and training records as applicable.
- 6.4.2 Contractor (Subcontractor) may be responsible for updating the OM&M manual during system operations, if activities are changed or further defined during commissioning. These responsibilities, if required, shall be as defined in Specification Section 01010 Summary of Work and/or the Technical Specifications (Section 4.0) of the RFP.

6.5 PROVE-OUT

6.5.1 Contractor (Subcontractor) may be responsible for operations during a prove-out period. These responsibilities, if required, shall be as defined in Specification Section 01010 Summary of Work and/or the Technical Specifications (Section 4.0) of the RFP.

7 SITE RESTORATION & DEMOBILIZATION

7.1 SITE RESTORATION

7.1.1 Complete site restoration in accordance with the Technical Specifications (Section 4.0) of the RFP. If not specifically specified, restore to current (or better) conditions.

7.2 DEMOBILIZATION

- 7.2.1 <u>Submit</u> an inventory listing all surplus materials.
- 7.2.2 Unless otherwise directed by Honeywell (*or AP*), remove all Temporary Work, tools and equipment at Work completion.
- 7.2.3 Properly decontaminate all tools and equipment before removal from site.
- 7.2.4 Properly decontaminate all supplies and materials before removal from site, or manage as waste materials in accordance with the requirements of this specification.
- 7.2.5 Remove all Temporary Facilities at the conclusion of the project.

8 CONTRACT CLOSEOUT

8.1 CLOSEOUT PROCEDURE

- 8.1.1 Notify Honeywell and Facility Operations (*and AP*) when Work is Substantially Complete.
- 8.1.2 <u>Submit</u> inspection reports and Certificates of Occupancy as required by the Contract Documents or by authorities having jurisdiction.
- 8.1.3 <u>Submit</u> Signed and sealed as-built survey showing final grades and lines.

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- 8.1.4 <u>Submit</u> the Final Closeout Report which shall include the following information:
- 8.1.4.1 Project Summary highlighting project objectives were achieved
- 8.1.4.2 Health and Safety Closeout Documentation
- 8.1.4.3 Final OSHA Man-hour summary
- 8.1.4.4 Off-site disposal Record
- 8.1.4.5 Project Photographs
- 8.1.4.6 An assessment of the project schedule and cost variance
- 8.1.5 Accompany Honeywell and Facility Operations (*and AP*) on Substantial Completion inspection and document Punch List items as needed.
- 8.1.6 Rectify all Punch List items.
- 8.1.6.1 <u>Submit</u> detailed written resolution for each Punch List item.
- 8.1.7 <u>Submit</u> to Honeywell and Facility Operations (*and AP*) written certification of Substantial Completion that addresses the following:
- 8.1.7.1 Contract Documents reviewed and updated or markups provided.
- 8.1.7.2 Work is complete, inspected and in accordance with Contract Documents.
- 8.1.7.3 Work is ready for Honeywell (and AP) Final inspection.
- 8.1.8 Accompany Honeywell and Facility Operations (*and AP*) on Final inspection and verify all Punch List items have been rectified to Honeywell's (*and AP*'s) satisfaction.
- 8.1.9 Repeat Punch List and final inspection processes until there are no items to be addressed.

8.2 SURPLUS MATERIAL

- 8.2.1 Upon completion of the project, inventory surplus materials.
- 8.2.2 Surplus materials purchased by contractor via Lump Sum contract remains the property of the contractor and must be removed from the site.
- 8.2.3 Surplus materials purchased/supplied by Honeywell remains the property of Honeywell and are to be stored on-site in area determined by Honeywell.

8.3 SPARE PARTS AND MAINTENANCE PRODUCTS

- 8.3.1 Provide spare parts, maintenance and any other extra Products in quantities specified in the Contract Documents.
- 8.3.2 Deliver to Project site and place in location as directed by Honeywell; obtain receipt prior to final payment.
- 8.3.3 All spare parts should be securely labeled with equipment name, part description, and number, quantity, etc.

8.4 FINAL DOCUMENTATION SUBMITTAL

- 8.4.1 <u>Submit</u> final "Record Drawing" Contract Submittals at or before Closeout Meeting.
- 8.4.2 <u>Submit</u> OM&M Manuals and Warranties. Refer to Paragraphs 1.5.7, OM&M Manual and 1.6.2, Warranties.
- 8.4.3 <u>Submit Commissioning documentation, if not already included within OM&M Manual appendices.</u>
- 8.4.4 <u>Submit</u> final Photographic / Video Records of Work progress and events.
- 8.4.5 Return all copies of Contract Documents.
- 8.4.6 Surrender all other project related photographs, negatives and videos (whether provided by Honeywell or otherwise acquired by Bidder)

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- 8.4.7 For any missing documentation or records, <u>provide</u> an itemized listing of each missing item with appropriate designation name and number, and a statement explaining why Contractor is unable to return specific items.
- 8.4.8 <u>Provide</u> sign-off sheet for contractor and Honeywell.

8.5 CLOSEOUT MEETING

- 8.5.1 Attend Project Closeout Meeting
- 8.5.2 Project Closeout Meeting shall be scheduled within eight (8) weeks of project completion.

9 OPERATION, MAINTENANCE, AND MONITORING

9.1 GENERAL REQUIREMENTS

- 9.1.1 Be responsible for operation, maintenance, and monitoring management and reporting consistent with requirements set forth in the Contract Documents and RES-OP-04 OMM Management and Reporting.
- 9.1.2 Be responsible for maintaining operation, maintenance, and monitoring plans and manuals consistent with requirements of RES-OP-01 OM&M Manual and Plan Requirements.
- 9.1.3 Be responsible for meeting all regulatory requirements. Reference documents, including sitespecific permits, orders, and agreements, have been included as part of the Contract Documents. The Contractor shall acknowledge that during the Contract Period requirements may change from those provided herein.
- 9.1.4 Provide personnel qualified in technical, laboratory, operations, maintenance, administrative/management skills to meet regulatory requirements and provide services in a responsible, professional manner.
- 9.1.5 Be responsible for providing their own general purpose tools and equipment as necessary for operation, maintenance, and repairs.
- 9.1.6 Supply and maintain all personal protective equipment for staff.
- 9.1.7 Be responsible for replacing spare parts and materials that are used for the routine maintenance of equipment.
- 9.1.8 Provide routine, preventative and normal maintenance of project equipment, wells, pipelines, buildings, grounds, etc. Including, but not limited to, mowing, plowing, week weed eating, painting, erosion control, and any other activity specifically called out in the site specific documents.
- 9.1.9 Be responsible for ordering and scheduling delivery of chemicals, spare parts, replacement equipment, and miscellaneous supplies as necessary. Contractor shall be onsite for all deliveries and is responsible for unloading and storage of all chemicals, equipment, and supplies.
- 9.1.10 Immediately notify Honeywell and/or, if required by Honeywell, regulatory authorities of any scheduled or unscheduled long-term shutdowns of project.
- 9.1.11 Short-term shutdowns (less than 24 hours) due to power outages, maintenance, repair, or general operating problems shall be logged and reported accordingly to site-specific protocol.
- 9.1.12 Provide on-going training programs for project personnel in operations, maintenance, and monitoring procedures; laboratory and process control; equipment operation and safety; and Right-to-Know requirements.
- 9.1.13 Implement a proven maintenance management program that provides the appropriate level-ofeffort and is suitable for the size and complexity of each specific site.
- 9.1.14 Conduct required site-specific sampling, coordinate shipment/pickup of samples to authorized analytical laboratory, and report, as necessary, in accordance and compliance with all local, state, and federal regulations.

- 9.1.15 Conduct emergency repairs to prevent violations of regulatory requirements set forth in documents such as, consent orders, permits, etc. Prior to making such repairs, Contractor shall attempt to contact Honeywell or its approved representative for approval. Contractor shall maintain a log of the Unscheduled Maintenance and Repairs completed.
- 9.1.16 Be responsible for maintaining onsite SDSs for all materials being used on site. Copies of the SDS shall be provided to Honeywell. Contractor shall provide an SDS for new chemicals used onsite.
- 9.1.17 Contact Honeywell with problems, issues, or questions regarding the proper operation, maintenance, and monitoring of the site.
- 9.1.18 Keep the site neat at all times and free of accumulation of debris (scrap, trash, and rubbish) related to site work.
- 9.1.19 Provide notification of the intended disposal of wastes (hazardous and non-hazardous) to Honeywell prior to disposal to determine if the material qualifies to be handled by Honeywell preapproved Transportation and Disposal (T&D) contractors. The contractor shall work with Honeywell in preparation as noted in other parts of this section.
- 9.1.20 Maintain all parking areas, roadways, and traffic areas impacted by site work free of spilled materials, tracked soil, and debris on a periodic basis (at a minimum during onsite visits.)
- 9.1.21 Maintain work areas, passageways, and stairs, in and around buildings or other structures in a clear, unobstructed and orderly manner.
- 9.1.22 Maintain work areas around well vaults, outfalls, cleanouts, monitoring wells, etc. in a clear, unobstructed and orderly manner. Maintain safe access to all locations.
- 9.1.23 Maintain life safety equipment fire extinguishers, emergency showers, eyewash stations, first aid kits, fire alarm systems, security systems etc.
- 9.1.24 Calibrate all instruments in accordance with manufacturer's recommendations, standard operating procedures, regulatory requirements, or at a minimum of once per year whichever is more frequent.

9.2 EQUIPMENT REPLACEMENT

- 9.2.1 Unless approved in writing by Honeywell, Contractor shall replace defective, worn, inoperable, etc. equipment with identical equipment (model, specifications, etc.) by same manufacturer or equivalent, if contractor can demonstrate that the substitute is of equal quality and there is significant cost savings in the purchase of the substitute.
- 9.2.2 Contractor shall evaluate equipment with chronic failures (failures that occur within the warranty period or more often than the anticipated life expectancy of the equipment) and propose alternatives to Honeywell.
- 9.2.3 Contractor shall evaluate the facilities for which they are responsible, including all associated process equipment, on an annual basis and provide to Honeywell an itemized list of anticipated potential maintenance or repairs and an estimation of associated costs and projected schedule.
- 9.2.4 Contractor shall submit equipment data and cut sheets on all equipment replacement to Honeywell for review and approval before replacement.
- 9.2.5 Contractor shall be paid for equipment replacement under Unscheduled Maintenance and Repairs provided that the Contractor can provide documentation of proper maintenance and that the Contractor was not at fault or negligent for the damaged piece of equipment.
- 9.2.6 Contractor shall receive written approval from Honeywell before performing Unscheduled Maintenance and Repairs. Honeywell reserves the right not to pay for unauthorized Unscheduled Maintenance and Repairs.
- 9.2.7 Honeywell and the Contractor shall cooperate and work together in determining the proper maintenance and operation.

9.2.8 Contractor shall document that the equipment has been installed according to manufacturer's recommendations, has been properly started up, has been properly tested, and the appropriate start-up data has been recorded.

9.3 SPARE PARTS REPLACEMENT

- 9.3.1 The Contractor shall only use manufacturer recommended spare parts and lubricants for each piece of equipment unless an exception is established through Management of Change and explicitly authorized by Honeywell.
- 9.3.2 Prepare a list of recommended spare parts that are required to maintain continuous operation. List shall consider availability of spare parts and time required for ordering and delivery.
- 9.3.3 The Contractor shall replace spare parts as needed in accordance with the recommended spare parts list and the requirements of this section.
- 9.3.4 The Contractor shall replace in stock spare parts as they are used for routine operation and maintenance to the extent that they are necessary for possible future repair or replacement and they are not normally readily available from a supplier or distributor inventory.
- 9.3.5 See also Spare Parts Inventory.

9.4 SUBCONTRACTORS

- 9.4.1 Contractor shall be required to use Honeywell approved subcontractors through the ISN qualification process as appropriate. Subcontractors that are not approved shall be required to obtain ISN qualification and be approved by Honeywell (see Section 1.0 of the RFP and Paragraph 2.2.3 of this specification).
- 9.4.2 The value of subcontracted work shall not exceed fifty percent (50%) of each project's agreed upon annual total value unless approved by Honeywell in writing.
- 9.4.3 Honeywell reserves the right to accept or reject proposed Subcontractors.
- 9.4.4 Contractor shall provide and maintain list of subcontractors and vendors, with a copy to Honeywell.
- 9.4.5 Contractor shall immediately notify Honeywell of any change in the use of a subcontractor or vendor.

9.5 SITE RECORD KEEPING

- 9.5.1 Contractor shall be responsible for maintaining project documents in accordance with local, state, federal, and contract-specific requirements.
- 9.5.2 The Contractor shall be responsible for recording and maintaining a complete daily log of activities, to include documentation of daily and other periodic inspections, equipment problems, actions taken, and notifications made to Honeywell and regulatory authorities.
- 9.5.3 When personnel are onsite, the Contractor shall record the following information, as applicable:
- 9.5.3.1 A list of people visiting or working on the site.
- 9.5.3.2 Average daily flow rate and total daily flow of each extraction well.
- 9.5.3.3 Total daily flow and average daily flow rate through each treatment unit.
- 9.5.3.4 Analytical results for influent and effluent samples.
- 9.5.3.5 Daily maintenance and repairs made to equipment.
- 9.5.3.6 All observations noted as unusual during site inspections.
- 9.5.3.7 Daily chemical usages and deliveries
- 9.5.3.8 Maintenance performed.
- 9.5.3.9 Documentation of sampling and monitoring activities.
- 9.5.3.10 Weekly quantity of sludge processed and dry sludge produced.

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- 9.5.3.11 Description of any observations or problems associated with the operation, maintenance, or monitoring of the project.
- 9.5.3.12 Time of arrival and departure from the site.
- 9.5.3.13 Weather conditions
- 9.5.3.14 Deliveries
- 9.5.3.15 Disposal pickups/quantities.
- 9.5.4 Field Books:
- 9.5.4.1 The Contractor shall use, if applicable, field books to document field sampling and monitoring events (including extraction wells, monitoring wells, treatment facilities, etc.) and onsite lab data collection.
- 9.5.5 Regulatory Reports:
- 9.5.5.1 The Contractor shall, pursuant to requirements identified in the OM&M manual, prepare and submit (if required) for review by Honeywell reports as required by the Contract Documents and regulatory authorities.
- 9.5.5.2 The Contractor shall certify the validity and accuracy of each report.
- 9.5.6 Laboratory Logbook:
- 9.5.6.1 The Contractor shall, if applicable, maintain a hardbound, laboratory logbook to document laboratory analyses that are conducted onsite.
- 9.5.7 Correspondence:
- 9.5.7.1 The Contractor shall keep a record of each substantive phone conversation and written correspondence related to the performance of this contract. A summary of the phone conversations and written correspondence shall be submitted to Honeywell monthly and is to be included in the monthly progress report. For this contract, "substantive" is defined as:
 - 1. All calls to or from Honeywell that require action by either Honeywell or the Contractor.
 - 2. All calls to or from Honeywell that directly or indirectly affect contract terms and conditions.
 - 3. All calls to or from federal, state, or local regulatory agency personnel.
 - 4. All calls from third parties seeking information about the project such as, but not limited to, news media, local residents, non-government organizations, other government entities, etc.
 - 5. All calls to Contractor personnel that require calling party to be referred to Honeywell.
- 9.5.8 Off-Site Waste Disposal Records:
- 9.5.8.1 The Contractor shall be responsible for maintaining records of waste disposal consistent with RES-CP-WPC-12 Waste Management Procedure, RES-OP-04 OMM Management and Reporting, contract documents, and local, state, and federal requirements.
- 9.5.9 Maintenance Records:
- 9.5.9.1 The Contractor shall establish and maintain a preventive maintenance program suitable for a project of this size and complexity.
- 9.5.9.2 The Contractor shall maintain regulatory required preventative maintenance schedules in Honeywell's centralized task scheduling and management database within the e-Portal.
- 9.5.9.3 If the Contractor elects to also utilize a commercial or proprietary computerize program to support their maintenance program, the Contractor shall provide to Honeywell, at no additional cost, a licensed copy of the software program and all necessary instructional material that will remain at the site at the end of the Contract. The data base entered into the software shall also be provided to Honeywell so that Honeywell and/or its representatives can continue to utilize maintenance software.
- 9.5.9.4 The Contractor shall maintain and update maintenance information on each piece of equipment in the project. This information shall, as applicable, include:

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- 1. Equipment name and number.
- 2. Nameplate data.
- 3. Date of installation and start-up.
- 4. Manufacturer name, address, e-mail address, contact name and telephone number.
- 5. Local supplier name, address, e-mail address, contact name and telephone number.
- 6. Routine maintenance requirements.
- 7. Routine maintenance schedule.
- 8. Spare parts.
- 9. Maintenance history.



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-1 Applicable Procedures

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Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-2 Example Three-Week Look-Ahead Schedule

THREE-WEEK LOOK-AHEAD SCHEDULE

(<u> </u>																				
Item #	Description of Work		Dat	tes on	Site	_				Dat	tes on	Site					Dat	es on	Site	
		Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Tues	Wed	Thurs	Fri
		11/16	11/17	11/18	11/19	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30	12/1	12/2	12/3	12/4
	[Prime Contract Activities - see examples below]																			
1	Complete installation of 8-inch FRP	х	Х																	
2	Complete pressure testing of installed piping		X	X																
3	Heat trace and insulate 8-inch FRP		X	X																
4	Extend PVC to Precoat Tank?		X	х																
5	Off-load GAC vessels				х															
6	Install GAC vessels and piping on pad					x	v	v												
	Installation of 6-in FRP&PVC @ GAC vessels						~	~								v	v			
8	Assist with hydrating new adsorbers															^	×			
9 10																	^	Y		
10	Relocate temporary GAC units																	^	v	
12	Remove existing adsorbers and P\/C nining																		Ŷ	
12	Shin/scrap old adsorbers and piping																		^	x
10	empreerup ein auserbere and piping																			~
	[MEP Subcontract activities]																			
14	Wiring and conduit for new backwash pump	x	x	x						2										
15	Verify rotation of backwash pump	~		x					17	0										
16	Connect Heat Trace to power				х			\bigcirc	1 1	6										
17	Relocate ASSY 14 RIO Panel					х			L											
18	Start up backwash pump for precoat filling?					X														
19	On-call for wiring modification if necessary				0	R		00	x							х		х		
	, , , , , , , , , , , , , , , , , , ,			\sim			$\mathcal{N} \sim$													
	[Equipment Vendor Activities]			15	10	5														
20	Ship GAC Vessels			X		~														
21	Deliver GAC Vessels			L	X															
22	Load GAC vessels with Carbon															х				
23	Inspect Installation															х				
24	Start-up Assistance/Operator Training/Orientation																	х		
	[Equipment Vendor Activities]																			
25	Inspect backwash pump installation (10 AM)				х															
26	Operator Training/Orientation					х														
27	[HONE I WELL APS]					v														
21	Control program modifications					~			v									v		
20	On-call for program modifications @ startup								^									^		
	[HONEYWELL O&M Activities]																			
29	Plant shut down					x														
30	Assist with GAC filling					~										x				
31	Assist with GAC hydration															x	х			
32	Set un/test surplus backwash water supply	ll															Ŷ	Y		

[Project Location] _____Facility [Project Name] Three-Week Look-Ahead: [November 16th through December 4, 2009]



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-3 Request for Information Form

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REQUEST FOR INFORMATION

GENERAL INFORMATION					
Project Name:	RFI No.:				
	Date Information Required:				
Project Location:	Date Information Provided:				
Site Owner:	Project No.:				
Client:	RFI Results in a Design Change Bulletin:				
Contractor(Subcontractor):	☐ Yes, DCB No				

REQUEST						
Information Requested:						
		<u> </u>				
Relevant Design Documents:	Attachments:	🗌 Yes 🗌 No				
RFI Originator:	Initial:	Date:				

	RE	SPONSE	
RFI Received By:		Initial:	Date:
Honeywell (AP) Respo	nse:		
Honeywell (AP) Review	/:		
Individual	Discipline	Initial	Date
Distribution:			



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-4 Design Change Bulletin

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DESIGN CHANGE BULLETIN

Project Name:		DCB No.:					
		Effective Date:					
Project Location:		Associated RFI:					
Site Owner:		Yes, RFI No.	None				
Client:		Project No.:					
Contractor (Subcontractor	<i>')</i> :						
Description of Change/Mo	dification:						
Reason for Change/Modifi	cation: fering Site Conditions	Explanation or R	leason:				
Owner/Client Rec Other (describe)	uest	Attachments:	Yes No				
Additional Comments:		Design Documer	nts Affected:				
Honeywell (AP) Review:							
Individual	Discipline	Initial	Date				
		Does DCB					
Contractor (Subcontractor) Keview:	Result in CCO?					
(Name / Signature):			Date				
Distribution:							



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-5 Work Acceptance Checklist

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WORK ACCEPTANCE CHECKLIST

ACTION ITEM	Y N NA Comments
START-UP AND COMMISSIONING	
1. Honeywell (AP) notified/aware prior to start-up of each system?	
2. Approved O&M manual available prior to start of training?	
3. Have SOPs in the O&M manual included PHA recommendations?	
4. Piping, vessels, tanks and operating equipment prepared for testing and startup?	
5. Construction debris, trash, vendor's protective coatings and oils removed?	
6. Acceptance and closure of Management of Change (MOC) and all associated documentation (JHA, PHA, SOPs, PSM) completed in compliance with RES-OP-02 MOC?	
7. Start-up:	
Proper lubrication, drive rotation, belt tension, control sequence verified?	
Tests, meter readings, and electrical characteristics agree with those required by equipment manufacturer?	
Wiring and support components for equipment complete and tested?	
Equipment adjusted for smooth and unhindered operation?	
Has manufacturer and/or installer submitted performance test certificate(s) covering items listed in Section 01100, paragraph on "Start-up"?	
8. Has Operation and Maintenance Training included:	
Start-up/shut-down, operation, control, and adjustment?	
Trouble-shooting, servicing, and maintenance?	
Seasonal requirements for systems requiring seasonal operation?	
9. Has training been properly documented in accordance with RES-OP-02 MOC?	
10. Is the written documentation of O&M training also included in the Final OM&M Manual?	

WORK ACCEPTANCE CHECKLIST

ACTION ITEM		Y	Ν	NA	Comments
	DEMOBILIZATION				
11.	Has an inventory listing of surplus materials been submitted?				
12.	Has surplus materials purchased by Contractor (<i>Subcontractor</i>) via Lump Sum Contract been removed from site as Contractor's (<i>Subcontractor's</i>) property?				
13.	Has surplus materials purchased/supplied by Honeywell been identified as Honeywell's property, and been properly protected and stored on-site in an area determined by Honeywell?				
14.	Have tools and equipment been decontaminated prior to removal from site?				
15.	Have all patching, reseeding, and repaving been completed as specified?				
16.	Have temporary work and facilities (temporary power, telephone, water sanitary) been removed?				
CONTRACT CLOSEOUT					
17.	Has Substantial Completion notification been issued by Contractor (Subcontractor)?				
18.	Has Substantial Completion Inspection been performed with Contractor (<i>Subcontractor</i>) and Punch List Items documented?				
19.	Has Contractor (<i>Subcontractor</i>) submitted a detailed written resolution for each Punch List Item?				
20.	 Has Contractor (<i>Subcontractor</i>) submitted written certification of Substantial Completion indicating the following: Contract Documents have been reviewed and updated or markups provided; Work is complete, inspected and in accordance with Contract Documents; and Work is ready for Honeywell (<i>and AP</i>) Final Inspection. 				
21.	Has Final Inspection with Honeywell, Facility Operations (<i>and AP</i>) been performed to verify that all Punch List Items have been rectified?				
22.	Will Punch List and Final Inspection process need to be repeated?				

WORK ACCEPTANCE CHECKLIST

ACTION ITEM		Ν	NA	Comments
23. Have the following closeout submittals been submitted:				
Inspection reports and Certificates of Occupancy required by the Contract Documents or authorities having jurisdiction?				
Signed and sealed as-built survey showing final grades and lines?				
Final Closeout Report with information required by Section 01100?				
Final "Record Drawings" at or before the Closeout Meeting?				
Photographic / Video Records of Work progress and events?				
Returned copies of the Contract Documents?				
Other project related photographs, negatives, digital files, videos?				
An itemized listing of any missing documentation or records with appropriate designation name and number and statement explaining why Contractor is unable to return specific items?				
Sign-off sheet for Contractor and Honeywell?				
24. Spare parts and maintenance products:				
Are they provided in quantities required by the Contract Documents?				
Are they placed in a location as directed by Honeywell?				
Has a receipt been obtained and submitted to Honeywell?				
Are spare parts labeled with equipment name, part description, number and quantity?				
Recommended spare parts lists provided?				
25. Equipment IDs defined and assigned for all applicable items according to the plants nomenclature system?				
26. Final Release and Waiver of Claims Form signed and received?				
27. Closeout meeting attended?				



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-6 Nonconforming Conditions Report

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→ Honeywell.com

NONCONFORMING CONDITIONS REPORT

Project Name: Project Location: Project Number: Contractor (*Subcontractor*): Rev. / Date:

No.	Condition Description	Date Reported ⁽¹⁾	Recommendation	Action By	Due Date	Comments/Status
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

(1) Insert date that Contractor (Subcontractor) reports the nonconfroming conditon to the Honeywell Construction Representative (Construction Manager).



Specification Section 01100 Remediation Construction and OM&M Requirements

ATTACHMENT 01100-7 Boring And Well Construction Data Entry Form



BORING AND WELL CONSTRUCTION DATA ENTRY FORM

BOREHOLE DATA

BOREHOLE_ID	
BOREHOLE_START_DATE	
BOREHOLE_COMPLETION_DATE	
DRILLING_COMPANY	
FIELD_GEOLOGIST (initials)	
LOGGING_COMPANY	
BOREHOLE_COMMENTS	
COMPLETED_AS_WELL	
BOREHOLE_TOTAL_DEPTH	
SAMPLE_METHOD	
SAMPLE_INTERVAL (FT)	
SAMPLE_TIME	

SOLID_SAMPLE_DESC	START_DEPTH (FT)	END_DEPTH (FT)	SOLID_SAMPLE_ID	SAMPLE_DATE	RECOVERY	RECOVERY_UNITS	PID_(PPM)	USCS_CODE	SAMPLE_LITHOLOGY	SAMPLE_COLOR	SAMPLE_ODOR	CONSISTENCY	MOISTURE_CONTENT	ROCK_QUALITY_DESIGNATION

BORING AND WELL CONSTRUCTION DATA ENTRY FORM (cont'd)

WELL CONSTRUCTION DATA

WELL	COMPONENT	DIAMETER	UNITS	MATERIAL	COMMENTS	START DEPTH	воттом рертн
PZ-103	SCREEN	2	inches	PVC		49	54
PZ-103	RISER	2	inches	PVC		-2	49
PZ-103	SEAL	8	inches	BENTONITE		45	47
PZ-103	SAND	8	inches	SAND		47	54
PZ-103	GROUT	8	inches	GROUT		1	45
	BACKFILL						
	FILTER PACK						
	FLUSH MOUNT CAP						
	GROUND SEAL						
	OPEN HOLE						
PZ-103	PROTECT CASING	3	inches	STEEL		-2.5	1.5
	STANDPIPE						
PZ-103	SURFACE PAD	3	feet	CONCRETE		0	0.5

Note: Not all components need to be filled in - leave blank or delete as needed.

Honeywell The power of connected	GENERAL REQUIREMENTS SAFETY, HEALTH, AND EMERGENCY RESPONSE	Pg. 1 of 12 Late	0162 Spec. N st Revision July 2017	2 0 lo.
Honeywell International, Inc. 115 Tabor Road Morris Plains, NJ 07950	Corporate HSER, RES Group Remediation Specification	By Docum WJH By	Date Dent Approva Julv 20 Date	No. I 17

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ATTACHMENT 01620-8	HONEYWELL HSES PROCEDURE FILE (electronic file only)



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GENERAL

- 1.1 Any disregard for the provisions of the following Health and Safety requirements shall be deemed just and sufficient cause for termination of the Contract Agreement or any Contract without compromise or prejudice to the rights of Honeywell (Client) [and insert Appliance Partner name].
- 1.2 This document is written for use under the Honeywell Fixed Price/Unit Price contract. It may also be applied to Alliance Partner (AP) subcontractors under and Honeywell-AP Environmental, Remediation, Construction, and Procurement (ERCP) contract in which case the requirements indicated for the Contractor shall apply to the Alliance Partner's Subcontractor.
- 1.3 The Contractors and all its subcontractors shall obtain satisfactory ISN listing and be approved by Honeywell prior to working at a site. If a contractor or subcontractor is unable to obtain satisfactory ISN status, they may work at the site only if Honeywell grants a waiver. In that case the contractor awarded the waiver must develop an acceptable Risk Management Plan that must be reviewed and accepted by Honeywell (or the AP for ERCP contracts). A Risk Management Plan may include, but is not limited to, full-time supervision of all subcontractor activities, and requiring the subcontractor to provide full-time health and safety professionals to implement and support required safety programs, safety assessments, and audits. The following Safety Metrics are targets in the ISN approval process; however, other factors are also included:
 - Experience Modification Rate (EMR) at or below 1.00,
 - OSHA Total Case Incident Rate (TCIR) at or below industry average,
 - Lost Workday Case Incident Rate (LWCIR) at or below industry average.
- 1.4 The Contractor shall have a competent person or persons, when required under the Occupational Safety and Health Act (OSHA) regulations, to inspect the Work and to supervise the conformance of the Work with the regulations under the Act.
- 1.5 The Contractor shall provide a Site Health and Safety Representative (SHSR) for all field projects. The SHSR shall be responsible for ensuring and/or implementing the site-specific Health and Safety Plan (HASP) and that the HASP adequately addresses the hazards and controls associated with site work activities. All Contractor or Contractor's subcontractor employees shall comply with all provisions
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in the HASP. The SHSR may be a multi-duty employee, but should have specific dedicated time to implement a safe work environment for all work activities.

- 1.5.1 For all heavy construction (i.e., use of heavy equipment such as drill rigs, cranes, earth moving equipment), Level A/B, or confined space activities, the Contractor shall provide at least one full-time dedicated SHSR during such activities whose ONLY responsibility is to ensure the health, safety and welfare of all Contractor and Contractor's subcontractor employees participating in the project. This individual shall also be responsible to ensure that the Contractor's or Subcontractor's competent person for the construction activities performs daily inspections of all protective structures and devices implemented by the Subcontractor to ensure the safe, continual and un-interrupted functioning of the ongoing operational activities for the duration of this Contract.
- 1.6 The Contractor shall become familiar and comply with Honeywell's applicable project and site-specific Health, Safety, Fire Protection, Emergency Response, Operational Permits and other relevant requirements.
- 1.7 The Contractor shall become familiar with and comply with Honeywell safety procedures. Honeywell corporate HSES procedures and checklists are provided as zip file (ATTACHMENT 01620-8) for reference.

2 REGULATORY AND HONEYWELL-SPECIFIC REQUIREMENTS

- 2.1 The Contractor and its subcontractors shall comply with all applicable federal, state, and local laws, ordinances, codes, rules, regulations, policies, and governmental interpretations thereof. The Contractor shall be responsible for the health and safety of its workers and subcontracted workers at this Site.
- 2.2 Contractor, its employees and subcontractors shall comply with all safety rules common to the construction trades and shall abide by all safety standards and practices in use by Honeywell (or Third Party Owner/Operator [TPO/O] if Honeywell is not the property owner/operator). At a minimum, the Contractor and its subcontractors shall comply with CD-13-1 Safety & Occupational Health; Compliance (ATTACHMENT 01620-1) CD-13-2 Contractor's Safety Declaration) (ATTACHMENT 01620-2), and CD-13-3 Contractor's Employee Safety Declaration (ATTACHMENT 01620-3). Each on-site Contractor employee and lower-tier subcontractor employee must sign the Employee Safety Declaration Form CD-13-3 prior to starting work.

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- 2.3 Contractors shall provide its employees and subcontractor employees a copy of the Honeywell RES Contractor Safety Booklet for all projects where workers will be on site for a period of time longer than 40 hours or one week. The workbooks can be obtained from Honeywell RES staff. In addition, in accordance with Honeywell RES procedure HS-01, Construction Orientation & Safety Booklet, Contractor and subcontractor employees must read the Safety Booklet and sign the Acknowledgement Page of the Booklet (ATTACHMENT 01620-4). The Acknowledgement Page must be submitted prior to his/her working no more than 16 hours onsite. The Contractor and subcontractor employees shall participate in annual safety booklet refreshers or booklet updates if applicable.
- 2.4 A Site Kick-Off meeting is mandatory, at which time the selected Contractor shall familiarize itself with Honeywell's (or TPO/O) applicable rules, including those site-specific safety and fire protection requirements. Contractor shall comply with Honeywell's (or TPO/O) safety and fire protection rules, as well as any other applicable Federal, State, and Local laws or regulations.
- 2.5 The Contractor shall ensure that remediation work performed at active Honeywell (or TPO/O) facilities is coordinated with the management of the facility and that all facility rules and requirements are followed by their employees.
- 2.6 Prior to commencement of field activities, the Contractor shall certify that personnel employed at, or who later become employed at the Site, who are directly involved with activities that have the potential for exposure to hazardous waste, including direct employees as well as employees of subcontractors, have completed an appropriate 24- or 40-hour health and safety training course in accordance with 29 CFR 1910.120(e) and/or 29 CFR Part 1926.65(e) (or applicable OSHA state requirement). Certificates of completion of appropriate 24- or 40-hour training and latest annual refresher training certificates shall be maintained at the Site for all employees engaged in activities with the potential exposure to hazardous waste.
- 2.7 Prior to the start of demolition activities (if applicable), the Contractor shall conduct an engineering survey of the structure(s) to determine the condition of the framing, floors, and walls, and possibility of unplanned collapse of any portion of the structure. Any adjacent structure where personnel may be exposed shall also be similarly checked. The engineering survey shall be conducted by a competent person, in accordance with 29 CFR 1926, Subpart T. The Contractor shall submit to

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the Engineer in writing, evidence that such a survey has been performed. The Engineer will forward written evidence to Honeywell.

- 2.8 The Contractor shall prepare a site-specific Health and Safety Plan (HASP) in accordance with Sections 4 and 6 below.
- 2.9 The Contractor shall be solely responsible for the preparation, implementation, and oversight of the HASP. Any review and comments by [*insert Alliance Partner's or Engineer's name*], Honeywell, or any third party does not relinquish the Contractor of its responsibility for the health safety and welfare of site personnel under the Contract.
- 2.10 The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970.
- 2.11 Except as may by prohibited by local laws, contractors and/or subcontractors performing and individuals directly supervising the use of heavy construction-type equipment, the operation of treatment plants, the conduct of safety sensitive/at-risk work (e.g., lock-out/tag-out, confined space entry, hot work, dredging, and similar activities), or other activities designated by Honeywell shall comply with Honeywell's Substance Abuse and Prevention Requirements. (If this provision is prohibited by local laws, the Contractor is responsible for providing Honeywell with evidence of such legal prohibition.)
- 2.11.1 The Honeywell Substance Abuse and Prevention Compliance Program (Honeywell RES procedure RES-HS-9) prohibits the use, manufacture, sale, possession, or transfer of illegal drugs, alcohol and controlled substances on Honeywell project premises. Violation of this contract requirement may be considered by Honeywell to be a material breach of contract and subject the Contractor to all remedies available to Honeywell and/or Alliance Partners at equity, contract, and law. In addition, Contractor is advised that violation of this contract requirement shall be considered in the evaluation of the Contractor as being qualified to supply personnel under future contracts with Honeywell and/or its Alliance Partners. Contractor's attention is directed specifically to the contract terms (See Section 2.0 of the RFP) including, but not limited to the Substance Abuse and Prevention Requirements and the contract articles indemnity, and termination. The Contractor and each subcontractor is required to provide certification that its substance abuse and Prevention Requirements
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as detailed in Honeywell RES procedure RES-HS-09, Contractor Substance Abuse and Prevention Compliance Program.

- 2.12 Provide necessary barricades, covers, guards and other protective measures to keep all personnel that can enter the affected areas during the course of their normal activities, safe from all construction hazards.
- 2.13 Honeywell and its Alliance Partner reserve[s] the right to restrict Contractor's use of Products that represent an unreasonable risk to workers or the public based upon Safety Data Sheets (SDS), Manufacturer information or Governmental Guidelines.
- 2.14 Contractor is required to cooperate with Environmental, Health, and Safety audits conducted by Honeywell or the Alliance Partner and respond to the findings and recommendations generated from such audits.

3 EMERGENCY PHONE NUMBERS AND HSER EVENT REPORTING

- 3.1 Emergency phone numbers (Fire, Medical, Police) and a map detailing the route/directions to the nearest hospital shall be conspicuously posted by Contractor at the Site, and all personnel involved with the Work shall be informed of this location. Also, Contractors must keep a list of project personnel and their phone numbers in accordance with Honeywell RES procedure RES-HS-11 (ATTACHMENT 01620-5).
- 3.2 Event reporting includes fatalities, catastrophes, injuries, motor vehicle accidents, environmental releases or incursions, fire, explosion, property damage, and near misses. Events must be reported in accordance with Honeywell's HSER (Adverse) Event Reporting System in accordance with Honeywell RES procedure RES-HS-11 (ATTACHMENT 01620-5). Contractors must maintain on site a written investigation report that includes at a minimum all of the information required by the Honeywell HSER Event Reporting requirements.

4 SUBMITTALS

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4.1 Submit to Honeywell (AP), the completed Contractor Safety Evaluation Form (see Section 1 of the RFP) to document verification of all Contractor and subcontractor compliance with Honeywell Safety Metrics and assess overall contractor safety management and performance history prior to the Contractor performing any work. All contractors must be evaluated and placed on Honeywell RES Contractor List.

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- 4.2 The Contractor shall submit to [*insert Alliance Partner name*] [Honeywell] prior to commencement of any on-site activities the Contractor prepared HASP (see Section 6) for review and comment. Review and comment of the HASP may also be required by additional parties including regulatory agencies and/or third party owners/operators.
- 4.3 Certificates of completion of training applicable to the Work and medical clearances applicable to the Work shall be maintained at the Site for all employees engaged in activities with the potential exposure to hazardous waste.
- 4.4 In addition, the Contractor shall submit the following items:
 - CD-13-1 Safety & Occupational Health Compliance (ATTACHMENT 01620-1);
 - CD-13-2 Contractor's Safety Declaration (ATTACHMENT 01620-2);
 - CD-13-3 Contractor's Employee Safety Declaration (ATTACHMENT 01620-3);
 - Contractor's Substance Abuse and Prevention Program Compliance Certification see RES-HS-09, see ATTACHMENT 01620-06)
 - Daily and weekly Safety Reports as part of daily and weekly construction reports (see Specification Section 01100 Remediation Construction and OM&M Requirements);
 - Incident Reports as applicable (see ATTACHMENT-01620-5);
 - Employee/Visitor Register;
 - Monitoring/Sampling Results;
 - Training Logs; and
 - Monthly Exposure-Hours Report (ATTACHMENT 01620-7).

5 PREPARATION FOR SITE ACTIVITY

- 5.1 The Contractor shall be solely responsible for the safety of its employees, subcontractors, suppliers, and other parties at the work area as a result of the Contractor's direction.
- 5.2 Determination of the appropriate level(s) of worker safety equipment and procedures shall be made by the Contractor.
- 5.3 Should any unforeseen or site-specific safety-related factor, hazard, or condition become evident during the performance of Work at the Site, it shall be the Contractor's responsibility to bring such to the attention of [Honeywell] [*insert Alliance*
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Partner name] both verbally and in writing immediately for resolution. At all times, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public, and the environment.

5.4 The Contractor shall be responsible for the safe operation and storage of any equipment used or brought on-site during the Work.

6 HEALTH AND SAFETY PLAN

- 6.1 The Contractor shall prepare a site-specific Health and Safety Plan (HASP) in accordance with the requirements of 29 CFR 1910.120 and/or 29 CFR 1926.65, and all other applicable OSHA regulations and published guidelines. This HASP shall cover all personnel who will be employed by the Contractor to perform Work at the Site, including direct employees as well as employees of subcontractors and others as may be required by the Contract Documents. Duplication of the general information contained in the Contractor's Safety and Health Program is unnecessary and shall be incorporated by reference. The level of detail provided in the HASP shall be tailored to the type of work, complexity of operations to be accomplished, and hazards anticipated. The HASP must be reviewed and approved by a Certified Safety and Health Professional.
- 6.2 The Contractor shall be responsible for preparation of a site-specific HASP, its implementation, and related requirements as specified herein. This plan shall address at a minimum, but not be limited to, the following components:
- 6.2.1 Identification of Key Personnel Identify, by name and by title, the on-site and offsite health and safety personnel responsible for the implementation of health and safety procedures.
- 6.2.2 Training Describe health and safety training requirements for all supervisory and on-site personnel. Training requirements shall also include attending an initial site orientation prior to engaging in any on-site activities. Sign-off sheets acknowledging attendance shall be provided.
- 6.2.3 Medical Surveillance Certify that all supervisory and on-site personnel have received appropriate medical examinations and are able to conduct the tasks required for this project. This includes medical examinations required by 29 CFR 1910.120(f) and 29 CFR Part 1926.65(f), respiratory protection medical evaluations, respirator fit test requirements, and any site-specific biological monitoring requirements. Medical clearances shall be maintained at the Site for all employees engaged in activities with the potential exposure to hazardous waste.
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- 6.2.4 Hazard/Risk Analysis - Identify and provide a means of mitigating all foreseeable chemical and physical hazards associated with the Work. A Job Hazard Analysis or similar type document, must be completed for each major Work task.
 - 6.2.5 Work Zones - A site plan, which depicts the designation of zones including: (1) Exclusion Zones (EZ), (2) Contamination Reduction Zones (CRZ), and (3) Support Zones (SZ). The level of personal protection for each zone shall be specified by the Contractor.
 - 6.2.6 Personal Safety Equipment and Protective Clothing - Identify personal safety equipment and protective clothing to be used and available on-site. This shall include identification of expected levels of protection (e.g., B, C, and D) for each task, and the action levels and protocols for determining and implementing personal protective equipment (PPE) upgrades/downgrades.
 - 6.2.7 Emergency Response and Contingency Plan - Identify and provide procedures for emergencies arising during Work activities. A route map and directions to the nearest hospital shall also be included.
 - 6.2.8 Equipment Cleaning - Describe methods and procedures for decontamination of equipment.
 - 6.2.9 Safety Data Sheets - Provide Safety Data Sheets (SDSs) for all chemical materials to be brought on, handled, stored, and/or otherwise used at the site by the Contractor. Provide an inventory of all chemicals brought on site by all Contractors and Subcontractors in accordance with HAZCOM requirements. All chemical containers must be labeled and all personnel handling or using chemicals must be trained in accordance with HAZCOM requirements.
 - 6.2.10 Noise Level - Describe methods and procedures for controlling noise levels, as produced by construction activities, to safe and tolerable limits as set forth by OSHA and any applicable state or local codes or ordinances. All construction activities presenting a potential noise nuisance (potential to generate complaints from facility or adjacent properties) shall be provided with noise muffling devices.
 - 6.2.11 Dust Management – As applicable, describe methods and procedures for managing dust produced by site activities. Describe monitoring methods and action levels to necessitate implementation of dust management measures. The use of any materials other than clean potable water for dust management is prohibited unless approved by Honeywell and/or its Alliance Partner.
 - 6.2.12 Equipment Maintenance – Contractor HASP shall address specific health and safety considerations associated with the maintenance of all equipment, tools and electrical devices. Contractor shall specify maintenance locations, anticipated work activities
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and related worker protections, spill response, containment and cleanup, storage of chemical materials, fuels and lubricants, during vehicle maintenance activities.

- 6.2.13 Fall Protection The HASP shall address the fall hazards and controls associated with site work activities. Walking/working surfaces (horizontal and vertical surfaces) at remediation construction sites with an unprotected side or edge that is 6 feet (1.8 m) or more above a lower level shall be protected by the use of guard rail systems, safety net systems, or personal fall arrest systems. Walking/working surfaces (horizontal and vertical surfaces) at routine operation and maintenance sites with an unprotected side or edge that is 4 feet (1.2 m) or more above a lower level shall be protected by the use of guard rail systems. Contractor and all subcontractors shall comply with 29 CFR 1926, Subpart M Fall Protection, or the equivalent state requirements. Fall protection shall meet the minimum requirements of Honeywell procedure HSEMS 343 Fall Protection Procedure.
- 6.2.14 Confined Space Entry The Contractor shall identify the presence or absence of confined space entry work activities. If entry into tanks, process equipment, sumps, sewers, manholes, trenches, or other spaces identified as a confined space is identified as a work activity, a confined space entry program must be included in the HASP. The confined space entry program must include requirements for labeling confined spaces, permit requirements, monitoring requirements, PPE, retrieval equipment, training requirements, and emergency response procedures. Confined space entry program shall meet the minimum requirements of Honeywell procedure HSEMS 303 Confined Space Entry.
- 6.2.15 Crane Safety The HASP shall address the hazards and controls associated with crane, hoist, and rigging operations. This includes personnel training/certification, crane equipment inspection, positioning, and operations; general hoist operations; and rigging equipment inspection and use for material handling via cranes and hoists. Critical lift procedures and planning shall be addressed as required. Contractor] and all subcontractors shall comply with 29 CFR 1926 Subpart N Cranes, Derricks, Hoists, Elevators, and Conveyors, or the equivalent state standards.
- 6.2.16 Hot Work The Contractor shall include the requirements for a hot-work permit system for any welding, burning, open flame, spark-producing or similar activity (for example, abrasive grinders, abrasive saws). The permit should include, as a minimum, fire prevention procedures, PPE, and cylinder safety. Provide a fire watch, and necessary safety equipment (welding screen/blankets, agreed to fire extinguishers, fire hoses, firewater etc.) while performing any Hot Work. All Hot
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Work shall meet the minimum requirements of Honeywell procedure HSEMS 389-Hot Work.

- 6.2.17 Utility Clearance The HASP shall address the requirements for buried utility clearance prior to performing work activities. Sources of information to identify buried utilities include use of a utility locator service, plant drawings, locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, fuel tanks and lines, and facility personnel knowledgeable of utility location. The HASP shall assess the risk from overhead power lines and ensure adequate clearance distance is maintained.
- 6.2.18 Hazardous Energy Control The HASP shall include hazardous energy control requirements if work activities have the potential to expose Contractor employees or others working at the site to hazardous energy sources. This includes activities related to the installation, maintenance, service, repair, decommissioning, or dismantlement of machines, equipment, piping, processes, or systems. The Contractor shall provide trained and authorized employees to conduct lock out/tag out operations. This section shall include a site-specific lockout/tagout procedure. It must identify all machines, equipment, electrical installations, processes, or systems that are included in the procedure. Lock out / tag out shall meet the minimum requirements of Honeywell procedure HSEMS 301 Lock/Tag/Try.
- 6.2.19 Line Breaking The HASP shall include line breaking procedures if work activities have the potential to expose Contractor employees or others working at the site to hazardous materials contained within enclosed pipes or vessels. This includes activities related to the installation, maintenance, service, repair, decommissioning, or dismantlement of machines, equipment, piping, processes, or systems. This section shall include a site-specific line breaking procedure. It must identify all machines, equipment, piping, processes, or systems that are included in the procedure. Line breaking shall meet the minimum requirements of Honeywell procedure HSEMS 311 Line Breaking.
- 6.2.20 Excavation The HASP shall address the hazards and controls associated with excavation activities conducted by the Contractor and all subcontractors. Excavation is defined as any man-made cut, cavity, trench, or depression in an earth surface that is formed by earth removal. Excavation hazards include, but are not limited to, cave-ins, falls, falling objects, hazardous atmospheres, unstable structures, and excavating into underground utilities. Contractor and all subcontractors shall comply with 29 CFR Subpart P Excavations, or the equivalent state requirements. Excavations shall meet the minimum requirements of Honeywell procedure HSEMS 339 Excavation.
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6.2.21 Scaffolds and Ladders - The HASP shall address the hazards and controls associated with the use of scaffolds and ladders to perform work activities. This requirement applies to the use of various types of scaffolds including, but not limited to, pole, tube and coupler, fabricated frame, horse, ladder jack, outrigger, interior hung, needle beam, suspended, adjustable suspended, and mobile. It also applies to the various types of ladders that may be used to perform work activities including, but not limited to, step, extension, and fixed. Hazards that should be addressed include falls to different levels, being struck by falling objects, and exposure to unstable scaffolds and work platforms. Scaffold and ladder controls shall meet the minimum requirements of Honeywell procedure HSEMS 333 (aka Safe-43[P]) – Ladders & Scaffolds.

ATTACHMENT 01620-1 CD-13-1 Safety & Occupational Health; Compliance

ATTACHMENT 01620-1

CD-13-1 SAFETY & OCCUPATIONAL HEALTH COMPLIANCE

TO: Honeywell Site Superintendent ______.

FROM: Contractor

The employees listed below:

	If Employed by Sub-Contractor		If Employed by Sub-Contractor
<u>Name</u>	<u>List Sub's Name</u>	<u>Name</u>	<u>List Sub's. Name</u>
		11.	
		12.	
		13.	
		14.	
		15.	
		16.	
		17.	
		18.	
		19.	
		20.	

All the Safety rules presented in 01620, and all special safety and occupational health matters pertaining to this project site and its operations have been explained to those contractor employees listed above.

We believe that these employees understand the rules and risks of work at this site and that they fully intend to work safely within the spirit and letter of the documents mentioned above. If we observe any deviations, we will call it to their attention immediately and take any other corrective action, including dismissal, to comply with Honeywell's intention of safe, productive work with minimal occupational risk.

For Contractor:

Date:_____

ATTACHMENT 01620-2 CD-13-2 Contractor's Safety Declaration

ATTACHMENT 01620-2

CD-13-2 CONTRACTOR'S SAFETY DECLARATION

TO:	Honeywell Site Superintendent	
FROM:	Contractor's Safety Officer	
As the du	ly authorized and designated representative and agent of	hereina

As the duly authorized and designated representative and agent of ______, hereinafter called "Contractor", I hereby certify and agree for myself and for and on behalf of Contractor that:

- (1) I have been advised and instructed by the Honeywell Site Superintendent concerning working conditions including hazards, if any, involved in the job and/or job location in which Contractor and Contractor's agents and employees will be working or present;
- (2) I have already instructed or will immediately instruct all such agents and employees with respect to such conditions and/or hazards and the proper safety precautions to be observed in regard thereto. I will also see to it that each Contractor employee signs form CD-13-3 and will submit these weekly for all new employees;
- (3) All necessary, adequate and operative protective clothing and equipment have been or will be immediately issued to all such agents and employees, together with full instructions and training for their use;
- (4) Procedures including employee clothing and equipment requirements will be put into effect; that all such agents and employees will be properly supervised to insure compliance in the use of protective clothing and equipment and in the strict observance of safety rules and regulations; and
- (5) The following items among other items, were specifically covered:
 - a.) General safety rules and regulations
 - b.) Special safety and occupational health matters pertaining to this site and its environs.
 - c.) Compliance with 29 CFR 1910.120.

Date:

Signature of Contractor's Representative for himself and for and on behalf of Contractor

Signature of Honeywell employee giving instructions

ATTACHMENT 01620-3 CD-13-3 Contractor's Employee Safety Declaration

ATTACHMENT 01620-3

CD-13-3 CONTRACTOR'S EMPLOYEE SAFETY DECLARATION

TO: Honeywell Site Superintendent

FROM: Contractor

I have been instructed in detail on and understand the following:

- 1. The existence and requirements of the OSHA Hazard Communications Standard.
- 2. The chemical hazards present in the areas where I will be working.
- 3. The hazards associated with these chemicals.
- 4. Where the Project Site maintains the written Health and Safety Plan.
- 5. The list of Material Safety Data Sheets and the location of these sheets.
- 6. Site Specific Health and Safety Plan

Employee Signature

Employee Name Printed

Contractor Name Printed

ATTACHMENT 01620-4

RES Contractor Safety Booklet Acknowledgement Page

RES CONTRACTOR SAFETY BOOKLET ACKNOWLEDGEMENT PAGE

Acknowledgement Page Read Carefully Before Signing Below

This is to acknowledge that I have received my copy of the Honeywell Project Contractor Safety Handbook and an orientation on its contents as well as other project rules and policies. I have read, understand and will abide by all rules and regulations in the handbook and any additional rules and regulations of my job. I understand that working safely, complying with and obeying any and all of my Company and Honeywell project safety rules, regulations or standards is a condition of employment at this Honeywell project site location. Should I not comply with my Company and/or Honeywell project safety rules, regulations or standards, I am subject to disciplinary action including removal from the site and possible termination of employment. I understand further that this handbook and the rules and regulations it contains do not in any way constitute a contract (either expressed or implied) of employment between the Company as my employer and me for any indefinite or specified period of time.

Print Full Name

Signature

Contractor Company Name

Honeywell Project Contact/Representative

Date

Note: After properly endorsed, the perforated page is to be removed and given to the Honeywell Project Contact and/or Representative.

March 2013

ATTACHMENT 01620-5 RES-HS-11 Event Notification / Communication

ATTACHMENT 01620-6 RES-HS-09 Substance Abuse and Prevention Requirements and Certification Form

SUBSTANCE ABUSE AND PREVENTION REQUIREMENTS (EXCERPT FROM RES HEALTH AND SAFETY MANUAL)

Contractors performing, and those individuals that provide direct supervision (means and methods) of the following work activities shall comply with Honeywell's Substance Abuse and Prevention Requirements:

- The use of heavy, construction-type equipment including, but may not be limited to, excavator, cranes of any type, drilling equipment, including geoprobe, compactor, etc.;
- Operations and maintenance at treatment plant-treatment systems facilities;
- Safety sensitive/at-risk work such as, but may not be limited to, confined space entry, lockout/tagout, dredging operations, hot work activities, etc.;
- Other work activities not listed can be assessed on a case-specific basis by the PM of the Alliance/Non-Alliance Firm and/or the certified safety and health professional approving the HASP for such activity to determine applicability to the requirements.

The requirements prohibit the use, manufacture, sale, possession, or transfer of illegal drugs, alcohol, and controlled substances on Honeywell sites. The Substance Abuse and Prevention Requirements are included in Honeywell contracts. Specification 01620 and contract documents contain specific details regarding the Substance Abuse and Prevention Requirements. As an overview the requirements includes the following elements:

- Contractor's drug screening program and reporting shall comply with and be in accordance with Parts 382 and 40 of the Federal Motor Carrier Safety Regulations, Department of Transportation;
- Pre-assignment screening for illegal/unauthorized substances (alcohol, marijuana, cocaine, opiates, amphetamines and phencyclidine) must occur not more than two (2) weeks prior to their initial assignment for work at Honeywell's site. Contractor personnel who are in a continuous random drug testing program are not required to be screened for subsequent work activities at the same site, except for alcohol testing. If contractor does not have a random monthly screen rate of 10 percent, contractor is required to be drug and alcohol screened on a monthly basis for long-term projects (projects greater than 30 days) and be retested each time they begin a work at any site; and,
- In addition, to pre-assignment testing, contractors shall establish procedures in the HASP for post-accident and reasonable suspicion testing for illegal/unauthorized substances.

CERTIFICATION OF COMPLIANCE

Contractor/Subcontractor (Company):						
Contractor/Subcontractor (Point-of-Contact): Phone Number:						
Address:						
Project Site:						
Work Activities to Be Performed by the Contractor/Subcontractor (check any and all that apply):						
Use of heavy, construction-type equipment including, but may not be limited to, excavator, cranes of any type, drilling equipment, including Geoprobe, compactor, etc.						
Operations and maintenance at treatment plant-treatment systems facilities						
Safety sensitive/at-risk work such as, but not be limited to, confined space entry, lockout/tagout, dredging operations, hot work activities, etc.						
Other work activities determined to trigger applicability of the requirements (please list work activities below)						
I, (print name of Contractor/Subcontractor's representative), a duly						
authorized representative of (print name of Contractor/Subcontractor),						
certify that (Company's name) is in full compliance with Substance						
Abuse and Prevention Requirements, including the prohibition on the use, manufacture, sale,						
possession, or transier of megal drugs, alconol, and controlled substances of homeywell sites.						

further certify that (Company's name) is in full compliance with the drug screening, pre-assignment testing, and drug testing requirements also described in the Substance Abuse and Prevention Requirements. I understand that compliance with this certification and with all applicable Health and Safety requirements may be subject to review, audit, and verification at any time prior to or during execution of our work.

Contractor's Representative

Date

ATTACHMENT 01620-7

Monthly Exposure Hours Report



ATTACHMENT 01620-7 Monthly Exposure Hours Report

Instructions: This form is used to <u>report monthly</u> contractor exposure hours that are worked at a Honeywell location. Definitions and the different types of contractor activities that should or should not be reported are discussed below. Unless alternate arrangements are made (e.g., Allinace Partner with access to event reporting system enters directly), Email completed form by the 10th day of each month to report exposure hours for the previous month to <u>merry.abbott@honeywell.com</u>.

Definitions:

Contractor = non-Honeywell individual(s) that <u>provide independent contract labor services</u>, either by direct purchase order, blanket purchase order, contract or other agreement. This labor service typically includes, but is not limited to, capital improvement projects, minor renovations, equipment installation, service, maintenance or repair activities.

Independent Contract Labor = individual(s) <u>working on-site</u> that have the means, methods and processes by which the work objective is accomplished, <u>directly supervised by the contractor</u> <u>company</u>.

Categories of "Contractor Hours and Injuries" that should be reported

Capital = individuals associated with a specific construction or remediation project [work requiring an Appropriation Request (AR)] that has a dedicated Honeywell Project Manager or Engineer.

General = individuals working on an <u>as-needed basis</u>, usually more than four (4) hours/day and a couple of times per month (e.g. fire or security alarm personnel, office or equipment repairs, etc.)

Resident = individuals working on a <u>regular or temporary permanent basis</u> (e.g. outsourcing) related to site/plant operations including, but not limited to; administration/clerical, cleaning services, consultants, food service, mail delivery, maintenance and repair activities, security guards, technical/laboratory, etc.

Work hours and injuries that are NOT considered a "Contractor"

Temps = agency personnel <u>working under the direct supervision</u> of Honeywell. These individuals are not considered independent contractors and should have their work-related hours and injuries <u>reported as "Honeywell"</u>, for the purpose of calculating Honeywell incident rates.

Delivery = individuals briefly coming onto Honeywell property for the drop-off of materials (e.g. FedEx, UPS, common carriers, vending machines, etc.). <u>NOTE:</u> Although work hours are not captured, procedures should be in place to address the potential hazard of chemical deliveries by tanker trucks (e.g. nitrogen, oxygen, etc.) **Visitors** = individuals coming onto Honeywell property for non-labor related activities, usually on an one-time basis (e.g. meetings, inspections, plant tours)

Contractor Classification	Contractor/Subcontractor Name	Work Hours

Reporting Month		Total Hours	1t
-----------------	--	-------------	----

Reporting Location	Honeywell Project #	Contact	
	Other Project # (if any)		

Safety Performance

Were there any incidents during the month (e.g. near misses, property damage, first aid or medical treatment cases, lost time injuries, fatalities)? No Yes If "Yes", the contractor must complete a Contractor Incident Investigation Report (see RES-HS-05).

ATTACHMENT 01620-8

Honeywell HSES Procedures File (electronic file only)





SECTION 01 02 03

HYDROTURF[®] CS ENGINEERED TURF SPECIFICATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section Includes:
 - Specifications for the Engineered Turf component (Turf Type 1) of the HydroTurf[®] CS System.

1.02 RELATED SECTIONS

Section 31 23 13	- Subgrade Preparation
Section 01 73 19	- HydroTurf CS Structured Geomembrane Specifications
Section 03 49 01	- HydroBinder [®] Infill Specification

1.03 SUBMITTALS

A. MANUFACTURER

- 1. MQC Testing Engineered Turf Component
 - a. Certificate of Compliance: Certificate of Compliance shall indicate that the engineered turf meets or exceeds the property values in Table 1. Also, the turf fiber color / blend shall be indicated.
 - b. Provide inspection records of the tufting procedures for every 300,000 sq.ft. of Engineered Turf, including:
 - Inspection records that indicate the following properties as they relate to Section 2.01 – Engineered Turf:
 - a.) Tufting Gauge;
 - b.) Pile height;
 - c.) Roll length and roll numbers;
 - d.) Total product weight;
 - e.) Tensile Strength Product (lbs./ft.) (MARV) ASTM D 4595; and
 - f.) Tensile Strength of Yarn (lbs.) (MARV) ASTM D 2256.

- 2. Conformance Testing Engineered Turf
 - a. Obtain one Engineered Turf sample for every 100,000 sq. ft. of material supplied to the site;
 - b. Forward samples to the INDEPENDENT TESTING LABORATORY and test for the following:
 - 1.) Total product weight;
 - 2.) CBR Puncture ASTM D6241;
 - 3.) Tensile Strength Product ASTM D 4595; and
 - 4.) Tensile Strength of Yarn ASTM D2256.
 - c. Refer to the properties table under Section 2 for required values for the above properties.

B. GEOSYNTHETICS INSTALLER

- Prior to beginning the installation of the HydroTurf CS System, GEOSYNTHETICS INSTALLER shall submit the following to the OWNER'S REPRESENTATIVE for Engineered Turf component:
 - a. Verify in writing that GEOSYNTHETICS INSTALLER'S PERSONNEL have the following experience:
 - 1.) GEOTEXTILE SEAMERS
 - i. Shall have installed at least 1,000,000 square feet of like materials.
 - OWNER'S REPRESENTATIVE shall be responsible for approving resumes and qualifications of GEOSYNTHETICS INSTALLER PERSONNEL; and
 - c. GEOSYNTHETICS INSTALLER PERSONNEL shall attend HydroTurf CS orientation prior to starting the work.

C. PRODUCT DATA

2. Refer to Section 2.0 for the Engineered Turf specifications applicable to this project and integral part of the product specifications.

PART 2: PRODUCTS

2.01 ENGINEERED TURF – HYDROTURF CS

- A. Manufacturer: Shaw Industries, Inc.
 - The engineered turf component shall meet or exceed property values listed in Table 1 as an individual component and as the performance property for the HydroTurf CS system.
 - 2. Engineered synthetic turf shall be supplied by Watershed Geosynthetics as a component of the HydroTurf CS Revetment System.
- B. Substitutions
 - a. None
- C. The engineered synthetic turf shall be comprised of the following components:
 - a. Polyethylene slit tape fibers; and
 - b. Two polypropylene backing geotextiles.
- D. The polyethylene yarn shall conform to the color selected by the Owner per color coding provided under Section 1.04(A)(1).

Table 1 – Property Values for Engineered Turf Component (Turf Type 1) of HydroTurf CS

System

Property	Test Method	Value			
Engineered Turf Component					
Tufted Pile Height (inches)	ASTM D 5823	$.1.25 \pm 0.25$			
CBR Puncture, lbs	ASTM D6241	.800 (MARV)			
Tensile Strength, MD/XMD, lbs/ft	ASTM D4595	-1000 (MARV)			
Pile Weight	ASTM D5848	$.19 \pm 2.0$ oz./sq. yd			
Total Product Weight		25 ± 2.0 oz./sq. yd			
Yarn	ASTM D 1577	Polyethylene Fibrillated			
Tensile Strength of Yarn	ASTM D2256	.15 lbs min			
A gradynamic Evaluation	GTRI Wind	120 mph with max.			
	Tunnel	uplift of 0.12 lb/sf			
UV Resistance and Stability of Synthetic	ASTM G147	.>60% Retained Tensile Strength at			
Turf	ASTM G7	100-year exposure (projected)			
Standard Roll Dimensions .15-ft (4.57-m) Wide x 300-ft (91.4-m) Le		Wide x 300-ft (91.4-m) Long			
Roll Area (approximate)	$-4500 \text{ ft}^2 (418 \text{-m}^2)$				
HydroTurf CS System Performance Properties					
Full-Scale Steady State Overtop Test	ASTM D7277 / ASTM D7276	.40 ft/s of velocity			
Manning's N Value	ASTM D7277 / ASTM D7276	.0.017 - 0.020			
Full-Scale Steady State Hydraulic Jump Test	Colorado State University (CSU)	Dissipates 30 horsepower per ft (min)			
Full-Scale Wave Overtopping Test –	CSU Wave	.165,000 ft ³ /ft (min)			
Cumulative Volume	Simulator				
Full-Scale Wave Overtopping Test –	CSU Wave	-4.0 cfs/ft			
Maximum Average Wave Discharge	Simulator				
Internal Friction of Combined Components (Low Confining Stress)	ASTM D 5321	.23° min (peak) MicroSpike .33° min (peak) Super GripNet			

PART 3: EXECUTION:

3.01 INSTALLERS

A. Installer shall be trained by Watershed Geosynthetics, LLC.

3.02 INSTALLATION

- A. ENGINEERED TURF COMPONENT:
 - 1. CQA PERSONNEL shall verify that:
 - a. Engineered Turf tufts are not excessively pulled out by the installation process; and
 - b. After the first panel is deployed, all subsequent panels are deployed on top of the previous panel, seamed, and then flipped into position.
3.03 ENGINEERED TURF COMPONENT DEPLOYMENT

- A. Prior to installation of Engineered Turf Component, the CQA PERSONNEL must observe the following:
 - 1. HydroTurf CS geomembrane component has been seamed, tested, approved, and is released for further component deployment by the POR; and
 - 2. The supporting surface (e.g., the geomembrane) is substantially free of debris or large scraps.
- B. During deployment of Engineered Turf, the CQA personnel must observe the following:
 - Observe the turf as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.);
 - 2. That repairs are made in accordance with Section 3.05 and the HydroTurf Installation Guidelines;
 - 3. Equipment used does not damage the turf or underlying geomembrane;
 - 4. That all panels are deployed from the top of the slope in a way that the Engineered Turf filaments are pointing upslope after deployment is complete;
 - That the turf is anchored to prevent movement by the wind (the GEOSYNTHETICS INSTALLER is responsible for any damage resulting to or from windblown Engineered Turf);
 - 6. That the turf remains substantially free of contaminants;
 - 7. That the turf is laid substantially smooth;
 - 8. That on slopes, the turf is secured with sandbag anchoring at the top of the slope after deployment;
 - 9. Fusion Seaming Method
 - a. Engineered Turf fusion seaming device will be a DemTech VM20/4/A
 (Model No. VM-20/4/A Pro-Wedge Welder 120V, VM20 Outfitted with 100-KIT/4S/VC/A.2 Welding Kit, 4-in, 220V, S.S.) fusion welder only.
 - b. Fusion seams require a minimum of 5 inches of overlap.
 - c. Demonstrate the preparation methods and equipment utilized for removal of the salvage from the outside edge of the rolls of turf (i.e. trimming & cutting devices). Mechanical trimming and cutting devices will be utilized

for salvage trimming. Box blades and knives shall not be utilized for salvage preparations. Fraying of geotextile strands when performing the removal of salvage is not acceptable.

- d. Frayed or loose edges and/or geotextile strands shall be cut off or removed.
- e. Since the temperature and speed controls of the DemTech VM-20 wedge welder are variable and can be increased / decreased depending on weather and environment conditions, the temperature and speed shall be confirmed with a trial seam. This trial seam shall be field tested. Trial seams shall be performed at the beginning of each day, the beginning of the afternoon, and during the day when the weather (i.e., temperature, humidity, etc.) conditions change.
- f. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).
- g. Production field seaming shall be performed and verified in the same manner as trial seams. The field seams shall be inspected every hour at a minimum. This inspection of the field seams shall be the same as the inspection for the trial seams.
- h. Production fusion seams shall be continuous and have no gaps.
- Any damage and defects (including burnouts) that occur during production seaming will be repaired as outlined in Section 3.05 and HydroTurf Installation Guidelines (most recent revision).
- j. All seams not passing the visual inspection shall be repaired.
- k. After seaming operations, the edges of the synthetic turf panels shall be sufficiently anchored with sandbags in the top of slope perimeter anchor trenches unless otherwise noted on the construction drawings.

3.04 EQUIPMENT ON THE TURF:

A. Construction equipment on the deployed synthetic turf shall be minimized to reduce the potential for synthetic turf material puncture. Small equipment such as

generators shall be placed on scrap synthetic turf / geosynthetic material (rub sheets) above engineered synthetic turf.

- B. During Construction:
 - 1. On slopes exceeding 15%
 - a. No equipment will be allowed until HydroBinder Infill is in place.
 - 2. On slopes less than 15%
 - ATV type vehicles and/or rubber tracked skid steer machines will be allowed prior to infill placement if the tire / track ground pressure is less than 5 psi.
 - 3. Equipment operators shall inspect equipment rubber tires or tracks for sharp protrusions from foreign matter or tire/track damage, embedded rocks, or other foreign materials protruding from tires/track prior to driving on the synthetic turf. Equipment travel paths driven on synthetic turf shall be as straight as possible with no sharp turns, sudden stops or quick starts.
 - Damage caused by having equipment on the engineered synthetic turf (i.e., tears, rips, punctures, wrinkles, ripples, movement, etc.) shall be the responsibility of the installer to repair.
- C. Post installation, no equipment shall be allowed on the HydroTurf until HydroBinder Infill is fully cured for 28 days:
 - Driving should be limited and only in areas where the subgrade under the HydroTurf is well-compacted, firm and unyielding.
 - Drivability tire / track (ground) pressures should be limited to less than 35 psi. Rubber tire and/or tracked vehicles or equipment only.
 - 3. On slopes flatter than 10%, allowable ground pressures may only be increased with the written approval of the POR.
- D. Any activity that may be identified during the course of construction by the POR, OWNER'S REPRESENTATIVE, or CQA PERSONNEL as being a possible danger to the integrity of the HydroTurf CS system will be prohibited regardless of any prior approval.

3.05 REPAIR AND TIE-IN PROCEDURES

- A. ENGINEERED TURF COMPONENT:
 - 1. When Repairs and Tie-Ins of Engineered Turf occur, the CQA PERSONNEL

must observe the following:

- a. Repairs to Engineered Turf are completed by using a 4-in overlapped heatbonded seam;
- All tie-in seams along flatter slopes (i.e. 15% or less) with length greater than 25 feet will use an approved fusion welding machine so that consistent pressure is achieved throughout the seam; and
- c. A hand-held heat gun or leister with hand pressure will be used in smaller/concentrated areas. Passing trial seams using the hand-held heat gun shall be performed prior to production seaming. Trial seams shall be performed as outlined in the HydroTurf Installation Guidelines (most recent revision).
- 2. GEOSYNTHETICS INSTALLER may also demonstrate techniques and practices as follows:
 - a. Field demonstration and approval by the OWNER'S REPRESENTATIVE is required before incorporating any alternative technique.

3.06 INSTALLATION ACCEPTANCE

- A. The Geosynthetics Installer retains all ownership and responsibility for the HydroTurf CS system until acceptance by the Owner.
 - 1. After HydroTurf CS components are deployed, seamed, has passed required testing successfully, and any repairs are made;
 - a. The completed installation will be inspected by the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR;
 - b. Damage and/or defects found during this inspection will be repaired by the GEOSYNTHETICS INSTALLER; and
 - c. The installation will not be accepted until it meets the requirements of these specifications and any applicable State, Federal or Local Regulations.
- B. Installation of the HydroTurf CS system will be accepted by the POR only when the following has been completed:

- 1. The installation is complete;
- 2. Seams have been observed and documented by the CQA PERSONNEL and accepted by the POR;
- 3. Required independent testing laboratory and field tests have been completed, reviewed and approved;
- 4. Required GEOSYNTHETICS INSTALLER supplied documentation has been received, reviewed and approved; and
- 5. As built record drawings have been completed and verified by the POR.

END OF SECTION

SECTION 01 73 19

HYDROTURF® CS STRUCTURED GEOMMEMBRANE COMPONENT SPECIFICATION

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes:

 Specifications for the Structured Geomembrane Component of the HydroTurf CS[®] System

1.02 RELATED SECTIONS

Section 31 23 13	- Subgrade Preparation
Section 01 02 03	- HydroTurf CS Engineered Turf Specification
Section 03 49 01	- HydroBinder [®] Infill

1.03 REFERENCES

A. See Section 01 42 00 - References and Definitions

1.04 SUBMITTALS

A. MANUFACTURER

- 1. Pre-Production Manufacturer's Product Data
 - a. Submit to the OWNER'S REPRESENTATIVE prior to ordering of geomembrane component:
 - Certificate of Compliance that shows that the proposed material for this project will meet the project specifications;
 - 2.) Indicate tentative product order date and manufacturer location;
 - 3.) Provide representative Product Data Sheets;
 - 4.) Provide four (4) representative product samples (if requested); and
 - 5.) Provide manufacturer's quality control program, including test procedures and frequencies for this product.
- 2. Pre-Shipment Manufacturer Quality Control (MQC) Data
 - a. Submit to the OWNER'S REPRESENTATIVE prior to shipment of geomembrane component:

- 1.) A copy of the MQC test results;
- 2.) Statement that MQC testing has been done in accordance with manufacturer's quality control program;
- 3.) Certificate of Compliance stating;
 - a.) Production dates and origin of resin;
 - b.) All resin is from same manufacturer;
 - c.) Reclaimed resin does not exceed 10 percent by weight; and
 - d.) Any additional MQC certifications required by the CONTRACT.
- 4.) MQC Certifications shall include:
 - a.) Geomembrane roll numbers and identification;
 - b.) Sampling procedures; and
 - c.) Results of MQC tests, and the test methods used.
- 3. Conformance Testing
 - Sampling required once rolls are received onsite or at Manufacturer's Plant prior to shipment with written approval:
 - 1.) OWNER'S REPRENTATIVE (or approved 3rd party) shall collect samples at the specified interval and sizes listed below; and
 - a.) OWNER'S REPRESENTATIVE may also have a 3rd party collect the samples and have them shipped to an INDEPENDENT TESTING LABORATORY for testing.
 - 2.) Take samples across entire roll width;
 - 3.) Sample size: 15 inches x roll width;
 - a.) Indicate machine direction;
 - b.) Indicate roll identification number;
 - c.) Assign a unique conformance test number to the sample; and
 - d.) Mark sample with date listed above.
 - 4.) Conformance frequency samples
 - a.) Obtain for each resin lot; and
 - b.) Each 100,000 sq. ft. of geomembrane.

- 5.) Forward samples to the Independent Testing Lab for the following tests (refer to Table 1):
 - a.) Density (ASTM D 792, Method B);
 - b.) Carbon black content (ASTM D 4218);
 - c.) Carbon black dispersion (ASTM D 5596);
 - d.) Thickness (ASTM D 5994); and
 - e.) Tensile properties (ASTM D 6693/Type IV Specimen).
- 4. Limitations
 - a. No material will be installed until Independent Testing Lab results show conformance with the specifications; and
 - b. The DESIGN ENGINEER will inform the INDEPENDENT TESTING LABORATORY in writing if additional tests are required.
- **B. GEOSYNTHETICS INSTALLER**
 - Prior to beginning the installation of the HydroTurf CS System and its components, GEOSYNTHETICS INSTALLER shall submit the following to the OWNER'S REPRESENTATIVE as it relates to the Geomembrane Component:
 - a. Shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane component;
 - b. HydroTurf CS system, including geomembrane, installation schedule;
 - c. Installation capabilities, including:
 - 1.) Information on equipment proposed for this project; and
 - 2.) Construction Quality Control (CQC) procedures.
 - d. Submit to OWNER'S REPRESENTATIVE:
 - Signed Subgrade Acceptance Certificates for each area to be covered by the geomembrane component;
 - 2.) A flow chart showing GEOSYNTHETICS PERSONNEL responsible positions for this project; and
 - 3.) Resumes of (Include date hired and duration of employment)
 - a.) Project designated GEOSYNTHETICS SEAMING SUPERVISOR;

- b.) CQC SUPERVISOR if other than above;
- c.) All personnel who will perform seaming operations;
- d.) Verify in writing that GEOSYNTHETICS INSTALLER'S PERSONNEL have the following experience:
 - i. CQC SUPERVISOR and the MASTER GEOMEMBRANE SEAMER;
 - i.) Shall have installed at least 5,000,000 square feet of like geosynthetics materials.
 - ii. All other GEOSYNTHETICS INSTALLER SEAMING PERSONNEL:
 - i.) Shall have seemed at least 1,000,000 s.f. of polyethylene geomembrane; and
 - ii.) Personnel who have seamed less than 1,000,000 s.f. of polyethylene geomembrane will be allowed to seam only under the direct supervision of the MASTER GEOMEMBRANE SEAMER or CQC SUPERVISOR.
- e.) OWNER'S REPRESENTATIVE shall be responsible for approving resumes and qualifications of GEOSYNTHETICS INSTALLER PERSONNEL; and
- f.) GEOSYNTHETICS INSTALLER PERSONNEL shall attend HydroTurf CS orientation prior to beginning the installation.
- C. CLOSEOUT SUBMITTALS:
 - 1. GEOSYNTHETICS INSTALLER shall furnish to the OWNER upon completion of the project:
 - a. Two year warranty against defects in workmanship;
 - b. As-built Geomembrane Panel Drawings; and
 - c. As-built Drawings shall include:
 - 1.) Panel locations,
 - 2.) Panel identification numbers,
 - 3.) Geomembrane roll numbers for each panel,
 - 4.) Seam caps,

- 5.) Destructive sample locations, and
- 6.) Location of repairs.
- D. PRODUCT DATA
 - 1. See Section 2.01

1.05 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's recommendations to prevent damage to the materials;
- B. Deliver materials to the site only after the OWNER'S REPRESENTATIVE and the OWNER approve required submittals;
 - 1. CQA PERSONNEL shall observe and document that all rolls of geomembrane delivered to the site have been properly identified (at the manufacturer's location) along with the following:
 - a. Manufacturer's name,
 - b. Product identification,
 - c. Lot number,
 - d. Roll number, and
 - e. Roll dimensions.
 - 2. CQA PERSONNEL shall observe and document the following:
 - a. Rolls are wrapped with protective covering; and
 - b. Rolls are protected from any outside source that could degrade or damage the product.
- C. Storage and Handling Requirements
 - 1. On-Site Storage
 - a. Store in space allocated by the OWNER;
 - b. Store on level prepared surface (not on wooden pallets) graded to drain away from HydroTurf CS components; and
 - c. Stack no more than three rolls high.
 - 2. On-Site Handling
 - a. The GEOSYNTHETICS INSTALLER is responsible for storage and transporting material from storage area to installation area;
 - b. Use appropriate handling equipment approved by the OWNER'S REPRESENTATIVE;

- c. Dragging panels on ground surface will not be permitted; and
- d. Do not fold geomembrane component material.
- 3. Packaging and Waste Management
 - a. GEOSYNTHETICS INSTALLER shall be responsible for proper containment, collection and disposal of:
 - 1.) Waste and packaging; and
 - All waste products produced by the installation of the HydroTurf CS System.

1.06 SITE CONDITIONS

- A. Ambient Conditions
 - Excessive heat or cold, ambient temperatures less than 35°F and greater than 104°F, will require additional testing as indicated below; and
 - 2. The acceptable ambient temperature range may vary from parameters shown in Article 1.06A-1 only if field test seams can pass at the specific ambient temperature at which welding will take place.
- B. Existing Conditions
 - 1. See Section 31 23 13 for Subgrade Preparation Specifications.

PART 2: PRODUCTS

2.01 GEOMEMBRANE COMPONENT OF HYDROTURF CS SYSTEM

- A. AGRU 50 mil Super Gripnet[®] LLDPE Geomembrane
 - 1. Manufacturer: AGRU America, Inc.
 - a. The geomembrane shall meet or exceed the property values listed in Table1.
 - b. AGRU Super Gripnet[®] LLDPE Geomembrane shall be supplied by Watershed Geosynthetics as a component of the HydroTurf CS Revetment System.
 - 1. SUBSTITUTIONS
 - a. None

Property	Test Method	HDPE Values
.Thickness, nominal, mil (mm)	ASTM D5994	.50 (1.25)
.Thickness, min avg, mil (mm)		.47.5 (1.19)
Thickness (8 out of 10), mil (mm)		.45 (1.12)
-Thickness, lowest individual., mil (mm)		-42.5 (1.06)
Drainage Stud Height, min. avg., mil (mm)	.ASTM D7466	_130 (3.3)
Friction Spike Height, min. avg., mil (mm)	-ASTM D7466	.175 (4.45)
Density, g/cc	ASTM D792, Method B	.0.939 (min)
Tensile Properties, avg., both directions		
.Strength @ Yield, min. avg., lb/in (N/mm)	ASTM D6693, Type IV	_105 (18.4)
Elongation @ Yield, min. avg., %, GL=1.3 in		_13.0
.Strength @ Break, min. avg., lb/in (N/mm)		.110 (19.3)
Elongation @ Break, min., %, GL=2.0 in		300
-Tear Resistance, min., avg., lbs (N)	.ASTM D1004	_30 (133)
Puncture Resistance, min. avg., lbs (N)	.ASTM D4833	_55 (245)
Carbon Black Content, range in %	-ASTM D4218	.2-3
Carbon Black Dispersion, Category	ASTM D5596	Only spherical agglomerates for 10 views in Cat. 1 or 2
Oxidative Induction Time, minutes	-ASTM D 3895, 200°C, 1 atm O ₂	.≥140
Standard Roll Dimensions	23-ft (7.0-m) Wide by 300-ft (91.4-m) Long	
Roll Area (approximate)	6900 ft ² (640m ²)	

Table 1 – HydroTurf CS Super Gripnet Geomembrane Component Properties

PART 3: EXECUTION

3.01 INSTALLERS

A. Installer shall be trained by Watershed Geosynthetics, LLC.

3.02 EXAMINATION

- A. Verification of Conditions
 - 1. OWNER'S REPRESENTATIVE shall:
 - a. Verify provisions set forth in Section 31 23 13 SUBGRADE PREPARATION; and
 - b. Verify that SUBMITTALS and forms have been completed.

B. Pre-Installation Testing

- 1. FIELD TRIAL SEAM TESTING TRIAL WELDS
 - a. Prior to geomembrane component welding, CQA personnel shall observe

and document the following:

- 1.) Welding apparatus (both wedge and extrusion welder) are tested;
 - a.) At daily start-up;
 - b.) Immediately after any break; and
 - c.) Anytime the machine is turned off for more than 30 minutes.
- b. Procedures
 - The trial weld will be completed under conditions similar to those under which the panels that will be welded;
 - If at any time, the CQA PERSONNEL believe that an operator or welding apparatus is not functioning properly, a Field Trial Seam Test must be performed;
 - Any dispute concerning proper installation techniques or the proper function of welding equipment shall be resolved by the OWNER'S REPRESENTATIVE;
 - The trial weld must be allowed to cool to ambient temperature before testing; and
 - Trial weld samples must comply with "PASSING CRITERIA FOR WELDS" included in Section 3.07-B.
 - 6.) Field Seam Test Failure
 - a.) Unacceptable locus-of-break codes per their description in ASTM D6392:
 - i. Hot Wedge: AD and AD-Brk>25%
 - ii. Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)
 - b.) There shall be no apparent weld separation (i.e., greater than 1/8 inch); and
 - c.) The INDEPENDENT TESTING LABORATORY strength tests must:
 - i. Meet the manufacturer's specifications for the sample sheets; or

- ii. Percentage of the manufacturer's parent sheet strength as determined by the manufacturer; and
- iii. For dual-track fusion welds, both sides (the inner and outer weld) must meet the minimum requirements for a satisfactory peel test.
- c. Additional Field Seam Testing Requirements:
 - 1.) A trial weld will also be obtained prior to welding tie-ins;
 - 2.) The trial weld sample must be 3 feet long and 12 inches wide, with the seam centered lengthwise;
 - If a welding apparatus exceeds 5 hours in the second half of the day, another trial seam must be performed;
 - 4.) Required number of specimens per trial weld:
 - i. Two coupons for shear and two coupons for peel; and
 - ii. Both the inner and outer welds of dual track fusion welds:
 - i.) Must be tested for each peel test coupon; or
 - ii.) Additional coupons may be required.
- d. CQA documentation of trial seam procedures will include the following:
 - 1.) The names of the seaming personnel;
 - 2.) The name of the welding technician;
 - 3.) The welding apparatus number, time, date;
 - 4.) Ambient air temperature; and
 - 5.) Welding apparatus temperature.

3.03 INSTALLATION

- A. Geomembrane Component will not be deployed under following conditions:
 - 1. During precipitation;
 - 2. In the presence of excessive moisture as determined by the CQA Personnel onsite;
 - 3. In areas of ponded water; and
 - 4. In the presence of excessive winds (sustained winds greater than 25 MPH) or

at the discretion of the POR.

- B. CQA PERSONNEL shall observe the following while the geomembrane component is being deployed:
 - 1. Use equipment which will not damage geomembrane;
 - 2. Observe that personnel working on geomembrane do not engage in activities that could damage HydroTurf CS Components;
 - 3. Smoking on the liner is prohibited;
 - 4. Clamps and other metal tools are not tossed or thrown;
 - 5. Geomembrane component has had adequate time to acclimate to ambient temperature prior to welding;
 - 6. Panels are deployed with the spike down and the stud side up;
 - The deployment method will protect both the geomembrane component as well as the underlying subgrade;
 - 8. Adequate anchoring techniques are placed to prevent uplift by wind;
 - 9. Anchoring techniques are used that will not damage the geomembrane component;
 - 10. Continuous anchors are used along leading edges of the geomembrane to reduce wind flow under panels;
 - Panels will be deployed perpendicular to slope elevation contours (parallel to slope);
 - 12. Generation of seams will be reduced where possible;
 - Protect geomembrane in heavy traffic areas using methods approved by the POR;
 - 14. Rubber tired ATV's are acceptable if specified wheel pressure limitation is specifically observed and provided to the POR by the GEOSYNTHETICS INSTALLER in writing;
 - 15. The bottom and side anchor trenches are left open until the engineered turf and sand infill placement are complete;
 - Top anchor trenches are backfilled as soon as practical to avoid creeping of the geomembrane;
 - 17. Verify that the HydroTurf CS system is properly deployed into the anchor

trench prior to backfilling;

- 18. Where possible, anchor trenches are filled when temperatures are coolest to reduce bridging of the geomembrane component;
- Material placed in anchor trenches are placed in uniform lifts, not to exceed
 inches loose thickness and are compacted;
- 20. In-place moisture/density tests in anchor trenches may be taken at the discretion of the POR; and
- 21. Slightly rounded corners will be provided in anchor trenches.

3.04 WRINKLES

- A. The CQA PERSONNEL shall:
 - 1. Inspect geomembrane for wrinkles;
 - 2. Notify the GEOSYNTHETICS INSTALLER if wrinkles are present above the maximum tolerance level as described below;
 - 3. Document corrective actions taken to reduce the wrinkles;
 - 4. Observe that wrinkles are reduced prior to field seaming; and
 - Observe that snapping procedures described in Article 3.06 SPECIAL TECHNIQUES are followed.
- B. Any wrinkles that can fold over must be repaired if:
 - 1. Overnight temperature reduction does not contract the geomembrane to an acceptable level as determined by the CQA PERSONNEL; and
 - 2. Time constraints do not allow for an overnight wait time to be observed whether wrinkles were reduced adequately.

3.05 HYDROTURF CS GEOMEMBRANE COMPONENT FIELD SEAMING

- A. CQA PERSONNEL must observe the following:
 - 1. Prior to geomembrane seaming operations;
 - a. Panel layout drawing has been accepted by the POR;
 - A seam numbering system has been incorporated as agreed upon by the POR and GEOSYNTHETICS INSTALLER prior to the start of seaming operations;

- c. The GEOSYNTHETICS INSTALLER shall have a previously agreed upon number of welding apparatus and spare parts necessary to perform the work;
- d. Verify that equipment used for welding will not damage any HydroTurf CS[®] system components;
- e. The extrusion welding machine is purged to remove heat degraded extrudate;
- f. Seam grinding has been completed less than one hour before seam welding;
- g. The upper sheet is beveled (extrusion welding only);
- h. The ambient temperature requirements (Section 1.06 SITE CONDITIONS), are met;
- i. The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture prior to welding;
- j. The weld area is substantially free of dust, rocks, and other debris;
- k. The seams are overlapped a minimum of 3 inches for extrusion and hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent;
- 1. Panels will be overlapped (shingled) in the downgrade direction;
- m. No solvents or adhesives are present in the seam area;
- n. The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing;
- The panels to be welded are in accordance with the plans and site specific specifications;
- p. There is no obvious free moisture in the weld area;
- q. Measure and document surface sheet temperature every two hours; and
- r. At the end of each day or installation segment, un-seamed edges are anchored with sandbags or other approved anchoring device.
- 2. During Geomembrane Seaming Operations;
 - a. At the end of previously placed welds, (with a cooling time longer than 5 minutes), grinding is required to expose new material before restarting a

weld (extrusion welding only).

3.06 SPECIAL TECHNIQUES

- A. During field seaming operations special attention will be given to the following:
 - 1. Once two panels have been seamed together or at the approx. 1/3 seaming process, a seam snapping process shall be applied;
 - a. Perform with manual labor by utilizing 3-4 technicians on the open side of the panel applying a pulling pressure to snap out the tented welded seam.

3.07 TESTING CONCURRENT WITH INSTALLATION:

A. DESTRUCTIVE AND NON-DESTRUCTIVE TESTING

- 1. NON-DESTRUCTIVE SEAM TESTING
 - a. GEOSYNTHETICS INSTALLER shall:
 - 1.) Non-destructively test field welds for continuity over their full length using vacuum test units; and
 - a.) Perform concurrently with seaming work progress; and
 - b.) Repair seam defects in accordance with Article 3.07 REPAIR PROCEDURES.
 - 2.) Non-destructive testing procedures
 - a.) Apparatus used to test the field seams for continuity:
 - i. Vacuum box testing equipment for extrusion welds will have:
 - i.) A rigid housing;
 - ii.) Transparent viewing window;
 - iii.) A soft rubber gasket attached to bottom of housing;
 - iv.) Porthole or valve assembly; and
 - v.) A vacuum gauge.
 - ii. Be capable of applying 5 psi gage pressure of vacuum to the box.
 - iii. Have a soapy solution.
 - b.) Vacuum Box testing procedures:

- i. Clean window, gasket surfaces, and check for leaks;
- Energize vacuum pump and reduce tank pressure to approximately 5 psi;
- iii. Wet a strip of geomembrane approximately 12 inches by 30 inches (or length of box) with soapy solution;
- iv. Place box over wetted area and compress;
- v. Close bleed valve and open vacuum valve;
- vi. Ensure that a leak tight seal is created;
- vii. Examine length of weld through viewing window for presence of soap bubbles for a period of not less than 10 seconds; and
- viii. If no bubbles appear after 10 seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three inches overlap and repeat process.
- c.) Defects:
 - i. Mark with a defect code;
 - ii. Repair the area in accordance with Section 308 REPAIRPROCEDURES; and
 - iii. Retest the repaired area.
- d.) Air Pressure Testing equipment for double fusion seams:
 - An air pump, equipped with pressure gauge having an accuracy of 1 psi, capable of generating and sustaining a pressure between 25 to 30 psi and mounted on a cushion;
 - ii. Rubber hose with fittings and connections; and
 - iii. Sharp hollow needle or other pressure feed device approved by the Owner.
- e.) Air Pressure testing procedures:
 - i. Seal both ends of the seam to be tested;
 - ii. Insert a needle or other approved pressure feed device into tunnel created by double hot wedge seaming and

insert a protective cushion between air pump and geomembrane;

- iii. Energize air pump to 25 to 30 psi, close valve, and sustain pressure for a minimum of five minutes;
- iv. If loss of pressure exceeds 2 psi or does not stabilize, locate faulty area and repair in accordance with Article
 3.08 REPAIR PROCEDURES;
- v. Release pressure at opposite end of seam from gauge to verify that the seam is not blocked; and
- vi. Remove approved pressure feed device and seal penetration holes by extrusion welding.

2. DESTRUCTIVE SEAM TESTING Geomembrane Component:

- a. GEOSYNTHETICS INSTALLER shall:
 - Cut destructive samples 12 inches wide by 48 inches long with seam centered lengthwise;
 - Repair holes in geomembrane resulting from obtaining destructive samples and vacuum test patches;
 - 3.) Obtain two 1-inch wide specimens from each side of the sample, test for peel and shear in the field;
 - i. Provide OWNER'S REPRESENTATIVE with the following:
 - i.) One sample per 500 feet of seam length per welding apparatus prior to completion of liner installation.

b. OWNER'S REPRESENTATIVE shall:

- 1.) Mark destructive samples with:
 - a.) Consecutive numbering;
 - b.) Location;
 - c.) Apparatus I.D.;
 - d.) Technician I.D.;
 - e.) Engineer I.D.;
 - f.) Apparatus settings; and
 - g.) Date;

- 2.) Record, in written form:
 - a.) Weld and test date;
 - b.) Time;
 - c.) Location;
 - d.) Seam number;
 - e.) Ambient temperatures;
 - f.) Machine settings;
 - g.) Technician I.D.;
 - h.) Apparatus I.D.; and
 - i.) Pass or fail description.
- c. Additional Destructive Testing Procedures:
 - 1.) Cut ten 1-inch wide specimens from one piece;
 - 2.) Test five specimens for peel and five for shear;
 - 3.) Test results will meet requirements of Section 3.07-B.
 - 4.) Failing Destructive Tests:
 - a.) GEOSYNTHETICS INSTALLER'S CQC REPRESENTATIVE shall;
 - i. Track the failure immediately; and
 - ii. Cut the remaining sample into three 14-inch long pieces and distribute as follows:
 - i.) To the Owner's Representative for destructive testing;
 - ii.) To the Owner's Representative for archive; and
 - iii.) To the Geosynthetics Installer for their use.
 - b.) In the event of failure, the procedures for failed seam tracking are:
 - Retrace welding path 10 (ten) feet in both directions from the failed test location and remove (at these locations) a one inch wide specimen for testing;

- Obtain destructive samples from each side of the welding path and give samples to the OWNER'S REPRESENTATIVE for destructive testing;
- iii. Repeat process if additional tests fail; and
- iv. Reconstruct seam between passing test locations to satisfaction of the OWNER'S REPRESENTATIVE.
- v. Reconstruction may be one of the following:
 - i.) Cut out old seam, reposition panel and re-seam;
 - ii.) Add cap strip;
 - iii.) Cut additional destructive samples from reconstruction at discretion of OWNER'S REPRESENTATIVE; and
 - iv.) If additional destructive sample results are not acceptable, repeat process until reconstructed seam is judged satisfactory by the OWNER'S REPRESENTATIVE.
- 5.) Final seaming inspection:
 - a.) Check the seams and surface of geomembrane for:
 - i. Defects,
 - ii. Holes,
 - iii. Blisters,
 - iv. Undispersed raw materials, and
 - v. Signs of contamination by foreign matter.
 - b.) Brush, blow, or wash geomembrane surface if dirt inhibits observation; and
 - c.) The OWNER'S REPRESENTATIVE shall decide if cleaning of geomembrane surface and welds is needed to facilitate inspection.

B. PASSING CRITERIA FOR WELDS

1. Passing criteria are based on Geosynthetic Institute Test Method GM-19 for

geomembrane seams.

- a. An extrusion or fusion-welded seam will pass when the following values are met:
 - 1.) Shear and peel strengths for 4 out of 5 test specimens (the 5th

specimen can be as low as 80 percent of the listed values) for 50-mil

LLDPE geomembrane:

- a.) Shear strength (lb./in) 100
- b.) Shear elongation at break (%) 50
- c.) Peel strength (lb./in) 75 (65 extrusion weld), and
- d.) Peel separation (%) 25
- 2.) A geomembrane seam sample passes the field testing when:
- a.) The break is a film tear bond (FTB);
- b.) The seam strength meets the required strength values for peel and shear given above; and
- c.) For dual track welds, both welds pass.
- 3.) Elongation measurements should be omitted for field-testing.

3.08 **REPAIR PROCEDURES**

A. GEOMEMBRANE COMPONENT:

- 1. The GEOSYNTHETICS INSTALLER shall be responsible for repair of damaged or defective areas;
- 2. The appropriate repair method shall be decided between the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER.
 - a. Procedures available include:
 - 1.) Patching:
 - a.) Used to repair holes (over 1/4-inch diameter), tears (over 1/4 inch long), undispersed raw materials, and contamination by foreign matter.
 - 2.) Grinding and welding:
 - a.) Used to repair pinholes, and blemishes.
 - 3.) Capping:
 - a.) Used to repair large lengths of seams.

- 4.) Removing the seam and replacing with a strip of new material.
- b. The CQA Personnel will observe and document the following:
 - 1.) The surface of the geomembrane component is clean at the time of inspection;
 - 2.) Non-conforming geomembrane component is removed and replaced;
 - Any portion of the geomembrane component exhibiting a flaw identified as defective by the POR or CQA PERSONNEL is replaced;
 - 4.) Repair areas are distinctively marked and the required type of repair is indicated.
- c. Repair Methods:
 - 1.) Geomembrane surfaces to be repaired will be abraded (extrusion welds only) no more than 1/2 hour prior to the repair;
 - 2.) All geomembrane surfaces will be clean and dry at the time of repair;
 - 3.) The repair procedures, materials, and techniques will be approved in advance of the specific repair by the OWNER'S REPRESENTATIVE;
 - 4.) Patch Requirements:
 - a.) Will be a minimum of 12 inches in diameter with all corners rounded;
 - b.) Will extend at least 6 inches beyond the edge of the defect;
 - c.) Temporarily bond the patch to the geomembrane with an approved method;
 - d.) Extrusion weld the patch; and
 - e.) Vacuum test the repair.
- d. Repair Verification:
 - 1.) CQA PERSONNEL shall number and log each patch repair;
 - 2.) CQC REPRESENTATIVE shall non-destructively test each repair using methods specified in this Section; and
 - 3.) Provide daily documentation of non-destructive and destructive testing to the OWNER'S REPRESENTATIVE.
 - 4.) The documentation will identify;
 - a.) Seams that initially failed the test; and

b.) Include the evidence that these seams were repaired and retested successfully.

3.09 INSTALLATION ACCEPTANCE

- A. The Geosynthetics Installer retains all ownership and responsibility for the HydroTurf CS system until acceptance by the Owner.
 - 1. After HydroTurf CS components are deployed, seamed, have passed required testing successfully, and any repairs are made;
 - a. The completed installation will be inspected by the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR;
 - b. Damage and/or defects found during this inspection will be repaired by the GEOSYNTHETICS INSTALLER; and
 - c. The installation will not be accepted until it meets the requirements of these specifications and any applicable State, Federal or Local Regulations.
- B. Installation of the HydroTurf CS system will be accepted by the POR only when the following has been completed:
 - 1. The installation is complete;
 - 2. Seams have been observed and documented by the CQA PERSONNEL and accepted by the POR;
 - 3. Required independent testing laboratory and field tests have been completed, reviewed and approved;
 - 4. Required GEOSYNTHETICS INSTALLER supplied documentation has been received, reviewed and approved;
 - 5. As built record drawings have been completed and verified by the POR;
 - Any other requirements shown in Section 01 73 19 1.04 D CLOSEOUT SUBMITTALS are complete and accepted by the POR.

END OF SECTION

SECTION 03 49 01

HYDROTURF[®] HYDROBINDER[®] INFILL SPECIFICATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section Includes:
 - Specifications for the HydroBinder[®] Infill Component of the patented HydroTurf[®] System.

1.02 RELATED SECTIONS

Section 31 23 13	- Subgrade Preparation
Section 01 73 19	- HydroTurf CS Structured Geomembrane Specifications
Section 01 02 03	- HydroTurf CS Engineered Turf Specifications

1.03 REFERENCES

B. See Section 01 42 00 - References and Definitions

1.04 SUBMITTALS

A. HYDROBINDER INSTALLER

- 1. HYDROBINDER INSTALLER shall submit a certificate stating that the HydroBinder meets or exceeds the requirements outlined in the project specifications, including:
 - a. That the type of cement meeting the requirements of ASTM C150 (AASHTO M85) Type I or Type II; and
 - That the cementitious infill mix shall have a minimum 28-day compressive strength of 5000 psi in accordance with ASTM C 387 as tested in accordance with ASTM C 109.

PART 2: PRODUCTS

2.01 HYDROTURF HYDROBINDER INFILL COMPONENT

A. DESCRIPTION

1. HydroBinder is a proprietary cementitious product used as the infill

component of the HydroTurf system.

- 2. HydroBinder shall be supplied by Watershed Geosynthetics as a component of the HydroTurf Revetment System.
- B. MATERIALS
 - 1. The infill will be HydroBinder Cementitious Infill;
 - The infill material may be delivered in either pallet form of 80 lb. bags or 3000 lb. bulk bag super sacks;
 - 3. Cement, except as otherwise specified herein, will be a brand of Portland Cement, meeting ASTM C 150 and will be Type I or Type II;
 - The cementitious infill mix will conform to the requirements of ASTM C 387 for high strength mortars;
 - 5. The cementitious infill mix will have a minimum 28-day compressive strength of 5000 psi as measured in accordance with ASTM C 109; and
 - 6. Freeze-thaw properties of the HydroTurf system with the HydroBinder infill treated with the Catalyzed Colloidal Silicate Concrete Treatment shall have been tested in accordance to ASTM C666 with the results of 0.2% loss (avg.) at 100 cycles and <3.0% loss (avg.) at 300 cycles.</p>

PART 3: EXECUTION:

3.01 INSTALLERS

A. Installer shall be trained by Watershed Geosynthetics, LLC.

3.02 HYDROBINDER PLACEMENT

- A. Placement of HydroBinder infill shall be performed as follows:
 - 1. HydroBinder is typically delivered to the jobsite on pallets in either 3000# bulk bags (1 per pallet) or 80# bags (42 per pallet). It is delivered on a flatbed with 16 pallets (typical) per truckload.
 - 2. The HydroBinder shall be installed into the turf while it is in a dry state.

- 3. Prior to placing the HydroBinder, the engineered turf shall be dry. If the turf is wet from rain or dew, the installer shall wait until it is dry. The installer may attempt to speed up the drying process by using a blower (i.e., leaf blower, industrial blower, etc.).
- 4. HydroBinder shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather. Also, the HydroBinder shall not be installed in cold weather as defined by American Concrete Institute (ACI) 306.
- 5. The HydroBinder infill shall be placed at a minimum thickness of 7/8-inch minimum dry thickness and a ³/₄-inch minimum finished thickness after hydration and curing. Typically, this thickness is achieved by placing between 6.5 and 7.0 lbs/sf of the dry HydroBinder over the engineered synthetic turf.
- 6. The infill is to be placed / spread using a manual drop spreader, topdresser and/or drop spreader attached to low ground pressure equipment with adequate dust control. Alternative methods can be used to spread and place the infill as approved by the Owner's Representative and/or Engineer. Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The Owner's Representative and/or Engineer shall approve the method.
- 7. Manual hand spreading is acceptable when equipment is not practical.
- B. The HydroBinder infill will need to be worked into the turfs of the engineered turf such that the turf fibers are in an upright position. This can be achieved as follows:
 - 1. The infill shall be worked into the turf fibers, so the turf fibers are in an upright position with the infill at a measurable 7/8-inch minimum depth in the dry state. This is typically achieved with common mechanical turf broom, power broom, shop broom, yard rakes, or greens groomer rakes.
 - 2. Brushing of the HydroBinder infill shall be performed such that the fibers of the engineered turf are upright and trapped fibers are minimal. This shall be confirmed by visual inspection. Multiple brushing passes in multiple directions may be required to achieve this.
 - 3. The HydroBinder may need to be placed in 2 to 4 lifts with brushing in between lifts to effectively work the material into the tufts and achieve fibers that are upright.
 - 4. Thickness measurements of the HydroBinder infill shall be taken using a caliper or equivalent device. Measurements shall be taken at a minimum frequency of 5 measurements per 1,000 sf (for smaller projects) or 20 per acre (for larger projects) of installed area.

- 5. The desired HydroBinder infill thickness shall be achieved prior to the hydration process.
- C. The HydroBinder infill shall be hydrated in place as follows:
 - 1. The hydration process shall occur on the same day as the HydroBinder infill placement.
 - 2. The infill shall be hydrated thoroughly with a light and consistent spray of water to avoid displacement of the non-hydrated infill. Estimated application rate is between 0.12 and 0.20 gallons per square foot of area. During hot temperatures and/or in dry climates, additional water may be needed.
 - 3. The installer shall not overhydrate the infill so that water begins to runoff and cause loss of cement infill during the process. The general objective is to soak the area to start the hydration process but not to inundate with water beyond saturation of the infill.
 - 4. The Owner's Representative shall visually verify that the HydroBinder infill has been fully hydrated, and not over hydrated. Visually observe that the top of the HydroBinder has a wet sheen (denoting saturation) but that water is not ponding on top. Also, excavate (with finger or small tool) into the HydroBinder to confirm full hydration of the section has been achieved.
 - 5. To improve curing, the hydrated area may be covered with plastic sheeting.
 - 6. If cold weather temperatures are expected, the hydrated area should be covered with heated blankets and plastic sheeting. Procedures in ACI 306 shall be followed for cold weather HydroBinder installation.
 - 7. The HydroBinder infill shall harden within 24 hours following hydration, and shall reach its maximum compressive strength at 28 days. If the HydroBinder has not hardened in 24 hours, it will need to be removed and replaced.
 - 8. Personnel access on the HydroTurf shall be prohibited following the hydration of the HydroBinder until it sets up hard.
- D. Once hydration is completed and the HydroBinder has set up (min. 24 hours); backfill and compaction of the remaining perimeter anchor trenches may be performed. The HydroBinder infill layer may be placed using appropriate equipment capable of completing the work;

- E. Manual hand spreading and raking is acceptable when mechanical equipment is not practical;
- F. Once hydration has been completed, and the HydroBinder has cured for a minimum of 24 hours and has fully set up; the HydroBinder Catalyzed Colloidal Silicate Concrete Treatment shall be sprayed onto the HydroTurf System in accordance with Section 03 05 59 of these Specifications.
- G. CQA PERSONNEL shall verify the following:
 - 1. INSTALLER shall explain in detail in the pre-construction meeting the method of HydroBinder infill deployment;
 - 2. Installation of HydroBinder infill will only be performed by a Watershed Geosynthetics' trained installer;
 - 3. HydroBinder shall not be installed in inclement, wet or rainy weather, or the threat of inclement weather;
 - 4. The HydroBinder shall not be installed in freezing temperatures;
 - 5. The HydroBinder will be installed into the turf while it is in a dry state;
 - 6. The HydroBinder will be worked into the tufts so the tufts are in an upright position;
 - 7. The HydroBinder infill will be placed dry at a minimum thickness of 7/8 inch;
 - 8. Do not backfill anchor trenches until turf has been infilled with HydroBinder infill;
 - 9. The hydration process must occur the day of the HydroBinder infill placement;
 - 10. The desired HydroBinder infill thickness will be achieved and confirmed by measurements prior to the hydration process;

- 11. The cemented infill is hydrated thoroughly however care must be taken to avoid displacement of the non-hydrated infill;
- 12. Hydration shall start at the upstream or upslope portion and move downstream or downslope;
- 13. The objective is to soak the area to start the hydration process but not to inundate with water beyond saturation;
- 14. Once hydration is completed as described, backfill and compaction of the anchor trenches should take place;
- 15. HydroBinder that does not set up within 24 hours on account of improper hydration shall be removed and replaced;
- Cold weather installation of HydroBinder shall be performed in accordance with American Concrete Institute (ACI) - 306R-10 Guide to Cold Weather Concreting; and,
- 17. Once hydration has been completed, and the HydroBinder has cured for a minimum of 24 hours and has fully set up; the HydroBinder Catalyzed Colloidal Silicate Concrete Treatment shall be sprayed onto the HydroTurf System in accordance with Section 03 05 59 of these Specifications.

END OF SECTION

SECTION 31 01 01

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes excavation and backfilling including the loosening, removing, refilling, transporting, storage and disposal of materials classified as "earth" necessary to be removed for the construction and completion of work under the Contract, and as shown on the Contract Drawings, specified or directed.
- B. Where certain features related to Earthwork are shown on the Contract Drawings, the Contractor shall be entirely responsible for final sequencing, scheduling, coordinating and planning the actual areas and their implementation in accordance with laws and property ownership. These may include storage and staging areas, temporary stock pile areas, vehicle parking areas, temporary haul roads for construction ingress and egress, and other similar zones and land uses

1.2 REFERENCES

- A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)
 - a. A328 Specification for Steel Sheet Piling
 - b. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - c. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³)
 - d. D1760 Specification for Pressure Treatment of Timber Products
 - e. D6398 Test Methods for Density of soil and Soil-aggregate in Place by Nuclear Methods (Shallow Depth)

1.3 **DEFINITIONS**

- A. Excavation (including Trenching)
 - 1. Grubbing, stripping, removing, storing and re-handling of materials of every name and nature necessary to be removed for purposes incidental to the construction and completion of the work under construction.
 - 2. All sheeting, sheet piling, bracing and shoring, and the placing, driving, cutting off and removing of the same.
 - 3. All diking, ditching, fluming, coffer-damming, pumping, bailing, draining, well pointing, or otherwise disposing of water.
 - 4. The removing and disposing of surplus materials from the excavations in the manner specified.

- 5. The maintenance, accommodation and protection of traffic and pedestrian travel and the temporary paving of highways, roads and driveways.
- 6. The supporting and protecting of pavements, overhead wires, poles, trees (if scheduled to remain), pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over or underground or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury.
- 7. All temporary bridging and fencing and the removing of same
- B. Earth
 - 1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding ledge or bedrock.
- C. Backfill
 - 1. The refilling of excavation and trenches to the line of filling indicated on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required.
- D. Spoil
 - 1. Surplus excavated materials not required or not suitable for backfills or embankments.
- E. Embankments
 - 1. Fills constructed above the original surface of the ground or such other elevation as specified or directed.
- F. Limiting Subgrade
 - 1. The underside of the pipe barrel for pipelines
 - 2. The underside of footing lines for structures
- G. Excavation Below Subgrade
 - 1. Excavation below the limiting subgrades of structures or pipelines.
 - 2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures or pipelines, the Contractor shall excavate to such new lines and grades as required.

1.4 COORDINATION REQUIREMENTS

A. Coordinate layout and installation of Contract work with earthwork activities and space requirements.

1.5 SUBMITTALS

- A. Sheeting and bracing drawings stamped and signed by a licensed Professional Engineer in the State of the project, if sheeting and bracing is required.
- B. A written Control of Water Management Plan, if removal of water is required.
- C. A representative list of satisfactory similar operations, including contact names and telephone numbers, if well point dewatering is required.

PART 2 - PRODUCTS

2.1 WOOD SHEETING AND BRACING

- A. Wood sheeting and bracing shall be sound and straight; free from cracks, shakes and large or loose knots; and shall have dressed edges where directed.
- B. It shall conform to National Design Specifications for Stress Grade Lumber having a minimum fiber stress of 1200 pounds per square inch.
- C. Sheeting and bracing to be left in place shall be pressure treated in accordance with ASTM D1760 for the type of lumber used and with a preservative reviewed by the Engineer.

2.2 STEEL SHEETING AND BRACING

- A. Steel sheeting and bracing shall be sound.
- B. It shall conform to ASTM A328 with a minimum thickness of 3/8 inch.

PART 3 - EXECUTION

3.1 UNAUTHORIZED EXCAVATION

- A. Whenever excavations are carried beyond or below the lines and grades shown on the Contract Drawings, or as given or directed by the Engineer, excavated space shall be refilled with select fill, controlled low strength material, concrete or other materials as the Engineer may direct.
- B. Material which slides, falls or caves into the established limits of excavations shall be removed and disposed of and void areas filled in with appropriate select fill.

3.2 CONTROL OF WATER

- A. General
 - 1. Maintain proper and satisfactory means and devices for the control and removal of water entering the excavations, and shall remove such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work.
 - 2. Unless otherwise specified, excavations which extend down to or below the static groundwater elevations shall be de-watered by lowering and maintaining the groundwater beneath such excavations when work thereon is in progress, during subgrade preparation and the placing of the structure or pipe thereon.
 - 3. Water shall not be allowed to rise over or come in contact with masonry, concrete, or mortar, until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as the Engineer may permit.
 - 4. Where the presence of fine grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the subontractor shall install and operate a well point system to prevent the upward flow of water during construction.
 - 5. Water pumped or drained from excavations, sewers, drains, or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads, drives, and water courses. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by a reviewed method.
 - 6. Dewatering activities shall be conducted in accordance with laws and permits. Discharges shall be controlled and pre-treated as necessary.
 - 7. Damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor.
- B. Work Included
 - 1. Preparation and submittal of a written "Control of Water Management Plan" to manage and control dewatering activities.
 - 2. The construction and removal of cofferdams, sheeting and bracing, and the furnishing of materials and labor necessary thereof.
 - 3. The excavation and maintenance of ditches and sluiceways.
 - 4. If required, the furnishing and operation of pumps, well points, and appliances needed to maintain control of water related to the work in a satisfactory manner.
 - 5. The installation and removal of temporary sediment and discharge control devices.
- C. Well Point Dewatering Systems (if required)
 - 1. Installation
 - a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing and which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations, including contact names and telephone numbers.

- b. Well point headers, points and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.
- c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least 5 feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1 inches in diameter.
- d. Standby gasoline or diesel powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week.
- 2. Operation
 - a. Where well points are used, the groundwater shall be lowered and maintained continuously (day and night) at a level not less than 2 feet below the bottom of the excavation. Excavation will not be permitted at a level lower than 2 feet above the water level as indicated by the observation wells.
 - b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.
 - c. The water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled.

3.3 STORAGE OF MATERIALS

- A. Topsoil
 - 1. Topsoil suitable for final grading shall be removed and stored separately from other excavated material. It is anticipated topsoil specified for this project will be brought in from off-site.
 - 2. Control erosion run-off from stockpiles by installing perimeter silt fencing. Maintain silt fence during construction and remove upon completion of work.
- B. Excavated Materials
 - 1. All excavated materials shall be stored in locations so as not to endanger the work, and so that easy access may be had to the excavation. Stored materials shall be kept neatly piled and trimmed, to mitigate impact to public travel and to adjoining property owners.
 - 2. Special precautions shall be taken to permit access to fire hydrants, fire alarm boxes, police and fire department driveways, and other points where access may involve the safety and welfare of the general public.
 - 3. Details regarding temporary staging and material characterization shall be detailed in the "Construction Work Plan."
3.4 DISPOSAL OF MATERIALS

A. Spoil Material

- 1. All spoil materials shall be staged for characterization sampling.
- 2. After characterization sampling results indicate the material may stay on site, a minimum of 6-inches of clean fill shall be placed over the graded surface and dressed. No unsightly mounds or heaps shall be left on completion of the work. On site disposal areas, if permitted and where designated, shall be permanently restored with turf establishment or as otherwise specified within the "Construction Work Plan."

3.5 SHEETING AND BRACING

- A. Installation
 - 1. The Contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such manner as to prevent movement which could injure the pipe, structures, or other work; diminish the width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.
 - 2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.
 - 3. Sheeting shall be driven as the excavation progresses, and in such manner as to maintain pressure against the original ground. The sheeting shall be driven vertically with the edges tight together and bracing shall be of such design and strength as to maintain the sheeting in its proper position. Seepage that carries fines through the sheeting shall be plugged to retain the fines.
 - 4. Where breast boards are used between soldier piles, the boards shall be back packed with soil to maintain support.
 - 5. The Contractor shall be solely responsible for the adequacy of sheeting and bracing.
- B. Removal
 - 1. In general, sheeting and bracing, whether of steel, wood or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe or structural foundation and before bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be reviewed.
 - 2. The Contractor shall not remove sheeting and bracing until the work has attained the necessary strength to permit placing of backfill.

C. Left in Place

- 1. If the Contractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the Engineer may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the Contractor.
- 2. The Contractor shall leave in place sheeting, shoring and bracing which are shown on the Contract Drawings or specified to be left in place or which the Engineer may order, in writing, to be left in place.
- 3. In case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within 12 inches of the subgrade or finished ground surface.

3.6 MANUFACTURER'S FIELD SERVICES

- A. General
 - 1. All excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown, specified or directed.
 - 2. Backfilling shall be done with suitable excavated materials that can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, Select Fill as specified or ordered by the Engineer shall be used for backfilling.
 - 3. Settlement occurring in the backfilled excavations shall be refilled and compacted
- B. Unsuitable Materials
 - 1. Stones and pieces of rock greater than six inches in any single dimension shall not be used in the backfill.
 - 2. All stones and pieces of rock shall be distributed through the backfill and alternated with earth backfill in such a manner that interstices between them shall be filled with earth.
 - 3. Stone and pieces of rock greater than 1.5-inches in any single dimension shall not be used in the initial backfill (centerline of pipe to 12-inches above the top of pipe).
 - 4. Pieces of pavement, frozen earth, or other miscellaneous debris shall not be allowed in the backfill.
- C. Compaction and Density Control
 - 1. The compaction shall be as specified for the type of earthwork, i.e., structural, trenching or embankment.
 - a. The compaction specified shall be the percent of maximum dry density.
 - b. The compaction equipment shall be suitable for the material encountered.
 - 2. Where required, to assure adequate compaction, in-place density test shall at the expense of the Contractor be made by an Engineer reviewed testing laboratory.
 - a. The moisture-density relationship of the backfill material shall be determined by ASTM D1557.
 - 1) Compaction curves for the full range of materials used shall be developed.

- b. In-place density shall be determined by the methods of ASTM D1556 or ASTM D6398 and shall be expressed as a percentage of maximum dry density.
- 3. Where required, to obtain the optimum moisture content add sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary, before resuming compaction or filling efforts.

3.7 OTHER REQUIREMENTS

- A. Drainage
 - 1. All material deposited in roadway ditches or other water courses shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.
- B. Unfinished Work
 - 1. When the work is to be left unfinished, trenches and excavations shall be filled and roadways and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of roadways shall have a temporary pavement.
- C. Hauling Material over Public Roads and Streets
 - 1. When it is necessary to haul material over public streets or pavements, provide suitable, tight vehicles to prevent deposits on the streets or pavements shall be used. In cases where materials are dropped from the vehicles, clean up the same as often as required to keep the crosswalks, streets and pavements clean and free from dirt, mud, stone and other hauled material.

D. Dust Control

- 1. Calcium chloride and petroleum products shall <u>not</u> to be used for dust control.
- E. Test Pits
 - 1. For the purpose of obtaining detail locations of under-ground obstructions, make excavations in advance of the work.

END OF SECTION

SECTION 31 05 14

SELECT FILL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes select fill materials used as either embedment or special backfill, as specified, as directed by the Owner's Representative, or as shown on the Contract Drawings.
- B. Acceptable alternate New York State Department of Transportation (NYSDOT) specified materials are included. Any other alternatives requested shall be submitted for approval.

1.2 REFERENCES

- A. Materials and installation shall comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. D422 Method for Particle-Size Analysis of Soil
 - 3. New York State Department of Transportation Standard Specifications/Construction and Materials, last revised.

1.3 SUBMITTALS

- A. Submit the following as specified in the CQAPP:
- B. The name and location of the source of each material. Samples and test reports of each material, including analytical that complies with Part 375 Unrestricted Use Soil Cleanup Objectives and 40 CFR 261.20 for Maximum Concentration of Contaminants for the Toxicity Characteristic.
- C. An affidavit from the Owner for each product stating that the site of the source was never used as a dump site for chemical, toxic, hazardous, or radioactive materials and it is not now or ever been listed as a suspected depository for chemical toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.

1.4 DEFINITIONS

- A. Embedment or Lining
 - 1. Granular material specified or directed to be placed below an imaginary line drawn one foot above the inside diameter of the pipe crown and within the trench limits.
- B. Special Backfill
 - 1. Pipelines
 - a. Select fill material specified or directed to be placed above an imaginary line drawn one foot above the inside diameter of the pipe crown and within the trench limits.
 - 2. Structures
 - a. Select fill material specified or directed to be placed within the excavation limits, either in, under or adjacent to the structure.
 - Structure shall be defined as any building slab/footing/foundation, manholes, catch basins, vaults, sidewalks, curbing, pavements, slabs, etc.
- C. Special Granular Material
 - 1. Special granular material shall mean granular materials listed below or other materials ordered by the Owner or Owners Representative.

PART 2 - PRODUCTS

2.1 SELECT FILL MATERIALS

- A. Type A (or Alternate: NYSDOT Item No. 203.07)
 - 1. Crushed Gravel
 - a. Thoroughly washed crushed, durable, sharp angled fragments of gravel free from coatings. Crushed particles shall be a minimum of 85% by weight of the particles with at least two fractured faces. The total area of

each fractional face shall exceed 25% of the maximum cross-sectional area of the particle.

b. Crushed Gravel shall have the following gradation by weight:

% Passing	SIEVE
100	1½-inch
0-25	³ ⁄4-inch
0-5	¹ /2-inch

- 2. NYSDOT Material Designation 703-0202, meeting No. 2 screen-size designation.
- 3. Note: On the Contract Plans & Details where the select fill or gravel type has not been specifically identified; Type A Crushed Gravel shall be used.
- B. Type B (or Alternate: NYSDOT Item No. 203.07)
 - 1. Crushed Stone
 - a. Thoroughly washed clean, sound, tough, hard crushed limestone or equal free from coatings. Gradation for crushed stone shall be the same as specified for Type A Select Fill.
 - 2. NYSDOT Material Designation 703-0201, meeting No. 2 screen-size designation.
- C. Type D
 - 1. Washed Sand
 - a. Washed coarse sand having the following gradation by weight:

% Passing	SIEVE	
100	3/8-inch	
95–100	No. 4	

80–100	No. 8
50-85	No. 16
25-60	No. 30
10–30	No. 50
0–10	No. 100

- 2. NYSDOT Material Designation 703-01, meeting the requirements of Section 703-07, Concrete Sand.
- D. Type E
 - 1. Run-of-Bank Gravel
 - a. Run-of-bank gravel or other acceptable granular material free from organic matter with the following gradation by weight, as determined by washing through the sieve in accordance with ASTM D422.

SIEVE
1 ¹ /2-inch
¹ /4-inch
No. 200

- 2. NYSDOT Material Designation 703-0203, meeting the above gradation designations.
- E. Type F (or Alternate: NYSDOT Item No. 304.12; Subbase Course, Type 2)
 - 1. Run-of-crusher Stone
 - a. Run-of-crusher hard durable limestone, or equal, having the following gradation by weight:

% Passing	SIEVE
100	2- inch
30–65	¹ /4-inch
5-40	No. 40
0–10	No. 200

- 2. NYSDOT Material Designation 703.02, meeting the requirements of Section 304 Subbase Course.
- F. Type G
 - 1. A mixture of Type E Select Fill material and Portland Cement mixed in a ratio of 15:1 and placed in a dry state.
- G. Type H
 - 1. Habitat Subgrade
 - a. Habitat subgrade material fraction passing the #40 sieve shall have a soil pH from 5.5 to 7.5 and soil organic matter concentration of 0.5 to 6%. The Habitat Subgrade Material shall have the following gradation by weight:

% Passing	<u>SIEVE</u>	
80-100		4- inch
30–65	¹ /4-inch	
15-60	No. 40	
0–25	No. 200	

H. Type H-SA

- 1. Habitat Subgrade for Seep Aprons
 - a. Habitat subgrade material fraction passing the #40 sieve shall have a soil pH from 5.5 to 7.5 and soil organic matter concentration of 0.5 to 6%. The Habitat Subgrade Material shall have the following gradation by weight:

% Passing	SIEVE
80-100	4- inch
30–65	¹ /4-inch
15-60	No. 40
0–15	No. 200

- I. Type I
 - 1. Liner Puncture/Gas Venting Layer Sand

a. Clean, hard, durable, non-crushed dense grains having the following gradation by weight:

% Passing	SIEVE
100	3/8-inch
80_100	No 4
60-80	No. 4
40-60	No. 16
25–40	No. 30
10–20	No. 50
0–10	No. 100

J. Type J Select Fill

- 1. Stone Substrate
 - a. Washed stone substrate shall be thoroughly washed, clean, non-angular, sound, hard, round, cobbley, "river stone" or "river rock" or other equal material free from coatings and organic matter. Washed stone substrate shall have the following gradation by weight:

% Passing	SIEVE
100	4-inch
5-20	1½ -inch
0-10	¹ /2-inch
0–5	No. 200

- K. Type K
 - 1. Revetment Rip Rap
 - a. Rip Rap shall meet the requirements of New York State Department of Transportation item number 620.04; Stone Filling (Medium) with the following gradation adjustment:

% Passing	SIEVE
100	18-inch
0–5	10-inch

L. Type L

1. Revetment Filter Material

a. Revetment Filter Material fraction passing the #40 sieve shall have a soil pH from 5.5 to 7.5 and soil organic matter concentration of 0.5 to 6%. The Revetment Filter Material shall have the following gradation by weight:

% Passing	<u>SIEVE</u>
100	6-inch
	3-inch
75-85	
15-40	No. 20
0-15	No. 200

- M. Type M
 - 1. Collection Trench Sand
 - a. Clean, hard, durable, non-crushed, dense grains having the following gradation by weight:

% Passing	SIEVE
100	³ / ₈ -inch – No. 20
	No. 4 – No. 25
70	
30	No. 16 – No. 30
0	No. 25 – No. 60

N. Type N

1. Pea Gravel

a. Pea Gravel shall meet the following gradation:

% Passing	SIEVE
100	1-inch
30-100	¹ /2-inch
0-30	¹ /4-inch
0-10	No. 10
0-5	No. 20

Type O

- 1. Bioretention and Dry Swale Soil
 - a. Material shall comply with NYSDOT Item 208.0103 22.

PART 3 - EXECUTION

3.1 INSTALLATION

- 1. Install special granular material for pipeline embedment in accordance with the Section entitled "Pipeline Installation" as specified or directed.
- 2. Install special backfill in accordance with the backfilling provisions of the Section entitled "Excavation and Fill", and the Section entitled "Earthwork", where specified or directed.

3.2 SETTLEMENTS

1. Settlements in the finished work shall be repaired to establish the proposed or existing grade, as the case may be.

END OF SECTION

SECTION 31 22 19

TOPSOIL, SEEDING AND PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes topsoil, fertilizer, seed, plantings, mulch anchorage, and associated work.

1.2 REFERENCES

- A. Improvement, restoration, and mitigation activities shall be performed in substantive compliance with Sections 401 and 404 of the Clean Water Act.
- B. Analytical References
 - 1. pH ASTM D4972
 - 2. Organic Matter ASTM D22974
 - 3. Particle size distribution ASTM D422

1.3 PERFORMANCE REQUIREMENTS

A. The Contractor shall comply with all applicable Federal, State and Local codes, ordinances, regulations, statutes and standards.

1.4 SUBMITTALS

- A. The following items shall be submitted:
 - 1. The name and location of source and data (pH, organic matter, particle size distribution) for off-site soil.
 - 2. Samples and test reports of each material shall include analytical that complies with Part 375 Unrestricted Use Soil Cleanup Objectives and 40 CFR 261.20 for Maximum Concentration of Contaminants for the Toxicity Characteristic.
 - 3. An affidavit from the Owner for each product stating that the site of the source was never used as a dump site for chemical, toxic, hazardous, or radioactive materials and it is not now or ever been listed as a suspected depository for chemical toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.
 - 4. Latin name, source and content data for seed mixes, plants, and trees. Data for each container of seed used shall be submitted; data submitted as representative of multiple containers will not be accepted.
 - 5. Should hydroseeding be used, the Contractor shall submit data including material and application rates.

- 6. Submit certificates from plant nursery stock supplier for each group of live plant stock required, stating botanical name, common name, origin, age, date of packaging, and name and address of supplier.
- 7. Invoices for plants and seed procured for the project shall be submitted.
- 8. Source and content data for organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Habitat layer shall comprise topsoil and habitat subgrade as follows:
- B. Topsoil shall have moderate pH (5 to 7.5) and organic matter concentration—as determined by loss on ignition—ranging from 5 to 15% in wetland areas (*i.e.*, deep emergent, shallow emergent and wet meadow zones) and 3 to 15% elsewhere.
 - 1. Topsoil shall be natural or manufactured, friable and fertile soil that meets the USDA basic soil texture classes of loam, silt loam or sandy loam to be recovered from the A horizon of an in-place soil. Topsoil shall can sustain healthy plant life. Topsoil shall be unscreened but be reasonably free of subsoil, heavy or stiff clay, brush, weeds, foreign material, stones larger than 4 inches in greatest dimension. Topsoil as delivered to the site or stockpiled shall meet the following requirements:
 - a. Topsoil shall be well graded and have the following particle size distribution (by weight):
 - 1. 85 to 100 percent passing 1 inch, 65 to 100 percent passing 1/4 inch, and 15 to 80 percent passing a Number 200 sieve (0.075 mm, 0.003 inch). The 2-micron particle size shall not be greater than 20 percent of the total sample mass, as determined by hydrometer analysis.
 - 2. Organic materials used in the manufacture of topsoil shall meet the requirements of NYSDOT 713-15.
 - Topsoil shall contain no nuisance weeds including seeds, stems or rhizomes of purple loosestrife, common reed, Japanese knotweed or plants on the Federal Noxious Weeds list.
 - 4. Each load of topsoil shall be inspected by the Owner's Representative and is subject to rejection.
- C. Habitat subgrade (Type H select fill) shall be as defined in Section 31 05 14 Select Fill.

- D. Fertilizer shall be a standard quality commercial carrier of available plant food elements and shall consist of a complete prepared and packaged material containing a minimum of 10% nitrogen, 0% phosphoric acid and 10% potash.
 - 1. Each bag of fertilizer shall bear the manufacturer's guaranteed statement of analysis.
- E. Seed
 - 1. Seed mixtures shall be of commercial stock of the current or prior season's crop and shall be delivered in unopened containers bearing the guaranteed analysis of the mix. Seed shall be labeled true to species and variety. The percent of pure live strain of the seed shall be submitted with the seed mixture.
 - 2. The nursery shall provide a seed analysis report including certified analyses of percent viability, percent weed seeds, and percent of other crop seed. The certifying laboratory shall be indicated on the seed tag or on associated nursery submittals.
 - 3. The state of origin of the seed shall be indicated on the seed tag or on associated nursery submittals.
 - 4. The following weed seeds shall not be present in seed mix:
 - a. smooth brome
 - b. tall fescue
 - c. purple loosestrife
 - d. common reed
 - e. cattail
 - f. reed canarygrass
 - g. others included in the Federal Noxious Weeds list
 - 5. Seed shall meet the standards of germination and purity set by New York State or the Association of Official Seed Certifying Agencies (AOSCA).
- A. Plantings
 - 1. Plant materials shall comply with state and federal laws with respect to inspection for plant diseases and insect infestations.
 - 2. Plants shall be in accordance with the current edition of the American Standard for Nursery Stock (ANSI Z60.1-2004) unless otherwise specified.
 - 3. Woody plants shall be of high quality and symmetrical. They shall be healthy, well branched and densely foliated when in leaf.
 - 4. Plants shall be free of disease and insects, eggs, or larvae, and have healthy, well-developed root systems such that the root ball does not fall apart upon plant removal from the pot or tray.
 - 5. Plants shall be tagged true to species name and variety and not contain weeds.

- a. For plugs, each tray shall be tagged
- b. For trees and shrubs in individual pots, each pot or stem shall be tagged.
- c. Plants shall arrive at the job site free from physical damage.
- d. Trays of grass and sedge plugs may be stacked during shipment. Forbs shall not be stacked. Trays of hardstem bulrush (Schonoplectus acutus) shall not be stacked.
- e. Each species shall be handled and packed in a manner reviewed for that plant. Precautions that are customary in good trade practice shall be taken to insure the arrival of the plants at the Site in good condition. Plants that arrive dried out, exposed to excessive heat, or that have been in storage for protracted periods of time, will not be accepted. If, upon inspection, the plants or root stocks display mold or decay, the material will not be accepted.
- f. All woody seedlings shall have a heavy fibrous root system that has been developed by proper horticultural treatment, transplanting, and root pruning.
- g. "Plugs" shall have root balls 2 to 4 inches in diameter.
- h. "Pots" shall be #2 or #3 container class.
- i. "Live Stake" material requirements:
 - 1. Live stakes shall be dormant and have a green cambium (sapwood) upon arrival to the job site.
 - 2. Live stakes shall be stored in a continuously cool, moist environment.
 - 3. In general, live stakes shall be approximately 24 inches long and 3/8 inch to 1-1/2 inch in diameter and dormant
 - a. Live stakes used in the Revetment shall be 36" long and otherwise equivalent to other live stakes.
- A. Mulch to accompany permanent seeding shall be wood fiber hydromulch with tackifier, Ecoblanket, or equivalent reviewed by the Owner's Representative.
- B. Temporary fence shall be free standing 10-foot-tall panels of chain link fence.
- C. Seed mixes shall be as specified in Tables 1 to 3.
- D. Vegetation zones shall be created by planting and/or seeding according to Tables 4 through 12 in areas defined in the Contract Drawings.

Common name	Latin name	Weight percent
Oats	Avena sativa	40
Virginia wild rye	Elymus virginicus	30
Showy ticktrefoil	Desmodium canadense	5
American senna	Senna hebecarpa	4
Nodding beggar-ticks	Bidens cernua	3
Smooth panicgrass	Panicum dichotomiflorum	2
Soft rush	Juncus effusus	2
Fowl bluegrass	Poa palustris	2
Redtop	Agrostis alba	2
Smooth Panic Grass	Panicum dichotomiflorum	2
Devil's beggar-ticks	Bidens frondosa	2
Eastern Bur Reed	Sparganium americanum	1
Fox Sedge	Carex vulpinoidea	1
Rice Cutgrass	Leersia oryzoides	1
Grass-leaved goldenrod	Euthamia graminifolia	1
Wrinkled goldenrod	Solidago rugosa	1
Rattlesnake grass	Glyceria canadensis	0.5
Three Way Sedge	Dulichium arundinaceum	0.5

Table 1. Wetland seed mix.¹

¹If seed mix is applied in the fall, add 10 pounds per acre of winter wheat (Triticum aestivum).

Common name	Latin name	Weight percent
Oats	Avena sativa	35
Indiangrass	Sorghastrum nutans	12
Virginia wildrye	Elymus virginicus	12
Canada wildrye	Elymus canadensis	6
Little bluestem	Schizachyrium scoparium	6
New England aster	Aster novae-angliae	4
Wingstem	Verbesina alternifolia	3
Switchgrass	Panicum virgatum	3
Monkey flower	Mimulus ringens	2
American senna	Senna hebecarpa	2
Grass-leaved goldenrod	Euthamia graminifolia	2
Fowl bluegrass	Poa palustris	2
Purpletop	Tridens flavus	1.5
Ticklegrass	Agrostis scabra	1.5
Partridge pea	Chamaecrista fasciculata	1
Tall white beardtongue	Penstemon digitalis	1
Annual sunflower	Helianthus annuus	1
Autumn bentgrass	Agrostis perennans	1
Purple bergamot	Monarda media	1
Blackeyed Susan	Rudbeckia hirta	1

Table 2. Successional old-field seed mix.¹

Common name	Latin name	Weight percent
Cutleaf coneflower	Rudbeckia laciniata	1
Common evening primrose	Oenothera biennis	0.5

¹If seed mix is applied in the fall (October 15 to December 1), add 10 pounds per acre of winter wheat (*Triticum aestivum*).

When applying seed to a slope steeper than or equal to 1H:2V (*e.g.*, upper portions of the Revetment and the NineMile Creek Seep Apron, add 10 pounds per acre of annual rye (*Lolium perenne*).

Tuble 5. B wale beed link.		
Common name	Latin name	Percent of seed mix
Oats	Avena sativa	21
Alkaligrass	Puccinellia distans	15
Redtop	Agrostis alba	12
Virginia wildrye	Elymus virginicus	12
Creeping bentgrass	Agrostis stolonifera	9
Fox Sedge	Carex vulpinoidea	5
Softstem bulrush	Schoenoplectus tabernaemontani	5
Hardstem bulrush	Schoenoplectus acutus	5
Eastern bur reed	Sparganium americanum	5
Fowl bluegrass	Poa palustris	5
Ticklegrass	Agrostis scabra	2
Autumn bentgrass	Agrostis perennans	2
Path rush	Juncus tenuis	2

Table 3. Swale seed mix.¹

¹If seed mix is applied in the fall (October 15 to December 1), add 10 pounds per acre of winter wheat (*Triticum aestivum*).

	Latin name	Stock type	Percent of	Spacing	Installation rate
			zone	(feet)	(per acre)
White waterlily	Nymphaea odorata	Plug	11	5	192
Yellow waterlily	Nuphar lutea	Plug	10	5	175
Bladderwort	Utricularia magnarhiza	Root	5	Random	88
	macrorniza	magment		bibaucast	
Coontail	Ceratophyllum demersum	Plug	5	5	88
Sago pondweed	Stuckenia pectinata	Plug	5	5	88
Water weed	Elodea canadensis	Plug	5	5	88
Pondweed	Potamogeton nodosus	Plug	3	5	53
Wild celery	Vallisneria americana	Plug	3	5	53
Water stargrass	Heteranthera dubia	Plug	3	5	53

Table 4. Deep emergent zone. Install plant materials as specified in the below table.

Common name	Latin name	Stock type (unit)	Percent of zone or seed mix	Spacing (feet)	Installation rate (per acre)
Wetland seed mix (Table 1)	-	Seed (Pounds)	95	-	20
Wild rice ¹	Zizania aquatica	Seed	5	-	30
Bluejoint grass	Calamagrostis canadensis	Plug	20	2	2178
Softstem bulrush	Schoenoplectus tabernaemontani	Plug	11	2	1198
Water willow	Decodon verticillatus	Plug	10	2	1089
Arrow arum	Peltandra virginica	Plug	5	2	545
Sweetflag	Acorus americanus	Plug	5	2	545
Soft rush	Juncus effusus	Plug	5	2	545
Pickerel-weed	Pontederia cordata	Plug	5	2	545
Arrowhead	Sagittaria latifolia	Plug	5	2	545
Hard-stem bulrush	Schoenoplectus acutus	Plug	5	2	545
Three-square	Schoenoplectus pungens	Plug	5	2	545
Eastern burreed	Sparganium americanum	Plug	5	2	545
Giant burreed	Sparganium eurycarpum	Plug	5	2	545
Broad-leaf cattail	Typha latifolia	Plug	5	2	545
Water plantain	Alisma subcordatum	Plug	1	2	109
Willow weed	Justicia americana	Plug	1	2	109
Water smartweed	Polygonum amphibium	Plug	1	2	109
Marsh smartweed	Polygonum hydropiperoides	Plug	1	2	109

Table 5. Shallow emergent zone. Install seed mix and plant materials as specified in the below table.

¹Within approximately 5% of the shallow emergent zone, wild rice seed shall be broadcast in unplanted/unseeded areas designated by the Owner's Representative. Seeding shall occur between November 1 and December 31 during the first fall after completion of earthwork and establishment of specified hydrology. Seed may be cast atop ice that is less than 0.25-inch thick during that acceptable period. Seeding may occur outside of this time frame only with acceptance from the Owner's Representative. Spring seeding may only occur if seed to be used is certified to have been prepared accordingly.

Common name	Latin name	Stock type (unit)	Percent of zone	Spacing (feet)	Installation rate (per acre)
Wetland seed mix (Table 1)	-	Seed (Pounds)	100	-	20
Buttonbush	Cephalanthus occidentalis	Live stake	2	4	55
Redosier dogwood	Cornus sericea	Live stake	2	4	55
Elderberry	Sambucus canadensis	Live stake	2	4	55
Nannyberry	Viburnum lentago	Live stake	2	4	55
Silky dogwood	Cornus amomum	Live stake	1	4	28
Pussy willow	Salix discolor	Live stake	1	4	28
Southern arrowwood	Viburnum dentatum	Live stake	1	4	28
Bluejoint grass	Calamagrostis canadensis	Plug	10	2	1089
Joe-pye-weed	Eupatorium maculatum	Plug	10	2	1089
Boneset	Eupatorium perfoliatum	Plug	10	2	1089
Freshwater cordgrass	Spartina pectinata	Plug	10	2	1089
Soft rush	Juncus effusus	Plug	5	2	545
Cosmos sedge	Carex comosa	Plug	3	2	327
Lake sedge	Carex lacustris	Plug	3	2	327
Blunt broom sedge	Carex scoparia	Plug	3	2	327
Fox sedge	Carex vulpinoidea	Plug	3	2	327
Path rush	Juncus tenuis	Plug	3	2	327
Green bulrush	Scirpus atrovirens	Plug	3	2	327
Woolgrass	Scirpus cyperinus	Plug	3	2	327

Table 6. Wet meadow zone. Install seed mix and plant materials as specified in the below table.

Common name	Latin name	Stock type (unit)	Percent of zone or seed mix	Spacing (feet)	Installation rate
Successional old-field seed mix (Table 2)	-	Seed (Pounds)	100	-	20
Southern arrowwood	Viburnum dentatum	Live stake	5	4	137
Black willow	Salix nigra	Live stake	5	8	35
Silky dogwood	Cornus amomum	Live stake	3	4	82
Redosier dogwood	Cornus sericea	Live stake	3	4	82
Nannyberry	Viburnum lentago	Live stake	3	4	82
Elderberry	Sambucus canadensis	Live stake	2	4	55
Red maple	Acer rubrum	Pot	15	8	103
Yellow birch	Betula alleghaniensis	Pot	15	8	103
Swamp white oak	Quercus bicolor	Pot	15	8	103
Slippery elm	Ulmus rubra	Pot	10	8	69
Speckled alder	Alnus incana subsp. rugosa	Pot	5	4	137
Silver maple	Acer saccharinum	Pot	5	8	35
Gray dogwood	Cornus racemosa	Pot	3	4	82
Eastern white pine	Pinus strobus	Pot	3	8	21
Black gum	Nyssa sylvatica	Pot	2	8	14
Shadbush	Amelanchier canadensis	Pot	2	4	55
Black chokeberry	Photinia melanocarpa	Pot	2	4	55
American hornbeam	Carpinus caroliniana	Pot	2	4	55

Table 7. Successional forest. Install seed mix and plant materials as specified in the below table.

Table 8. Successional old field. Install seed mix as specified in the below table.

Seed mix name	Installation rate (pounds per acre)
Successional old-field seed mix (Table 2)	60

Table 9. Swale. Install seed mix as specified in the below table.

Seed mix name	Installation rate (pounds per acre)
Swale seed mix (Table 3)	50

Common name	Latin name	Stock type (unit)	Percent of zone	Spacing (feet)	Installation rate
					(per acre)
Successional old field	-	Seed (Pounds)	100	-	60
seed mix (Table 2)					
Freshwater cordgrass	Spartina pectinata	Plug	40	2	4356
Swamp milkweed	Asclepias incarnata	Plug	5	2	545
New England aster	Aster novae-angliae	Plug	5	2	545
Joe-pye weed	Eupatorium maculatum	Plug	5	2	545
Boneset	Eupatorium perfoliatum	Plug	5	2	545
Switchgrass	Panicum virgatum	Plug	2	2	218
Silky dogwood	Cornus amomum	Live stake	10	4	273
Redosier dogwood	Cornus sericea	Live stake	10	4	273
Elderberry	Sambucus canadensis	Live stake	10	4	273
Pussy willow	Salix discolor	Live stake	8	4	218

Table 10. Shoreline meadow. Install seed mix and plant materials as specified in the below table.

Table 11. Successional shrubland. Install seed mix and plant materials as specified in the below table. No fertilizer shall be installed.

Common name	Latin name	Stock type (unit)	Percent of zone or seed mix	Spacing (feet)	Installation rate (per acre)
Successional old field seed mix (Table 2)	-	Seed (Pounds)	100	-	60
Gray dogwood	Cornus racemosa	Live stake	25	4	681
Elderberry	Sambucus canadensis	Live stake	20	4	545
Silky dogwood	Cornus amomum	Live stake	15	4	409
Redosier dogwood	Cornus sericea	Live stake	15	4	409
Spicebush	Lindera benzoin	Live stake	10	4	273
Nannyberry	Viburnum lentago	Live stake	5	4	137
American hornbeam	Carpinus caroliniana	Pot	5	4	137
Speckled alder	Alnus incana subsp. rugosa	Pot	5	4	137

Common name	Latin name	Stock type (unit)	Percent of area	Bias on revetment (feet, NAVD 1988) ¹	Spacing (feet)	Installation rate (per acre)
Silky dogwood	Cornus amomum	Live stake	25	364 to 367	4	681
Pussy willow	Salix discolor	Live stake	25	364 to 367	4	681
Elderberry	Sambucus canadensis	Live stake	20	367 to 372	4	545
Redosier dogwood	Cornus sericea	Live stake	15	365 to 367	4	409
Buttonbush	Cephalanthus occidentalis	Live stake	15	364 to 365	4	409

Table 12. Revetment joint plantings. Install plant materials as specified in the below table.

¹Bias on revetment indicates the general elevations within which each species will be installed, however, within these biases species will be installed in a random fashion in order to avoid monocultures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Habitat subgrade shall be applied to 12" depth on average and lightly compacted by tracking or similar.
- B. Topsoil shall be applied to 12" depth on average and tracked perpendicular to the slope gradient.
 - 1. In areas defined as "Turtle Nesting Zone" on the Contract Drawings, a 1:1 mix of Type H and Type I select fill materials shall be used in lieu of topsoil.
 - 2. In areas where the Habitat Layer tapers to meet elevations of adjacent areas, habitat subgrade shall taper, maintaining a minimum of 12" of topsoil where possible.
 - a. In the Swale zone, a minimum of 6" of topsoil is acceptable.
- C. Plant materials, fertilizer and mulch shall be installed in vegetation zones per Table 13.
- D. In general, the following sequence shall occur:
 - 1. Place, grade and compact soil.
 - 2. To the extent possible a two to three week waiting period shall occur in order to allow for weeds to germinate from topsoil.
 - 3. Apply an Engineer reviewed herbicide to weeds.
 - 4. Install plants (i.e., potted woody plants, plugs or lives stakes).
 - 5. Apply seed and mulch (e.g., hydroseed or ecoblanket).
 - 6. Install temporary fence around successional forest areas.
- E. Seeding procedures
 - 1. Seeding shall be performed during two seasonal windows: April 1 to June 15, October 15 through December 1, or as otherwise practicable and reviewed by the Owner's Representative. If site soils require stabilization at times outside of these dates, they shall be temporarily mulched using two tons per acre of straw.
 - 2. When the topsoil surface has been graded, tracked and planting completed, the seed mixture shall be uniformly applied upon the soil surface following Table 13 or by a method reviewed by the Owner's Representative.

- 3. Seeding and mulching shall not be done during windy weather (greater than 5 mph or as reviewed by the Owner's Representative).
- 4. Seed and mulch shall be spread to form a continuous blanket over the seed bed:
 - a. If EcoBlanket is used, it shall be applied in two separate passes, to a total depth of 1 inch.
 - a. The first pass shall be 0.75" thick and contain no seed.
 - b. The second pass shall be 0.25" thick and contain seed as directed for the particular vegetation zone (Table 13).
 - b. If hydromulch is used it shall be applied at a rate according to manufacturer's recommendations for a given slope percentage.
 - c. In areas with plug installation, broadcast seeding with straw placement (1-inch depth) is also acceptable in order to avoid damage to herbaceous plants.
 - d. In general, fertilizer shall not be applied, except where Successional old field (Table 8) is applied to areas with Solvay waste as the substrate.
 - a. When fertilizer is used, it shall be applied with the hydroseed mix at a rate of 900 lbs/acre
 - e. Unless otherwise specified, mulch shall be left in place and allowed to disintegrate.
- F. Procedures for planting woody potted stock:
 - 1. Planting of potted woody stock shall occur from April 1 to June 15, September 1 through December 1, or as otherwise practicable and reviewed by the Owner's Representative.
 - 2. Planting hole diameter shall be at least 1.5 times the diameter of the root ball and dug to a depth such that the root flare is even with the finished grade when the plant is placed in the hole.
 - 3. If the planting hole is initially dug too deeply, soil shall be added back into the hole to attain the proper elevation.
 - 4. Cut with a sharp knife roots encircling the root ball and install the plant as soon as possible once it has been removed from the pot.
 - 5. Backfill the planting hole and firmly work soil into and around the root ball with care taken to fill in air spaces.
 - 6. Tamp the backfill with foot pressure sufficient to prevent the root ball from shifting or leaning.

- 7. Leave the top of the root ball exposed or loosely apply a thin layer (less than 1 inch) of soil over the top of the root ball in order to allow water to flow down into it.
 - a. Hydromulch or ecoblanket shall be applied over the top of the root ball or the thin soil layer.
- 8. Form earthen water-holding saucers (4 inches high with a similar diameter as the planting hole) around each plant.
- 9. Water plants immediately after planting. Apply water directly to the root ball and adjacent soil. Fill the water holding saucer with water.
- 10. Evenly apply stem wrapping without gaps to a height of 10" above the base of the water holding saucer.
- 11. After the end of the monitoring period, remove tags, labels, strings, etc. from plants.

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Table 13: Summary of	f vegetation zone	treatments			
Vegetation zone	Plant	Fertilizer and	Mulch and application rate	Water depth	Notes (elevations indicate limits of wetland
	materials	application rate		(inches)	zones, NAVD 1988)
Deep emergent	Per Table 4	-	-	24 to 36	368.5' to 369.5' in Wetland A
					359.5' to 360.5' in the Connected Wetland
Shallow emergent	Per Table 5	-		6 to 24	369.5' to 371' in Wetland A
					367.5' to 368.5' in Wetland B
			Wood fiber bydromulab with tealifier		368.5' to 369.5' in Wetland C
			- (manufacturer recommanded rate		360.5' to 362' in Connected Wetland
Wet meadow	Per Table 6	-	(manufacturer recommended fate	-6 to 6	371' to 372' in Wetland A
			inch denth)		369.5' to 370.5' in Wetland B
			nich depui)		3769.5' to 370.5' in Wetland C
			- In areas with plug installation		362' to 364' in Connected Wetland
Successional forest	Per Table 7	-	- broadcast seeding with straw	-	
Successional old- field	Per Table 8	10-0-10 pelletized	placement (1 inch depth) is also	-	Fertilizer shall be applied to areas with
					Solvay waste as substrate and to areas
		fertilizer (900	to herbaceous plants		upslope of the revetment
		lbs/ac)	to herotaceous plants		
					Ecoblanket shall not be used in areas with
					Solvay waste as substrate
Swale	Per Table 9	-	Wood fiber hydromulch with tackifier	6	
			(manufacturer recommended rate		
			according to slope)		
Shoreline meadow	Per Table 10	-	Wood fiber hydromulch with tackifier	-	
			(manufacturer recommended rate		
			according to slope) or EcoBlanket (1		
			inch depth)		
			Broadcast seeding with straw		
			placement (1 inch depth) is also		
			acceptable		

Tuble 15 (cont.). Summary of Vegetation zone treatments					
Vegetation zone	Plant	Fertilizer and	Mulch and application rate	Water depth	Notes (elevations indicate limits of wetland
	materials	application rate		(inches)	zones, NAVD 1988)
Successional	Per Table 11	-	Wood fiber hydromulch with tackifier	-	
shrubland			(manufacturer recommended rate		
			according to slope)		
Revetment (joint	Per Table 12	-	-	-	
plantings on stone					
face)					

Table 13 (cont.): Summary of vegetation zone treatments

- G. Planting procedures for 2" plugs shall follow those outlined above for woody potted plants with the following exceptions:
 - 1. Planting of 2" plugs shall occur from April 1 to June 15; planting until July 15 may be permitted with permission from the Owner's Representative.
 - 2. Plugs shall be installed such that the top of the root ball is even with the finished soil grade.
 - 3. The height of the water holding saucer shall be approximately 1 inch.
 - 4. Roots encircling the plug shall not be cut.
 - 5. For plant installation, openings in the soil shall be made by ripping 4 to 6" deep furrows with a ripper or similar. Alternative approaches subject to approval by the Owner's Representative.
 - 6. Following planting, individual plugs shall be watered in a similar fashion as woody plants or 1 inch of water may be evenly applied across areas where plugs were installed.
- H. Planting procedures for live stakes:
 - 1. Planting of live stakes shall occur from April 1 to May 15 or as otherwise reviewed by the Owner's Representative.
 - 2. Install stakes by initially creating a pilot hole of sufficient depth such that a minimum of 2 inches to 4 inches and two live buds of the stakes shall be exposed above the soil surface upon planting.
 - 3. The pilot hole may be created with a dibble bar, stinger on an excavator bucket or equivalent, and the diameter of the hole shall be minimally wide enough to avoid damaging the stake upon planting.
 - 4. If soil conditions do not allow a sufficiently deep pilot hole to be created, the live stake may be trimmed to appropriate length with a sharp, fine toothed saw or lopper.
 - 5. A dead blow hammer may be used to assist with stake installation. The hammer head should be filled with sand or shot.
 - 6. Following installation, soil shall be firmed around each stake.
 - 7. Live stakes that are damaged during installation shall be left in place and supplemented with an intact stake.
 - 8. Upon installation, each stake shall be watered with approximately 2 quarts of water unless the area is moist (as determined by the Owner's Representative) at the time of plant installation.
 - 9. Unless the ground is consistently moist, plants shall be watered as often as required to obtain and maintain satisfactory growth.

- I. Watering of herbaceous species (i.e., seed or plugs) shall occur if 0.25 inches of precipitation is not received in any seven-day window from June to August in the year of seed (or plant) installation. In wetlands, watering shall not be performed if soils remain moist and plants are showing no signs of moisture stress. Watering shall be in such a manner as to prevent washing out of seed or exposing plant roots.
 - 1. Water shall not be pulled from wetlands or stormwater swales.
- J. Wet meadow and shallow emergent zones shall be minimally flooded during the growing season of planting in order to avoid plant mortality due to soil anoxia.
 - 2. After the first growing season, wet meadow and shallow emergent zones may be allowed to flood.
- K. Watering of woody species shall occur if one inch of rain is not received during any seven-day window from June 1 through August 31 in the year of installation.
- L. Impacts to vegetation outside the limits of work (*e.g.*, limb and bark damage, exposed roots) shall be avoided.
- M. Temporary fence shall be installed by abutting panels against each other around successional forest areas.
 - 1. The need to install temporary fencing shall be determined on site by the Owner's Representative.
 - 2. One 50 lb sand bag or similar shall be applied to the foot of each post for ballast.
 - 3. Fence shall remain in place and be maintained in working condition until removal is reviewed by the Owner's Representative.

3.2 MAINTENANCE

- A. Restored areas shall be monitored for a period of five years after construction is complete and corrective measures taken to maintain:
- B. 80% survivorship of potted woody and herbaceous plants (i.e., plugs) as determined by a random sample at the end of the first growing season after planting.
- C. 85% vegetative cover is achieved in accordance with the NYSDEC State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activities (GP-0-10-001) and areas are accepted by the owners' representative. Maintenance responsibilities begin immediately after seeding and planting and continue through at least the first full growing season following the year of planting.
- D. Invasive species cover shall be less than 5% by the end of year 5. During years one through four invasive species shall be controlled regardless of cover percentage.

E. Additional maintenance and monitoring activities may be performed in accordance with the project Operations, Maintenance, and Monitoring plan or as directed by the Owner.

END OF SECTION

SECTION 31 23 00

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes excavation and backfill as required for pipe installation or other construction in the excavation or trench, and removal and disposal of water, in accordance with the applicable provisions of the Section entitled "Earthwork" unless modified herein, or as shown on the Contract Drawings.

1.2 SUBMITTALS

A. None.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

- 3.1 EXCAVATION
 - A. The trench excavation shall be located as shown on the Contract Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath curbs, pavements, trees, driveways and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Contract Documents.
 - B. Trenches shall be excavated to maintain the depths as shown on the Contract Drawings or as specified for the type of pipe to be installed.
 - C. The alignment and depth shall be determined and maintained using a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.
 - D. The minimum width of trench excavation shall be 6 inches on each side of the pipe hub for 21-inch diameter pipe and smaller and 12 inches on each side of the pipe hub for 24-inch diameter pipe and larger.
 - E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required.
 - F. Bridging across open trenches shall be constructed and maintained where required.

3.2 SUBGRADE PREPARATION FOR PIPE

- A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation.
- B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.
- C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.
- D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent parts of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

3.3 STORAGE OF MATERIALS

- A. Traffic shall be maintained.
- B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Contractor, at his cost and expense, as soon as excavated. The excess material shall be removed to locations selected and obtained by the Contractor.
 - 1. The Contractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.
- C. The Contractor shall refill trenches with Select Fill or other suitable materials and excess excavated materials shall be disposed of as spoil.

3.4 REMOVAL OF WATER AND DRAINAGE

- A. The Contractor shall provide and maintain proper and satisfactory means and devices for the removal of water entering the trench, and shall remove such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.
- B. The removal of water shall be in accordance with the Section entitled "Earthwork".

3.5 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment

operations, enough the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.

- B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the Engineer. Before concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated unless otherwise authorized by the Engineer. Where concrete is to be placed in a sheeted trench it shall be poured directly against sheeting to be left in place or against a bondbreaker if the sheeting is to be removed.
- C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

3.6 BACKFILL ABOVE EMBEDMENT

- A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.
 - 1. The trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted to obtain 95% maximum density, and determined as set forth in the Section entitled "Earthwork".
 - 2. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.
- B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.
 - 1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.
- C. All settlement of the backfill shall be refilled and compacted as it occurs.
- D. Surfaces shall be restored as specified or directed.

END OF SECTION

SECTION 31 23 13

HYDROTURF[®] SUBGRADE PREPARATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Specifications for approved subgrade below the HydroTurf System.

1.02 RELATED SECTIONS

Section 01 73 19	- HydroTurf CS Structured Geomembrane Specifications
Section xx xx xx	- HydroTurf CS Engineered Turf Specification
Section xx xx xx	- HydroTurf Z Engineered Turf Specification
Section 03 49 01	- HydroBinder [®] Infill

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION:

3.01 EXAMINATION

- A. Evaluation and Assessment:
 - 1. Responsibilities for the approval and maintenance of the subgrade are as follows:
 - a. OWNER'S REPRESENTATIVE:
 - 1.) Verify in writing that the surface on which the HydroTurf system will be installed is acceptable.
 - b. INSTALLER:
 - 1.) Keep the accepted subgrade surface in a condition conducive to the deployment of all HydroTurf components.
 - 2.) Subgrade acceptance is determined when the deployment of the product, or its components, begins.

- 3.) Maintain the previously accepted subgrade at or above the accepted condition.
- 4.) Identify any part of the subgrade that becomes non-compliant to the specifications during the course of construction.
- Ensure a timely submission to the OWNER'S REPRESENTATIVE of subgrade acceptance certificates.

3.02 PREPARATION

- A. Surface Preparation:
 - 2. Subgrade shall be relatively smooth (free from ruts, depressions, etc.), uniform, firm and unyielding, and free from rocks, roots or other debris.
 - 3. No rocks or protrusions greater than 0.75 inch in diameter will be exposed at the subgrade surface.
 - 4. Approved subgrade shall be capable of supporting the weight of the product, installation equipment, and maintenance equipment.
 - 5. Daily evaluation shall be performed to show that no changes have occurred that would render the subgrade unacceptable.
- B. Anchor Trench Preparation
 - 1. Anchor trenches shall be excavated to the grades and dimensions as specified on the construction plans.
 - 2. Anchor trenches shall be straight and uniform with no rough edges.
 - 3. The inside edge of the anchor trench shall be rounded and smooth.
 - 4. Anchor trenches shall be free of sharp objects and other deleterious material.
- C. Non-Conforming Work
 - Subgrade not meeting specifications either before or during deployment of the HydroTurf, or its components, will be reported to the OWNER'S REPRESENTATIVE and corrected as required.

END OF SECTION

SECTION 31 24 00

EMBANKMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes construction of earth embankments constructed to established lines and grades at the locations as shown on the Contract Drawings and as directed by the Engineer.
- B. Certain features of Embankment shall be as scheduled on the Contract Drawings.

1.2 REFERENCES

- A. Materials and installation shall comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)

a.	D1557	Test M for Laboratory Compaction Characteristics of Soil
		Using Modified Effort (56,000 ft-lbf/ft ³) (2,700 kN-m/m ³)

- b. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- c. D6398 Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Proposed testing laboratory
 - 2. Source of off-site materials
 - 3. Compaction curves for materials to be used

PART 2 - PRODUCTS

- 2.1 GENERAL
 - A. Embankment material shall be free from frost, stumps, trees, roots, sods, muck, marl, vegetable matter or other unsuitable material and shall be suitable for compaction as described in the following provisions. Where embankments are to be placed underwater only acceptable granular materials shall be used.
 - B. Embankment materials shall be obtained from Engineer reviewed off-site sources.
PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. The entire surface to be covered with embankment shall be grubbed and stripped of grass, vegetation, topsoil, rubbish, or other unsuitable materials before embankment material is placed.
 - 1. Topsoil shall be stockpiled or placed as designated.
 - 2. Other grubbed and stripped materials shall be removed as spoil.
- B. Stripped or excavated surfaces on which embankments are to be placed shall be compacted to the required density of the embankment prior to fill being placed.

3.2 PLACEMENT AND COMPACTION

- A. Materials shall be placed in lifts not greater than 8 inches of thickness unless a greater thickness is allowed by the Engineer upon demonstration that the materials and compaction efforts are adequate to obtain the required density.
- B. Material shall be placed in a uniform lift and thoroughly compacted by compaction equipment suitable for the material en-countered to obtain the required density prior to the placement of succeeding lift.
 - 1. Each lift shall be tested for proper compaction before successive lifts are applied.
- C. Stones generally shall not exceed 6 inches in greatest dimension and shall be well distributed throughout the soil mass. Stone shall be defined as rock material either in its natural or broken state.
- D. Stones not well mixed with soil material shall not be used in earth embankments unless the stone material is sufficiently deteriorated or friable so as to be compactible to achieve minimum voids and required density.
- E. If the required density is not obtained, compaction of the embankment shall continue until specified densities are obtained, before additional embankment is placed. Improperly compacted embankment shall be removed.
- F. Where required, add sufficient water during the compaction effort to assure proper density. If, due to rain or other causes, the material exceeds the optimum moisture content for satisfactory compaction, it shall be allowed to dry, assisted by dicing or harrowing, if necessary, before compaction or filling effort is resumed.
- G. Seal the working surface at the close of each day's operation and when practical prior to rainfall. Sealing shall be accomplished by rolling the surface with a smooth wheel steel roller.

- H. Compaction or consolidation achieved by traveling trucks, machines and other equipment will not be accepted unless such procedures are reviewed by the Engineer and proper compaction density is achieved.
- I. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.
- J. Embankments shall be constructed to such elevations as to make allowance for settlement that may occur. Prior to the construction of structures, roadways or other ground features and before final acceptance of the contract, regrade embankments to conform to the established lines and grades.

3.3 DENSITY CONTROL

- A. Embankments shall be compacted to 95% of maximum dry density as determined by the density tests designated in ASTM D1557.
 - 1. Compaction curves for the full range of soil materials to be used in the embankment shall be developed by an Engineer reviewed independent testing laboratory.
- B. Field control samples shall be taken and tested by the testing laboratory as required to assure that adequate compaction of the embankment material is being achieved.
- C. A minimum of one (1) in-place density test shall be made for every (10,000) square feet of compacted area per lift.
 - 1. In-place density of soils shall be determined by the methods described in ASTM D1556 or ASTM D6398 and expressed as a percentage of the maximum dry density.

SECTION 31 37 00

DUMPED RIP-RAP

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes furnishing plant, labor, equipment, and materials to place a protective covering of erosion-resistant material as shown on the plans or as directed by the Engineer. The work shall be done in accordance with this specification and in conformity with the lines, grades and thicknesses shown on the plans or established by the Engineer.

1.2 SUBMITTALS

- A. The following items shall be submitted.
 - 1. The name and location of the source of the material
 - 2. An affidavit from the Owner for each product stating that the site of the source was never used as a dump site for chemical, toxic, hazardous, or radioactive materials and it is not now or ever have been listed as a suspected depository for chemical toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau
 - 3. Documentation that rip-rap meets the requirements of this section.
 - 4. All mining and borrow permits required by local, State, and Federal agencies.
 - 5. Certification from owner of source.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Embankment, Section 312400
- B. Select Fill, Section 310514
- C. Earthwork, Section 310101

PART 2 PRODUCTS

- 2.1 GENERAL
 - A. Stone used for dumped rip-rap shall be sound, tough, durable, angular in shape, resistant to weathering and shall meet the gradation requirement specified. Neither breadth nor thickness of a single stone should be less than one-third its length. Rounded stone, broken concrete, or boulders will not be accepted. Stone shall be

free from decomposed stones, overburden, spoil, shale, organic material, or other defects impairing its durability and shall meet the gradation requirement specified.

B. Materials shall comply to NYSDOT Standard Specifications Section 620 – Bank and Channel Protection.

2.2 MATERIALS AND CONSTRUCTION

A. The gradation of materials furnished for use as rip-rap shall be as follows and will be accepted or rejected based on a visual examination of the material by the Engineer. The size of a stone as specified shall be its least dimension and shall conform to the requirements of the local, State, and Federal agencies.

Rip-Rap (layer thickness)	Stone Size	Percent Total by Weight	
Heavy (36 Inches)	Heavier than 600 lbs	50 - 100	
	Smaller than 6 inches	0 – 10	
Medium (24 Inches)	Heavier than 100 lbs	50 - 100	
	Larger than 12 inches	50 - 100	
	Larger than 18 inches	0 – 10	
	Smaller than 4 inches	0 – 10	
Light (18 Inches)	Lighter than 100 lbs	90 - 100	
	Larger than 6 inches	50 - 100	
	Smaller than ¹ / ₂ inches	0 – 10	
Fine (12 Inches)	Smaller than 8 Inches	90 - 100	
	Larger than 3 Inches	50 - 100	
	Smaller than No. 10	0 – 10	
	Sieve		

Notes:

- 1) Stone sizes other than weights, refer to the average of the maximum and minimum dimensions of a stone particle as estimated by the Engineer.
- 2) Materials shall contain enough stones smaller than the average stone size to fill the spaces between the larger stones.
- 3) Materials shall contain less than 20 percent of stones with a ratio of maximum to minimum dimension greater than three.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The ground surface on which rip-rap is to be placed shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. Soft or spongy material shall be removed to the depth shown on the plans or as directed by the Engineer and replaced with reviewed material. Filled areas shall be compacted in accordance with applicable provisions of the Section titled "Earthwork".
- C. The area to be protected by rip-rap shall be accurately shaped prior to placing of liner material or rip-rap. Where the liner system is called for, it shall be placed on

the prepared area and compacted to the depth, lines and grades indicated on the plans.

The rip-rap shall be placed to its full course thickness in one operation in such a manner as to produce a reasonably well-graded mass of rock without causing displacement of the underlying material. The finished surface shall be free from pockets of small stones and clusters of larger stones. Placing this material by methods likely to cause segregation of the various sized of stone will not be permitted. Rearranging of individual stones by mechanical or hand methods will be required to the extent necessary to obtain a reasonably well-graded distribution of the specified stone sizes. The completed course shall be of the specified thickness and to the lines and grades as shown on the plans or as ordered by the Engineer.

- C. Placement of stone upon finished liner material or geotextile filter fabric, when used, shall be carefully controlled to avoid disruption and damage to the layer of liner material or geotextile filter fabric. The stone shall be so placed and distributed that there will be no pockets of uniform size material.
- D. The desired distribution of the various sizes of stone throughout the mass shall be obtained by selective loading of the material at the quarry of other source; by controlled dumping of successive loads during final placing; or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to secure the specified results. When stone filling is dumped under water, methods shall be used that will minimize segregation.

SECTION 32 31 13 CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes all labor, materials and equipment to properly install fence framework, fabric, and gates as shown on the Contract Drawings or as ordered by the Engineer, complete with accessories.
- B. Certain features of chain link fences and gates shall be as shown or scheduled on the Contract Drawings.

1.2 REFERENCES

- A. Materials and installation shall comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein or shown on the Contract Drawings:
 - 1. American Society for Testing and Materials (ASTM)
 - a. A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
 - b. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
 - c. A392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - d. A428 Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles
 - e. A491 Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
 - f. A585 Specification for Aluminum-Coated Steel Barbed Wire
 - g. A817 Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric
 - h. A824 Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain-Link Fence
 - i. A1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
 - j. B117 Method of Salt Spray (Fog) Testing
 - k. C94 Ready-Mixed Concrete
 - I. F567 Standard Practice for Installation of Chain-Link Fence
 - m. F626 Specification for Fence Fittings
 - n. F1043 Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
 - o. F1083 Standard Specification for Pipe, Steel and Hot Dipped Zinc Coated, (Galvanized) Welded, for Fence Structures

1.3 COORDINATION REQUIREMENTS

- A. Coordinate layout and installation of chain link fences and gates with surveyor, site features and Engineer.
- B. Pre-installation Meetings: Coordinate with Owner and Engineer prior to installation on fences and gates.
- C. Scheduling: Schedule fences and gate installation with Owner and Engineer one week in advance of the work.

1.4 SUBMITTALS

- A. Submit the following in accordance with the General Provisions.
 - 1. Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of the referenced standards, this specification and the Contract Drawings.
- B. Product Data: "Catalog cuts" and specification sheets indicating details of fence and gate construction, fence height, post spacing, dimensions and unit weights of framework and concrete footing details marked to specifically indicate the materials proposed for this project. Indicate selections with arrows, and cross out irrelevant data.
- C. Certificates: Submit manufacturer's affidavit stating compliance with all applicable provisions of all ASTM specifications specified herein.
- D. Qualification Statements: Provide statement indicating fence installer has five years experience in installing the specified fence and gate.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and store fence and gate materials to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are named to establish a standard of quality necessary for the Project:
 - 1. Allied Tube & Conduit Corp.
 - 2. Anchor Fence, Inc.
 - 3. Page Aluminized Steel Corp.
 - 4. Or equal

2.2 GENERAL

- A. *Framework: Type I or Type II Steel Pipe.
 - 1. Type I Schedule 40 steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to Standard Specification ASTM F1083; or
 - Type II pipe manufactured from steel conforming to ASTM A 569 or F 669, coldformed, high frequency welded and having a minimum yield strength of 50,000 PSI. External surface triple coated with 1.0 ounce +- 0.1 ounce of zinc per square foot, 30 +-15 micrograms of chromate per square inch and 0.5 +- 0.2 mils of clear, cross linked

polyurethane. Internal surface coated, after welding, with a zinc-rich based organic coating having an 87% zinc powder loading capable of providing galvanic protection.

3. Pipe shall be straight, true to section and conform to the following weights:

Pipe Size Outside Diameter	Type I Weight Lbs./Ft.	Type II Weight Lbs./Ft.
1 5/8"	2.27	1.84
2"	2.72	2.28
2-1/2"	3.65	3.12
3"	5.79	4.64
3-1/2"	7.58	5.71
4"	9.11	6.56

- B. Fabric: Zinc-Coated or Aluminum-Coated Steel.
 - 1. Zinc-coated fabric shall be galvanized after weaving with a minimum 2.0 ounces of zinc per square foot of surface area and conform to ASTM A 392, Class 2.
 - 2. Aluminum-coated fabric shall be manufactured in accordance with ASTM A 491 and coated before weaving with a minimum of 0.40 ounces of aluminum per square foot of surface area. The steel wire and coating shall conform to ASTM A 817.
- C. Fittings:
 - 1. Pressed steel or cast iron, galvanized with a minimum of 1.2 ounces of zinc per square foot of surface area, or cast aluminum alloy, all conforming to ASTM F 626.

2.3 CONCRETE MIX

A. ASTM C 94 Portland Cement concrete with maximum 3/4" aggregate having a minimum compressive strength of 3,000 PSI at 28 days.

2.4 MATERIALS AND CONSTRUCTION

- A. Fence Posts
 - 1. Fence posts shall be sized as follows:

Fabric Height	Line Post O.D. Terminal Post		
	Туре І	Туре II	
Under 6'	2"	2"	
6' to 9'	2-1/?"	2-1/?"	
9' to 12'	3"	3"	

Fabric Height	Line Post O.D.		Terminal Post O.D.	
	Туре I Туре II		Type I	Type II
Under 6'	2"	2"	3"	2-1/₪"
6' to 9'	2-1/?"	2-1/?"	3"	3"
9' to 12'	3"	3"	4"	3-1/2"

B. Gate Posts

1. Gate posts shall be sized as follows:

Single Gate	Double Gate	Post O.D.	
Width	Width	Туре І	Type II
Up to 6'	Up to 12"	3"	3"
7' to 12'	13' to 25'	4"	3-1/?"
13' to 18'	25' to 36'	6 5/8"	

- C. Rails and Braces
 - 1. Rails and braces shall be 1 5/8" O.D., Type I or Type II.
- D. Fabric
 - 1. Fabric shall be galvanized or aluminum-coated steel wire, 9 gage, woven in a 2-inch diamond mesh with top selvage twisted and barbed and bottom selvage knuckled. Fence heights up to 12 feet shall be one-piece widths.
- E. Gates
 - Gates shall have frame assembly of 2-inches O.D., Type I or Type II pipe with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions. Fabric shall match fence. Gate accessories, hinges, latches, center stops, keepers and necessary hardware shall be of quality required for industrial and commercial application. Latches shall permit padlocking of gate. Barbed wire shall be installed at top of gates.
- F. Fittings
 - 1. Post caps shall be pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts.
 - 2. Rail and brace ends shall be pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.
 - 3. Top rail sleeves shall be tubular steel, 0.051 thickness by 7 inches long, expansion type.
 - 4. Tension bars shall be steel strip, 5/8-inch wide by 3/16 inch thick.
 - 5. Tension bands shall be pressed steel, 14 gage thickness by 3/4^[I]-inch wide.
 - 6. Brace bands shall be pressed steel, 12 gage thickness by 3/42 inch wide.

- 7. Truss rods shall be steel rod, 3/8-inch diameter merchant quality with turnbuckle.
- 8. Barbed wire arms shall be pressed steel, cast iron or cast aluminum alloy fitted with clips or slots for attaching three strands of barbed wire. Arms shall be set outward on a 45 degree angle and be capable of supporting a 250 pound load at outer barbed wire connecting point without causing permanent deflection.
- G. Tension Wire
 - 1. Tension wire shall be marcelled 7 gage steel wire with minimum coating of 0.80 ounces of zinc or 0.40 ounces of aluminum per square foot of wire surface and conforming to ASTM A824.
- H. Barbed Wire
 - 1. Barbed wire shall be commercial quality steel, 12 gage, two strand twisted line wire with 4 point barbs at 5-inch spacing. Coating shall consist of a minimum of 0.80 ounces of zinc per square foot of wire surface conforming to ASTM A 121 or a minimum of 0.30 ounces of aluminum per square foot of wire surface conforming of ASTM A 585.
- I. Tie Wires
 - 1. Tie wires shall be aluminum 9 gage, alloy 1100-H4, A58 self-locking fabric bands or equal.
- J. Hog Rings
 - 1. Hog rings shall be steel wire, 11 gage with a minimum zinc coating of 0.80 ounces per square foot of wire surface.

PART 3 - EXECUTION

3.1 GENERAL

A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fence and gate as shown on the Contract Drawings and in accordance with the manufacturer's installation instructions.
- B. Fence installation shall conform to requirements of ASTM F 567.
- C. Provide fence heights as shown on Contract Drawings.
- D. Space line posts at intervals not exceeding ten feet.
- E. Set terminal, gate and line posts plumb in concrete footings as shown on Contract Drawings. Top of footing shall be 2 inches above grade and sloped to direct water away from posts.
- F. Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.
- G. Install top rail through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts. Fasten top rail to terminal posts.
- H. Stretch bottom tension wire between terminal posts 6 inches above grade and fasten to outside of line posts with tie wires.
- 1. Pull fabric taut to provide a smooth uniform appearance, free from sag, with bottom selvage 2-inches above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15-inch intervals. Tie to line posts and top rails

with tie wires spaced at maximum 12-inches on posts and 24-inches on rails. Attach to bottom tension wire with hog rings at maximum 24-inch intervals.

- J. Anchor barbed wire to terminal extension arms, pull taut to remove all sags and firmly install in slots of line post extension arms.
- K. Install gates plumb, level and secure for full opening without interference. Anchor center stops and keepers in concrete. Adjust and lubricate hardware for smooth operation.
- L. Install nuts for fittings, bands and hardware bolts on inside of fence. Peen ends of bolts or score threads to prevent removal.

SECTION 33 00 01 PIPELINE INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes installation requirements for metallic and non-metallic pipelines, except special pipelines where installation requirements are specified elsewhere, as shown on the Contract Drawings, complete with fittings and specials.
- B. Certain features of pipes shall be as scheduled on the Contract Drawings.

1.2 **REFERENCES**

- A. Comply with the latest revision of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM).
 - 2. American Water Works Association (AWWA).

1.3 COORDINATION REQUIREMENTS

A. Coordinate layout and installation of new work with existing facilities and work by others.

1.4 SUBMITTALS

- A. Submit the following:
 - 1. Manufacturer's certifications that materials furnished are in compliance with the applicable requirements of the referenced standards and this specification. Layout drawings are required for pipelines to be installed within structures, showing the location including the support system, sleeves and appurtenances.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Materials for the piping, joints and fittings shall be as specified in the Technical Specification Section for the type of pipe to be installed, shown in the pipe schedule or on the Contract Drawings.
 - 1. Pipe and appurtenances shall comply with the applicable standards for its type of material.
- B. Pipe Joints
 - 1. Type of pipe joints shall be as scheduled in the pipe schedule, or as shown, or noted on the Contract Drawings.
- C. Delivery Inspection
 - 1. Pipe and appurtenances shall be inspected by the Contractor in the presence of the Engineer on delivery and prior to installation for conformance with the standards and specifications.
 - 2. Materials not conforming to the standards and specifications shall not be stored on site but removed at once and replaced with material conforming to the specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The Contractor shall examine areas and conditions for compliance with manufacturer's installation recommendations and requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION – UNDERGROUND

A. General

- 1. Install pipelines, fittings, specials, and accessories as shown on the Contract Drawings and in accordance with the manufacturer's installation instructions.
- 2. Excavation and backfilling shall be in accordance with the applicable provisions of applicable Technical Specifications.
- 3. Blocking will not be permitted under pipe, except where the pipe is to be laid with concrete cradle or encasement.
- 4. No pipe shall be laid upon a foundation in which frost exists; nor when there is danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- 5. Temporary bulkheads shall be placed in open ends of pipe whenever pipe laying is not actively in process. The bulkheads shall be designed to prevent the entrance of dirt, debris or water.
- 6. Precautions shall be taken to prevent the flotation of the pipe in the event of water entering the trench.
- B. Location and Grade
 - 1. Pipelines and appurtenances shall be located as shown on the Contract Drawings or as directed and as established from the Contractor's control survey.
 - 2. The alignment and grades shall be determined and maintained by a method acceptable to the Engineer.
- C. Subgrade
 - 1. The subgrade for pipelines shall be earth or special embedment as specified or directed and shall be prepared in accordance with applicable Technical Specifications.
- D. Pipe Joints
 - 1. Joints shall be assembled using gaskets, lubricants and solvents as furnished by the pipe manufacturer and in accordance with the manufacturer's recommendations.
 - 2. Joint deflection shall be in compliance within manufacturer's tolerances or as otherwise specified.
- E. Embedment
 - 1. Embedment shall be deposited and compacted in accordance with the Contract Drawings, Technical Specification, and the Technical Specification Section or schedule for the type of pipe being installed.

3.3 CUTTING AND SPECIAL HANDLING

- A. Field cuts of pipes shall be in accordance with the manufacturer's instructions.
- B. Where a pipe requires special handling or installation it shall be in accordance with the schedule for that type of pipe.

3.4 FINAL INSPECTION OF PIPELINES

- A. Each section of pipe shall be inspected prior to final acceptance.
 - 1. Leakage tests shall be performed on solid wall pipe in accordance with Technical Specification Section entitled "Leakage Tests".
 - 2. The inspection shall be by observation with illumination, if ordered by the Engineer.
 - 3. If ordered by the Engineer, the inspection shall be by closed circuit television.
 - a. Shall be monitored by both the Engineer and the Contractor.
- B. The inspection shall determine the pipeline to be true to line and grade, to have no obstruction to flow, to have no projections or protruding of connecting pipes or joint materials, shall be free from cracks and shall contain no deposits of sand, dirt or other materials.
- C. All deficiencies located during the inspection shall be corrected.

SECTION 33 08 01 LEAKAGE TESTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes leakage tests of all hydraulic structures and non-pressure piping for leakage as specified.
 - 1. The Contractor shall furnish all labor, equipment, test connections, vents, water and materials necessary for carrying out the pressure and leakage tests.
- B. All testing shall be witnessed by the Engineer.

1.2 SUBMITTALS

- A. In addition to those submittals identified in the Contract Documents, the following items shall be submitted:
 - 1. Reports of test results.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

TESTS ON STORMWATER BASINS AND DRY SWALES

- A. General
 - 1. Lined impoundments and/or structures designed to collect, store, or transport ground water shall be tested hydrostatically and for leakage prior to being placed in service. This includes, but is not necessarily limited to manholes, dry swales, retention ponds, and catch basins.
 - 3. All fittings and appurtenances must be properly braced and harnessed before the impoundment/structure is filled.
 - 4. If the structure fails the test, the cause of the leakage shall be evaluated and after repairs have been made the structure shall be retested. This procedure shall be repeated until the impoundment/structure complies.
- B. Leakage Test

Exfiltration test may be performed prior to or after backfilling. The test shall be made by filling the structure with water and observing the level for a minimum of 24 hours.

Infiltration tests shall be performed when the groundwater level is above the joint of the top section of a precast manhole.

1. The rate of leakage shall initially be determined at intervals by means of volumetric measurement of the makeup water added to maintain the water level in the structure. Test water shall be added until the rate of leakage has stopped such that the level can be maintained without change. After this, the test water level shall be maintained for at least 12-hours, unless a longer period is determined to be required by the Engineer.

- 2. All exposed piping shall be examined during the test and all leaks, defective material or joints shall be repaired or replaced before repeating the tests.
- 3. The allowable leakage for structures shall not exceed the following in gallons per 24 hours per impoundment/structure:

TYPE OF STRUCTURE	ALLOWABLE LEAKAGE
All structures and impoundments	0

4. Any visible leaks shall be permanently stopped and the impoundment/structure will require retesting until it has passed.

TEST FOR NON-PRESSURE PIPELINES FOR TRANSPORT STORMWATER

- A. General
 - 1. Pipelines designed to carry storm water in open channel flow or at minimal pressures shall be tested for leakage prior to being placed in service.
 - 2. The leakage shall be determined by exfiltration, infiltration or low pressure air.
 - a. The testing method directed by the Engineer shall take into consideration the groundwater elevation of the section of pipe being tested.
 - 3. Intermediate leakage tests during construction shall be performed as required. Upon completion of any pipeline, the entire system including manholes shall be tested for compliance to allowable leakage.
 - 4. If the line fails the test, the cause of the leakage shall be evaluated and after repairs have been made the line shall be retested. This procedure shall be repeated until the pipe complies.
- B. Exfiltration Testing
 - 1. Exfiltration tests shall be made by filling a section of pipeline with water and measuring the quantity of leakage.
 - 2. The head of water at the beginning of the test shall be at least 2 feet above the highest pipe within the section being tested.
 - a. Should groundwater be present within the section being tested, the head of water for the test shall be 2 feet above the hydraulic gradient of the groundwater.
 - b. Should the requirement of 2 feet of water above the highest pipe subject any joint at the lower end of the test section to a differential head of greater than 11.5 feet another method of testing shall be employed.
 - 3. Stormwater conveyance pipes shall be tested at 10 psig.
- C. Infiltration Testing
 - 1. Infiltration tests will be allowed only when the water table gauges indicated that the groundwater level to be 2 feet or more above the highest pipe of the section being tested.
 - 2. Infiltration test shall be made by measuring the quantity of water leaking into a section of pipeline.
 - 3. Measurement of the infiltration shall be by means of a calibrated weir constructed at the outlet of the section being tested.

D. Allowable Leakage for Non-Pressure Pipelines

The allowable leakage (exfiltration or infiltration) for non- pressure pipelines shall not exceed the following in gallons per 24 hours per inch of diameter per 1000 feet of pipe:

TYPE OF PIPE	ALLOWABLE LEAKAGE
HDPE	0

E. Air Testing

For the acceptance of air testing in lieu of hydrostatic testing (exfiltration or infiltration), the hydrostatic and air tests shall be performed on at least three sections of pipeline for each type of pipe being used. The Engineer shall select the sections for the corroborative tests. If these duel tested sections indicate the same results, that is, acceptance under both tests, air testing will be allowed in lieu of hydrostatic testing to meet the project requirements.

Air testing for acceptance shall not be performed until the backfilling has been completed.

Low pressure air tests shall conform to ASTM C 828 except as specified herein and shall not be limited to type or size of pipe.

Air testing of exposed (non-buried) fiberglass, PVC or other plastic or non-metal piping is prohibited.

All sections of pipelines shall be cleaned and flushed prior to testing.

The air test shall be based on the average holding pressure of 3 psi gauge, a drop from 3.5 to 2.5 psi, within the period of time allowed for the size of pipe and the length of the test section. The time allowed for the 1 psi drop in pressure, measured in seconds, will be computed by the Engineer and will be based on the limits of ASTM C 828.

- a. When groundwater is present the average test pressure of 3 psig shall be above any back pressure due to the groundwater level.
- b. The maximum pressure allowed under any condition in air testing shall be 10 psig. The maximum groundwater level for air testing is 13 feet above the top of the pipe.
- 7. The equipment required for air testing shall be furnished by the Contractor and shall include the necessary compressor, valves and gauges to allow for the monitoring of the pressure, release of pressure and a separable test gauge.
 - a. The test gauge shall be sized to allow for the measuring of the one psig loss allowed during the test period and shall be on a separate line to the test section.

SECTION 33 31 70

HIGH DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all high density polyethylene (HDPE) pipe, fittings, specials and all accessories of the classification, size and type of joints as specified herein and shown on the Contract Drawings.
- B. Certain features of HDPE pipe shall be as scheduled herein or on the Contract Drawings

1.2 REFERENCES

- A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
 - 1. American Association of State Highway Transportation Officials (AASHTO)
 - 2. American Water Works Association (AWWA)
 - 3. National Sanitation Foundation
 - 4. American National Standards Institute (ANSI)
 - 5. American Society for Testing and Materials (ASTM)
 - 6. Plastic Pipe Institute (PPI)

1.3 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Product Data:
 - a. "Catalog cuts" and spec sheets marked to specifically indicate all materials (including pressure rating and dimensions) proposed for this project. Indicate selections with arrows, and cross out irrelevant data.
 - 2. Shop Drawings:
 - a. Layout drawings for HDPE pipe to be installed within structures showing the locations and details of the support system, sleeves and appurtenances.
 - 3. Certificates:
 - a. Manufacturer's certification that all materials affidavit that all delivered materials comply with the requirements of the specified Standards.

1.4 QUALITY ASSURANCE

- A. Prior to initiating joining of the pipe the Contractor or his subcontractor shall present evidence to the Engineer of having successfully installed HDPE piping using this method on a minimum of three previous projects.
- B. The Contractor shall test and certify each weld.
- C. All testing including field services needed during installation of the pipe shall be

provided by the Contractor.

D. Manufacturer's Factory Qualifications: Manufacturing facilities shall have accreditation to ISO 9000:2000 or an equivalent quality management system acceptable to the Engineer.

1.5 DELIVERY AND HANDLING

- E. Coordinate delivery of all materials to allow movement into designated space.
- F. Handle all materials according to manufacturer's written instructions

PART 2 PRODUCTS

- 2.1 MATERIALS AND CONSTRUCTION
 - A. The following manufacturers are named to establish a standard of quality necessary for the Project:
 - 1. Performance Pipe
 - 2. KWH Pipe
 - 3. Or equal
- 2.2 HDPE PIPE
 - A. Solid (Non-Perforated) Piping
 - 1. Solid smooth walled interior and exterior SDR 17 or thicker HDPE Piping without perforations as specified herein and manufactured by Performance Pipe or equal shall be considered as an equal.
 - B. Perforated Piping
 - 1. Perforated corrugated SDR 17, or thicker HDPE piing. Perforations shall be Class II per AASHTO M252, or equal.
 - G. HDPE pipe shall be constructed from PE 3408 extra high molecular weight polyethylene resin having a cell classification of PE 325420C pursuant to ASTM D3350, or as approved by the Engineer.
 - H. Piping shall be stabilized with UV stabilizers and minimum 2% carbon black to protect against degradation to ultra violet light.

2.3 FITTINGS AND COUPLINGS

- A. Polyethylene fittings and couplings shall conform to the requirements of the polyethylene pipe for classification and size and shall be specified herein.
- B. The high density polyethylene pipe fittings and couplings shall be capable of withstanding the pressure required for the leakage test specified.
- C. Fittings up to 8-inch in size shall be the molded type. Fittings Larger than 8-inch shall be fabricated. All fabricated fittings shall be one (1) class (SDR/DR) stronger than the mainline pipe.

- D. Where mechanical couplings are called for, a steel sleeve in accordance with the manufacturer's recommendations shall be used.
- E. Electrofusion couplings, up to 28-inches in diameter, shall be used where typical fusion welding is impractical
- 2.4 JOINTS
 - A. Unless otherwise specified, joints for pipe and fittings shall be fusion welded in accordance with the manufacturer's recommendations.
 - B. Flanged joints shall be used for connecting to valves and other appurtenances.
 - C. Gaskets shall be 1/8" thick soft natural or synthetic rubber with a durometer of 73, plus or minus 4."
 - D. Steel bolts and nuts shall be cadmium plated.
 - E. Backup (follower) rings shall be Ductile Iron.

PART 3 EXECUTION

- 3.1 GENERAL
 - A. HDPE pipe shall be installed in accordance with the applicable provisions of the Sections titled "Pipeline Installation".
 - B. Polyethylene pipe shall be handled and stored in accordance with the manufacturer's recommendations.
 - C. Piping installed between structures shall be staked in the trench to provide for movement due to thermal expansion and contraction.
 - D. Field fusion welding procedures shall only be performed by personnel trained by the pipe manufacturer with training certification provided by the manufacturer.

3.2 LOCATION AND GRADE

- A. The alignment and grades shown on the Contract Documents shall be determined and maintained in accordance with the Section titled "Trenching, Backfilling and Compacting".
 - 2. The alignment and grades shall be determined and maintained by a method acceptable to the Engineer.

3.3 EMBEDMENT

A. The alignment and grades shown on the Contract Documents shall be determined and maintained in accordance with the Section titled "Pipeline Installation".

3.4 LEAKAGE TESTS

A. Sections of the piping shall be hydrostatically leakage tested in accordance with the Section titled "Leakage Tests".



* * * * *

SECTION 01300

SHOP DRAWINGS AND SAMPLES

PART 1 GENERAL

1.1 LISTING OF ITEMS

Following execution of the Subcontract, the Contractor will provide to the Subcontractor a list of equipment, materials, and other items for which Shop Drawings, layouts, or samples will be required. This listing shall not be construed to be all-inclusive and may be added to, or deleted from, as may be required in the opinion of the Contractor.

1.2 ACCEPTANCE OF MANUFACTURERS OR VENDORS

The Subcontractor, with such promptness and in such sequence as to cause no delay in the Work, shall submit to the Contractor the name of the manufacturer or vendor for each item on the list or addition to the list submitted. No awards shall be made by the Subcontractor, and no work under any item shall proceed, until acceptance of the manufacturer or vendor has been given by the Contractor. Such acceptance will be only based on the manufacturer's or vendor's experience and reputation and will not imply that the Shop Drawings or samples for the item will be acceptable. Review of Shop Drawings for an item will depend upon full compliance with the Contract Documents as demonstrated by material submitted.

1.3 ELECTRICAL INTERCONNECTIONS

Where the Project includes electrical equipment and electrical control systems and where the Work of the Project involves more than one Subcontractor, it shall be the responsibility of the Electrical Subcontractor to coordinate and complete power, control, and electrical signal interconnections for equipment included in the Project.

1.4 SHOP DRAWING SUBMITTAL REQUIREMENTS

Shop Drawings and data shall be submitted to the Contractor for each item on the latest revised list determined from Section 1.1 above. Submittals shall be made sufficiently in advance of the time when items included therein are to be incorporated into the Work to permit proper review, necessary revisions, and resubmittals without causing a delay in the performance of the Work. The Subcontractor shall allow a minimum period of 10 business days for review of shop drawing submittals by Contractor.

Shop Drawings shall present complete and accurate information relative to working dimensions, equipment weights, assembly, section views, necessary details pertaining to coordinating the Work of the Contract, lists of materials and finishes, parts lists and the description thereof, lists of spare parts and tools where such parts or tools are required, and other items of information that are required to demonstrate detailed compliance with the Contract Documents. Drawings for electrical equipment shall include elementary and interconnection diagrams.

Except as otherwise provided, Subcontractor's submittal of Shop Drawings shall constitute Subcontractor's representation that submitted Shop Drawings and the specifications pertaining

thereto have been thoroughly reviewed by Subcontractor for consistency with the Specifications and that submitted Shop Drawings strictly comply with the requirements of the Contract Documents; that the Subcontractor has determined and verified quantities, dimensions, field construction criteria, materials catalog numbers, and similar data, and that Subcontractor has reviewed or coordinated each shop drawing with the requirements of the Work and the Contract Documents. The return to Subcontractor of Shop Drawings stamped "Reviewed" shall in no way relieve Subcontractor from sole responsibility for strictly complying with the specifications in the Contract Documents. Subcontractor shall reimburse Contractor for the costs (including labor costs) and expenses of Contractor's incurred in the review of Shop Drawings which have been twice before returned marked as "Rejected" or "Resubmit".

Unless otherwise permitted in specific cases, data shall be transmitted to the Contractor by the Prime Subcontractor.

Each shop drawing submitted shall indicate the following:

- (a) Project name and contract number
- (b) Manufacturer of the equipment
- (c) Notation as to whether original submittal or resubmittal
- (d) Date received by Subcontractor from manufacturer or vendor
- (e) Date submitted to Contractor

Each shop drawing submittal shall be accompanied by a transmittal letter indicating the item or items submitted, with particular reference to latest revised list of equipment, materials, and other items described in 1.1 above and the appropriate section of the Contract Documents to which the items apply. The transmittal letter shall also indicate whether the submittal constitutes a complete set of drawings for the item, a partial set of drawings for which additional submittals are to be expected by the Contractor, or a partial set of drawings to complete a previous submittal. The Subcontractor shall indicate by the transmittal letters when the submittals for an item are intended to be complete.

The Subcontractor shall submit at least five copies of drawings, catalog data, and similar items for review. This number includes one for return to the Subcontractor. If the Subcontractor desires more than one copy returned to it, the Subcontractor shall submit with the initial and subsequent transmittals the additional number desired up to a maximum of three copies.

If the Contractor requires additional copies, the Contractor will inform the Subcontractor upon return of the material noted as "Reviewed". Additional copies of "Reviewed" Shop Drawings will be requested in the cases where the subject matter shown thereon requires coordination of two or more prime Contracts. Copies of such drawings will be retransmitted by the Contractor when received.

A current file of "Reviewed" Shop Drawings will be maintained by the Contractor and said current file of "Reviewed" Shop Drawings will be at the job site. Subcontractors may have access to said "Reviewed" shop drawing file during normal office hours. It shall be the responsibility of each prime Subcontractor to avail itself of information in said "Reviewed" shop drawing file and

to be aware of coordination requirements involving its work in the event it does not receive appropriate Shop Drawings from the Contractor.

1.5 CONTRACTOR'S REVIEW OF SHOP DRAWINGS

The Contractor's review of Shop Drawings is for general compliance with the Contract Documents only and is not a complete check of the method of assembly, erection, construction or detailed review of the specifications. Such review shall in no way be construed as permitting departure from the Contract Documents, except where the Subcontractor has previously requested and received written approval of the Contractor for such departure. When requested by Subcontractor, proposed departures from the Contract Documents will be considered by Contractor at Subcontractor's expense, whether or not accepted. The cost of Contractor's conflict review and revisions made as a result of Subcontractor's requested departure shall be at the expense of Subcontractor. Subcontractor shall reimburse Contractor for the referenced costs and expenses of Contractor's upon demand.

Review of Shop Drawings by the Contractor will be limited to complete submittals except where review of a partial submittal is specifically requested by the Subcontractor and where such review of a partial submittal is necessary for timely completion of the Work of the Contract. Where Shop Drawings of related items are necessary for review of a particular submittal, the Contractor will so inform the Subcontractor, who will promptly submit such shop drawing of said related items.

Drawings and similar data will be reviewed and stamped by the Contractor as follows:

- (a) "Reviewed," if no change or rejection is made. All but four copies of the submitted data will be returned.
- (b) "Reviewed and Noted," if minor changes or additions are made but resubmittal is not considered necessary. The Subcontractor may proceed with fabrication, procurement, and installation provided that the Contractor's changes/additions have been incorporated. All but four copies of the submitted data will be returned and each copy will bear the corrective marks.
- (c) "Resubmit," if the changes requested are extensive or if retransmittal of the submittal to another Subcontractor is required. In this case, the Subcontractor shall resubmit the items after correction, and before fabrication, procurement or installation. The same number of copies shall be included in the resubmittal as in the first submittal. One copy of the first submittal will be retained by the Engineer and two copies will be returned to the Subcontractor.
- (d) "Rejected," if it is considered that the data submitted cannot, with reasonable revision, meet the requirements of the Contract Drawings and Specifications.

1.6 RESUBMITTALS

Changes, other than those indicated as requested, made in drawings or other data shall be specifically brought to the attention of the Contractor upon resubmittal. Changes or additions shall not be made in, or to, "Reviewed" data without specific notice to the Contractor.

If acceptance is not given after reasonable correction and resubmittal of the Shop Drawings for an item of equipment, the Subcontractor shall submit the name of another manufacturer or vendor to supply the item required in accordance with 1.2. Should progress of the Work be delayed by the changing of the manufacturer or vendor, such a cause will not be considered an extenuating circumstance beyond the control of the Subcontractor, and charges for delay if otherwise applicable, will be levied and shall be born solely by the Subcontractor.

1.7 SAMPLES

Samples shall be submitted to the Contractor as required on the latest revised list determined from Section 1.1. The samples shall be properly identified by tags and shall be submitted sufficiently in advance of the time when they are to be incorporated into the Work, so that rejections thereof will not cause delay. A letter of transmittal from the Subcontractor requesting review shall accompany such samples.

The procedures set forth in Section 1.5 and 1.6 above for Shop Drawings shall be used for processing samples.

SECTION 02292

GEOTEXTILE CUSHION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes furnishing of all labor, material, and equipment and performing all operations required for testing, furnishing, hauling, and placing the geotextile cushion. All work shall be completed as specified herein and as shown on the drawings or specified by the Engineer.

1.2 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basis designation only. Use the latest revision date available unless otherwise indicated.

A. American Society for Testing and Materials (ASTM).

	ASTM D 4355	Test Method for UV Resistance
	ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permittivity
	ASTM D 4533	Test Method to determine Trapezoid Tear
	ASTM D 4632	Test Method to determine the grab Tensile Strength and Elongation
	ASTM D 4751	Test Method for Measuring the Determining Apparent Opening Size of a Geotextile
	ASTM D 6241	Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
B.	Additional ASTM Stand	dards for High Tensile Strength Geotextile Cushion
	ASTM D 4595	Test Methods for Tensile Properties of Geotextiles by the Wide-Width Strip Method
	ASTM D 4884	Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles
	ASTM D 5199	Test Method for Measuring the Nominal Thickness of Geosynthetics
	ASTM D 5261	Test Method to determine the unit weight

1.3 SUBMITTALS

A. Manufacturer's certification of the geotextile cushion indicating that the geotextile cushion meets the physical, and manufacturing requirements stated in this Section.

PART 2 PRODUCTS

2.1 DITCH A GEOTEXTILE CUSHION

- A. The needle punched nonwoven geotextile cushion shall be Mirafi S1600N, or equal. Geocushion shall be composed of polypropylene fibers formed into a stable network such that the fibers retain their relative position.
- B. The geotextile cushion shall be a nonwoven, needle-punched geotextile.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value
Weight	ASTM D5261	oz/yd² (g/m²)	16.0 (542)
Thickness	ASTM D5199	mils (mm)	175 (4.4)
Grab Tensile Strength	ASTM D4632	lbs (N)	425 (1891)
Grab Tensile Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	155 (690)
CBR Puncture Strength	ASTM D6241	lbs (N)	1200 (5340)
			Maximum Opening Size
Apparent Opening Size (AOS)	ASTM D4751	U.S. Sieve (mm)	100 (0.15)
			Minimum Roll Value
Permittivity	ASTM D4491	sec ⁻¹	0.7
Permeability	ASTM D4491	cm/sec	0.31
Flow Rate	ASTM D4491	gal/min/ft² (l/min/m²)	50 (2037)
			Minimum Test Value
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	80

C. The geotextile cushion shall conform to the following minimum average roll values:

Physical Properties	Unit	Roll Size
Roll Dimensions (width x length)	ft (m)	15 x 300 (4.5 x 91)
Roll Area	yd ² (m ²)	500 (418)

- D. During all periods of shipment and storage, the geotextile cushion shall be protected from adverse weather, heavy winds or precipitation, direct sunlight, ultraviolet light, temperatures greater than 140°F, mud, dirt, dust, debris, and vandals. To the extent possible, the geotextile shall be maintained wrapped in a heavy duty protective covering. In the event of damage, the Contractor shall immediately make all repairs and replacements at no additional cost to the Owner.
- E. All geotextile cushion testing services as specified herein necessary for the Contractor to obtain an approved geotextile cushion material and thread shall be provided by the Contractor. All testing including laboratory and field services required during installation of the geotextile shall be provided by the Contractor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prior to installation of the geotextile cushion, all vegetation, rocks, debris, etc. and other deleterious materials shall be removed from the surfaces to be covered with the geotextile cushion. The surface shall be free from stones or clods greater than 1/4-inches in diameter. Any roots 1/2 inch or over in diameter shall be removed to at least 18 inches below the surface. Any depressions, potholes, ruts, etc., in the surfaces to be covered shall be filled with the appropriate soil material and compacted to final grade. The finished surface shall be smooth with no abrupt projections to damage the geotextile cushion. The supporting layer will be maintained in a smooth, uniform, and compacted condition during installation of the geotextile cushion. The subgrade shall be inspected and accepted by the Engineer prior to placement of the geotextile cushion.
- B. The geotextile cushion shall be placed in manner and at the locations shown on the drawings. At the time of the installation, the geotextile cushion shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.
- C. The geotextile cushion used shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. The geotextile cushion shall be overlapped a minimum of 2 feet along all edges or seamed by sewing in accordance with the manufacturers recommendations.
- D. The geotextile cushion shall be protected at all times during construction from damage by surface runoff and any geotextile cushion so damaged shall be removed and replaced with undamaged geotextile cushion. Any damage to the geotextile cushion during its installation or during placement of soil layers shall be replaced by the Contractor at the Contractor's expense.
- E. The work shall be scheduled so that the covering of the geotextile cushion with a layer of the specified material as shown on the Contract Drawings is accomplished within 14 days after placement of the geotextile cushion. Failure to comply shall require replacement of the geotextile cushion.
- F. The geotextile cushion shall be placed tightly against the soil such that no void spaces occur behind the geotextile cushion.

SECTION 02293

LLDPE GEOMEMBRANE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes testing, manufacturing, fabricating, furnishing, and installing 40 mil textured linear low-density polyethylene (LLDPE) geomembrane. Work shall be performed in strict accordance with the geomembrane manufacturer's recommendations, as reviewed and accepted by the Engineer, the Contract Drawings and these specifications.

1.2 REFERENCES

- A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM D1004 Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - b. ASTM D1204 Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting of Film at Elevated Temperature
 - c. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
 - d. ASTM D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - e. ASTM D1603 Test Method for Carbon Black in Olefin Plastics
 - f. ASTM D3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Colorimetry
 - g. ASTM D4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds
 - h. ASTM D4437 Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
 - i. ASTM D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 - j. ASTM D5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

- k. ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- 1. ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- m. ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes
- n. ASTM D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- o. ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- p. ASTM D7240 Standard Practice for Leak Location using Geomembranes with an Insulation Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)
- 2. Geosynthetic Research Institute (GRI)
 - a. GRI GM 13 Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene Smooth and Textured Membranes
 - b. GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear low Density Polyethylene Smooth and Textured Membranes

1.3 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Resin Supplier Submittals
 - a. Certification that the polyethylene resin is new, first quality resin manufactured in the United States from virgin ingredients, and meets or exceeds the requirements specified hereinafter and is free of contaminants.
 - b. Certification that resin is from the same manufacturer.
 - c. Origin, identification, and production date(s) of the raw materials used to manufacture the geomembrane.
 - d. Copy of quality control certificates of raw materials used to manufacture the geomembrane.

e. Reports of tests conducted to verify the quality of the raw materials will be provided as follows:

		MINIMUM	
PARAMETER	STANDARD	FREQUENCY	CRITERIA
<u>LLDPE (TEXTURED</u>	<u>))</u>		
Density	ASTM D1505	One sample from each resin batch	0.92 g/cm ³
Melt Flow Index	ASTM D1238	One sample from each resin batch	≤ 1.0 g/10 minutes
Oxidative Induction Time	ASTM D3895 @1 atm @200°C	One sample from each resin batch	\geq 140 minutes

- 2. Manufacturer Submittals
 - a. Certification of production capacity and schedule availability to meet this contract.
 - b. Manufacturer quality control program manual and copy of manufacturer quality control certificates.
 - c. Certified test results for material properties specified.
 - d. Certification that no reclaimed polymer, no more than 2% recycled material, and no work off material is added to the virgin resin during the manufacture of the geomembrane.
 - e. Certification of geomembrane formulation of at least 97% of polyethylene resin, the balance being carbon black and additives; and certification that no fillers, extenders, or other materials are added into the formulation.
 - f. Certification of chemical and physical resistance of the geomembrane to materials it may come in contact with.
- 3. Fabricator Submittals
 - a. Quality control program manual and copy of quality control certificates.
 - b. Certified seam test results.
 - c. Two samples of typical fabricated seams and a list of seam properties, minimum seam values, and test methods employed.
 - d. Geomembrane thickness measurements.
- 4. Installer Submittals

- a. Quality control program manual including, but not limited to:
 - 1) Installation procedures
 - 2) Field seaming procedures
 - 3) Procedures for repair
 - 4) Documentation procedures.
- b. Two samples of typical field seams and a list of seam properties, minimum seam values, and test methods employed.
- c. Resumes of the qualifications of the installation supervisor and personnel performing field seaming operations for this project.
- d. Proposed geomembrane panel layout showing proposed locations of field seams to be installed. The Installer shall inform the Engineer of changes in field seam locations.
- e. Daily seam strength test values for peel adhesion and seam shear strength.
- f. Weekly update copies of the as-built drawings supplied to the Subcontractor and Engineer.
- g. Notification of equipment or material problems within eight hours of the occurrence and the proposed course of corrective action.
- h. Samples of report/documentation forms.
- i. Summary log of field quality control work completed by the Installer.
- j. Certification by both the Installer and Fabricator that the material installation is complete and in accordance with the specifications.
- k. Statement of Warranty.
- 5. Contractor Submittals
 - a. Direct shear laboratory qualifications.
- 6. CQC Geosynthetic Laboratory
 - a. Quality control program manual.
- 7. Qualification Submittals
 - a. Manufacturer shall demonstrate qualification by having successfully manufactured at least ten million square feet of the proposed geomembrane.
 - b. CQC Geosynthetic laboratory shall demonstrate qualification by having provided a minimum of two successful years of geosynthetic

testing services. The Geosynthetic Laboratory Manager will be required to have a minimum of five years of geosynthetics testing experience. The CQC Geotechnical Laboratory will not be permitted to be owned by the Subcontractor, manufacturer, or installer, or owned by a subsidiary of the Subcontractor, manufacturer, or installer.

1.4 **DEFINITIONS**

- A. CQC Geosynthetic
 - Laboratory: The third-party construction quality control geosynthetic testing (CQC) lab hired by the Subcontractor, independent from the Subcontractor, manufacturer, fabricator and installer who is responsible for quality control geomembrane seam testing.
- Β. CQC Inspector: The third-party construction quality control (CQC) person or corporation hired by the Subcontractor, independent from the Subcontractor, manufacturer, fabricator, and installer, who is responsible for observing and documenting activities related to the quality control of the geomembrane from manufacture through The CQC Inspector shall report directly to the installation. Engineer. The Inspector shall be from an engineering firm or certified testing laboratory experienced in the installation and testing of geomembranes. The Inspector's qualifications shall be submitted to and reviewed by the Engineer. The cost of the inspection is paid for by the Subcontractor. The CQC Inspector shall report directly to the Engineer daily. CQC test results shall be presented to the Engineer by the CQC Inspector daily.
- C. Fabricator: A factory converter of narrow geomembrane sheets into panels by dielectric bonded solvent adhesive, or fusion methods.
- D. Installer: The person or corporation hired by the Subcontractor who is responsible for field handling, deploying, seaming, field construction quality control (CQC) testing and anchoring the geomembrane panels.
- E. LLDPE: Abbreviation for linear low-density polyethylene geomembrane.
- F. Manufacturer: The producer of geomembrane rolls by the blown-film process or the flat extrusion process.
- G. Panel: A factory-fabricated geomembrane composed of several narrow width geomembrane sheets seamed into one large unit.
- H. Roll: A manufactured seamless geomembrane sheet with a minimum width of 22 feet.

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1.5 EQUIPMENT

A. All equipment, tools and machines used in performance of the work shall be subject to acceptance by the Engineer prior to commencement of work. This equipment shall be maintained in satisfactory working condition.

1.6 DELIVERY, STORAGE AND HANDLING.

A. The geomembrane materials shall be packaged, shipped, and delivered by appropriate means so that no damage is incurred. Materials shall be delivered only after the required submittals have been received and reviewed by the Engineer. No offloading shall be done unless the CQC Inspector is present. The geomembrane shall be adequately protected to prevent degradation of the material and adhesion of individual whorls of a roll or layers. If outdoors, the geomembrane shall be stored in the sealed cover. The geomembrane shall be stored on a level surface (no wooden pallets) and shall be protected from the direct rays of the sun under a lightcolored, heat-reflective, opaque cover in a manner that provides a free-flowing air space between the crate and cover. The geomembrane shall also be protected from adverse weather, heavy winds, precipitation, temperature extremes and vandals. Appropriate handling equipment and techniques, as recommended by the manufacturer/fabricator and accepted by the CQC Inspector, shall be used. Geomembrane damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the CQC Inspector, at no additional cost to the Owner.

1.7 AS-BUILT DRAWINGS

A. The Subcontractor shall provide as-built drawings which shall be updated weekly, showing panel/roll numbers, layout plan, seam numbers, and the location(s) of patches, anchorage details, and penetrations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are named to establish a standard of quality necessary for the Project:
 - 1. Agru America, Inc.
 - 2. Or equal.
- B. The geomembrane selected shall meet the requirements of this section.

2.2 RAW MATERIALS

A. The materials used in production of geomembrane roll stock shall be 100 percent domestic, first-quality raw materials, using no more than 2% recycled material. The Subcontractor shall provide certification that the resin meets or exceeds the requirements along with a copy of the quality control certificates.

2.3 SHEET MATERIALS

- A. The geomembrane sheets shall be uniform in color, thickness, size, and surface texture.
- B. The geomembrane shall be black in color.
- C. The geomembrane sheets shall be free of damage, tears, punctures, pinholes, blisters, nodules, contaminants, and other imperfections.
- D. Geomembrane shall be AGRU LLDPE Microspike® Geomembrane or equal.
- E. The geomembrane sheets shall conform to the physical requirements listed below:

PARAMETER	STANDARD	FREQUENCY	CRITERIA
Thickness, absolute minimum	ASTM D5994	every roll	36 mils
		minimum	
Density (maximum)	ASTM D1505	200,000 lb	0.939 g/cm^3
Minimum Tensile Properties	ASTM 6693, Type IV		
1. Tensile Strength @ Break	Dumbell, 2 ipm	20,000 lb	112 lb/in (20
			N/m)
2. Elongation @ Break	G.L.=2.0 in (51 mm)		400 %
Tear Resistance	ASTM D1004	45,000 lb	25 lb (111 N)
Puncture Resistance	ASTM D4833	45,000 lb	50 lb (222 N)
Carbon Black Content	ASTM D1603*/4218	20,000 lb	2.0-3.0 %
Carbon Black Dispersion	ASTM D5596	45,000 lb	Notes 1
Asperity Height	ASTM D 7466	second roll	20 mil (0.5 mm)
Oxidative Induction Time	ASTM D3895, 200°C;	200,000 lb	>140
	O ₂ , 1 atm		
Roll Length ⁽³⁾ (approximate)	Double-Sided Textured		700 ft (213 m)
Roll Width ⁽³⁾			22.5 ft (6.9 m)
Roll Area			15,750 ft ² (1,463
			m ²)

NOTES:

Note 1: Dispersion only applies to near spherical agglomerates are considered. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

F. The Subcontractor shall provide certified test results for material properties specified along with a copy of the Manufacturer's quality control program manual and quality control certificates.

2.4 PANEL FABRICATION

- A. Where possible, geomembrane sheets, when less than 22 feet wide, shall be factory seamed into maximum sized panels so as to minimize field seaming.
- B. All factory seams shall be made by wedge welding and shall meet the minimum shear and peel strength requirements shown below:

PROPERTY	STANDARD	CRITERIA
Peel Strength (extrusion)	ASTM D6392	48 lb/in (8.4 kN/m)
Peel Strength (fusion)	ASTM D6392	50 lb/in (8.8 kN/m)
Shear Strength (extrusion)	ASTM D6392	60 lb/in (10.5 kN/m)
Shear Strength (fusion)	ASTM D6392	60 lb/in (10.5 kN/m)

2.5 SAMPLING AND TESTING

- A. General Requirements
 - 1. All testing services as specified herein necessary for installation of the geomembrane shall be provided by the Subcontractor. Testing including laboratory and field services required during construction of the geomembrane shall be provided by the Subcontractor.
 - 2. Geomembrane testing shall be performed by a testing laboratory accepted by the Engineer and paid for by the Subcontractor.
 - 3. The Subcontractor shall provide at least 2 days notice prior to testing. The Subcontractor shall provide transportation for the Engineer to and from the test site upon request.
- B. Manufacturing Testing
 - 1. Each resin batch shall be tested to ensure the consistency of the raw material quality. A resin batch which fails to meet the specified physical properties shall not be accepted for manufacturing the liner. The geomembrane sheets shall be randomly sampled and tested at a minimum of once every 20,000 square feet to evaluate the required physical properties listed in Section 2.3. Certified test results on each sample shall be submitted along with a complete stress rupture curve. In addition, a minimum of two 24-inch by 24-inch size samples, from each roll along with appropriate identification, shall be provided to the Owner for further testing if desired. The Subcontractor shall provide the Engineer with a permanent record of actual furnished material. Samples not meeting the minimum requirements specified shall result in the rejection of the applicable rolls.
 - 2. Manufacturer's certification of the parameters specified in Section 2.5 C.1 is acceptable.
 - 3. Conformance testing must be performed at a rate of 1 test per 100,000 square feet of material delivered to the site. Each sample must include the following tests:
 - a. Density (ASTM D792/D1505)
 - b. Carbon Black Content (ASTM D1603)
 - c. Asperity Height (ASTM D7466)
 - d. Thickness (ASTM D5994)
 - e. Tensile Properties (ASTM D6693)
Conformance samples will be 2 feet by the width of the roll and must be submitted to an approved third party laboratory for testing. Engineer may request archive samples be taken tht are representative of material based on lot number.

- C. Fabrication Testing
 - 1. Prior to factory seaming, roll goods shall be continuously inspected on both sides for defects and impurities. The geomembrane shall be continuously visually inspected for:
 - a. Uniformity
 - b. Damage
 - c. Imperfections
 - d. Holes
 - e. Cracks
 - f. Thin spots
 - g. Foreign material
 - h. Tears
 - i. Punctures
 - j. Blisters.

All defects and impurities shall be immediately removed, repaired, and reinspected prior to being fabricated into panels. Thickness measurements shall be made at the center and each edge of the beginning and end of each roll of material used for this project. Measurements shall be submitted by the Subcontractor to the Engineer. Rolls having a thickness less than the minimum value specified herein shall be rejected. The Subcontractor shall submit documentation to the Engineer that fabrication of geomembrane rolls took place in accordance with the requirements of this Section.

- 2. Prior to shipping to the site, non-destructive tests shall be performed on fabricated seams over their full length using the appropriate test unit and procedure as outlined in this Section. Deviation from these procedures shall be subject to review by the Engineer prior to use. Geomembrane factory seams shall be vacuum tested or pressurized dual seam tested (for double wedge process only). A seam which fails shall be documented and repaired in accordance with the requirements of this Section.
- 3. Destructive Factory Seam Testing
 - a. Destructive seam testing shall be performed on a minimum of two samples per geomembrane sheet. Where possible, the samples shall be taken from extra material at the beginning or end of sheet seams, such that the geomembrane sheet is not damaged and the sheet geometry is not altered.
 - b. The samples shall be a minimum of 18 inches wide by 72 inches long with the seam centered lengthwise. Each sample shall be cut into three pieces with one piece (18 inches by 24 inches) retained by the fabricator, one piece given to an independent laboratory, and one piece given to the Owner for further testing if desired and permanent record. Each sample shall be tagged to identify: (1)

manufacturer's roll number, (2) date cut, (3) panel from which cut, (4) location in panel, (5) visual inspection comments, (6) inspector's name, and (7) top sheet.

- Ten 1-inch wide replicate specimens shall be cut from the fabricator c. sample. Five specimens shall be tested for shear strength and five for peel adhesion. If one of the tested seams delaminates, failing in a non-film tear bond, the entire length of the seam will be reconstructed or repaired and retested using non-destructive seam testing over the full length of the seams using either the vacuum box or pressurized dual seam method. If no seams delaminate, but fail in the adjacent sheet material on either side of the seam in a film tear bond, the seam strength will be calculated for each test. To be acceptable, four out of five replicate test specimens must meet the specific property requirements listed in Section 2.3. If a sample fails a destructive test, the entire seam length will be reconstructed or repaired, and retested using non-destructive seam testing over the full length of the seams using either the vacuum box or pressurized dual seam method (for double wedge process only).
- d. The test procedures to be used by the independent laboratory shall be the same as defined in this Section.
- e. The Subcontractor shall provide the Engineer with certified copies of the factory test results prior to the arrival of material on site.
- f. The Subcontractor shall provide the following information from the manufacturer for each roll or pallet of geomembrane manufactured including, but not limited to:
 - 1) Name of manufacturer/fabricator
 - 2) Product type
 - 3) Product thickness
 - 4) Manufacturing batch code
 - 5) Date of manufacturer
 - 6) Physical dimensions (length and width)
 - 7) Direction for unrolling or unfolding the geomembrane.
- D. Field Sampling and Testing
 - 1. The Subcontractor shall provide two minimum 18-inch wide by 18-inch long samples of geomembrane for each lot number of geomembrane material that arrives at the site, for finger printing. The samples shall be provided to the Owner for possible future testing and analysis. One sample shall be stored at room temperature and in a light free environment.
 - 2. The CQC Inspector shall visually inspect the geomembrane for uniformity, damage, imperfections, tears, punctures, or blisters. Imperfections must be immediately repaired by the Subcontractor and reinspected by the Inspector at the Subcontractor's expense.

- 3. Non-Destructive Field Seam Testing
 - a. The Subcontractor shall non-destructively test field seams over their full length using the appropriate test unit and procedure as outlined in this Section. Deviation from these procedures shall be subject to review by the Engineer prior to use. Testing shall be performed as the seaming work progresses, not at the completion of field seaming. Geomembrane field seams shall be pressurized dual seam tested (for double wedge process only). Seams which fail shall be documented and repaired in accordance with this Section. Nondestructive testing shall be witnessed by the CQC Inspector and documented.

4. Destructive Field Seam Testing

- a. The Subcontractor shall obtain a minimum of one destructive test sample per field seam at locations specified by the CQC Inspector and accepted by the Engineer and a minimum of one test for each seaming machine per day or per 500 lineal feet of weld. When possible, these samples shall be taken from extra material at the beginning or end of panel seams such that the panel is not damaged and the panel geometry is not altered. Additional test locations may be selected at the direction of the Engineer.
- b. The samples shall be a minimum of 18-inches wide by 72-inches long with the seam centered lengthwise. Each sample shall be cut by the Installer into three pieces with one piece (18 inches by 24 inches) retained by the Installer, one piece given to an independent laboratory, and the remaining piece given to the Owner for further testing if desired and permanent record. Each sample shall be tagged to identify: (1) roll/panel number, (2) seam number, (3) date and time cut, (4) ambient temperature, (5) seaming unit, (6) name of seamer, (7) welding apparatus temperature and pressures, and (8) top sheet.
- c. The Subcontractor shall cut ten 1-inch wide replicate specimens from his sample using the appropriate ASTM cutting tool. Five specimens shall be tested for shear strength and five for peel adhesion in accordance with ASTM D4437. Each specimen will be 1inch wide and 12-inches long with the field seam at the center of the specimen. To be acceptable, four out of five replicate test specimens must meet the specified property requirements listed in Section 2.3 and fail in a film tear bond. If the field tests pass, independent laboratory testing shall be conducted in accordance with this Section. If the field tests fail, the seam shall be repaired in accordance with this Section. Certified test results from the Installer and independent laboratory shall be submitted prior to acceptance of the seam. No seams shall be covered until acceptance of the seam by the Engineer.

- d. The test procedures to be used by the independent laboratory shall be the same as defined in this Section.
- E. Non-Destructive Seam Testing Procedures
 - 1. Pressurized Dual Seam Test (in accordance with ASTM D5820)
 - a. The pressurized dual seam test unit shall comprise the following:
 - An air pump (manual or motor driven) capable of generating and sustaining the required pressure.
 - A flexible hose with fittings and connections.
 - b. The pressurized dual seam test procedure shall consist of the following steps:
 - Seal both ends of the seam to be tested.
 - Insert needle or other accepted pressure feed device into the air channel created by the wedge weld. The lower sheet beneath the air channel must not be penetrated.
 - Connect the air pump to the pressure gauge and pressurize the air channel to a pressure between 24 psi and 30 psi, close valve, and sustain pressure for approximately 5 minutes after equilibrium is achieved.
 - Remove the flexible hose which connects the pressure gauge to the air pump. Mark the time and pressure of the pressure gauge at the start of the test and at a duration of five minutes on the geomembrane with a white marker. If the loss of pressure exceeds 4 psi in the five-minute period or does not stabilize, locate the faulty area and repair.
 - At the conclusion of the pressure test, cut the end of the seam opposite the pressure gauge. A decrease in gauge pressure must be observed or the air channel will be considered "blocked" and the test will have to be repeated until the blockage is corrected.
 - Remove needle or other accepted pressure feed device and seal.

- F. Repair of Seam Failures
 - 1. A seam failing a non-destructive or destructive test shall be reconstructed between the failed location and a passed test location. Seam reconstruction shall be achieved by cutting out the existing seam and seaming in a replacement strip or adding a cap strip. In lieu of this, the seaming path shall be retraced to an intermediate location (at 10 feet minimum each side of the failed seam location). At each location a minimum 12 inch by 12 inch size sample shall be taken for two additional shear strength tests and two additional peel adhesion tests using a field tensiometer. If these tests meet the specified property requirements listed in Section 2.3 and are classified as film tear bond failures, then the remaining sample portion shall be sent to the independent laboratory for two shear strength and two peel adhesion tests. If the field and laboratory tests pass, then the seam shall be reconstructed between that location and the original failed location. If these tests fail to meet the specified property requirements listed in Section 2.3 and/or are not classified as film tear bond failures, then the process shall be repeated. After reconstruction, the entire reconstructed seam shall be nondestructively tested. Seams shall be bounded by two passed test locations and include one test location along the reconstructed seam. Seams will be required to pass non-destructive testing. Certified test results on repaired seams shall be submitted by the Subcontractor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Preparation of Subgrade for Geomembrane
 - 1. Prior to installation of the geomembrane, vegetation, rocks, debris, etc. and other deleterious materials shall be removed from the surfaces to be covered with the geomembrane. The surface shall be free from angular stones or clods greater than 1/4-inches in diameter. Depressions, potholes, ruts, etc., in the surfaces to be covered shall be filled with the appropriate soil material and compacted to final grade. The finished surface shall be smooth with no abrupt projections to damage the geomembrane.
 - 2. The trench side walls and supporting layers shall be maintained in a smooth, uniform, and compacted condition during installation of the geomembrane. The subgrade surface shall be observed daily by the CQC Inspector, Subcontractor, and Engineer to evaluate the surface condition. The Installer shall provide written acceptance of the subgrade to the Engineer prior to installation of the geomembrane. No installation of the geomembrane shall commence until the surface is accepted by the Installer. Damage to the subgrade caused by the Subcontractor's or Installer's operations shall be repaired at no additional cost to the Owner. No geomembrane or other geosynthetic material shall be placed on a subgrade that has become softened by water or overly dried, as determined by the CQC Inspector and accepted by the Engineer, until it has been properly reconditioned and/or recompacted. The Subcontractor shall be required to repair or re-work areas of the prepared surface requested by the Engineer, CQC Inspector, or Installer.

- B. Placement of Geomembrane
 - 1. General
 - a. The Subcontractor shall furnish the services of a competent field technical installation supervisor to supervise installation of the geomembrane. The geomembrane shall be placed over the prepared surfaces to be lined in such a manner as to assure minimum handling. Portions of geomembrane damaged during installation shall be removed or repaired, at the CQC Inspector's discretion and as specified hereinafter, at no additional cost to the Owner.
 - 2. Panel/Roll Deployment
 - a. Only those panels/rolls that can be anchored/ ballasted and seamed together the same day shall be deployed.
 - b. Equipment used shall not damage the geomembrane by handling, trafficking, or other means.
 - c. All personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane.
 - d. The method used to unroll the panels/rolls shall not cause scratches or crimps in the geomembrane.
 - e. The method used to place the panels/rolls shall minimize wrinkles (especially differential wrinkles between adjacent panels/rolls). The geomembrane shall not have excessive slack to the point where creases fold over upon themselves. Permanent (fold-over type) creases in the covered geomembrane will not be permitted.
 - f. Adequate loading (*e.g.*, sand bags) not likely to damage the geomembrane shall be placed to prevent uplift by wind.
 - g. Direct contact of construction equipment with the geomembrane shall not be allowed. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 8 psi.
 - h. The Subcontractor shall verify that the geomembrane thickness is in conformance with the specifications. At least two thickness readings shall be taken along the edge across each panel/roll width and four along each panel/roll length. Additional readings shall be taken across the width where the panel/roll has been cut. Panels/rolls whose mil thickness falls below the specified minimum value shall be rejected and replaced at no additional cost to the Owner.

C. Weather Conditions

- 1. Field seaming shall not be performed when the air or sheet temperature is below 32°F (or manufacturer's recommendations, whichever is greater), when the sheet temperature exceeds 158°F, when the air temperature is above 120°F, during periods of precipitation, or when winds are in excess of 20 miles per hour. Where weather conditions are marginal for seaming, as determined by the Engineer, test seams, as described in this Section, shall be made to decide if production seaming can proceed.
- 2. If circumstances as accepted by the CQC Inspector and the Engineer require that field seaming be conducted in cold weather conditions (below 32°F), the following procedures shall be followed:
 - a. The CQC Inspector shall measure surface temperature of the geomembrane at least every 10 feet of seaming length.
 - b. Preheating of the seaming area under wind protection shall be required if the measured surface temperature is below 32°F.
 - c. Preheating devices shall be reviewed by the CQC Inspector and the Engineer prior to operation.
 - d. Additional destructive tests may be taken by the CQC Inspector to monitor the quality of the installation.
 - e. No field seaming shall be conducted if ambient temperature is above 120°F unless the Installer can demonstrate to the satisfaction of the CQC Inspector that the quality of seaming is not compromised. Additional destructive tests may be required by the CQC Inspector for suspect areas.

D. Field Seams

- 1. The Installer shall obtain written approval from the CQC Inspector and Engineer prior to commencing field seaming.
- 2. All geomembrane field seams shall be made using double wedge welding with a void space for pressure testing as the primary method. Extrusion welding shall only be used for patching and seaming around appurtenances.
- 3. All seaming material shall be of a type recommended and supplied by the manufacturer. The seaming material shall be delivered in the original sealed containers, each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.
- 4. All geomembrane rolls/panels shall be overlapped 6 inches maximum for wedge welding and extrusion welding.
- 5. Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, and foreign material.

- 6. If seam overlap grinding is required, the process shall be completed according to the manufacturer's instructions and in a way that does not damage the geomembrane.
- 7. All double wedge welding shall be non-destructively tested in accordance with ASTM D5820.
- E. Field Seam Testing
 - 1. Test Seams
 - a. Test seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Test seams shall be made at a location selected by the CQC Inspector in the area to be seamed and in contact with the subgrade.
 - b. Test seams shall be made at the beginning of each seaming period, at the CQC Inspector's discretion, whenever there is a change in seaming personnel or equipment, if significant changes in geomembrane temperature are observed, and at least once in the morning and once at midday, by each seamer and seaming equipment used that day. One sample shall be obtained from each test seam. This sample shall be at least 2 feet long by 1 foot wide with the seam centered lengthwise. The test weld samples shall be labeled with:
 - 1) Date and time
 - 2) Roll/panel number
 - 3) Seam number
 - 4) Ambient temperature
 - 5) Welding apparatus
 - 6) Temperature and pressures
 - 7) Welder's initials
 - Five specimens 1 inch wide shall be cut from each opposite end of c. the sample by the Installer using the appropriate ASTM cutting tool. These specimens shall be field tested by the Subcontractor for shear strength and peel adhesion using an accepted quantitative tensiometer. Three shear strength tests and two peel adhesion tests shall be performed on one end and two shear strength tests and three peel adhesion tests shall be performed on the opposite end. If the field tests fail to meet the minimum specified seam requirements listed in Section 2.3 and/or are not classified as film tear bond failures, the entire operation shall be repeated. If the additional test seam fails, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Remaining samples shall be submitted to the Owner for subsequent laboratory testing, if required.

- d. No seaming personnel may begin work until his test weld has passed the on-site shear and peel tests as indicated by the CQC Inspector.
- F. Defects and Repairs
 - 1. Prior to back filling the trench with the geomembrane, seams and non-seam areas shall be visually inspected by the CQC Inspector for defects, holes, damage due to wind lift or other causes and signs of contamination by foreign material.
 - 2. Each suspect location in seam and non-seam areas shall be nondestructively tested as appropriate. Each location that fails the nondestructive testing shall be marked and documented by the CQC Inspector and Engineer and repaired by the Installer.
 - 3. Defective seams shall be repaired in accordance with this Section. Tears, holes, blisters and areas with undispersed raw materials or foreign material contamination shall be repaired by patches. Patches shall have rounded corners, be made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects. Corners of patches shall be rounded with a radius of approximately 3 inches. If extrusion materials are used, the surface of the geomembrane to be repaired shall be abraded no more than one hour prior to the repair. Spot welding or seaming shall be used to repair small tears or other localized flaws. Repairs shall be non-destructively vacuum tested, except where the CQC Inspector elects to perform a destructive seam test on a suspect area.
 - 4. All repairs shall be performed at no additional cost to the Owner.
 - 5. All extrusion welds must be non-destructively tested in accordance with ASTM D5641.
- G. Geomembrane Penetrations
 - 1. All geomembrane penetration details shall be as shown on the Drawings or recommended by the geomembrane manufacturer, and as accepted by the Engineer. Areas that cannot be tested by other means must be spark tested in accordance with ASTM 7240.
- H. Completion
 - 1. The Subcontractor shall commence post-construction care of the installed geomembrane in a timely manner following completion of geomembrane seaming including, but not limited to, covering or temporary weighting using sandbags to prevent damage from wind uplift, construction, and other weather related damage. Only sand shall be used to fill sandbags that will be in contact with the geomembrane.

END OF SECTION

02295 - GEOCOMPOSITE DRAINAGE LAYER

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the furnishing of all labor, material, equipment and performing all operations required for testing, furnishing, hauling, and placing the geocomposite drainage layer, as specified herein, shown on the Contract Drawings or as specified by the Engineer.

1.2 REFERENCES

- A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM D1603 Test Method for Carbon Black in Olefin Plastics
 - b. ASTM D3776 Test Method for Mass per Unit Area (Weight) of Woven Fabric
 - c. ASTM D3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method
 - d. ASTM D4355 Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
 - e. ASTM D4491 Test Methods for Water Permeability of Geotextiles by Permittivity
 - f. ASTM D4533 Test Method for Trapezoid Tearing Strength of Geotextiles
 - g. ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
 - h. ASTM D4716 Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
 - i. ASTM D4751 Test Method for Determining the Apparent Opening Size of a Geotextile
 - j. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 - k. ASTM D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
 - l. ASTM D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Test)
 - m. ASTM D5101 Test Method for Measuring the Soil Geotextile System Clogging Potential by the Gradient Ratio
 - n. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
 - o. ASTM F904 Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates made from Flexible Materials.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. LLDPE Geomembrane

1.4 SUBMITTALS

- A. In addition to those submittals identified in the Supplemental Conditions, the following items shall be submitted:
 - 1. Manufacturer's technical data, including test data to demonstrate flow capacity at the specified gradient.
 - 2. Manufacturer's installation requirements.
 - 3. Samples of any material shall be submitted at the Engineer's request.
 - 4. Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of the referenced Standards and this specification.
 - 5. Test Reports

1.5 TESTING

A. All testing, including field and laboratory services, shall be at the Contractor's expense without additional compensation, except where separate payment is specified.

1.6 SHIPMENT AND STORAGE

- A. During shipment and storage, the drainage composite shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. To that effect, geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings.
- B. The geocomposite shall not be exposed to sunlight for more than 15 days unless otherwise specified and guaranteed by the geocomposite manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are named to establish a standard of quality necessary for the Project:
 - 1. SKAPS Industries
 - 2. Or approved equal

2.2 GEOCOMPOSITE DRAINAGE SYSTEM

- A. The Geocomposite Drainage system (geocomposite) shall be SKAPS TRANSNET 270-6-6 mil Geocomposite or approved equal.
- B. The geocomposite shall consist of a combination of geonets and non-woven geotextiles. The combination of geotextiles and geonet shall offer a complete system of filter drainage protection. The geocomposite shall conform to the property requirements listed below:

Property	Test Method	Frequency	Minimum Average Roll Value
Geocomposite			
Transmissivity, gal/min/ft,(m²/sec) Double Sided Composite	ASTM D4716	1/540,000 ft ²	14.50 (3.0x10 ⁻³)
Ply Adhesion, lb/in	ASTM D7005	1/50,000 ft ²	1.00
Geonet Core			
Geonet Core Thickness, mil	ASTM D5199	1/50,000 ft ²	250
Density	ASTM D1505	1/50,000 ft ²	0.94
Tensile Strength (MD), lb/in	ASTM D7179	1/50,000 ft ²	55
Carbon Black Content, %	ASTM D4218	1/50,000 ft ²	2.0
Geotextile			
Mass per Unit Area, oz/yd ²	ASTM D5261	1/90,000 ft ²	6
Grab Tensile Strength, lb	ASTM D4632	1/90,000 ft ²	160
Grab Elongation, %	ASTM D4632	1/90,000 ft ²	50
CBR Puncture Strength, lb	ASTM D6241	1/540,000 ft ²	450
Trapezoidal Tear Strength, lb	ASTM D4533	1/90,000 ft ²	65
AOS, US Sieve, (mm)	ASTM D4751	1/540,000 ft ²	70
Permittivity, sec ⁻¹	ASTM D4491	1/540,000 ft ²	1.63
Water Flow Rate, gpm/ft ²	ASTM D4491	1/540,000 ft ²	125

C. Each roll of the geocomposite shall bear a label which identifies the following:

- 1. Manufacturer
- 2. Product identification
- 3. Unique roll or lot number
- 4. Roll dimension

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor shall take care to clear subgrade of sharp objects, stumps and debris, and ensure that grades are properly established prior to placement of the geocomposite.
- B. The geocomposite shall be unrolled on the subgrade and installed and anchored in accordance with the manufacturer's written instructions.
- C. Overlaps and seams of adjacent rolls of geocomposite shall meet the following manufacture requirements:

- 1. The geonet shall overlap a minimum of 3.0 and 6.0 inches in the machine and transverse direction, respectively.
- 2. On slopes, the ends of the geocomposite rolls shall be shingled down in the direction of the slope with a minimum of 24" overlap.
- 3. Plastic cable ties shall be placed once per every ten linear feet in the machine direction and once per every linear foot in the traverse direction.
- 4. The geotextile on the bottom shall be overlapped and the geotextile on the top shall be sewn.
- D. The Engineer, or a qualified representative hired by the Engineer, will perform the following activities:
 - 1. Observations to document that the geocomposite is placed in accordance with the design plans and specifications, and the manufacturer's instructions;
 - 2. Measurements to show that there are no gaps between adjacent panels of material; and
 - 3. Observations to ascertain that the geonet is not damaged during the installation process.

3.2 REPAIRS

- A. Any holes or tears in geotextiles shall be repaired by patching with the same geotextile. The patch shall be a minimum of 12 inches larger in all directions than the area to be repaired and shall be spot bonded thermally.
- B. Any holes or tears in the geonet shall be repaired by patching with the same geonet. The patch shall be a minimum of 12 inches larger in all directions than the area to be repaired. The patch shall be tied in place using cable ties ever 12" around the perimeter. Additional fabric to be heat fused atop all cable ties.

3.3 PLACEMENT OF COVER MATERIALS

- A. Placement of cover material shall be completed within 21 days following the installation of the Geocomposite Drainage Layer.
- B. Any cover material such as soil, which is placed over the geocomposite, shall be placed in such a manner as to assure that the geocomposite is not damaged.
- C. Care shall be taken to minimize any slippage of the geocomposite and to assure that no tensile stress is induced in the materials.

END OF SECTION

SECTION 02299

BIAXIAL GEOGRIDS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes labor, materials, supplies, and equipment necessary to furnish and install the biaxial geogrids as specified herein and as shown on the Contract Drawings.

1.2 REFERENCES

- A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM D1238 Melt Flow Index
 - b. ASTM D1505 Specific Gravity
 - c. ASTM D4355 Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
 - d. ASTM D4759 Practice for Determining the Specification Conformance of Geosynthetics
 - e. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics
 - f. ASTM D5732 Test Method for Trapezoid Tearing Strength of Geotextiles
 - g. ASTM D6637 Test Method for Determining the Tensile Properties of Geogrids by the Single Rib or Multi-Rib Tensile Method
 - 2. Geosynthetic Research Institute (GRI)
 - a. GRI-CG1 Standard Method for Ultimate Tensile Strength
 - b. GRI-GG2 Standard Method for Geogrid Junction Strength
 - c. GRI-GG4 Determination of Long Tern Design Strength of Geogrids
 - 3. Environmental Protection Agency (EPA)

- a. EPA 9090 Compatibility Test for Waste and Membrane Liner
- 4. U.S. Army Corps of Engineers
 - a. U.S. Corps of Engineers Methodology for measurement of Torsional Rigidity (Kinney, T.C. Aperture stability Modulus ref 3, 3.1.2000)

1.3 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Manufacturer's certification that materials furnished are in compliance with the applicable requirements of the referenced Standards and this specification. Geogrids will be rejected that are found to have defects, rips, flaws, deterioration or other damage.
 - 2. Manufacturer's installation requirements.
 - 3. Samples of material shall be submitted at the Engineer's request.
 - 4. The Subcontractor shall provide the Engineer with six (6) sets of the installation drawings showing the proposed location of geogrid material together with connection details.
 - 5. The Subcontractor shall submit actual test results for tension/creep, durability/aging, construction damage, and control. The manufacturer shall also produce written certification that resin used to produce the geogrid is classified as high density polyethylene and is capable of withstanding direct exposure to sunlight for 120 days with no measurable deterioration as determined per ASTM D4355.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are named to establish a standard of quality necessary for the Project:
 - 1. Tensar International Corporation
 - 2. Or approved equal
- B. The geogrid shall meet the requirements of this section.

2.2 MATERIALS

- A. Biaxial Geogrid
 - 1. The geogrid shall also conform to the properly requirements listed below for their respective uses. The geogrid shall be a regular grid structure formed by uniaxially drawing a continuous sheet of select high density polyethylene material and shall have aperture geometry and rib and junction crosssections sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through ribs and junctions of the grid structure. The geogrid shall have high resistance to deformation under sustained long-term design load while in service and shall also be resistant to ultraviolet degradation to damage under normal construction practices and biological or chemical degradation normally encountered in the material being reinforced.

The geogrid shall also conform to the property requirements listed below:

Index Properties	Units	MD Values ¹	XMD Values ¹
 Aperture Dimensions² 	mm (in)	25 (1.0)	33 (1.3)
 Minimum Rib Thickness² 	mm (in)	1.27 (0.05)	1.27 (0.05)
 Tensile Strength @ 2% Strain³ 	kN/m (lb/ft)	6.0 (410)	9.0 (620)
 Tensile Strength @ 5% Strain³ 	kN/m (lb/ft)	11.8 (810)	19.6 (1,340)
 Ultimate Tensile Strength³ 	kN/m (lb/ft)	19.2 (1,310)	28.8 (1,970)
Structural Integrity			
 Junction Efficiency⁴ 	%	93	
 Flexural Stiffness⁵ 	mg-cm	750,000	
 Aperture Stability⁶ 	m-N/deg	0.65	
Durability			
 Resistance to Installation Damage⁷ 	%SC / %SW / %GP	95 / 93 / 90	
 Resistance to Long Term Degradation⁸ 	%	100	
 Resistance to UV Degradation⁹ 	%	100	

Dimensions and Delivery

The biaxial geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) in length. A typical truckload quantity is 160 to 210 rolls.

Notes

 Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.

2. Nominal dimensions.

3. Determined in accordance with ASTM D6637-10 Method A.

4. Load transfer capability determined in accordance with ASTM D7737-11.

 Resistance to bending force determined in accordance with ASTM D7748-12, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs, and of length sufficiently long to enable measurement of the overhang dimension.
 Resistance to in-plane rotational movement measured by applying a 20 kg-cm (2 m-N) moment to the central junction of a 9 inch x 9

inch specimen restrained at its perimeter in accordance with GRI GG9. 7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be determined in accordance with ASTM D6637.

 Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.

 Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355-05.

Manufacture of the Geogrids

1. The Geogrid reinforcement shall be manufactured with a high degree of quality control. The manufacturer should emphasize that proper testing has been performed on the raw polymer to ensure a high integrity of the

manufactured product. As a minimum, the manufacturer should ensure that Melt Flow Index (ASTM D1238) and Specific Gravity (ASTM D1505) Testing has been performed.

The purpose of the QC testing program is to verify that the geogrid being supplied to the project is representative of the geogrid used for the performance testing described earlier in this specification. In most cases, however, sampling can be carried out on sacrificial portions of the supplied material.

Conformance testing shall be performed as part of the manufacturing process. If the manufacturer has an established quality control program, then documentation describing the program shall be submitted to the Engineer for review.

- 2. The Geogrid shall be manufactured from the appropriate polymers and compounding ingredients to form a material that meets requirements set herein. The geogrid shall be made from first quality virgin materials. No reprocessed material shall be used in the manufacture of the geogrid.
- 3. The manufacture shall identify rolls of geogrid with the manufacturer's name, product identification, lot number, roll number, and roll dimensions.
- 4. The manufacturer shall furnish complete written instructions for the storage, handling, installation, and seaming of the geogrid with the conditions of this warranty.
- 5. The manufacturer shall certify the quality of the rolls of geogrid. As a minimum, the manufacturer shall provide quality control certificates for each batch of resin and each shift's production. These quality control certificates shall be signed by an officer of the manufacturer and supplied to the Engineer at least three (3) weeks prior to installation of the structural geogrid.

The quality control certificate shall include:

- a) Roll numbers and identification
- b) Sampling procedures
- c) Result of quality control tests, including a description of test methods used.

PART 3 EXECUTION

3.1 SHIPMENT AND STORAGE

- A. During shipment and storage, the geogrid shall be protected from direct sunlight, ultraviolet rays, and temperatures greater than 120 degrees F or less than -20 degrees F, mud, dirt, dust, debris and other damaging or deleterious conditions.
- B. Store products in manufacturer's unopened packaging until ready for installation.

3.2 INSTALLATION

- A. The Subcontractor shall examine geogrid rolls upon delivery and deviation from these Specifications shall be reported to the Engineer and Owner. Damaged material or non-specified product shall be replaced by the Contractor immediately.
- B. Once the material is on site, it shall be protected by the Subcontractor from direct or indirect sunlight, dust, dirt, and other deleterious elements.
- C. Geogrids shall be laid at the proper elevation and orientation as shown on the Contract Drawings or as directed by the Engineer. Geogrids shall be oriented with the roll length parallel to the line of maximum slope.
- D. Correct orientation (roll direction) of the geogrids shall be verified by the Subcontractor.
- E. Geogrids shall be secured and anchored as shown on the Contract Drawings, as per manufacturer's recommendations, or as directed by the Engineer.
- F. Overlying layers of geogrid shall be unrolled with their machine direction at right angles (90°) to each other.
- G. All slack shall be mechanically removed from the placed geogrids before material is placed on top of it.
- H. A qualified and experienced representative of the geogrid manufacturer or its supplier shall be on site for a minimum of two days at the start of and during installation to assist the Subcontractor in the proper construction/installation techniques.
- I. Geogrid reinforcement shall be placed side by side with no overlap. Ends of rolls shall be connected with Bodkin connection only; other connections are prohibited.
- J. No mid-slope splicing or ties of the geogrid will be allowed. The grid shall run continuously from the specified key to the bottom of the swale side of slope, where applicable.
- K. Soil shall be placed, spread, and compacted in such a manner that minimizes movement of the geogrids and development of wrinkles.
- L. Soil shall be placed as specified on the Contract Drawings.
- M. No equipment will be allowed to operate or travel on the slopes following geogrid installation.
- N. Geogrid damaged during installation shall be replaced by the Subcontractor at no additional cost to the Owner.
- 3.3 REPAIRS

A. Holes or tears in geogrid shall be repaired in accordance with the manufacturer's recommendations.

3.4 PLACEMENT OF THE COVER MATERIAL

- A. Placement of cover material shall be completed within 14 days following the installation of the geogrid.
- B. Cover material such as soil, which are placed over the geogrid shall be placed in such a manner as to assure that the geogrid is not damaged.
- C. Care shall be taken to minimize slippage of the geogrid and to assure that no tensile stress is induced in the materials.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes cast-in place concrete as shown on the Contract Drawings, complete including formwork, steel reinforcing, admixtures, accessories, mix design, placement procedures, and finishes for foundations and footings, slabs-on grade, and equipment pads and bases.

1.2 REFERENCES

- A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements are specified herein:
 - 1. American Concrete Institute (ACI)
 - a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials
 - b. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
 - c. ACI 301 Specification for Structural Concrete
 - d. ACI 302 Guide for Concrete Floor and Slab Construction.
 - e. ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - f. ACI 305R Hot Weather Concreting.
 - g. ACI 306R Cold Weather Concreting.
 - h. ACI 308 Standard Practice for Curing Concrete.
 - i. ACI 318 Building Code Requirements for Structural Concrete.
 - j. ACI 350 Environmental Engineering Concrete Structures.
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM A615 Deformed and Plain Billet Steel for Concrete Reinforcement.
 - b. ASTM C33 Concrete Aggregates.
 - c. ASTM C94 Ready-Mixed Concrete.
 - d. ASTM C150 Portland Cement.
 - e. ASTM C260 Air Entraining Admixtures for Concrete.
 - f. ASTM C494 Chemical Admixtures for Concrete.
 - 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. Manual of Standard Practice.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with the following:
 - 1. ACI 117 for tolerances.
 - 2. ACI 301 for general requirements for structural concrete.
 - 3. ACI 305R for concrete installation during hot weather.
 - 4. ACI 306R for concrete installation during cold weather.
 - 5. ACI 318 for design and construction requirements for structures.
 - 6. ACI 350 for construction of environmental engineering concrete structures.
 - 7. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
 - 8. Manufacturer's instructions for manufactured products.
- B. An independent testing agency shall be engaged to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at no additional cost to the Owner.

1.4 SUBMITTALS

- A. In addition to those submittals identified in the "Contract", the following items shall be submitted:
 - 1. Product data for each type of manufactured material and product indicated, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing materials, bonding agents, waterstops, and others if requested by Owner's Representative.
 - 2. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, bent bar diagrams, arrangement, and support of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
 - 3. Submit documentation for the concrete mix design in accordance with Section 4 of ACI 301 including required laboratory test reports for concrete materials and mix design.
 - 4. Material certificates in lieu of material laboratory test reports as permitted by ACI. Material certificates shall be signed by manufacturer, certifying that each material item complies with or exceeds specified requirements. Provide

certification from admixture manufacturers that chloride content complies with specification requirements.

- 5. Proposed method of concrete curing.
- 6. Manufacturer's literature for admixtures used in concrete mix.
- 7. Name and location of concrete supplier.

1.5 COORDINATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.
- B. Coordinate openings with other disciplines and subcontractors.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND CONSTRUCTION

- A. Forms for exposed finish concrete shall consist of plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Forms for unexposed finish concrete shall consist of plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Form ties shall consist of factory-fabricated, adjustable-length, removable or snap-off metal designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
 - 1. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.2 STEEL REINFORCING MATERIALS AND CONSTRUCTION

- A. Reinforcing bars shall be ASTM A 615, Grade 60, deformed.
- B. Supports for reinforcement shall consist of bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS AND CONSTRUCTION

- A. Normal-weight structural concrete and concrete fill shall consist of Portland cement meeting ASTM C 150, Type I or Type II.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to Owner's Representative.
- B. Normal-weight aggregates shall meet ASTM C 33. Provide aggregates from a single source for exposed concrete.
 - 1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
- C. Water shall be potable.

2.4 ADMIXTURES

- A. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.
- B. Air-entraining admixture shall comply with ASTM C 260 and shall be certified by manufacturer to be compatible with other admixtures.
- C. Water-reducing admixture shall meet ASTM C 494, Type A.
- D. High-range water-reducing admixture shall meet ASTM C 494, Type F or Type G.
- E. Water-reducing, accelerating admixture shall meet ASTM C 494, Type E.
- F. Water-reducing, retarding admixture shall meet ASTM C 494, Type D.

2.5 WATERSTOPS

A. Waterstops shall be ribbed Viton Extreme ETP, GFLT, GF or GBL waterstops at construction joints and control joints as indicated. Use in strict accordance with manufacturer's instructions.

2.6 RELATED MATERIALS AND CONSTRUCTION

- A. Absorptive cover shall consist of burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- B. Moisture-retaining cover shall be one of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.

- 3. Polyethylene-coated burlap.
- C. Joint filler strips shall be asphalt-saturated cellulosic fiber meeting ASTM D1751 or cork meeting ASTM D1752.
- D. Bonding agent shall be epoxy base adhesive meeting ASTM C881, as a two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements. Bonding agents shall be equal to Sikadur 32, Hi-Mod LPL by the Sika Corporation.

2.7 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mix by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, an independent testing agency acceptable to Owner's Representative shall be engaged for preparing and reporting proposed mix design.
 - 1. Do not use the same testing agency for field quality control testing.
- B. Design mix to provide normal weight structural concrete with the following properties: 4000-psi 28-day compressive strength; water-cement ratio 0.45 maximum. Admixtures in the mix include air entraining and water-reducing as required: high-range water reducing admixture may be added if required to facilitate pumping.
- C. Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Slabs shall be not more than 3 inches.
 - 2. Reinforced foundation systems shall be not less than 1 inch and not more than 3 inches.
 - 3. Concrete containing a high-range water-reducing admixture (superplasticizer) shall be not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.
- D. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Owner's Representative. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Owner's Representative before using in Work.

2.8 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in mix design in pumped concrete, and as required, for placement and workability.
- B. Use accelerating admixture in mix design for concrete placed at ambient temperatures below 50 deg F (10 deg C).

- C. Use air-entraining admixture in exterior exposed concrete mix design. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1 percent within the following limits:
 - 1. $5\frac{1}{2}$ percent for coarse aggregate size No. 467.
 - 2. 6 percent for coarse aggregate size No. 57 or No. 67.
- D. Use admixtures in strict compliance with manufacturer's directions.

2.9 CONCRETE MIXING

- A. Ready-mixed concrete shall comply with the requirements of ASTM C 94, and as specified.
 - 1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate the installation of joint materials, and other related materials with placement of forms and reinforcing steel.
- B. Forms
 - 1. Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
 - a. Provide Class A tolerances for concrete surfaces exposed to view.
 - b. Provide Class C tolerances for other concrete surfaces.
 - 2. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
 - 3. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage

cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

- 4. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- 5. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- 6. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- 7. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- C. Waterstops
 - 1. Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.
- D. Placing Steel Reinforcing
 - 1. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.
 - 2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
 - 3. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as accepted by Owner's Representative.
 - 4. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

- E. Joints
 - 1. Construction joints not indicated in the contract documents shall be located and installed so they do not impair strength or appearance of the structure, as acceptable to Owner's Representative.
 - 2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise.
 - 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete unless otherwise indicated on the Contract Drawings.
 - 4. Construct isolation joints in slabs-on-grade at points of contact between slabs-ongrade and vertical surfaces, such as foundation walls, and other locations, as indicated.
 - 5. Construct control joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 3/16 inch wide by one-fourth of slab depth unless otherwise indicated.
 - a. Control joints in floor slabs shall be formed as soon as possible after slab finishing as may be safely done without dislodging aggregate.
- F. Installing Embedded Items
 - 1. Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
 - 2. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.
- G. Preparing Formed Surfaces
 - 1. Coat contact surfaces of forms with a reviewed, non-residual, low-VOC, formcoating compound before placing reinforcement.
 - 2. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
 - a. Coat steel forms with a nonstaining, rust-preventative material. Ruststained steel formwork is not acceptable.

- H. Concrete Placement
 - 1. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
 - 2. Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
 - 3. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location. Free fall of concrete shall not exceed five feet.
 - 4. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - a. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
 - b. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
 - 5. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
 - a. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 - Bring slab surfaces to correct level with a straightedge and strike off.
 Use bull floats or darbies to smooth surface free of humps or hollows.
 Do not disturb slab surfaces prior to beginning finishing operations.
 - c. Maintain reinforcing in proper position on chairs during concrete placement.
- I. Cold-weather placement shall comply with the provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a

concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

- a. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- b. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- J. When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete at the discretion of the Owner.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 - 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 - 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Owner's Representative.
- K. Finishing Formed Surfaces
 - 1. Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.
 - 2. Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- L. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

M. Finishing Slabs

- 1. Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- 2. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- 3. After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 - a. Apply a trowel finish to floor and slab surfaces exposed to view.
 - b. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
 - Specified overall values of flatness, F(F) 35, and levelness, F(L)
 25; with minimum local values of flatness, F(F) 24, and levelness, F(L) 17.
- 4. Conventional finishing techniques and equipment shall be used when finishing fiber-reinforced concrete. In some cases, an extra bull float process is advised and lowering the angle of the floating blades may help. The finished surface shall have no exposed fibers. Follow manufacturer's recommendations.
- N. Apply a nonslip rough broom finish to exterior concrete platforms, ramps, steps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner's Representative before application.

3.2 QUALITY CONTROL DURING CONSTRUCTION

- A. An independent testing agency shall be engaged to perform tests and to submit test reports. Field testing to be performed by an ACI certified concrete field testing technician grade I.
- B. Sampling and testing for quality control during concrete placement shall include the following, as directed by Owner's Representative.
 - 1. Sampling of fresh concrete shall be in accordance with ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump testing shall be in accordance with ASTM C 143. One test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

- b. Air content testing shall be in accordance with ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
- c. Testing of concrete temperature shall be in accordance with ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
- d. Molding of cylinders for compression testing shall be in accordance with ASTM C 31; one set of four standard cylinders for each compressivestrength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
- e. Compressive-strength testing shall be in accordance with ASTM C 39; one set for each 50 cu. yd. or fraction thereof, of each concrete mix placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
- 2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
- 3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
- 4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results will be reported in writing to Owner's Representative and ready-mix producer within 24 hours of test completion. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive testing shall consist of impact hammer, sonoscope, or other nondestructive device but shall not be used as the sole basis for acceptance or rejection.
- E. The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Owner's Representative. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.3 MISCELLANEOUS CONCRETE ITEMS

A. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

3.4 CONCRETE CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Cure concrete by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified. Curing compounds may be used with written permission from the Owner's Representative.
- D. Provide moisture curing by one of the following methods:
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Use continuous water-fog spray.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
- E. Provide moisture-retaining cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.
- F. Cure formed concrete surfaces, including supported slabs and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.5 REMOVING FORMS

A. Formwork not supporting weight of concrete, such as sides of walls, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

3.6 REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Owner's Representative.

3.7 CONCRETE SURFACE REPAIRS

- A. Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Owner's Representative.
- B. Mix dry-pack mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
 - 1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
 - 2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Remove and replace formed concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner's Representative. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

- D. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
 - 1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 - 3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Owner's Representative.
 - 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior acceptance by Owner's Representative for method and procedure, using specified epoxy adhesive and mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Owner's Representative.

END OF SECTION

Section 30000



LIQUID BOOT[®] Brownfield Membrane/Liner Specifications

Section 2 | Version 4.3

These specifications may have changed. Please contact visit http://remediation.cetco.com for the most recent version.

PART 1 - GENERAL

- 1.01 DESCRIPTION-General and Supplementary Conditions and Division 1- General Requirements applies to this section. Provide gas vapor barrier as indicated, specified and required.
- A. Work in this section principal items include:
 - 1. Gas vapor barrier providing protection from the following gases: Methane, other Hydrocarbon vapors in concentrations up to 20,000ppm, Hydrogen Sulfide, Radon
 - 2. Gas vapor barrier under single family homes.
- B. Related work <u>NOT</u> in this section: excavation and backfilling, parge coat on masonry to receive gas vapor barrier membrane, mortar beds or concrete toppings over gas vapor barrier membranes, latex waterproofing, damp-proofing, flashing and sheet metal, joint sealers, soil sterilant, gas collection systems, gas monitoring, and drainage.
- 1.02 QUALITY ASSURANCE-Gas vapor barrier contractor/applicator shall be trained and approved by gas vapor barrier manufacturer, CETCO. A pre-installation conference shall be held prior to application of gas vapor barrier to assure proper substrate and installation conditions, to include contractor, applicator, architect/engineer and special inspector.

1.03 SUBMITTALS

- A. Project Data Submit manufacturer's qualifications, product data and installation instructions for specific application.
- B. Samples Submit representative samples of the following for approval:
 - 1. Gas vapor barrier membrane material
 - 2. Protection board and/or protection mat
 - 3. Prefabricated drainage mat
 - 4. Geotextiles

1.04 DELIVERY, STORAGE AND HANDLING

Deliver materials to site in original unbroken packages bearing manufacturers label showing brand, weight, volume, and batch number. Store materials at site in strict compliance with manufacturer's instructions. Do not allow materials to freeze in containers.

1.05 JOB CONDITIONS

- A. Protect all adjacent areas not to receive gas vapor barrier. Where necessary, apply masking to prevent staining of surfaces to remain exposed wherever membrane abuts to other finish surfaces.
- B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for material and product used.
- C. Minimum clearance of required for application of product: 90° spray wand- 2 feet / Conventional spray wand- 4 feet.
- D. Ambient temperature shall be within manufacturer's specifications. If winter conditions apply, we recommend the use space of heaters and necessary cover (i.e. visqueen) to bring the ambient temperature to at least +45°F until the protection course and structural slab rebar or a mudslab protection course has been placed.
- E. All plumbing, electrical, mechanical and structural items to be under or passing through the gas vapor barrier shall be positively secured in their proper positions and appropriately protected prior to membrane application.
- F. Gas vapor barrier shall be installed before placement of reinforcing steel. When not possible, all exposed reinforcing steel shall be masked by General Contractor prior to membrane application.
- G. Expansion joints must be filled with a conventional waterproof expansion joint material.
- H. Surface preparation shall be per manufacturer's specification.

1.06 PRODUCT WARRANTY

Upon delivery and acceptance by the Owner of material specified by this Section, the materials manufacturer will provide a written one year standard material indicating the material conforms to its product specifications and is free of material defects. Factors affecting the results obtained from using this product including weather, equipment utilized, construction, workmanship and other variables are all beyond the manufacturer's control.

Under this product warranty, manufacturer will provide replacement material, at no charge, for any product proven not to meet the material properties listed in the published product literature This warranty is in lieu of any and all other warranties expressed or implied (including any implied warranty of merchantability or fitness for a particular use), and manufacturer shall have no further liability of any kind including liability for consequential or incidental damages resulting from any defects or delays caused by replacement or otherwise.

PART 2 - PRODUCTS

2.01 QUALIFICATIONS

The gas vapor barrier manufacturer must have produced at least 22 million square feet (2 million square meters) of gas vapor barrier, with at least 22 million square feet (2,000,000 square meters) installed.

2.02 MATERIALS

A. Fluid applied gas vapor barrier system - LIQUID BOOT[®]; a single-course, high-build, polymer modified asphaltic emulsion. Water borne and spray applied at ambient temperatures. A minimum thickness of 60 dry mils, unless specified otherwise as some cities and engineers may require a thicker membrane. Non-toxic and odorless. LIQUID BOOT[®] Trowel Grade has similar properties with greater viscosity and is trowel applied. Manufactured by CETCO, (800) 527-9948.

B. LIQUID BOOT[®] gas vapor barrier physical properties:

GAS VAPOR MEMBRANE	TEST METHOD	VALUE
Acid Exposure (10% H ₂ SO ₄ for 90 days)	ASTM D543	Less than 1% weight change
Benzene Diffusion	Tested at 43,000 ppm	2.90 x 10-11 m²/day
Chemical Resistance: VOCs, BTEXs (tested at 20,000 ppm)	ASTM D543	Less than 1% weight change
Chromate Exposure (10% Chromium6+ salt for 31 days)	ASTM E96	Less than 1% weight change
Diesel (1000 mg/l), Ethylbenzene (1000 mg/l), Naphthalene (5000 mg/l) and Acetone (500 mg/l) Exposure for 7 days	ASTM D543	Less than 1% weight change, Less than 1% tensile strength change
Radon Permeability	Tested by US Dept. of Energy	Zero permeability to Radon (222Rn)
Bonded Seam Strength Tests	ASTM D6392	Passed*
Micro Organism Resistance (Soil Burial)- average weight change,	ASTM D4068-88	Passed*
Methane Permeability	ASTM 1434-82	Passed*
Oil Resistance Test- average weight change, average tensile strength change, average tensile stress change, average elongation change, bonded seams, methane permeability	ASTM D543-87	Passed*
Heat Aging- average tensile strength change, average tensile stress change, average elongation change, bonded seams	ASTM D4068-88	Passed*
Dead Load Seam Strength	City of Los Angeles	Passed*
Environmental Stress-Cracking	ASTM D1693-78	Passed*
PCE Diffusion Coefficient	Tested at 6,000 mg/m ³	2.74 x 10-14 m²/sec
TCE Diffusion Coefficient	Tested at 20,000 mg/m ³	8.04 x 10-14 m²/sec
Soil Burial	ASTM E154-88	Passed
Water Vapor Transmission	ASTM E96	0.069 perms
POTABLE WATER	TEST METHOD	VALUE
Toxicity Test	22 CCR 66696	Passed. CCR Bioassay—Flathead Minnow
Potable Water Containment	ANSI/NSF 61	NSF Certified for tanks >300,000 gal**
Hydrostatic Head Resistance	ASTM D751	Tested to 138 feet or 60 p.s.i
GENERAL INFORMATION	TEST METHOD	VALUE
Freeze-Thaw Resistance (100 Cycles)	ASTM A742	Meets criteria. No spalling or disbondment
Accelerated Weathering & Ultraviolet Exposure	ASTM D822	No adverse effect after 500 hours
Elongation	ASTM D412	1,332% - Ø reinforcement, 90% recovery
Tensile Strength	ASTM D412	58 p.s.i. without reinforcement
Tensile Bond Strength to Concrete	ASTM D413	2,707 lbs/ft2 uplift force

*per City of Los Angeles approval for 100-mil LIQUID BOOT® gas vapor barrier.

**per NSF approval for 80-mil Liquid Boot® potable water containment membrane

C. LIQUID BOOT® Agency Approvals:

- City of Los Angeles Research Report # 24860-Approved for "LIQUID BOOT[®] Membrane for Below-Grade Waterproofing and Gas Barrier"
- United States Navy-Approved for "LIQUID BOOT[®] for Use World Wide to Waterproof Earth-Covered Steel Ammunition Storage"
- NSF International-NSF/61 approved for "Potable Water Tank Liner"
- Canadian Construction Materials Board-Approved for "Waterproofing and Damp Proofing"
- County of Los Angeles Department of public works-Approved for "LIQUID BOOT[®] Application as a Methane Gas Barrier"
D. LIQUID BOOT® 500

Contact CETCO before specifying or bidding LIQUID BOOT® 500 to insure LIQUID BOOT® 500 is appropriate for the project. LIQUID BOOT® 500 may be used in lieu of LIQUID BOOT® (described in section 2.01 B. above) where the membrane is exposed to methane and may be suited for low-level VOC applications. The Agency Approvals in section 2.01 C above do not apply to LIQUID BOOT® 500. The physical properties for LIQUID BOOT® 500 are as follows:

Note: LIQUID BOOT[®] 500 may tend to sag on vertical surfaces at higher ambient temperatures. When this condition occurs, use LIQUID BOOT[®] at these locations.

GAS VAPOR MEMBRANE	TEST METHOD	VALUE
Elongation	ASTM D412	542%
Bond Seam Strength Tests	ASTM D6392	Passed
Methane Permeability	ASTM D1434	None detected
Water Vapor Permeability	ASTM E96	0.22 perms

 LIQUID BOOT[®] 500 Agency Approval - City of Los Angeles Research Report-RR 25549-Approved for "LIQUID BOOT[®] 500 Spray-Applied Membrane for Below-Grade Waterproofing and Gas Barrier"

E. Protection

On vertical surfaces, use UltraShieldTM P-100 or other protections as approved by the manufacturer, project architect or engineer. On horizontal surfaces, use UltraShieldTM G-1000 or other protections as approved by the manufacturer, project architect or engineer.

Due diverse jobsite conditions, all protection materials must be approved by the membrane manufacturer, including the use of the LIQUID BOOT[®] UltraShield products.

F. Prefabricated Drain Mat

- 1. On vertical surfaces, use UltraDrain[™] 6200
- 2. On horizontal surfaces, use UltraDrain[™] 9000
- G. Adhesive system for UltraShield[™] and UltraDrain[™]: Use UltraGrip[™].
- H. Gas vapor vent piping- GeoVent[™] system

I. Base Geotextile

BaseFabric[™] T-40 non-woven geotextile, unless otherwise specified and approved by membrane manufacturer. The heat-rolled side shall be used as the application surface. Some projects may require a heavier geotextile (BaseFarbic[™] T-60.)

J. Cold Joints, Cracks, Form Tie Holes: Covered with Hardcast CRT 1602 Tape 3" wide.

PART 3 - EXECUTION

3.01 EXAMINATION

All surfaces to receive gas vapor barrier shall be inspected and approved by the applicator at least one day prior to commencing work.

3.02 SURFACE PREPARATION- Provide 24 inch minimum clearance out from surfaces to receive the gas vapor barrier. The application surface shall be prepared and provided to the applicator in accordance with manufacturer's specifications listed below:

A. Concrete/Shotcrete/Masonry

Concrete surfaces shall be light broom finish or smoother, free of any dirt, debris, loose material, release agents or curing compounds. Fill all voids more than 1/4 inch deep and 1/4 inch wide. Masonry joints, cold joints, and form joints shall be struck smooth. All penetrations shall be prepared in accordance with manufacturer's specifications. Provide a 3/4 inch minimum cant of LIQUID BOOT[®], or other suitable material as approved by manufacturer, at all horizontal to vertical transitions and other inside corners of 120° or less. Allow to cure overnight before the application of LIQUID BOOT[®]. All cracks or cold joints greater than 1/16 inch must be completely grouted with non-shrink grout as approved by engineer. Install Hardcast reinforcing tape over all cold joints, cracks and form tie holes (after holes and cracks are grouted).

B. Dirt & Gravel

The sub-grade shall be moisture conditioned and compacted to a minimum relative compaction of 90 percent or as specified by civil/geotechnical engineer. The finished surface shall be smooth, uniform, and free of debris and standing water. Remove all stones or dirt clods greater than 1/4 inch. (NOTE: Aggregate sub-bases shall be rolled flat, free from any protruding sharp edges). Penetrations shall be prepared in accordance with manufacturer's specifications. All form stakes that penetrate the membrane shall be of rebar which shall be bent over and left in the slab. Trenches shall be cut oversize to accommodate gas vapor barrier membrane and protection course with perpendicular to sloped sides and maximum obtainable compaction. Adjoining grade shall be finish graded and compacted. Excavated walls shall be vertical or sloped back, free of roots and protruding rocks. Specific sub-grade preparation shall be designed by a qualified civil or geotechnical engineer. If organic materials with potential for growth (ie: seeds or grasses) exist within the sub-base, spray apply soil sterilant at the sterilant manufacturer's recommended rate.

3.03 INSTALLATION

3.03.10 INSTALLATION ON CONCRETE/SHOTCRETE/MASONRY (Follow the procedures below carefully)

- A. Refer to section 3.03.30, "Sealing Around Penetrations", for procedures to seal around penetrations.
- B. Provide a ³/₄" minimum cant of LIQUID BOOT[®], or other suitable material as approved by manufacturer, at all horizontal to vertical transitions and other inside corners of 120° or less. Allow to cure overnight before the application of LIQUID BOOT[®].
- C Delineate a test area on site with a minimum dimension of 10 feet by 10 feet (3m by 3m). Apply LIQUID BOOT[®] to a thickness of 60 mils and let it cure for **24 hours**. Observe for blisters. If minor or no blistering occurs, proceed to the next step. (See note regarding blisters). If significant blistering does occur, apply a thin (10 mil) tack coat of LIQUID BOOT[®] "A" side without catalyst to the entire concrete surface and allow curing before proceeding. (See also information regarding blister repair).
- D. Spray-apply LIQUID BOOT[®] to a 60 mil minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane. If a second coat is required, remove any standing water from the membrane before proceeding with the second application.
- E. <u>Do not penetrate membrane</u>. Keep membrane free of dirt and debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.
- F. After membrane has cured and checked for proper thickness and flaws, install protection material pursuant to manufacturer's instructions. NOTE: All testing or inspection to be performed prior to placing protection course.

NON-HORIZONTAL SURFACES: Spray on non-horizontal surfaces should begin at the bottom and work towards the top. This method allows the product to adhere to the surface before hitting catalyst runoff.

NOTE: Due to the nature of concrete as a substrate, it is normal for some blistering to occur. This is caused by either concrete's tendency to off-gas or water that is temporarily trapped between the concrete and the membrane. With time and the applied pressure of backfill or over-slab, blisters will absorb into the concrete without detriment to the membrane. A small number of blister heads should be sampled and checked for proper membrane thickness. If the samples have the minimum required membrane thickness, then the remaining blisters should not be punctured or cut. If the samples have less than the minimum required membrane thickness, then the area can either be re-sprayed to obtain the proper thickness, or the blisters can be cut out and the area resprayed or patched with LIQUID BOOT[®] Trowel Grade.

3.03.20 INSTALLATION ON DIRT SURFACES AND MUDSLABS

- A. Roll out BaseFabric[™] geotextile on sub-grade with the heat-rolled side facing up. Overlap seams a minimum of 6 inches. Lay geotextile tight at all inside corners. Apply a thin 10 mil tack coat of LIQUID BOOT[®] "A" side without catalyst within the seam overlap. Line trenches with geotextile extending at least six inches (6") onto adjoining sub-grade if slab and footings are to be sprayed separately.
- B. Minimize the use of nails to secure the geotextile to the dirt subgrade. Remove all nails before spraying membrane, if possible. Nails that cannot be removed from the dirt subgrade are to be patched with geotextile or Hardcast reinforcing tape overlapping the nail head by a minimum of two inches (2"). Apply a thin tack coat of LIQUID BOOT[®] under the geotextile patch, when patching with geotextile.
- C. Refer to section 3.03.30, "Sealing Around Penetrations", for procedures to seal around penetrations.
- D. Spray-apply LIQUID BOOT[®] onto geotextile to a 60 mil minimum dry thickness. Increase thickness to 100 dry mils if shotcrete is to be applied directly to membrane. If a second coat is required, remove any standing water from the membrane before proceeding with the second application.
- E. <u>Do not penetrate membrane.</u> Keep membrane free of dirt, debris and traffic until a protective cover is in place. It is the responsibility of the General Contractor to insure that the membrane and the protection system are not penetrated.
- F. After membrane has cured and checked for proper thickness and flaws, install protection material pursuant to manufacturer's instructions. NOTE: All testing or inspection to be performed prior to placing protection course.

3.03.30 SEALING AROUND PENETRATIONS

3.03.31 OPTION 1

- A. Clean all penetrations. All metal penetrations shall be sanded clean with emery cloth.
- B. For applications requiring BaseFabric[™] geotextile, roll out geotextile on sub-grade with the heat-rolled side facing up, overlapping seams a minimum of six inches (6"). Cut the geotextile around penetrations so that it lays flat on the sub-grade. Lay geotextile tight at all inside corners. Apply a thin (10 mil) tack coat of LIQUID BOOT[®] "A" side without catalyst within the seam overlap.

- C. At the base of penetration install a minimum ³/₄ inch thick membrane cant of LIQUID BOOT[®], or other suitable material as approved by manufacturer. Extend the membrane at a 60 mil thickness three inches (3") around the base of penetration and up the penetration a minimum of three inches (3"). Allow to cure overnight before the application of LIQUID BOOT[®] membrane. (See manufacturer's standard detail.)
- D. Spray apply LIQUID BOOT[®] to an 60 mils minimum dry thickness around the penetration, completely encapsulating the collar assembly and to a height of one and one half inches (1 1/2") minimum above the membrane as described in 3.03.31 C above. Spray-apply LIQUID BOOT[®] to surrounding areas as specified for the particular application. (SEE MANUFACTURER'S STANDARD DETAIL)
- E. <u>Allow LIQUID BOOT® to cure completely before proceeding to step "F".</u>
- F. Wrap penetration with polypropylene cable tie at a point two inches (2") above the base of the penetration. Tighten the cable tie firmly so as to squeeze, but not cut, the cured membrane collar.

3.03.32 OPTION 2 (For Gas Vapor Membrane Only)

- A. Clean all penetrations. All metal penetrations shall be sanded clean with emery cloth.
- B. For applications requiring BaseFabric[™] geotextile, roll out geotextile on sub-grade with the heat-rolled side facing up, overlapping seams a minimum of six inches (6"). Cut the geotextile around penetrations so that it lays flat on the sub-grade. Lay geotextile tight at all inside corners. Apply a thin (10 mil) tack coat of LIQUID BOOT[®] "A" side without catalyst within the seam overlap.
- C. Spray-apply LIQUID BOOT[®] to surrounding areas as specified for the particular application to a 60 mil minimum dry thickness. At the base of penetration install a minimum 3/4 inch thick membrane cant of LIQUID BOOT[®], or other suitable material as approved by manufacturer. Extend the membrane at 60 mil thickness up the penetration a minimum of three inches (3"). Allow curing overnight before proceeding to D (SEE MANUFACTURER'S STANDARD DETAIL)
- D. Spray apply LIQUID BOOT[®] the membrane at an 60 mil thickness three inches (3") around the base of penetration and up the penetration, completely encapsulating the collar assembly, to a height of one and one half inches (1 1/2") minimum above the membrane as described in 3.03.32 C above. (SEE MANUFACTURER'S STANDARD DETAIL)
- E. Allow LIQUID BOOT[®] to cure completely before proceeding to step "F".
- F. Wrap penetration with polypropylene cable tie at a point two inches (2") above the base of the penetration. Tighten the cable tie firmly so as to squeeze, but not cut, the cured membrane collar.

3.04 FIELD QUALITY CONTROL- Field Quality Control is a very important part of all LIQUID BOOT[®] applications. Applicators should check their own work for coverage, thickness, and all around good workmanship <u>before</u> calling for inspections.

The membrane must be cured at least overnight before inspecting for dry-thickness, holes, shadow shrinkage, and any other membrane damage. If water testing is to be performed, allow the membrane to cure at least 72 hours prior to the water test. When thickness or integrity is in question the membrane should be tested in the proper manner as described below. However, over-sampling defeats the intent of inspections. Inspectors should always use visual and tactile measurement to guide them. Areas suspected of being too thin to the touch should be measured with the gauges to determine the exact thickness. With practice and by comparing tactile measurements with those of the gauges, fingers become very accurate tools.

3.04.10 ON CONCRETE/SHOTCRETE/MASONRY & OTHER HARD SURFACES

- A. Membrane may be checked for proper thickness with a blunt-nose depth gauge, taking one reading every 500 square feet. Record the readings. Mark the test area for repair, if necessary.
- B. If necessary, test areas are to be patched over with LIQUID BOOT[®] to a 60 mils minimum dry thickness, extending a minimum of one inch (1") beyond the test perimeter.

3.04.20 ON DIRT AND OTHER SOFT SUBSTRATES

- A. Samples may be cut from the membrane and geotextile sandwich to a maximum area of 2 square inches. Measure the thickness with a milreading caliper, per 500 sq. feet. Deduct the plain geotextile thickness to determine the thickness of LIQUID BOOT[®] membrane. Mark the test area for repair.
- B. Voids left by sampling are to be patched with geotextile overlapping the void by a minimum of two inches (2"). Apply a thin tack coat of LIQUID BOOT[®] under the geotextile patch. Then spray or trowel-apply LIQUID BOOT[®] to a 60 mils minimum dry thickness, extending at least three inches (3") beyond geotextile patch.
- 3.04.30 SMOKE TESTING FOR HOLES (Optional) Holes or other breaches in the membrane can be detected by conducting a smoke test. This involves pumping smoke under the membrane for a specified period of time, under a specified pressure, which varies from project to project. Contact CETCO for information about this test at 800-527-9948.



Appendix C

Construction Quality Assurance Project Plan



WORK PLAN

Semet Residue Ponds Site OU-2 Remedial Design Construction Quality Assurance Project Plan Geddes, New York

Honeywell

August 2019 Revised October 2019



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1. INTRODUCTION

This Construction Quality Assurance Project Plan (CQAPP) has been prepared to provide guidelines and procedures for Construction Quality Assurance and Construction Quality Control (CQA/CQC) during the Phase 1 & 2 remedial action for the Semet OU-2 Remedial Design.

CQA means a planned system of activities that provides assurance that the facility is constructed as specified in the design. CQA refers to measures taken by the CQA organization to assess if the installer or contractor follows the plans, specifications and permits for the project. This may also include quality control for those actions taken before construction to evaluate if materials chosen and workmanship comply with agency approved engineering plans and specifications.

CQC means a planned system of inspections that are used to directly monitor and control the quality of a construction project. CQC includes those actions normally performed by the installer to achieve high quality in the constructed or installed system. CQC refers to measures taken by the installer or contractor to assess compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

This CQA/CQC Plan outlines the responsibilities of each of the entities associated with the project. This includes a delineation of the appropriate lines of communication between the Owner, Regulatory Agency, Contractor, inspection personnel and design personnel associated with construction activities. Also provided is a description of the required level of experience and training for the contractor and CQA/CQC inspectors in sufficient detail to document that personnel permitted to be involved with the project have the necessary qualifications to properly complete the work in accordance with the methods and procedures specified. In addition to personnel requirements, a description of the CQA/CQC protocols to be utilized for documenting construction activities and compliance with the specifications is provided.



2. PROJECT ORGANIZATION AND RESPONSIBILITIES

In this section, organizations involved in CQA/CQC for this project along with their responsibilities and qualifications are discussed. Lines of communication are presented, along with procedures for submission of CQA/CQC information.

2.1. PROJECT ORGANIZATION AND RESPONSIBILITIES

Several organizations are involved in CQA/CQC prior to, during, and following construction. These include the following:

- New York State Department of Environmental Conservation (NYSDEC) as the lead regulatory agency
- Honeywell International, Inc. (Honeywell) as the Owner
- O'Brien & Gere, Part of Ramboll as the Design Engineering Firm and contractor for construction
- Testing laboratories (to be determined)
- Manufacturers and fabricators (to be determined)
- Installers (to be determined)

The responsibilities of these organizations are delineated in the following subsections.

NYSDEC Responsibilities. As the lead regulatory agency, the NYSDEC will perform the following functions:

- Review and approve original designs
- Review project submittals for compliance with regulations
- Issue approval to construct the project once design has been approved
- Review and approve major design modifications or requests for variances from the regulatory conditions during construction

Honeywell Responsibilities. As the Owner, Honeywell will:

- Bear responsibility for the design, construction, construction inspection and operation of the project
- Comply with NYSDEC requirements to obtain approvals and/or permits
- Bear responsibility for all communications with the NYSDEC
- Bear responsibility for providing CQA/CQC documentation to the NYSDEC that construction activities associated with the project are proceeding in accordance with the approved design (and approved design modifications)
- Select organizations charged with design, CQA/CQC, and construction activities
- Accept or reject design plans and specifications, CQA/CQC plan, reports and recommendations of the design engineer, and the materials and workmanship of the Contractor
- Bear responsibility for providing the Construction Certification Report to the NYSDEC for review and acceptance.

O'Brien & Gere, Part of Ramboll Responsibilities. As the Design Engineering Firm and contractor for construction, O'Brien & Gere, will perform the following:

- Provide a project design that fulfills the performance requirements of the NYSDEC and USEPA
- Prepare this CQA/CQC Plan



- Prepare design modifications during construction, if necessitated by unexpected site conditions or required changes in construction methodology
- Retain and oversee qualified subcontractors to perform specialized components of construction
- Coordinate the review of the subcontractor, supplier, and installer shop drawing submittals
- Observe construction activities
- Confirm that regular calibration of testing equipment is properly conducted and recorded
- Confirm that testing laboratories conform to CQA requirements and procedures and sample custody procedures are followed
- Confirm that test data inspection reports are accurately recorded and maintained
- Provide the Owner with reports on testing and inspection results
- Schedule and attend project CQA/CQC meetings during construction
- Oversee the preparation of the Construction Completion Report and Record Drawings
- Provide daily on-site inspection of the work in progress to assess compliance with design plans and specifications
- Attend job meetings as required
- Construct the project in accordance with the design plans, specifications, and approved modifications using appropriate construction procedures and techniques
- Schedule and coordinate CQA/CQC inspection and testing activities
- Retain testing laboratories to provide CQC testing services

The O'Brien & Gere, Part of Ramboll Construction Manager will have overall responsibility for CQA and CQC. Other related duties may include coordinating shop drawings submittals, providing required samples, and coordinating with the NYSDEC.

Testing Laboratory Responsibilities. The testing laboratory utilized will meet the following requirements:

- Have an internal CQC plan in-place to confirm that laboratory procedures conform to the appropriate American Society for Testing and Materials (ASTM) standards or other applicable standards and methods
- Follow internal CQC procedures
- Maintain sample chain-of-custody records
- Report results of testing

The testing laboratory will be required to allow representatives of Honeywell, NYSDEC, O'Brien & Gere, Part of Ramboll, and/or the Installer to observe sample preparation, testing procedures, or record-keeping procedures upon request. Honeywell, NYSDEC, O'Brien & Gere, Part of Ramboll, and/or the Installer will be allowed to observe some or all tests on a particular job at any time, either announced or unannounced. It is anticipated that the laboratory required for this project will include CQC laboratory for analytical, geotechnical, and geosynthetic testing.

Manufacturer and Fabricator Responsibilities. The manufacturers and fabricators of geosynthetic components and other equipment required for construction of the project will:

- Certify that materials manufactured or fabricated meet the specifications
- Provide quality control steps taken during manufacturing or fabrication



Allow Honeywell, NYSDEC, O'Brien & Gere, Part of Ramboll, and/or the Installer to observe the manufacturing and fabrication process and QC procedures.

Installer's Responsibilities. The Installer is the contractor or subcontractor that installs manufactured and fabricated products, such as geosynthetics. The Installer's responsibilities include the following:

- Maintaining a CQC Plan in-place for handling, storing, placing, and installing materials
- Handling, storage, placement, and installation of manufactured and fabricated materials
- Following CQC procedures
- Informing the Engineer of the schedule for installation of manufactured or fabricated materials

2.2. PERSONNEL QUALIFICATIONS

It is important that organizations and personnel involved in implementing the remedy possess suitable qualifications to perform the work. The following sections describe qualifications and minimum acceptable experience for positions identified in the CQA/CQC Plan.

Contractor. O'Brien & Gere, Part of Ramboll has been selected to construct this project based upon experience in constructing projects of similar size and scope, including, but not limited to, projects requiring construction of pump stations, material excavation, construction of ground water collection trenches, and installation of LLDPE geomembrane and other geosynthetics. Specialty contractors will be retained under subcontract for construction of some components of the work. Prior to award of subcontracts, O'Brien & Gere will request evidence that each subcontractor have the necessary experience to fulfill the requirements set forth in this plan.

Contractor's CQC Manager. O'Brien & Gere, Part of Ramboll's Construction Manager will serve as the CQC Manager. The CQC Manager will have a working knowledge of civil and construction engineering and soil and geosynthetic materials. The CQC Manager will be on-site during the construction period. The CQC Manager will have a thorough familiarity with the project and testing requirements. The CQC Manager will have demonstrated experience with earthwork projects, geosynthetic materials, concrete, and drainage structures.

CQC Geotechnical Laboratory. The CQC Geotechnical Laboratory will be an independent laboratory approved by O'Brien & Gere. The CQC Geotechnical Laboratory will not be owned by O'Brien & Gere, Part of Ramboll or its subcontractors.

The laboratory will be qualified to perform geotechnical testing presented in the specifications and have a minimum of five years experience in testing soil properties required for the project. The laboratory will be required to submit references from three other similar projects. All laboratory test results will be certified by a Laboratory Manager with a minimum of two years of soils testing experience.

CQC Geosynthetic Laboratory. The CQC Geosynthetic Laboratory will be an independent laboratory approved by O'Brien & Gere. The CQC Geosynthetic Laboratory will not be owned by O'Brien & Gere, Part of Ramboll or its subcontractors or Installers.

The laboratory will be qualified to perform geosynthetic testing presented in the specifications and have a minimum of five years experience in testing geosynthetics. All laboratory test results will be certified by a Laboratory Manager with a minimum of two years of geosynthetic testing experience.

CQC Analytical Laboratory. The CQC analytical laboratory will be an independent laboratory approved by O'Brien & Gere. The CQC analytical laboratory will not be owned by O'Brien & Gere, Part of Ramboll or its subcontractors.

The laboratory will be qualified to perform analytical testing presented in the specifications and have a minimum of five years experience in the testing required for the project. The laboratory will be required to



submit references from three other similar projects. All laboratory test results will be certified by a Laboratory Manager with a minimum of two years of analytical testing experience.

Manufacturers and Fabricators. Manufacturers and fabricators of the project components will be required to have experience in manufacturing or fabricating similar materials for a minimum of five completed projects. The manufacturers and fabricators will each be required to submit a list of the projects for approval by O'Brien & Gere, Part of Ramboll.

Installers. Installers of specified equipment and materials will be required to demonstrate experience in projects of similar size and nature for approval by O'Brien & Gere, Part of Ramboll. Installers responsible specifically for the installation of geosynthetic materials will be trained and qualified to install and test geosynthetic materials. Geosynthetic Installers will be required to demonstrate experience in installing LLDPE geomembrane for a minimum of five completed facilities. The Geosynthetic Installer will be required to submit the list of facilities for approval by O'Brien & Gere, Part of Ramboll.

2.3. LINES OF COMMUNICATION

An important component to the successful completion of any project is effective communication between the parties involved. A project specific communications matrix will be developed as part of O'Brien & Gere, Part of Ramboll's pre-construction project execution planning efforts.

O'Brien & Gere, Part of Ramboll will notify Honeywell and the NYSDEC if deficiencies in the work are noted based on field inspections, CQA/CQC results and, if appropriate, order corrective measures or recommend work stoppage. Formal communications related to submittals and changes or modifications of work shall be made in accordance with the Contract Documents and this CQAPP.

2.4. MEETINGS

To enhance communications and maintain the progress of the work in an orderly and efficient manner, scheduled on-site construction and project management meetings will be held prior to and throughout the course of construction.

Pre-Construction Meeting. After award of the contract, a Pre-Construction meeting will be held. Attendees at this meeting may include:

- Regulatory representatives (NYSDEC and NYSDOH)
- O'Brien & Gere, Part of Ramboll and select subcontractors
- Representatives of Honeywell

The meeting will cover scheduling and construction details. Important objectives of the meeting directly related to construction quality will be to:

- Provide each organization with all relevant CQA/CQC documents and supporting information
- Familiarize all entities with this CQAPP and its role relative to the plans and specifications
- Evaluate changes to the CQAPP that may be needed to monitor that the Project will be constructed to meet or exceed the specified design
- Review the responsibilities of each organization
- Review lines of authority and communication
- Discuss the established procedures or protocol for observations and tests including sampling strategies
- Discuss CQC proposed by O'Brien & Gere, Part of Ramboll and Installers
- Discuss established procedures or protocol for handling construction deficiencies, repairs, and retesting



- Review methods for documenting and reporting inspection data
- Review methods for distributing and storing documents and reports
- Review work area security and safety protocols
- Discuss procedures for the location, storage, and protection of construction materials and for the prevention
 of damage to the materials from inclement weather or other adverse events
- Conduct a site walk to review the project site layout, construction material and inspection equipment storage locations.

Minutes of the pre-construction meeting will be kept by O'Brien & Gere, Part of Ramboll and distributed to all attendees.

Weekly Construction Meetings. Construction meetings will be held weekly to discuss project progress and scheduling. Attendees at the meeting may include the NYSDEC representative. Representatives of the Owner and various property owners may also attend. Items of discussion will include:

- The progress of the work to date
- The schedule to accomplish upcoming work tasks
- Health and safety issues
- Problems encountered or anticipated during construction
- Proposed field modifications to the design
- Work deficiencies that have been noted in the field.

O'Brien & Gere, Part of Ramboll will prepare, distribute and maintain an "Action Item" list summarizing key items discussed during the weekly construction meetings.



3. CQA/CQC

This CQA/CQC Plan shall provide the basis for CQA/CQC activities associated with the Semet OU-2 remedial design work.

- Earthwork
- Geosynthetics
- Storm Water Drainage Facilities
- Engineered Final Cover Systems

DETAILED INFORMATION, INCLUDING THE FREQUENCY OF INSPECTION, FIELD TESTING METHODS, SAMPLING REQUIREMENTS FOR LABORATORY TESTING, TESTING PROCEDURES AND EQUIPMENT TO BE USED, CRITERIA FOR ACCEPTANCE/FAILURE, AND A DESCRIPTION OF THE CORRECTIVE ACTIONS TO BE INITIATED UPON TEST FAILURE ARE PRESENTED IN THE TECHNICAL SPECIFICATIONS WHICH HAVE BEEN ATTACHED AS APPENDIX B TO THE CONSTRUCTION WORK PLAN.

3.1. EARTHWORK

This section includes activities associated with excavation, backfilling, and placing embankment including the placement, loosening, removing, refilling, transporting, storage and disposal of materials necessary to be removed for construction.

3.1.1. Excavation

Construction Quality Control. Excavations shall be dewatered during construction activities, as necessary. The bottom of the excavation shall be cleaned of loose or soft material and leveled. Prior to installation of the select fill and piping, O'Brien & Gere, Part of Ramboll shall inspect the excavation and record the findings of the inspection. Records of excavation inspections shall be kept by O'Brien & Gere, Part of Ramboll.

Excavations generally shall not be opened for more than 300 feet in advance of pipe installation or left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress. Open excavations shall be protected and barricaded. Material excavated from the Site shall be transported to and placed as subgrade fill without stockpiling.

Construction Quality Assurance. Onsite materials shall be graded and utilized onsite and will not be removed from site. The general grade of the property will be managed during excavation, to control runoff in accordance with the SWPPP. Deviation from the sequencing detailed in the SWPPP is allowable with written acceptance from the Engineer.

3.1.2. Backfill

Construction Quality Control. Backfill with onsite excavated materials that can be compacted as specified in this document and in the CWP. Offsite soils will be utilized in addition to those onsite to make up the required volume for completion of the subgrade.

Backfilling around structures shall not be commenced before the structure has developed sufficient strength to withstand the loads applied. No backfill material shall be allowed to fall directly on a structure nor shall any material be pushed directly against a structure in backfilling.

Deposit backfill in horizontal layers and at no greater thickness than can be compacted to obtain the specified minimum densities.



Pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted around each pipe as laid.

Embedment materials placed above the centerline of the pipe to a depth of 12-inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified. The surface shall be restored in accordance with the Contract Drawings and topsoil and seeding specification.

3.1.3. Embankment

Construction Quality Control. Embankments shall be constructed with suitable material that can be compacted as specified in the following section. Embankment material shall be free from frost, stumps, trees, roots, sods, muck, marl, vegetable matter or other unsuitable material. Where embankments are to be placed underwater only acceptable granular materials shall be used. The surface to be covered with embankment shall be grubbed and stripped of grass, vegetation, topsoil, or other unsuitable materials before placement of embankment material. Stones within the embankment material shall generally not exceed 6-inches in greatest dimension and shall be well distributed throughout the soil mass.

Construction Quality Assurance. Embankment material shall be obtained from acceptable offsite sources. An affidavit stating the source of material shall be required for review by O'Brien & Gere, Part of Ramboll. Analytical requirements are identified in section 3.6 Select Fill.

3.1.4. Compaction

Construction Quality Assurance. Compaction of offsite imported fill is specified as the percent of maximum dry density. Prior to compaction, the moisture-density relationship of the backfill material shall be tested in accordance with ASTM D1557. Compaction curves are required for each material that will be required to achieve a specified compaction during construction. Compaction curves shall be reviewed by O'Brien & Gere, Part of Ramboll prior to placement of material. In-place density testing shall be performed by a third-party laboratory by ASTM 6398 or ASTM D1556 and be expressed as a percentage of maximum dry density. Water shall be added during compaction effort as required to achieve the specified densities. If the material exceeds optimum moisture content for satisfactory compaction, it shall be allowed to dry before compaction or filling effort is resumed.

Excavations shall be backfilled in horizontal layers not more than 12-inches in thickness and compacted to obtain 95% of the maximum dry density or as shown on the Contract Drawings. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment. Settlement of the backfill shall be refilled and compacted as it occurs. Material may be placed in greater thickness upon demonstration that the materials and compaction efforts are adequate to obtain the required density.

Embankments and berms shall be placed in horizontal layers not more than 12-inches in thickness and compacted to obtain 95% maximum density or as shown on the Contract Drawings. Settlement of the embankment shall be filled and compacted as it occurs. Frequency of in-place density testing shall be in accordance with the table herein.



Backfill around structures shall be placed in horizontal layers and at no greater thickness than can be compacted to obtain 95% maximum density or a shown on the Contract Drawings. Subsurface for structures shall be compacted native material and thoroughly compacted select fill obtaining 95% maximum density or as shown on the Contract Drawings.

Frequency of In-Place Density Testing			
Parameter	Standard	Frequency	
In-Place Density Test	ASTM D6398 or ASTM D1566	Minimum one (1) in-place density test per 10,000 square feet of compacted area per lift For linear construction elements, such as berms, minimum one (1) in-place density test per 200 linear feet	
		Source: O'Brien & Gere, Part of Ramboll	

Permeable drainage materials shall be placed in accordance with NYSDOT recommendations not be compacted. Topsoil and sand select fill materials shall not be compacted.

Records of the in-place density testing for each Select Fill and Embankment material shall be submitted to the Engineer. Testing that does not conform to the Contract Documents will be required to be performed again and resubmitted.

3.2. GEOSYNTHETICS

3.2.1. Anchor Trench Excavations

Construction Quality Control. Anchor trenches will be constructed by excavating trench to the depths shown on the Contract Drawings. Each excavation will be dewatered during construction activities. The bottom of the excavation will be cleaned of loose or soft material and leveled. Prior to installation of the stone and collection piping, O'Brien & Gere, Part of Ramboll will be required to inspect the excavation and record the findings of the inspection. Records of excavation inspections will be kept by O'Brien & Gere, Part of Ramboll.

3.2.2. Geotextile Cushion

The CQA/CQC and procedures for installation of the geotextile cushion are discussed in Technical Specification Section 02292.

3.2.3. LLDPE Geomembrane

The CQA/CQC and procedures for installation of the textured 40-mil LLDPE geomembrane are discussed in Technical Specification Section 02293.



3.2.4. Geotextile Separation Fabric

The CQA/CQC and procedures for installation of the geotextile separation fabric are discussed in Technical Specification Section 02277.

3.2.5. Composite Geonet

The CQA/CQC and procedures for installation of the geocomposite drainage layer are discussed in Technical Specification Section 02295.

3.2.6. Super Gripnet Geomembrane

The CQA/CQC and procedures for installation of the 50-mil Super Gripnet® geomembrane are discussed in Technical Specification Section 01 73 19.

3.2.7. HydroTurf®

The CQA/CQC and procedures for installation of the HydroTurf® are discussed in Technical Specification Section 01 02 03.

3.2.8. HydroBinder[®] Infill

The CQA/CQC and procedures for installation of the cementitious HydroBinder® infill are discussed in Technical Specification Section 03 49 01.

3.2.8. Cetco[®] Liquid Boot

The CQA/CQC and procedures for installation of the Cetco® Liquid Boot are discussed in Technical Specification Section 30000.

3.3. SELECT FILL MATERIALS

3.3.1. Select Fill – Granular Fill Stone

Construction Quality Control. The stone used for construction of the roadway and parking areas will comply with NYSDOT Item 304.12 subbase material as shown on the Contract Drawings and Specifications. The stone shall be as described in Specification Section 02231-Select Fill. Prior to installation, the supplier will be required submit, to O'Brien & Gere for approval, geotechnical testing results as follows:

CQC of Stone Prior to Construction				
Param	ieter		Standards	Criteria
Partic	le Size Analysis		ASTM D422	See Specification Section 02231-Select Fill
Note:				
(1)	ASTM D422	Method for Particulate Size Analysis of Soil		
				Source: O'Brien & Gere, Part of Ramboll

The supplier shall submit an affidavit from the owner of the source of each type of borrow material to be imported to the site stating that to the best of his knowledge, the site of the source material was never used as a dump site for chemical, toxic, hazardous or radioactive materials and it is not now, or ever has been, listed as a suspected depository for chemical, toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.

Construction quality assurance. Prior to procurement of any material and during construction, O'Brien & Gere, Part of Ramboll will review and verify submittal and sample information from the supplier. The information will



be reviewed to evaluate if the proper information has been submitted. O'Brien & Gere, Part of Ramboll will proceed with ordering the materials only after the submittals have been reviewed.

The material delivered to the site will be visually inspected by O'Brien & Gere, Part of Ramboll to check that the same materials are used during construction. If changes in material occur prior to the acceptance of the material by O'Brien & Gere, Part of Ramboll the material will be tested and evaluated with respect to the requirements of the Contract Documents. Any material not meeting the requirements will be removed from the site and replaced.

3.3.2. Rip-rap

Construction Quality Control. Prior to installation of the rip-rap, the supplier will be required to collect samples of proposed rip-rap and submit the samples to the COC Geotechnical Laboratory for testing as follows:

CQC of Rip-Rap Prior to Construction of Storm Water Drainage Facilities			
Parameter	Standard	Criteria	
Particle Size	ASTM D422	Stone size	% of Total by Weight
Rip-Rap:			
Heavy (36 Inches)		Heavier than 600 lbs	50 – 100
		Smaller than 6 inches	0 - 10
Medium (24 Inches)		Heavier than 100 lbs	50 - 100
		Larger than 12 inches	50 - 100
		Larger than 18 inches	0 - 10
		Smaller than 4 inches	0 - 10
Light (18 Inches)		Lighter than 100 lbs	90 - 100
		Larger than 6 inches	50 - 100
		Smaller than ½ inches	0 - 10
Fine (12 Inches)		Smaller than 3 Inches	90 - 100
		Larger than 3 Inches	50 - 100
		Smaller than No. 10 Sieve	0 - 10
Notes:			

Stone sizes other than weights refer to the average of the maximum and minimum dimensions of a stone particle.

(1) Materials shall contain a sufficient amount of stones smaller than the average stone size to fill the spaces between the larger stones.

Materials shall contain less than 20 percent of stones with a ratio of maximum to minimum dimension greater than (2)three.

Source: O'Brien & Gere, Part of Ramboll

Results of the testing will be submitted to O'Brien & Gere, Part of Ramboll for acceptance.

The supplier shall submit an affidavit from the owner of the source of each type of borrow material to be imported to the site stating that to the best of his knowledge, the site of the source material was never used as a dump site for chemical, toxic, hazardous or radioactive materials and it is not now, or ever has been, listed as a suspected depository for chemical, toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.

Construction Quality Assurance. O'Brien & Gere, Part of Ramboll will perform visual inspections during construction. If a change in material is observed, additional testing will be required and material not in compliance with the Contract Document will be removed from the Site.



3.4. Topsoil, Fertilization, and Seeding

3.4.1. Topsoil

Construction Quality Control. Prior to installation of the topsoil, the supplier will be required to collect samples of the proposed topsoil and submit, to O'Brien & Gere, Part of Ramboll for approval, geotechnical testing results as follows:

CQC of Topsoil Layer Prior to Construction			
Par	ameter	Standard	Criteria
Тор	osoil Grain Size	ASTM D422-63	Monitor consistency of borrow source
Тор	osoil pH	ASTM D4972-89	pH in the range of 5.5 to 7.6
Topsoil Organic Content ASTM D2974-87Not less than		ASTM D2974-87	Not less than 6% or more than 20%
Note	es:		
1. ASTM D422 Method for Particulate Size Analysis of Soil			
2.	ASTM D2974-87 Test	Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils	
3.	ASTM D4972-89 Stand	D4972-89 Standard Test Method for pH in Soils	
			Source, O'Prion & Core Dart of Domball

Source: O'Brien & Gere, Part of Ramboll

Results of the testing will be submitted to O'Brien & Gere, Part of Ramboll for acceptance.

The supplier shall submit an affidavit from the owner of the source of each type of borrow material to be imported to the site stating that to the best of his knowledge, the site of the source material was never used as a dump site for chemical, toxic, hazardous or radioactive materials and it is not now, or ever has been, listed as a suspected depository for chemical, toxic, hazardous, or radioactive materials by any federal, state, or other governmental agency, department, or bureau.

The supplier shall also provide laboratory analytic data (or documentation of such data) for these topsoils for characteristics of hazardous waste found under Subpart C of 40 CFR 261.20 including percent solids, pH, flashpoint, reactive cyanide, and sulfide, as well as for constituents identified on Table 1 of 40 CFR 261 which identifies Maximum Concentration of Contaminant for the Toxicity Characteristics. Laboratory data (or documentation of such data) shall be submitted to O'Brien& Gere, Part of Ramboll for review and acceptance prior to use of the material on-site.

In addition, topsoil shall either:

- Have composite samples tested for the compounds in Table 375-6.8(a) "Commercial Use Soil Cleanup Objectives" in NYSDEC Subpart 375. Sampling for 1,4-dioxane and polyfluroalkyl substances will be included, as required. Test results shall be below the cleanup objective concentrations provided in this table. Failure of a single compound test result shall mean that the entire material batch will be rejected unless specifically accepted on a test-by-test basis in writing by O'Brien& Gere; or
- Originate from a borrow site that has been otherwise verified as having no compounds exceeding the limits in Table 375-6.8(a) "Commercial Use Soil Cleanup Objectives" in NYSDEC Subpart 375.

Documentation giving the location of properties from which the topsoil will be obtained, names and addresses of the owners, and depth to be stripped will be submitted to O'Brien & Gere, Part of Ramboll for acceptance.

Construction Quality assurance. Prior to procurement of any material and during construction, O'Brien & Gere, Part of Ramboll will review and verify submittal and sample information from the supplier. The information will



be reviewed to evaluate if the proper information has been submitted. O'Brien & Gere, Part of Ramboll will proceed with ordering the materials only after the submittals have been reviewed.

The material delivered to the site will be visually inspected by O'Brien & Gere, Part of Ramboll to check that the same materials are used during construction. If changes in material occur prior to the acceptance of the material by O'Brien & Gere, Part of Ramboll the material will be tested and evaluated with respect to the requirements of the Contract Documents. Any material not meeting the requirements will be removed from the site and replaced.

O'Brien & Gere, Part of Ramboll will perform inspections to evaluate the placement of topsoil in accordance with the Contract Documents, any irregularities with respect to proposed finished grades will be corrected prior to installation of grass seed, fertilizer, and mulch.

3.4.2. Seeding

Construction Quality Control. As part of CQC, the suppliers will be required to submit the following information to O'Brien & Gere, Part of Ramboll for acceptance prior to fertilization and seeding activities:

- Seed vendor's certified statement for the grass seed mixture required, stating common name, scientific name, percentage by weight, and percentages of purity and germination
- Documentation giving data concerning hydroseeding equipment (if used), including all material application rates

The grass seed will be of commercial stock of the current season's crop and will be delivered in unopened containers bearing the guaranteed analysis of the mix. The mix will be in accordance with the requirements of the approved Contract Documents.

Construction Quality Assurance. O'Brien & Gere, Part of Ramboll will review submittals to evaluate that seeding materials meet the requirements of the Contract Documents. If materials fail the requirements of the Contract Documents, the materials will be rejected. O'Brien & Gere, Part of Ramboll will also inspect the application rates of seed with respect to the specifications.



4. DOCUMENTATION

This section describes the recordkeeping that will be used to document the CQA/CQC activities performed during construction of this project. The documentation will comprise the final records of the project, with the results of material and installation inspections and tests.

4.1. PROBLEM IDENTIFICATION AND CORRECTIVE MEASURES REPORTS

In the event that O'Brien & Gere, Part of Ramboll or others determine that material or workmanship does not meet the requirements of the plans, specifications or CQA/CQC Plan, or if an obvious defect in material or workmanship is noted and removal/replacement of work is not feasible, O'Brien & Gere, Part of Ramboll will complete a problem identification and corrective measures report and present it to the NYSDEC.

4.2. ACTION ITEM LIST

O'Brien & Gere will prepare and maintain a list of "Action Items" based on the discussions during weekly meetings. The action item list will be circulated to meeting attendees and the NYSDEC to keep them apprised of the status of identified items.

4.3. PHOTOGRAPHS

All photographs taken by O'Brien & Gere, Part of Ramboll will be recorded on a photo log which will include, at a minimum, the date, time, location, and description of the work.

4.4. RECORD DRAWINGS

At the completion of the project, O'Brien & Gere, Part of Ramboll will transfer as-built information to a set of final record drawings to document site conditions.

4.5. STORAGE AND DISPOSITION OF RECORDS

During construction of this project, O'Brien & Gere, Part of Ramboll will be responsible for all CQA/CQC documents. This includes the originals of all the data sheets and reports.

Once project construction is complete, the original document will be stored in a manner that will allow for recovery while still protecting them from damage.

4.6. DAILY REPORT

O'Brien & Gere will prepare a daily report that will provide a summary of project activities conducted that day and observations made. A copy of these reports will be maintained and available for review on site during construction.

4.7. WEEKLY REPORT

O'Brien & Gere, Part of Ramboll will prepare a weekly report that will summarize the progress of work as it relates to the schedule, conditions encountered in the field and formal communications regarding the work. A copy of the weekly report will be maintained and available for review on site during construction.



5. CHANGES AND CORRECTIONS OF WORK

This section summarizes the requirements and procedures for tracking requests for information, changes to design and/or drawings, control of discrepant and non-conformant items, and tracking corrective actions.

5.1. PROCEDURE FOR CHANGES

Honeywell at any time may make changes in the Work by making alterations therein, by making additions thereto, or by omitting Work therefrom. Honeywell will not, however, make changes to the design during construction connected to the environmental remedy without first reviewing the proposed change with the NYSDEC and receiving the agency's approval to proceed.

Honeywell may authorize minor changes in the Work which do not alter the character, quantity, or cost of the Work as a whole. These changes may be accomplished by a Field Order.

5.2. INSPECTION AND CORRECTION OF WORK

O'Brien & Gere, Part of Ramboll will observe the progress and quality of the executed Work to determine, in general, if the Work is proceeding in substantial compliance with the design plans and technical specifications. O'Brien & Gere, Part of Ramboll may disapprove Work as failing to conform to design plans or technical specifications.



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