QUALITY CONTROL PLAN
FOR
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
BRUNSWICK, MAINE

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032
Delivery Order 0040

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OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

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1.0 STATEMENT OF QC PROGRAM

OHM Remediation Services Corp. (OHM), a subsidiary of OHM Corporation, will provide and maintain an effective Contractor Quality Control (CQC) Program as required by contract clauses. This program will be performed in conjunction with the Program Quality Control Plan (OHM, 1994) as applicable and in accordance with the requirements of Contract No. N62470-93-D-3032, Atlantic Division, Naval Facilities Engineering Command, dated August 1993. OHM will perform the inspections and tests required to ensure that materials, workmanship, and construction conform to the drawings, specifications, and contract requirements. OHM will perform the test or inspection specified, unless the required inspection and/or test is specifically designated to be performed by the Government.

2.0 PROGRAM ORGANIZATION AND PERSONNEL RESPONSIBILITIES

OHM will implement the CQC Program by establishing a QC organization which works directly with the Navy's on-site representative and reports to the OHM Program QC Manager. The QC organization will consist of not less than one full-time QC person who will be at the site while work is in progress to verify compliance with the contract requirements. The QC organization will be supplemented by additional QC personnel as may be necessary. OHM recognizes that the Navy Technical Representative (NTR) reserves the right to replace a member of the QC staff who, in the opinion of the NTR, is not accomplishing their assigned duties.

The CQC Program includes an inspection schedule, which will be available for review prior to the start of construction and throughout the life of the project. The inspection and testing processes will monitor the overall quality of work, and project controls will be instituted to assure correction of deficiencies identified during the inspections and testing. Project scheduling will be instituted to assure proper sequence and performance of work activities.

The NTR will be notified in writing prior to proposed changes to the CQC Program, and the proposed changes will be subject to the NTR's approval prior to implementation.

OHM's QC organization chart for Delivery Order 0040 is included as Figure 2-1. Professional profiles of OHM's delivery order specific project team and QC team are provided in Appendix A of this plan. Professional profiles of OHM's Program Management team are provided in the Program QC Plan. The responsibilities of each person identified in the QC organization are presented below.

2.1 PROGRAM MANAGER, GEORGE E. KRAUTER, P.E.

The program manager has ultimate responsibility for QC of project deliverables. Specific responsibilities includes:

- Reviewing all deliverables prior to submittal to Atlantic Division, Naval Facilities Engineering Command
- Communicating with the OHM project manager to ensure project schedule and scope compliance
- Communicating with contracting officer (CO), contracting officer's technical representative (COTR), and/or NTR on a regular basis to review project progress and contract compliance
- Reviewing program QC procedures
- Providing cost accounting updates to verify project is within budget.

2.2 PROJECT MANAGER, JOSEPH W. COLELLA, P.E.

The project manager is responsible for:

- Providing deliverables which are both responsive and on schedule
- Reviewing all project activities including, but not limited to, sampling, remediation, decontamination, documentation, chain-of-custody procedures, site rules and compliance, and compliance with the OHM site-specific health and safety plan and the work plan
- Monitoring project progress to ensure schedule and budget maintenance
- Ensure CQC program is being performed.

2.3 SITE SUPERVISOR, TOM SHARPLESS

The site supervisor is responsible for day-to-day on-site activities. He communicates with the project manager to update him on project progress and QC activities.

2.4 PROGRAM QC MANAGER, MICHAEL I. GILMAN

The program QC manager is responsible for delivery order quality and, for this delivery order, will provide support to the project manager on an as-needed basis. If an independent site audit were to take place during site activities, the program QC manager's representative would perform the audit. The program QC manager will oversee work performed by the site QC representative. The QC manager will also monitor the correction of any nonconforming work. He will be responsible for reviewing the laboratory QC program to ensure its conformance with the contract program requirements.

2.5 SITE QUALITY CONTROL REPRESENTATIVE, ALAN BROWN

The responsibilities of the site QC representative will include:

- Perform, or cause to be performed, daily inspections and tests of the scope and characters necessary to achieve the quality of construction outlined in the plans and specifications for work under the contract.
- Maintain the latest applicable drawings and specifications with amendments and/or approved modifications at the job site and assure that they are used for shop drawings, fabrication, construction, inspections, and testing.
- Maintain marked-up drawings at the site depicting as-built conditions. The drawings will be available for review by the NTR at all times.

- Maintain the delivery order submittal register (see Section 6.4 of this plan) for the duration of the contract. A review of the register will be performed at least every 14 days in conjunction with the scheduled dates on the register and in relation to the actual work status. Appropriate actions will be undertaken should slippages or other changes so necessitate.

- Review shop drawings and/or other submittals for compliance with the contract requirements prior to their transmission to the Navy.

- Authorization to temporarily shut down a portion of work if work practices or procedures are determined to be incorrect or out of compliance with the specifications.

- Authorization to stop a work task or series of tasks after consultation with the site supervisor and NTR in the event that severe weather conditions interfere with quality of work.

- Responsible for testing construction and backfill materials for compliance with specifications and authorized to reject materials to be used if they are not in compliance.

- Establish and maintain a Rework Items List program and a tracking and/or suspense system to monitor and assure inspection and testing activities and frequencies are in accordance with the contract requirements. This list will be submitted on a monthly basis.

- Attend and assist the Government at the prefinal inspection and final acceptance inspection.

- Assist in preparing Contractor Production Report.

- Prepare and submit daily Contractor QC Report.

- Maintain and continually update the Construction Testing Plan and Log for the field activities.

- Conduct and document weekly QC meetings on site.

The site QC representative, along with the field technicians from the independent geotechnical testing subcontractor (GTS), will serve as the QC specialists for the slurry wall construction as defined in Section 01400, Paragraph 1.5.3 of the project specifications. The responsibilities of the QC specialists for the slurry wall include visual inspections and all sampling and testing, as required in the project specifications.

2.6 GEOTECHNICAL TESTING SUBCONTRACTOR, BISHOP TESTING SERVICES, INC.

OHM will employ Bishop Testing Services, Inc. as the independent GTS to perform QC inspection tasks and testing. Bishop Testing Services, Inc. has subcontracted Carl Burdick of Sevee & Maher Engineers, Inc. as the QC specialist for the geomembrane installation as defined in Section 01400, Paragraph 1.5.3 of the project specifications. The qualifications of Bishop Testing Services, Inc. and Sevee & Maher Engineers, Inc. are presented in Appendix A. The responsibilities of the QC specialist for the geomembrane installation include visual inspection and all sampling and testing, as required in the project specifications. The GTS will perform the following duties:

- Collect samples and perform all required soils and construction material laboratory testing
- Collect samples and perform all required laboratory testing of materials for slurry wall construction
- Collect samples and perform all required laboratory testing of asphalt concrete paving materials
- Perform field testing, collect test samples, and perform laboratory testing during geomembrane installation
- Perform QC testing at cast-in-place concrete
- Perform all required field QC inspections during soil placement and geosynthetics installation.

The GTS will report to the site QC representative. The GTS will submit all test results to the site QC representative for review and submittal to others.

3.0 METHODS OF INSPECTION

A three-phase control system will be implemented for each major work task and will include preparatory, initial, and followup inspections. The QC representative will assure that no work proceeds until the appropriate inspections have been performed. An inspection schedule listing the expected major phases of work for which the inspections will be conducted is presented in Table 3-1. In addition to, and independent of, the site QC representative, the site safety officer (SSO) and site supervisor will implement this same control system as part of their normal duties/responsibilities. The inspection phases are discussed in the following paragraphs.

A preparatory inspection will be performed by the site QC representative prior to beginning physical work. This will include a review of contract requirements; a check of the data sheets to assure that materials and/or equipment have been tested, submitted, and approved; a check to assure that provisions for required control testing have been made; and a physical examination of materials and drawings or submittal data and that material and/or equipment are on hand.

As a part of this preparatory work, the site QC representative will review shop drawings, certificates, and other submittal data prior to submission to the NTR. Each submittal presented to the NTR will bear the date and the signature of the site QC representative indicating that the submittal has been reviewed and is in compliance with plans and specifications or shows the required changes to meet the specifications. The NTR will be notified a minimum of 24-hours prior to the beginning of the preparatory inspection.

An initial inspection will be performed by the site QC representative as soon as a representative segment of the particular item of work has been accomplished. The initial inspection will include examination of the quality of workmanship and a review of control testing results for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements.

Follow-up inspections will be performed by the site QC representative daily or as frequently as necessary to assure continuing compliance with contract requirements, including control testing, until completion of the particular segment of work.

In addition to this three-phase inspection control system, special inspections or testing may be conducted in the event of an approved change or modification to work plans or field operations. The QC representative will coordinate scheduling of special inspections with the Contracting Officer at the time when a change or modification in work operations has been approved.

It is OHM's responsibility to identify and correct deficiencies in the work. To ensure that defective work is corrected and not built upon, a Rework Items System will be implemented. Rework items identified in the work during any of the inspections or testing programs by a party to this contract will be corrected as soon as practicable and recorded by completing a Rework Items List. The list will be issued to the site supervisor and a copy attached to the inspection report. The site QC representative will notify the site supervisor of any nonconformance and/or rework. The site supervisor will be responsible for implementing corrective action and will return the notice report upon correction with a description of the action taken and date completed. The list will be updated accordingly. The site QC representative will reinspect to confirm compliance. Rework items will be corrected prior to the final inspection. Copies of the Rework Items List are presented in the Program QC Plan and Procedures.

Safety inspections will be performed by the SSO on a daily basis to assure compliance with occupational health and safety requirements of the contract. Daily QC reports will be used to document the safety inspection and other inspections, and will address the safety deficiencies observed and corrective actions taken.

In addition to site QC representative directed inspections, standard site QC inspections will be performed during the course of remediation to verify the quality of the final construction work. There will also be visual inspections performed by the site supervisor, a qualified general foreman, or other appropriate personnel. These inspections are supplemental to the site QC inspections and are intended to enhance the QC inspections by identifying problem areas that may require more stringent QC inspection. In the event of a discrepancy between one of these visual inspections and the field verification test performed as per this document, the field verification test result will take precedence.

Inspections will be performed in accordance with this plan, as described in Table 3-1, and checklists developed for the remediation. Inspections performed to a guide procedure will be documented in the daily field log while inspections performed to a checklist will be documented on the checklist.

As part of the QC requirements for construction activities, OHM will employ an independent GTS to perform the following duties:

- Provide on-site QC field technicians who are qualified to perform all required site QC inspections and field testing during construction activities dealing with the geotechnical materials

- Collect samples and perform laboratory tests for all soils and construction materials including geosynthetics.

All laboratory and field test results provided by the GTS will be reviewed by OHM and the site QC representative to ensure compliance with the QC requirements as stated in the project specifications. All test data will then be submitted to the NTR as required.

4.0 SAMPLING AND TESTING PROCEDURES

OHM sampling and testing procedures will meet the requirements of the project scope of work. The sampling and testing procedures for this delivery order are summarized in Tables 4-1, 4-2, and 4-3. Performance evaluation tables for the components of the slurry wall and landfill cap are presented in Tables 4-4 and 4-5. The QC Plan is not meant to replace the project specifications. The purpose of the QC Plan is to stress the importance of quality control through testing and visual observations as required in the project specifications. Some of the critical project specifications are provided in Appendix B.

4.1 CONFIRMATORY SAMPLING AND TESTING

In the waste excavation areas, OHM will collect soil samples for confirmatory testing to determine if the excavation area is clean. The sampling procedures for confirmatory testing are described in detail in Section 3.0, Data Quality Objectives, of the Field Sampling and Quality Assurance Plan. The samples will be sent to an approved independent laboratory for analysis. The results will be reviewed by OHM and the site QC representative.

The results of the confirmatory sampling will be the major component of the QC procedures for waste excavation activities. If any of the test results from the first round of sampling indicate a contaminated zone, the contaminated area will be excavated and resampled.

Site 5 was used to dispose of asbestos-lined pipe from a building that was demolished on base. The site was inspected in 1980 by a facility engineer who described the site as consisting of two trenches filled with the asbestos-containing material (ACM) and covered with soil.

Site 6 was reportedly used for general dumping of construction debris and other nonputrescible wastes. Aircraft parts and asbestos-containing pipes were reportedly buried here. Concrete, asphalt, pipes, ACM, and other debris are visible at the site surface.

Site 8 was a disposal area for rubble, debris, and trash from the base. In addition, industrial solvents may have been disposed here.

4.2 AIR SAMPLING FOR ASBESTOS

OHM's site safety officer (SSO) will conduct air sampling for asbestos throughout waste excavation. If airborne asbestos concentrations exceed 0.1 fibers/cubic centimeter, work will be stopped and corrective measures will be implemented. Specific air sampling procedures for asbestos are described in the Asbestos Abatement Plan which can be found in Appendix A of the Work Plan for D.O. No. 0040.

4.3 GEOTECHNICAL SAMPLING AND TESTING PROCEDURES

Geotechnical sampling procedures include all methods used to obtain samples of materials to be used in construction activities. These materials will include slurry wall materials, soils, aggregates, asphalt, concrete, and various geosynthetic materials. All tests for geotechnical samples will be performed according to the project specifications. OHM has selected Bishop Testing Services, Inc. as the geotechnical testing subcontractor (GTS). Bishop Testing Services, Inc. will follow all required sampling and testing procedures as listed in the project specification and test plan log provided in

Tables 4-1, 4-2, and 4-3. Bishop Testing Services, Inc. will also provide experienced QC field technicians to perform the field testing identified as part of the QC program.

4.3.1 Slurry Wall Construction

OHM has selected Inquip Associates, Inc. as the slurry wall subcontractor. The bentonite slurry and the backfill mix for the slurry wall will be sampled and tested by the GTS to ensure that all raw materials and mixtures meet the specifications as stated in Section 02214 - "Soil-Bentonite Slurry Wall" of the project specifications. The slurry wall subcontractor will also provide the GTS with samples for testing to ensure the quality of the materials and mixes.

The excavation of the trench for the slurry will be constantly monitored during excavation. The QC field technicians will monitor the slurry wall construction for the following:

- Profile - Measurement of trench bottom at intervals of 1 per 20 linear feet of excavation
- Continuity - Monitor the movement of excavation equipment to ensure a continuous trench
- Key - Examine excavation cuttings to check where the excavation is relative to the homogeneous gray silty clay; will ensure 3-foot key into clay
- Width - Ensure that bucket width is constant at a 3-foot minimum width
- Alignment - Alignment of slurry wall will be staked 50-foot on center by the surveyors.

The slurry wall subcontractor will use only bentonite that is comprised of pulverized, natural, unadulterated, premium grade cation montmorillonite. No polymers will be used. The slurry wall subcontractor will submit one manufacturer certificate of compliance with each truckload of bentonite.

The water source for mixing is from the water service at the Naval Air Base. The tests for pH, hardness, and dissolved salts will only have to be performed once per water source or when changes occur in the initial water supply.

Prior to placement in the trench, the slurry mix will be tested at a sampling frequency of two samples of slurry mix per shift per mixing pond. One shift is defined as one 10-hour working day. The samples will be tested for viscosity, filtrate loss, and pH according to the standard testing procedures as stated in the American Petroleum Institute (API) recommended practice 13B-1 entitled "Recommended Practice, Standard Procedure for Field Testing Water-Based Drilling Fluids." The slurry mix must meet the specified values as listed in the QC table in Section 02214 - "Soil-Bentonite Slurry Wall" of the project specifications prior to placement in the trench.

After the slurry is in the trench, three samples per shift (defined as one 10-hour working day) will be collected and tested for density, viscosity, and filtrate loss. For each test, samples will be collected at the following locations in the trench:

- One sample will be collected at or near the trench bottom at the point of excavation (defined as the location where the excavator is working at the time of the test)
- One representative sample will be collected at or near point of excavation
- One representative sample will be collected away from the point of excavation.

Slurry containing excessive suspended material as indicated by a slurry density exceeding 85 pounds per cubic feet (pcf), will be recirculated and suspended material will be separated and removed by use of air lifting and stilling ponds, screens, cyclones, or other appropriate methods. The slurry density in the trench will be maintained at less than 90 pcf at all times. If the slurry density exceeds 85 pcf, the slurry wall subcontractor will commence desanding or other operations to control slurry density at less than 90 pcf.

Prior to backfilling, the backfill mix will be sampled at the remote mixing pad as required in the QC table in Section 02214 - "Soil-Bentonite Slurry Wall" of the project specifications. The samples of backfill mix will be tested for the following:

- Density (API BB-1)
- Slump (ASTM C143)
- Material Fines Content (ASTM C117)
- Hydraulic Conductivity (ASTM D5084-90)
- Gradation (ASTM 022156 and ASTM C136).

Backfill mix will be placed in the trench so that backfill surface below the surface of the slurry will be maintained at a uniform slope between 5 horizontal (h):1 vertical (v) to 9h:1v. Slope measurements of the backfill surface will be taken at an interval of 1 per 20 linear feet of trench.

A performance evaluation table for the components of the slurry wall is presented in Table 4-4.

4.3.2 Common Fill

Common fill will be used to bring low areas in the landfill and detention basin up to subgrade elevations. All common fill will be sampled and tested by the GTS prior to use to ensure that the material meets the requirements as specified in Section 02220 - "General Excavation, Filling, and Backfilling" of the project specifications and in Tables 4-1, 4-2, and 4-3. The QC field technicians provided by the GTS will also monitor the placement of common fill to ensure that the material is placed and compacted according to the specifications.

Any waste from the removal sites will be compacted by the heavy equipment working in that area of the landfill. Geotechnical sampling and testing of the waste fill will not be required.

4.3.3 Soil Components of the Landfill Cap

Soil components of the landfill cap include gas vent sand, drainage sand and aggregate, filter sand, and vegetative material. All of these soil components will be sampled and tested by the GTS prior to use to ensure that all materials meet the requirements as specified in Section 02220 - "General Excavation, Filling, and Backfilling" of the project specifications. The QC field technicians will also monitor the placement of the soil components to ensure that the materials are placed and compacted according to the specifications and in Tables 4-1, 4-2, and 4-3.

4.3.4 Asphalt and Cast-In-Place Concrete

Site activities include the asphalt paving of a road around the southeast side of the landfill and a small amount of cast-in-place concrete at the bottom of the riser pipe in the detention basin. Samples of asphalt and concrete will be collected by the QC field technicians during placement for testing to ensure that the materials meet the product specifications as stated in the appropriate section of the project specifications and in Tables 4-1, 4-2, and 4-3.

4.3.5 Sample Tracking and Custody

All samples will be accompanied by a complete chain-of-custody record. A chain-of-custody record will accompany the sample during shipment to the laboratory and through the laboratory. If samples are split, a copy of the chain-of-custody record will accompany each split sample. When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time of the record, and will document any discrepancies in samples.

Two copies of this record will accompany the samples to the laboratory. The laboratory will maintain one file copy and the completed original will be returned to the site QC representative as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler to the laboratory.

4.3.6 Sample Numbering System

A sample numbering system will be used to identify each sample taken. The numbering system will provide a tracking procedure to allow retrieval of information about a particular location and to ensure that each sample is uniquely numbered. A listing of sample numbers will be maintained by the site QC representative. Each sample number will assume the format described as follows:

- Project Identification - The project identification will include the project name and the OHM project number

- Sample Identification - Each sample will be assigned a unique matrix and number designation as follows:

  - Matrix: (VM - vegetative material; DS - drainage sand; GVS - gas vent sand; DST - drainage stone; AB - aggregate base; ASB - aggregate subbase; CF - common fill; FS - filter sand; GB - gravel borrow; SBM - sand bedding material; SB - sand borrow; CS - crushed stone; FDS - french drain stone; SM - slurry mix; BM - backfill mix)

  - Number: Consecutively numbered as collected

  - Examples: BNAS-VM-0012, BNAS-GVS-0003, etc.

4.3.7 Sample File

A secure sample file will be established and maintained by the QC field technicians under the direction of a field supervisor from the GTS. Upon completion of the field program, the on-site file will be transferred to the site QC representative. The sample file will contain field log and reports, archived samples, chain-of-custody forms, analytical results, QC information regarding samples, etc.

4.3.8 Sample Custody Requirements

The following procedures will be used to document, establish, and maintain custody of field samples:

- Sample labels will be completed for each sample using waterproof ink, making sure that the labels are legible and affixed firmly to the sample container

- All sample related information will be recorded in the project sample log books

- During the course of the field work, the site QC representative will ensure that these procedures have been followed.

4.3.9 Sample Labeling

Each sample will be identified with a separate identification label. The information on the label will include the following information:

- Project identification
- Initials and affiliation of person performing the sampling
- Sample identification
- Date of collection
- Time of collection.

4.3.10 Transfer of Custody and Shipment

The following procedures will be used in transferring and shipping samples:

- Samples will be accompanied by a chain-of-custody record at all times
- When transferring the possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the record, thus documenting transfer of custody of samples from the sampler to another person or to the laboratory
- If samples have to be shipped to the laboratory by overnight express mail, the samples will be packaged in shipping containers with a separate signed chain-of-custody record enclosed in each container
- Whenever samples are split, a separate chain-of-custody record will be prepared for those samples and marked to indicate with whom the samples are being split
- All packages will be accompanied by the chain-of-custody record showing identification of the contents with the original record accompanying the shipment and a copy being retained by the site QC representative
- When sent by common carrier, a copy of the bill of lading is retained as part of the permanent custody documentation.

4.4 GEOSYNTHETIC CLAY LINER

OHM has selected Chenango Contracting, Inc. as the Geosynthetics Installer. Chenango Contracting, Inc. will be responsible for installing the GCL and the geomembrane. The GTS will provide a geosynthetics QC inspector to monitor the installation of the GCL. The QC inspector will ensure that the GCL panels are not damaged and that the seam overlaps are placed according to the project specifications.

The GCL will be delivered to the site in rolls. The GTS will monitor the arrival of the GCL to ensure that the rolls are individually wrapped in waterproof protective covers. OHM will return any rolls of GCL that are discovered to be damaged. The GTS will collect tags from the individual rolls for identification purposes. Information collected includes the following:

- Name of manufacturer
- Lot number
- Dimensions (thickness, length, width, and height)
- Roll number
- Date of fabrication.

All GCL must meet the material specifications as listed in Section 02738 - "Geosynthetic Clay Liner (GCL)" of the project specifications.

4.4.1 Material Placement and Protection

OHM will subcontract the installation of the GCL to the Geosynthetics Installer. OHM will also employ a manufacturer's representative to provide guidance during the following:

- When GCL installation begins
- At substantial completion of the GCL installation
- At written notification from the NTR that installation is not in conformance with the manufacturer's recommended procedures or specifications.

The Geosynthetics Installer will follow all requirements of Part 3 - "Execution" of Section 02738 - "Geosynthetic Clay Liner (GCL)" of the project specifications for GCL handling and deployment practices as well as the manufacturer's recommendations. The GCL is deployed by unrolling from the top of the landfill to the toe of the slope. On slopes, continuous runs will be maintained from crest to toe with the GCL longitudinal direction running perpendicular to the toe.

The GCL will not be exposed to excessive moisture prior to placing the geomembrane. The installation of the GCL will proceed in conjunction with the installation of the geomembrane. As the GCL is deployed, the Geosynthetics Installer will follow directly behind to cover the GCL with the VLDPE geomembrane. To prevent hydration of the GCL, only that amount of GCL that can be placed, inspected, repaired, and covered in the same day will be installed. All edges of GCL left unprotected will be covered with a heavy, waterproofing tarp which is adequately secured and protected with sand bags or other ballast. At no times will the GCL be left uncovered at the end of the working day or when it appears that rain is pending.

4.4.2 Seams

The GCL installation will conform to the guidelines presented in Part 3.3 - "Field Seams" of Section 02738 - "Geosynthetic Clay Liner (GCL)" of the project specifications for seams. The GCL panels are not sewn together but simply overlapped. Once the first run of GCL has been laid, the adjoining panels will be laid with a minimum 9-inch overlap. End seams (those parallel to the toe of slope) will have a minimum overlap of 24 inches. The seam overlap at the bottom of the slope will be placed such that the direction of flow is from the top sheet to the bottom forming a "shingle" effect.

Seams will be oriented perpendicular to the toe of the slope at all times. Seams at the base of the slope will be a minimum of 5 feet away from the toe. In the event an end seam cannot be avoided and occurs on a slope, construction adhesive will be used to secure the overlap, with the overlap increased to 3 feet in a rainlap orientation. The ends of the GCL at the toe of the landfill slope will be tied into the anchor trench along with the geomembrane.

Any pipe boots will be fabricated as indicated in Part 3.4 - "Pipe Penetrations and Repair" of Section 02738 - "Geosynthetic Clay Liner (GCL)" of the project specifications.

4.4.3 Repairs

OHM will mark any roll arriving on site having visible damage or rolls damaged during the installation process and set them aside to avoid accidentally using them in later installations. GCL sheets incurring small damaged areas will be repaired with patches of 12-inch overlap. A tape, staples, or similar method as approved by the NTR or manufacturer will be used to secure all patches. Bentonite will be placed at a rate of ¼ pound per lineal foot between the damaged GCL sheet and the patch, spread 6 inches wide. Geomembrane will not be placed over repairs until approval has been given by the NTR or his representative.

4.4.4 Field Quality Control/Quality Assurance

The GTS will be responsible for:

- Observing each roll of GCL material for defects
- Reviewing each GCL's certificates as they come on site
- Conducting photographic records of the GCL installation
- Recording installation logs, including panel placement log, inspection log, and GCL repair log.

The technical representative from the GCL manufacturer will be available when the following situations occur:

- When GCL installation begins
- When GCL installation is essentially complete
- When written notification from the NTR has indicated that the progress or quality of work is unacceptable or is not in conformance.

4.4.5 Cleanup/Geosynthetic Clay Liner Acceptance

OHM's Geosynthetics Installer will be responsible for all GCL placed at the site until all of the following have occurred:

- Installation is complete according to the NTR
- Verification that all repairs are satisfactory
- All certifications have been submitted to the NTR
- The record drawing (as-builts) has been submitted to the NTR by OHM.

During the last stages of installation and throughout the installation process, OHM and the geomembrane subcontractor will dispose of all trash associated with the installation, removed all excess material and equipment, and leave the work area in a neat and acceptable condition to the NTR.

4.5 GEOMEMBRANE INSTALLATION

OHM has selected Chenango Contracting, Inc as the Geosynthetics Installer. Chenango Contracting Inc. will be responsible for installing the GCL and the geomembrane. The GTS will provide an independent geosynthetics QC inspector for on-site QC monitoring and field sampling and testing. Prior to installation, the Geosynthetics Installer and Manufacturer will submit all required certificates and warranties for all products and services as required in the project specifications and in Table 4-1.

4.5.1 Placement

The Geosynthetics Installer will label each panel with an "identification code," along with the original roll number. The GTS will verify that each field panel is installed at the location indicated on the Geosynthetics Installer's panel layout plan, unless otherwise approved by the site QC representative. The GTS will record the panel identification code, location and date of installation of each panel. Following visual observation of an installed panel, the GTS will advise the site QC representative which panels, if any, should be rejected. If required by the site QC representative, repairs shall be made by the Geosynthetics Installer in accordance with the technical specifications. Repair locations shall be indicated on a set of as-built drawings, along with seam locations and penetrations.

4.5.2 Field Seaming

The Geosynthetics Installer will provide a panel layout shop drawing to the site QC representative and GTS at the Pre-Construction Meeting. The site QC representative will approve the panel layout. No deviations from the panel layout may be made without the approval of the site QC representative. Seams will be oriented and located in accordance with the technical specifications, and will be numbered with a system which can be cross-referenced to the panel identification code. Seams will extend to the outside edge of panels placed in the anchor trench.

The GTS will log welding temperature, extrudate temperature, and ambient temperature at intervals of no more than 2 hours. Ambient temperature will be measured at 2 feet above the geomembrane surface. The GTS will also be responsible for verifying that the Geosynthetics Installer maintains on site the number of spare operable seaming apparatus agreed to at the Pre-Construction Meeting. As seaming proceeds, the GTS will verify that the geomembrane is adequately protected from damage from seaming equipment, electric generators, traffic, etc. If seaming operations are performed at night, the GTS will verify that adequate illumination is provided to install or test materials. Adequate illumination for site safety is the responsibility of OHM.

4.5.2.1 Seaming Equipment

Approved geomembrane seaming processes are extrusion seaming and hot wedge, dual-bond seaming. The Geosynthetics Installer will use seaming apparatus equipped with gauges giving applicable welding temperatures.

For extrusion seaming, the extrudate will consist of the same resin as the geomembrane sheeting. Prior to beginning a seam, the GTS will verify that the extruder barrel is purged of all heat-degraded extrudate. The Geosynthetics Installer will ensure, and the GTS will verify, that extrusion seams have a minimum overlap of 6 inches prior to welding.

Apparatus for hot wedge, dual-bond seaming will be automated vehicular-mounted devices. The Geosynthetics Installer will ensure, and the GTS will verify that hot wedge, dual-bond seams have a minimum finished overlap of 4 inches. The Geosynthetics Installer will take precaution to prevent the buildup of moisture between the sheets which are to be seamed with a movable protective layer placed directly below each overlap, or with other means. For cross seams, the GTS will verify that the edge of the cross seam is ground to a smooth incline (both top and bottom) prior to seaming.

4.5.2.2 Seam Preparation

All seam interfaces will be dry and cleaned of dust and dirt. For extrusion-bonded seams, the Geosynthetics Installer will roughen slick sheet surfaces to become seam interfaces with a handheld disk grinder with grit paper no coarser than No. 80 or finer than No. 100. The grinder marks will not appear beyond 1/8-inch on each side of the extrudate after seaming. A cap or patch will be placed over the entire seam length where excessive grinding occurs. The geomembrane will not be ground more than 10 minutes before extrusion welding to prevent surface oxidation of the surface.

For hot-wedge, fusion-bonded seams, the sheet surface will not be roughened by grinding or other means. Surfaces to be bonded will be clean and dry.

4.5.2.3 Weather Conditions for Seaming

The normally required weather conditions for seaming are as required by the technical specifications. Deviations from these conditions will require the site QC representative's approval. The Geosynthetics Installer must demonstrate to the site QC representative that the seaming procedure produces seams entirely equivalent to seams produced under the conditions stated in the technical specifications and does not cause any physical or chemical modification to the geomembrane that will generate any short- or long-term damage to the geomembrane. The GTS will verify that these weather conditions are fulfilled, and will advise the site QC representative if they are not. The site QC representative reserves the right to suspend geosynthetics installation under adverse weather conditions.

4.5.3 Field Sampling Plan

This subsection describes the procedures for CQC testing of geomembrane seams. The sampling and testing frequencies and test methods for these activities are described in Section 02737 - "Very Low Density Polyethylene (VLDPE) Geomembrane" of the project specifications and in Tables 4-2 and 4-3.

4.5.3.1 Geomembrane Test Seams

A general requirement is that "test welds" be made of fragment pieces of geomembrane on a periodic basis. Test welds generally reflect the quality of field seams but will not be used solely for final field seam acceptance. Final field seam acceptance will include a minimum level of non-destructive and

destructive testing of the field seams. Test welds are made to minimize the amount of destructive sampling/testing which requires subsequent repair of the final field seam. These test welds, for each sampling crew, shall be made on the following basis:

- If the seaming apparatus is turned off for any reason
- Every time equipment or crew is changed
- If the ambient temperature varies more than 20 degrees Fahrenheit or more in 2 hours
- As required in Section 02737 of the project specifications.

The purpose of these tests is to establish that proper seaming materials, temperatures, pressures, rates, and techniques, along with the necessary geomembrane preseaming preparation is being accomplished. A flow chart for the test weld process is provided as Figure 4-1 of this QC Plan.

Each seaming crew and the materials they are using must be traceable and identifiable to their test seams. If a test weld fails to meet the field seam design specification, then an additional test weld sample will have to be made by the same seaming crew (using the same tools, equipment, and seaming materials) and retested. Production seaming of installed materials shall not commence until a test weld with acceptable destructive test results has been achieved and approved by the GTS.

The finished geomembrane field seams will not be accepted by the site QC representative unless the "before" and "after" test seam sample strips' results are acceptable. If an "after" test seam is not accepted, destructive testing of samples from the installed seam will be removed and tested. If the actual seam destructive test results do not meet the design specification requirement, production seaming of installed materials will be halted. All production seams of installed materials made during the interval will be checked with non-destructive methods to the point of previous acceptance. The unacceptable seams will be repaired or reconstructed with seaming materials by a test-proven seaming crew that has passed its testing requirements. At this point, the seaming crew that failed to pass must adjust and recertify current seaming equipment and technique, or obtain new seaming equipment or tools, and/or retrain personnel and remade the test strip samples.

All test seam samples must be prepared in triplicate sets from a single continuous test strip which can be cut into thirds; one set for the Geosynthetics Installer to perform field testing, one set for the GTS for field testing, and one set made available to the NTR for project files.

During the test evaluation period, the geomembrane will not be covered and cannot be placed into service. This will ensure that it is available for repairing or reconstructing in the event it is required. During this period, it is imperative that the geomembrane be properly ballasted or otherwise secured so as to prevent wind or unusual weather damage in accordance with the technical specifications.

4.5.3.2 Geomembrane Destructive Tests

Geomembrane destructive test samples shall be taken in accordance with Section 02737 - "Very Low Density Polyethylene (VLDPE) Geomembrane" of the project specifications and Table 4-3. Laboratory test results will be received within 24 hours of sampling.

Test samples will exhibit Film Tearing Bond (FTB) failure for the sample to pass in peel (ASTM D 4437). Values of recorded stress will meet or exceed the values given in the technical specifications to pass the test. Shear testing involves applying shear stress from one sheet through the seam to the other sheet, indicating the strength of the bond. Peel testing involves applying tensile stress from the top sheet to the bottom, peeling the sheets apart.

4.5.3.3 Non-Destructive Seam Testing

The Geosynthetics Installer will non-destructively test all accessible field seams as required by the project specifications and Table 4-3. Seam number, date of observation, name of tester, and outcome of testing or observation will be recorded by the GTS. Repairs will be made in accordance with this QC Plan and the project specifications, as appropriate.

4.5.3.4 Sample Tracking and Custody

The sample custody and documentation procedures for geomembrane are identical to the procedures used for soil samples as described in Sections 4.3.5 through 4.3.10.

5.0 FIELD VERIFICATION TESTING

The following requirements will be used by the OHM site QC representative during the performance of his/her duties to verify compliance with the contract requirements. Additions or modifications to these requirements may be necessary to address changing circumstances. The responsibilities of the site QC representative are fully described in Section 2.0 of this QC Plan.

5.1 GENERAL REQUIREMENTS

Verification of field testing requirements will be performed in accordance with this plan. OHM will witness/verify on a sampling basis the tests performed by the contractors/suppliers as required by the project installation specifications. Additional testing that may be required by the QC representative of the project such as specific field verification testing will be performed in accordance with this plan. OHM will utilize Bishop Testing for various types of field testing requirements. The testing laboratories used in the testing shall have a QA/QC program acceptable for this project. The equipment/measurements used in testing shall be calibrated on regular intervals and all measurements shall be traceable to national bureau of standards. The results of testing will then be used to determine the acceptance or rejection of the construction task, or equipment/material being monitored.

5.2 FIELD TESTING

The site QC representative will review the QC data to verify that testing requirements are being met, or to determine when defective material or work may require removal and/or reconstruction, and to determine when additional testing may be required to confirm the quality of the material or work. The results of field tests, field inspections, receiving inspections, and surveys will be reviewed by the site QC representative. The review will be made on a daily basis to prevent the construction of new work over defective material or work which is later found to be defective.

The GTS will provide qualified on-site QC representatives to perform field tests and inspections to ensure the quality of the materials and/or work. The GTS will also perform all laboratory analysis of samples that were collected as part of the field QC testing program. All field test results will be submitted in a timely manner to OHM and the site QC representative for review and approval.

OHM will perform all confirmatory sampling in the waste excavation areas. This will include establishing a sampling grid, collecting and properly identifying the samplings, and sending the samples off-site to the approved, independent, laboratory for analysis. All tests results will be sent to the site QC representatives for review and approval.

During the excavation of the Asbestos-Containing Material (ACM), OHM's SSO will perform air sampling for airborne asbestos fibers. Tests results from the air sampling will be used to monitor air quality in the work area. If airborne concentrations of asbestos fibers exceed the allowable level, the removal work will be shut down until corrective measures are implemented.

5.3 CALIBRATION PROCEDURES FOR TEST EQUIPMENT

Instruments and equipment used to gather, generate, or measure field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications or the test method being used.

Calibration of laboratory equipment will be based on approved written procedures from the equipment manufacturer. Records of calibration, repairs, or replacement will be filed and maintained by the Soils Laboratory personnel performing QC activities. These records will be subject to QA/QC audits. For all instruments, the Soils Laboratory will either maintain a factory-trained repair staff with in-house spare parts or maintain service contracts with vendors.

6.0 INSPECTION AND TESTING DOCUMENTATION

6.1 DAILY RECORDS

Daily records of inspections and tests performed for each shift or subcontractor operation will be signed by the site QC representative and the original and one copy provided to the NTR no later than the next working day. Samples of reports and forms to be utilized are included in the Program QC Plan.

The site QC representative will prepare a daily CQC report/production report which will include, as a minimum, the following:

- Project identification
- Data on weather and any delays attributable to such weather
- Factual evidence that continuous QC inspections and tests have been performed. This includes, but is not limited to, the following data:
  - Type and number of inspections or tests performed
  - Results of inspections or tests including computations
  - Evaluation of test results--accept or reject work
  - Nature of defects, if present
  - Causes for rejection
  - Safety inspections/violations
  - Proposed remedial action
  - Corrective actions taken
- The records will cover both conforming and non-conforming work
- A statement that supplies and materials incorporated into the work are in full compliance with the requirements of the contract.

Any documentation regarding non-conforming work will be submitted to the NTR and the EPA representatives so that the corrective measures can be implemented, if needed.

6.2 PERFORMANCE DOCUMENTATION

Construction inspection personnel (site supervisor, foreman, and site QC representative) will keep a daily log of project activities. Whenever possible, information will be recorded on a standardized form or in a bound field logbook. Documentation will include a daily log of construction activities; the appropriate field test, laboratory test, and survey data forms; photographs; and field collection and sampling custody forms. The daily log will also include lists of the personnel and equipment on site (OHM and subcontractors) and the equipment usage for that day. The daily logs will be reviewed by the site supervisor on a daily basis. After review, copies of the daily logs will be submitted to other members of the project team as needed.

As part of the remediation control activities, a photographic record is to be prepared. Photographs will be in color. As examples, photographs could be taken of field testing, sampling locations, remediation processes, and final constructed features.

Photographs are to be identified with the project number, date taken, and a brief description. This may be done individually on the back of the photographs or in an album in which the photographs are mounted. Album photographs must be provided with individual descriptions and dates taken.

Appropriate remediation control test, survey, and material installation data forms will also be prepared. They will include the activity location. All requested information will be addressed. If not applicable, requested information will be designated as such. Results of field and laboratory testing will be sent to the NTR, the project manager and site supervisor as soon as they become available.

Field construction verification records will be collected and maintained by the site supervisor until they are submitted to the project central file.

6.3 AS-BUILT DOCUMENTATION

All appropriate documentation will be retained in the project records system to provide documentation of how the remedial action was actually built. Final as-built drawings and specifications will be prepared utilizing this information and retained as a permanent record of the final location, dimensions, and orientation of the construction.

At contract closeout, record documents will be delivered to the NTR. A transmittal letter in duplicate accompanying the submittal will contain:

- Date
- Contract name and number
- Contractor's name, address, and telephone number
- Number and title of each record document
- Signature of contractor or his authorized representative.

6.4 SUBMITTAL REGISTER

The submittal register has been generated based on the requirements set forth in each individual specification section of NAVFAC Spec. No. 04910034 dated June 11, 1993. This register will be maintained in the field office by the site QC representative and will be available for review by the NTR. It will be updated monthly.

6.5 CHANGE ORDER COMMUNICATION

The system of processing minor and major field change request submittals, or variances, is defined in Section 01300 - "Submittals" of the project specifications. Variations from the requirements of the contract documents require government approval pursuant to the contract clause entitled "Specifications and Drawings for Construction."

When proposing both minor and major contract variances, a written request is made by the Contractor to the Navy Technical Representative (NTR) with supporting documentation of the nature and features of the variation. The submittal will also include a written explanation of why the submittal is desirable and beneficial to the government. Where lower cost is the benefit, an estimate of the cost savings will be provided in the request. In accordance with the contract documents, ten working days are allowed for consideration by the NTR of submittals with variations. It is the responsibility of the NTR to notify regulatory agencies of those variances that require regulatory review.

7.0 MEETINGS/COORDINATION

7.1 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC plan addendum and prior to the start of construction, OHM's project manager, program QC manager, and site QC representative will meet with the COTR and the NTR to discuss the QC program required by this delivery order. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used; administration of on-site and off-site work; and coordination of the OHM management, production, and the QC representative's duties with the NTR. Minutes of the meeting will be prepared by the QC manager and signed by both OHM and the COTR. This meeting may be combined with the pre-construction meeting.

7.2 QC MEETINGS

After the start of construction, the OHM site QC representative will conduct QC meetings once every week or as required by the COTR/delivery order at the work site, or where specified, with the site supervisor, the foreman responsible for the upcoming work, and the NTR. The OHM site QC representative will prepare the minutes of the meeting and provide a copy to the COTR within two working days after the meeting. The site QC representative will notify the NTR at least 48 hours in advance of each meeting. As a minimum, the following will be accomplished at each meeting:

- Review the minutes of the previous meeting.
- Review the schedule and the status of work:
  - Work or testing accomplished since last meeting
  - Rework items identified since last meeting
  - Rework items completed since last meeting
- Review status of submittals:
  - Submittals reviewed and approved since last meeting
  - Submittals required in the near future
- Review work to be accomplished in the next week and documentation required. Schedule the three phases of control and testing:
  - Establish completion dates for rework items
  - Preparatory phases required
  - Initial phases required
  - Follow-up phases required
  - Testing required
  - Status of off-site work or testing
  - Documentation required.

- Resolve QC problems
- Address items that may require revising the QC plan (e.g., changes in procedures)

  - Changes in procedures.

TABLES

TABLE 3-1
INSPECTION SCHEDULE

Activity	*Preparatory*	*Done*	*Initial*	*Done*	*Followup*	*Done*
Clearing and Grubbing (Sites 1 and 3)	Limits of work established		Survey control		Remove material from site as required	
Gravel Access Roads, Fences	Materials meet specification Layout and dimensions established Test methods defined Test laboratory approved Work zones clearly marked		Survey control Location and grade Dust control Mix samples taken and checked • Trial Batch • Two samples/day Density testing of placed materials		On going Fencing installation guard rails installed	
Excavation, Filling, and Backfilling	Initial limits of area and depth defined Alignment, limits and grade Sampling and laboratory procedures established Soil bentonite backfill mix for slurry wall meets specification requirements		Survey control Visual inspection of excavation Field screening of excavation Dust control Chain of custody Field QC testing Compaction of layers		Verification of sampling Data inspection/evaluation Required grades established Density testing Material thickness daily logs maintained Moisture and density testing	

TABLE 3-1
(CONTINUED)

Activity	*Preparatory*	*Done*	*Initial*	*Done*	*Followup*	*Done*
Borrow Material	Sampling and analysis Geotechnical properties		Conformance with test data Dust control		On going	
Slurry Wall Installation	Initial limits of area and depth defined Alignment, limits, and grade Materials meet specifications Sampling and lab procedures established		Mix samples taken and checked • Trial batch • QC testing Refer to Table 4-2 for testing requirements Trench excavation		Level of slurry to desired elevation	
Cast-in-Place Concrete	Mix design approval Material meets specification requirements Limits and placement of concrete established Placement of reinforcement established		Sampling and testing as specified Form work per specification Concrete placement as specified Surface finishes are as specified Field quality control tests: • Slump tests • Temperature test • Compressive strength test • Air content		Curing and protection are performed as specified Data inspection/evaluation On going field quality control tests	

TABLE 3-1
(CONTINUED)

Activity	*Preparatory*	*Done*	*Initial*	*Done*	*Followup*	*Done*
Metal Fabrications • Chain Link Fencing • Gas Vent Piping	Material meets specification requirements Material stored to protect from damage/rust		Welding meets specification requirements Installation meets specification requirements: • Anchorage/hooks • Built-in-work/braces/framing • Finishes • Handrails/posts • Chain link fabric • Barbed wire		As-built conditions meet spec/plan requirements	
Erosion and Sedimentation Control	Materials and installation procedures meet specification: • Haybales • Silt fence • Riprap Alignment		Proper installation Alignment and location		Proper maintenance and on going inspection	
Transportation of Contaminated Material (including asbestos-containing materials)	Specified trucks being utilized		Monitoring for spillage/airborne contamination during loading and transportation		Roadway spillage and condition at completion	
Temporary Decontamination Areas	Materials meet specification requirements Location defined		Proper installation Proper grades		Decontamination liquids recovered Area restored	

TABLE 3-1
(CONTINUED)

Activity	*Preparatory*	*Done*	*Initial*	*Done*	*Followup*	*Done*
Gas Vent System	Materials meet specification requirements Locations established		Proper installation		Visual inspection	
Monitoring Well Extensions	Limits of work established Materials meet specification and storage and handling requirements		Survey control Proper installation of casings and extensions		Visual inspection	
Confirmation Sampling and Analysis for Waste Excavation Areas	Sampling and laboratory procedures established		Quality control of sampling and analysis procedures Chain of custody		Data inspection/evaluation	
Landfill Cap System • Geocomposite Clay Liner • Geomembrane Liner • Drainage Layer • Drainage Piping • Filter Sand • Vegetative Material	Materials meet specification requirements Storage and handling of material meets specification		Proper installation Alignment and location Field QC testing		Data inspection/evaluation	
Detention Basin • Common Fill • Geomembrane Liner • Filter Sand • Vegetative Material • Riser Pipe • Drainage Pipe	Materials meet specification requirements Storage and handling of material meets specifications		Proper Installation Alignment and location Field QC testing		Data inspection/evaluation	

TABLE 3-1
(CONTINUED)

Activity	*Preparatory*	*Done*	*Initial*	*Done*	*Followup*	*Done*
Revegetation, Topsoil and Seeding, Mulching and Fertilizing	Proper mixture Meets specifications Topsoil composition tests		Topsoil thickness Limits of placement Seeding, mulching and fertilizing per specification requirements		Sufficient growth Proper placement	

TABLE 4-1
PRE-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
BRUNSWICK, MAINE
Delivery Order #0040
OHM Project #16285

Facility Component	Section of Specifications Containing Test Requirements	Pre-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
1) Slurry Wall Trench	Section 02214	Water will be tested for the following: pH Hardness Dissolved salts	Per water source or as changes occur.	Relatively low in hardness Relatively low in dissolved salts pH 7-10 (water source at Naval Air Station Brunswick conforms to these requirements - approved source)	Site QC Field Technicians	Navy NTR
		Bentonite supplier will supply certificates of compliance. (API Std. 13A)	One certificate per truckload.	Natural unadulterated premium grade sodium cation montmorillonite (no polymers). Min. 90 barrel yield.		
2) Vegetative Layer Material	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 615.02 loam materials	3 Tests/Material At Geotech. Lab	Maximum stone size of 2 Inches and a maximum percent passing the No. 200 Sieve of 35 percent.	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 1 Per Material At Geotech. Lab			
	Section 02930	Composition	Minimum 1 Per Material At Geotech. Lab	>3 % Organic Matter Silt 25-50% Clay 10-30 % Sand 20-35 % pH 6-7.5 Soluble Salts-500 ppm max		
3) Drainage Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	5 Tests Per Material At Geotech. Lab	100 % < 1/2 Inch Sieve 80-100 < No. 4 Sieve 35-85 < No. 10 Sieve 0-25 < No. 40 Sieve 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	2 Tests/Material At Geotech. Lab			
		Permeability: USACE 1110-2-196 (remolded permeability)	Min. 2 Tests Per Material At Geotech. Lab	Minimum permeability of 1X10-3 cm/sec		

TABLE 4-1
PRE-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
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Facility Component	Section of Specifications Containing Test Requirements	Pre-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
4) Gas Vent Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	5 Tests Per Material At Geotech. Lab	100 % < 1/2 Inch Sieve 80-100 < No. 4 Sieve 35-85 < No. 10 Sieve+/-5% 0-25 < No. 40 Sieve+/-5% 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	2 Tests/Material At Geotech. Lab			
		Permeability: USACE 1110-2-196 (remolded permeability)	Min. 2 Tests Per Material At Geotech. Lab	Minimum permeability of 1X10-3 cm/sec		
5) Drainage Stone	Section 02220	Gradation: (ASTM C-117 AND C-136)	3 Tests/Material At Geotech. Lab	100 % < 1 Inch 90-100 < No. 3/4 Inch 0-75 < No. 3/8 Inch 0-5 < No. 10 Sieve	Site QC Field Technicians	Navy NTR
6) Aggregate Base	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.06 (a) Type C	5 Tests Per Material At Geotech. Lab	100 % < 4 Inch 35-75 < No. 1/2 Inch 25-60 < No. 1/4 Inch 0-25 < No. 40 Sieve 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
7) Aggregate Subbase	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.06 (b) Type D	5 Tests Per Material At Geotech. Lab	100 % < 6 Inch Gradation < 3 Inch Sieve as follows: 25-70 < No. 1/4 Inch 0-30 < No. 40 Sieve 0-7 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
8) Common Fill	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 703.18 Common Borrow (modified)	3 Tests/Material At Geotech. Lab	Maximum stone size of 6 Inches	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 1 Per Material At Geotech. Lab			

TABLE 4-1
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Facility Component	Section of Specifications Containing Test Requirements	Pre-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
9) Filter Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	5 Tests Per Material At Geotech. Lab	100 % < No. 4 Sieve 50-100 < No. 10 Sieve 15-100 < No. 40 Sieve 5-75 < No. 100 Sieve 0-30 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
10) Gravel Borrow	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 703.20 Gravel Borrow (modified)	Min. 5 Tests Per Material At Geotech. Lab	Gradation < 3 Inch Sieve as follows: 100% < 3 Inch 0-70 < No. 1/4 Inch 0-10 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
11) Sand Bedding Material	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.05 Aggregate for Sand Leveling (modified)	3 Tests Per Material At Geotech. Lab	100 % < 3/4 Inch 85-100 < No. 3/8 Inch 25-80 < No. 20 Sieve 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
12) Sand Borrow	Section 02220	Gradation: (ASTM C-117 AND C-136)	5 Tests Per Material At Geotech. Lab	100 % < 1 Inch 85-100 < No. 4 Sieve 40-90 < No. 40 Sieve 20-40 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	Minimum 2 Per Material At Geotech. Lab			
13) Crushed Stone	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.31 Crushed Stone	3 Tests Per Material At Geotech. Lab	100 % < 2 1/2 Inch 95-100 < 2 Inch 0-30 < 1 Inch 0-5 < 3/4 Inch	Site QC Field Technicians	Navy NTR
14) French Drain Stone	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.24 Stone for French Drains	3 Tests Per Material At Geotech. Lab	90-100 % < 6 Inch 0-40 < 1 1/2 Inch 0-5 < No. 4 Sieve	Site QC Field Technicians	Navy NTR

TABLE 4-1
PRE-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
BRUNSWICK, MAINE
Delivery Order #0040
OHM Project #16285

Facility Component	Section of Specifications Containing Test Requirements	Pre-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
15) Riprap	Section 02220	Gradation: (ASTM C-117 AND C-136)	Min. 3 Tests Per Material At Geotech. Lab	Maximum stone size = 6 Inches and the d50 shall be 4 Inches	Site QC Field Technicians	Navy NTR
16) Landfill Gas Collection Piping and Vents	Section 02720	Certificates must be provided by the manufacturer indicating specified results.	NA	Submit Certificates for Collection Pipe and Fittings, Risers, Tees, Elbows, Pipe Caps, Screens, Solid Gas Venting Pipe and Fittings	Site QC Field Technicians	Navy NTR
17) Cap Drainage Piping	Section 02720	Certificates must be provided by the manufacturer indicating specified results.	NA	Submit Certificates for Collection Pipe and Fittings	Site QC Field Technicians	Navy NTR
18) Storm Drainage System	Section 02720	Certificates must be provided by the manufacturer indicating specified results.	NA	Submit Certificates for Riser Pipe, Drainage Pipe, Flow Control Structure, and Catch Basins	Site QC Field Technicians	Navy NTR
19) Geosynthetic Clay Liner	Section 02738 Table 02738-1 and Table 02738-2	Certificates must be provided by the manufacturer indicating specified results.	NA	Submit Certificates for Bentonite and Textile Backings	Site QC Field Technicians	Navy NTR
20) Very Low Density Polyethylene Geomembrane	Section 02737	Warranties must be submitted by the Manufacturer and the Installer. Manufacturer's certificate that the VLDPE meets the specifications.	NA	Submit all required warranties and certifications.	Site QC Field Technicians	Navy NTR
		Test Welds(Startup Testing) ASTM D4545-86 6.1.2 for Shear Strength and ASTM D4545-86 6.1.1 for Peel Strength	Minimum of 3 times per day; Beginning, mid-day and the end. Tests will also be run when a new operator starts or whenever the welders are shut off and allowed to cool down. Test Welds will also be run when the ambient temperature drops more than 20 deg. in 2 hours or when seaming occurs under wet conditions.	Passing test weld for peel shall exhibit Film Tear Bond (FTB) with no brittle cracking and have a separation of 10% or less Passing test weld for shear shall exhibit necking of the parent material prior to any necking or splitting of the weld.		

TABLE 4-1
PRE-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Delivery rder #0040
OHM Project #16285

Facility Component	Section of Specifications Containing Test Requirements	Pre-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
21) Non-woven geotextile	Section 02736, Part 2.1.1	Certificates must be provided by the manufacturer indicating specified results.	NA	NA	Site QC Field Technicians	Navy NTR
22) Woven geotextile	Section 02736, Part 2.1.2	Certificates must be provided by the manufacturer indicating specified results.	NA	NA	Site QC Field Technicians	Navy NTR
23) Geogrid	Section 02736, Part 2.1.3	Certificates must be provided by the manufacturer indicating specified results.	NA	NA	Site QC Field Technicians	Navy NTR
24) Chain Link Fence	Section 02831	Submit Manufacturer's catalog data and certificates	NA	Submit all required certificates and catalog data	Site QC Field Technicians	Navy NTR
25) Revegetation	Section 02930	Submit Manufacturer's catalog data and topsoil composition reports	NA	Submit Certificates for Seed for Grass Turf, Plantings, pH adjusters, Soil Conditioners, Fertilizer, Erosion Control Materials	Site QC Field Technicians	Navy NTR
26) Cast-in-Place Concrete	Section 03300	Submit manufacturer's catalog data and concrete mix design	NA	Submit manufacturer's catalog data and concrete mix design	Site QC Field Technicians	Navy NTR
27) Asphalt	Section 02511	Submit manufacturer's certificates, asphalt mix design, and trial batch reports	NA	Submit manufacturer's catalog data and concrete mix design	Site QC Field Technicians	Navy NTR

TABLE 4-2
CONSTRUCTION PHASE INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
BRUNSWICK, MAINE
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
1) Slurry Wall Trench	Section 02214	Slurry Mix (prior to placement)			Site QC Field Technicians	Navy NTR
		Viscosity (API Std. 13B-1)	2 Tests Per Shift Per Pond	V greater than or equal to 40 sec. - Marsh at 68 deg F		
		Filtrate Loss (API Std. 13B-1)	2 Tests Per Shift Per Pond	Loss less than or equal 25 cc in 30 min at 100 psi		
		pH (API Std. 13B-1)	2 Tests Per Shift Per Pond	pH = 7-10		
		Slurry Mix (after placement)				
		Density (API Std. 13B-1)	3 Tests Per Shift	Density = 64-90 pcf and at least 20 pcf lighter than backfill mix.		
		Viscosity (API Std. 13B-1)	3 Tests Per Shift	V greater than or equal to 40 sec. - Marsh at 68 deg F		
		Filtrate Loss (API Std. 13B-1)	3 Tests Per Shift	Loss less than or equal 25 cc in 30 min at 100 psi		
		Backfill Mix - must be sampled and tested prior to placement for following:				
		Density (API Std. 13B-1)	2 Test Per Shift	110-125 pcf and 20 pcf greater than or equal to slurry weight.		
		Slump (ASTM C-143)	1 per batch and 1 per 100 cy (min.)	3 to 6 inches		
		Material Fines Content (ASTM C-117)	1 per batch and 1 per 100 cy (min.)	20% to 40% by weight passing Std. No. 200 sieve		
		Backfill Mix - sampled prior to placement for following; (can be tested after placement)				
		Hydraulic Conductivity (ASTM D-5084-90)	1 per 500 cy	k less than or equal to 1 x 10-7 cm/sec.		
		Gradation (ASTM 02216 and ASTM C-136)	1 per 500 cy (simultaneous with hydraulic conductivity)	20% to 40% by weight passing Std. No. 200 sieve		
		Backfill Mix (at trench) Slope	1 Test per 20 L.F. of trench	Uniform Slope - 5H:1V to 9H:1V		
		Trench				
		Profile (measurement of trench bottom)	1 Test per 20 L.F. of trench	Min. specified key depth		
		Continuity (movement of excavation equipment)	Each cut	Continuous trench		
		Key (examine cuttings)	Continuous during excavation	Homogeneous gray silty clay - 3.0 ft minimum		
		Width (minimum bucket width)	Start of construction and when buckets are changed.	3.0 ft minimum		
		Alignment (surveyed)	Staked 50 feet on center	Required alignment		

TABLE 4-2
CONSTRUCTION PHASE INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
2) Vegetative Layer Material	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 615.02 loam materials	1 Test per 20,000 cubic yards At Geotech. Lab	Maximum stone size of 2 Inches and a maximum percent passing the No. 200 Sieve of 35 percent.	Site QC Field Technicians	Navy NTR
	Section 02930		Minimum 1 Per Material At Geotech. Lab	>3 % Organic Matter Silt 25-50% Clay 10-30 % Sand 20-35 % pH 6-7.5 Soluble Salts-500 ppm max		
3) Drainage Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	1 Test per 5,000 Cubic Yards	100 % < 1/2 Inch Sieve 80-100 < No. 4 Sieve 35-85 < No. 10 Sieve 0-25 < No. 40 Sieve 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	1 Test per change in material			
		Permeability: USACE 1110-2-196 (remolded permeability)	Min. 1 Test Per Change in Material At Geotech. Lab	Minimum permeability of 1X10-3 cm/sec		
4) Gas Vent Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	1 Test per 5,000 Cubic Yards	100 % < 1/2 Inch Sieve 80-100 < No. 4 Sieve 35-85 < No. 10 Sieve+/-5% 0-25 < No. 40 Sieve+/-5% 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	1 Test per change in material			
		Permeability: USACE 1110-2-196 (remolded permeability)	Min. 1 Test Per Change in Material At Geotech. Lab	Minimum permeability of 1X10-3 cm/sec		
5) Drainage Stone	Section 02220	Gradation: (ASTM C-117 AND C-136 or AASHTO T27)	1 Test per 1,000 Cubic Yards	100 % < 1 Inch 90-100 < No. 3/4 Inch 0-75 < No. 3/8 Inch 0-5 < No. 10 Sieve	Site QC Field Technicians	Navy NTR

TABLE 4-2
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REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
6) Aggregate Base	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.06 (a) Type C	1 Test per 5,000 Cubic Yards	100 % < 4 Inch 35-75 < No. 1/2 Inch 25-60 < No. 1/4 Inch 0-25 < No. 40 Sieve 0-5 < No. 200 Sieve	Site QC	
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	Minimum 1 per change in material At Geotech. Lab			
7) Aggregate Subbase	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT spec. 703.06 (b) Type D	1 Test per 5,000 Cubic Yards At Geotech. Lab	100 % < 6 Inch Gradation < 3 Inch Sieve as follows: 25-70 < No. 1/4 Inch 0-30 < No. 40 Sieve 0-7 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	Minimum 1 per change in material At Geotech. Lab			
8) Common Fill	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 703.18 Common Borrow (modified)	1 Test per 20,000 Cubic Yards At Geotech. Lab	Maximum stone size of 6 Inches	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557-78)	Minimum 1 per change in material At Geotech. Lab			
9) Filter Sand	Section 02220	Gradation: (ASTM C-117 AND C-136)	1 Test per 5,000 Cubic Yards At Geotech. Lab	100 % < No. 4 Sieve 50-100 < No. 10 Sieve 15-100 < No. 40 Sieve 5-75 < No. 100 Sieve 0-30 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	Minimum 1 per change in material At Geotech. Lab			

TABLE 4-2
CONSTRUCTION PHASE INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
10) Gravel Borrow	Section 02220	Gradation: (ASTM C-117 AND C-136) MDOT 703.20 Gravel Borrow (modified)	1 Test per 5,000 Cubic Yards At Geotech. Lab	Gradation < 3 Inch Sieve as follows: 100% < 3 Inch 0-70 < No. 1/4 Inch	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	Minimum 1 per change in material At Geotech. Lab			
11) Sand Bedding Material	Section 02220	Gradation: (ASTM C-117 AND C-136 or AASHTO T27 MDOT spec. 703.05 Aggregate for Sand Leveling (modified)	1 Test per 1,000 Cubic Yards At Geotech. Lab	100 % < 3/4 Inch 85-100 < No. 3/8 Inch 25-80 < No. 20 Sieve 0-5 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture-Density: (ASTM D 1557)	1 Test per 5,000 Cubic Yards At Geotech. Lab			
12) Sand Borrow	Section 02220	Gradation: (ASTM C-117 AND C-136)	1 Test per 5,000 Cubic Yards At Geotech. Lab	100 % < 1 Inch 85-100 < No. 4 Sieve 40-90 < No. 40 Sieve 20-40 < No. 200 Sieve	Site QC Field Technicians	Navy NTR
		Moisture Content (ASTM D-2216)	1 Test per 1,000 Cubic Yards			
		Moisture-Density: (ASTM D 1557)	Minimum 1 per change in material At Geotech. Lab			
13) Crushed Stone	Section 02220	Gradation: (ASTM C-117 AND C-136 or AASHTO T27) MDOT spec. 703.31 Crushed Stone	1 Test per 1,000 Cubic Yards At Geotech. Lab	100 % < 2 1/2 Inch 95-100 < 2 Inch 0-30 < 1 Inch 0-5 < 3/4 Inch	Site QC Field Technicians	Navy NTR
14) French Drain Stone	Section 02220	Gradation: (ASTM C-117 AND C-136 or AASHTO T27) MDOT spec. 703.24 Stone for French Drains	1 Test per 1,000 Cubic Yards At Geotech. Lab	90-100 % < 6 Inch 0-40 < 1 1/2 Inch 0-5 < No. 4 Sieve	Site QC Field Technicians	Navy NTR
15) Riprap	Section 02220	Gradation: (ASTM C-117 AND C-136 or AASHTO T27)	1 Test per 1,000 Cubic Yards At Geotech. Lab	Maximum stone size = 6 Inches and the d50 shall be 4 Inches	Site QC Field Technicians	Navy NTR

TABLE 4-2
CONSTRUCTION PHASE INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
16) Landfill Gas Collection Piping and Vents	Section 02720	QC Inspection during installation as specified in Section 02720	NA	NA	Site QC Field Technicians	Navy NTR
17) Cap Drainage Piping	Section 02720	QC Inspection during installation as specified in Section 02720	NA	NA	Site QC Field Technicians	Navy NTR
18) Storm Drainage System	Section 02720	QC Inspection during installation as specified in Section 02720	NA	NA	Site QC Field Technicians	Navy NTR
19) Geosynthetic Clay Liner	Section 02738 Table 02738-1 and Table 02738-2	QC Inspection during installation as specified in Section 02738	NA	Submit Certificates for Bentonite and Textile Backings	Site QC Field Technicians	Navy NTR
20) Very Low Density Polyethylene Geomembrane	Section 02737	Geomembrane Thickness (ASTM D-751-89)	1 Sample Per Roll	Minimum Thickness = 40 mil	Site QC Field Technicians	Navy NTR
		Specific Gravity (ASTM D-792-86)	1 Sample Per Roll	0.90 - 0.925		
		Carbon Black Content (ASTM D-1603-76)	1 Sample Per Roll	2%		
		Tensile Properties (ASTM D-638-89 Type IV)	1 Sample Per Roll	Tensile Strength at Break = 140 lbs/ inch width Elongation at Break = 780%		
		Air Channel Seam Testing	For each dual hot wedge seam length and on either end of a seam	Channel will be pressurized to 30 psi. Initial test pressure will be read after 5 minute stabilization period at no lower than 25 psi. Pressure shall not drop more than 3 psi in 5 min.		
		Destructive Tests	1 sample per 500 feet of welded seam, or at a minimum of 1 per seam, including patches of seams.			
		Shear Strength (ASTM D-4545-86 6.1.2)	"	The shear strength of 4 of the 5 specimens obtained from each sample shall be equal to or exceed 80% pf the mean tensile strength at yield pf the parent material.		
		Peel Strength (ASTM D-4545-86 6.1.2)	"	The peel test of 4 of the 5 specimens obtained from each sample shall exhibit a Film Tear Bond (FTB) and a have a peel seam separation of 10% or less.		

TABLE 4-2
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
21) Non-woven geotextile	Section 02736	QC Inspection during installation as specified in Section 02736	NA	NA	Site QC Field Technicians	Navy NTR
22) Woven geotextile	Section 02736	QC Inspection during installation as specified in Section 02736	NA	NA	Site QC Field Technicians	Navy NTR
23) Geogrid	Section 02736	QC Inspection during installation as specified in Section 02736	NA	NA	Site QC Field Technicians	Navy NTR
24) Chain Link Fence	Section 02831	QC Inspection during installation as specified in Section 02831	NA	NA	Site QC Field Technicians	Navy NTR
25) Revegetation	Section 02930	QC Inspection during installation as specified in Section 02831	NA	NA	Site QC Field Technicians	Navy NTR
26) Cast-in-Place Concrete	Section 03300	Sampling (ASTM C-172) Making test specimens (ASTM C-31)		Submit manufacturer's catalog data and concrete mix design	Site QC Field Technicians	Navy NTR
		Slump Tests (ASTM C-143)	1 Sample per 10 Cubic Yards or 1 for each batch (min.)	1 - 4 inches		
		Compressive Strength Tests 28 day - (ASTM C-39)	Collect minimum of 5 test cylinders for for each sampling event. Sample each mix design at not less than once a day, nor less than once for each 100 cy, nor less than once for each 5,000 sq ft of surface area for slabs or walls.	4,000 psi		
		Air Content (ASTM C-173 or ASTM C-231 for normal weight concrete)	1 Sample per 10 Cubic Yards or 1 for each batch (min.)	5 -7 percent		
		Temperature Tests Test concrete delivered and concrete in the forms.	Perform tests in hot or cold weather conditions (below 50 deg F and above 80 deg F) for each batch (min.) or every 10 cubic yards (max.) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.			
		Mix Duration Limits Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 deg F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 deg F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.				

TABLE 4-2
CONSTRUCTION PHASE INSPECTION SCHEDULE
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Facility Component	Section of Specifications Containing Test Requirements	Construction Phase Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
27) Asphalt	Section 02511	Extraction (ASTM D-2172) Sieve Analysis (AASHTO T30) Stability and Flow (ASTM D-1559)	Two samples per mix type at the plant or at the truck.	Submit manufacturer's catalog data and concrete mix design	Site QC Field Technicians	Navy NTR

TABLE 4-3
POST-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
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Facility Component	Section of Specifications Containing Test Requirements	Post-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
1) Slurry Wall Trench	Section 02214	Allow backfill mix to settle for 2 months. Inspect trench for potential settlement of backfill mix	Inspect 2 months after placement of backfill mix before placing cap materials.	If at the end of two months the backfill mix settles to a point below working platform, OHM will place lifts of clay as specified in the Work Plan.	Site QC Field Technicians	Navy NTR
2) Vegetative Layer Material	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
3) Drainage Sand	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Density to provide permeability equal to or greater than 1 x 10-3 cm/sec	Site QC Field Technicians	Navy NTR
		Permeability: USACE 1110-2-196 (remolded permeability)	5 per acre per lift	Greater than or equal to 1 x 10-3 cm/sec		
4) Gas Vent Sand	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Density to provide permeability equal to or greater than 1 x 10-3 cm/sec	Site QC Field Technicians	Navy NTR
		Permeability: USACE 1110-2-196 (remolded permeability)	5 per acre per lift	Greater than or equal to 1 x 10-3 cm/sec		
5) Drainage Stone	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
6) Aggregate Base	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
7) Aggregate Subbase	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
8) Common Fill	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Minimum 90% of max. dry density (under roadways) Minimum 88% of max. dry density (untraveled areas)	Site QC Field Technicians	Navy NTR
9) Filter Sand	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Minimum 90% of max. dry density (below landfill cap) Minimum 95% of max. dry density (below roadways)	Site QC Field Technicians	Navy NTR
10) Gravel Borrow	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR

TABLE 4-3
POST-CONSTRUCTION INSPECTION SCHEDULE
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION
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Facility Component	Section of Specifications Containing Test Requirements	Post-Construction Testing, (Test Method)	Frequency of Testing/Location	Minimum Passing Requirements	Person Responsible for Conducting Test	Person Responsible for Approving Test Result
11) Sand Bedding Material	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Minimum 90% of max. dry density (below and adjacent to pipes) Minimum 85% of max. dry density (above pipes)	Site QC Field Technicians	Navy NTR
12) Sand Borrow	Section 02220	In-Place Density (ASTM D-2922-81)	5 per acre per lift	Minimum 90% of max. dry density	Site QC Field Technicians	Navy NTR
13) Crushed Stone	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
14) French Drain Stone	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
15) Riprap	Section 02220	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
16) Landfill Gas Collection Piping and Vents	Section 02720	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
17) Cap Drainage Piping	Section 02720	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
18) Storm Drainage System	Section 02720	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
19) Geosynthetic Clay Liner	Section 02738	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
20) Very Low Density Polyethylene Geomembrane	Section 02737	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
21) Non-woven geotextile	Section 02736	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
22) Woven geotextile	Section 02736	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
23) Geogrid	Section 02736	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
24) Chain Link Fence	Section 02831	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
25) Revegetation	Section 02930	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
26) Cast-in-Place Concrete	Section 03300	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR
27) Asphalt	Section 02511	QC Inspection following installation.	NA	NA	Site QC Field Technicians	Navy NTR

TABLE 4-4

PERFORMANCE EVALUATION TABLE
SLURRY WALL, SECTION 02214

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Water	As required to properly hydrate bentonite	Specification Paragraph 2.1.1	pH Hardness Dissolved Salts	7 to 10 Relatively Low Relatively Low (water source at Naval Air Station Brunswick conforms to these requirements	Laboratory Tests
Bentonite	Mixed with water to form trench stabilizing slurry and mixed with soil to make soil bentonite backfill	Specification Paragraph 2.1.2	Conformance with API RP 13A	Manufacturer's Catalog Certificate	Certificate of Compliance with each truck load
Bentonite Slurry	Mixture of water and bentonite used to maintain trench stability during excavation	Specification Paragraph 2.1.4	Viscosity, prior to placement Filtrate Loss, prior to placement pH, prior to placement Density, in trench Viscosity, in trench Filtrate Loss, in trench	≥40 sec Marsh @ 68° F ≤25 cc in 30 min @ 100 psi 7 to 10 64 to 90 pcf, and at least 20 pcf lighter than backfill mix ≥40 sec Marsh @ 68°F ≤25 cc in 30 min @ 100 psi	Field Measurements

TABLE 4-4
(CONTINUED

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Backfill Mix	Mixture of soil trench cuttings, 2% bentonite by weight, and bentonite slurry, used as a low- permeability backfill for the completed slurry wall	Specification Paragraph 2.1.5	Density	110 to 125 pcf, and at least 20 pcf ≥ the unit weight of the bentonite slurry	Field Measurements
			Slump	3 to 6 inches	
			Material Fines	20 to 40% passing No. 200 sieve	
			Hydraulic Conductivity	≤1 x 10^{-7} cm/sec	Laboratory Measurements
			Gradation	20 to 40% passing No. 200 sieve	
Trench	A 3-foot minimum width of continuous trench excavation by slurry trench method	Specification Paragraph 1.4.4	Profile	As required to achieve the minimum key width	Measurement of Trench Bottom
			Key	3 feet (min) into homogeneous silty clay	Examination of Trench Cuttings
			Width Alignment	3 feet, constructed as shown on Contract Drawings C-6 and C-7	Minimum Bucket Width Surveyed in the Field

TABLE 4-5

PERFORMANCE EVALUATION TABLE
LANDFILL CAP COMPONENTS

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Vegetative Material	Soil capable of supporting root and plant growth	Specification Section 02220, Paragraph 2.1.1	Meeting MDOT 615.02 Loam Materials (Modified)	Well graded with maximum stone size of 2 inches and a maximum percent passing No. 200 of 35 percent	Laboratory Tests
Filter Sand	Soil placed above the drainage sand to filter surface water that permeates the layer of vegetative material layer	Specification Section 02220	Gradation	**Sieve** **% Passing** No. 4 100 No. 10 50-100 No. 40 15-100 No. 100 5-75 No. 200 0-30	Laboratory Tests
			Compaction	90% Maximum Dry Density (min.) below landfill cap 95% Maximum Dry Density (min.) below roadways	Field Measurements

TABLE 4-5
(CONTINUED

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Drainage Sand	Soil placed above the geomembrane liner with a permeability capable of transmitting infiltration to installed drainage pipes	Specification Section 02220, Paragraph 2.1.2	Permeability Gradation	1×10^{-3} cm/sec (min.) **Sieve** **% Passing** 1/2 inch 100 No. 4 80-100 No. 10 35-85 No. 40 0-25 No. 200 0-5	Laboratory Tests
		Specification Section 02220, Paragraph 3.6.3	Compaction	Density to provide permeability $\geq 1 \times 10^{-3}$ cm/sec	Field Measurements
Drainage Piping	A system of collection pipes, installed in the drainage sand, from the top of the landfill to the toe of the cap to transmit infiltration to the detention basin	Specification Section 02720	--	Installed in accordance with the contract drawings	Field Inspection

TABLE 4-5
(CONTINUED

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Geomembrane Liner (VLDPE)	A very low density polyethylene (VLDPE) layer of material serving as a barrier to prevent surface water from permeating the landfill	Specification Section 02737	Thickness Tensile Strength at Break Elongation at Break: Tear Resistance Puncture Resistance Specific Gravity Dimensional Stability Low Temp. Brittleness Seam Strength Shear Seam Strength Peel Carbon Black Content Soil Burial Resistance Environmental Stress Crack Carbon Black Dispersion	40 mil 140 lb/inch width 780% 16 lb (min.) 52 lb (min.) 0.9 to 0.925 2 to 3% -94°F 40 lb/inch min. 35 lb/inch min. 2% 90% 1,500 hours (min.) A1, A2, B-1	Field Inspection Laboratory Tests Manufacturer's Certificate of Compliance
Geosynthetic Clay Liner (GCL)	A layer of inert sodium bentonite, sandwiched between two layers of geotextile, that will hydrate and swell to provide a low permeability layer directly underneath the geomembrane in the event of puncture	Specification Section 02738	Mass per Unit Area Hydraulic Conductivity Required Overlap Bentonite Moisture Content Non-Woven Geotextile Weight Grab Strength Grab Elongation Woven Geotextile Weight Grab Strength Grab Elongation	16 ox/sf 5 x 10^{-9} cm/sec (max.) 9 inches 12% (max.) 6.0 oz/sy 6 lbs 89% 3.25 oz/sy 95 lbs 20%	Manufacturer's Certificate of Compliance

TABLE 4-5
(CONTINUED

Design Element	*Critical Performance Aspect*	*Design Requirement*	*Design Prediction*	*Performance Criteria*	*Performance Measurement*
Gas Vent Sand	Soil placed below the GCL, capable of transmitting landfill gas to the installed gas vent pipes	Specification Section 02220, Paragraph 2.1.3	Permeability	1 x 10^{-3} cm/sec (min.)	Laboratory Tests
			Gradation	**Sieve** **% Passing** 1/2 inch 100 No. 4 80-100 No. 10 35-85 No. 40 0-25 No. 200 0-5	
			Compaction	Density to provide permeability ≥1 x 10^{-3} cm/sec	Field Measurements
Gas Vent Piping	A system of collection pipes installed in the gas vent sand, to collect any buildup of gas from the decomposing waste, and capable of transmitting the gas to vent pipes installed through the landfill cap components	Specification Section 02720	--	Installed in accordance with the contract drawings	Field Inspection

FIGURES

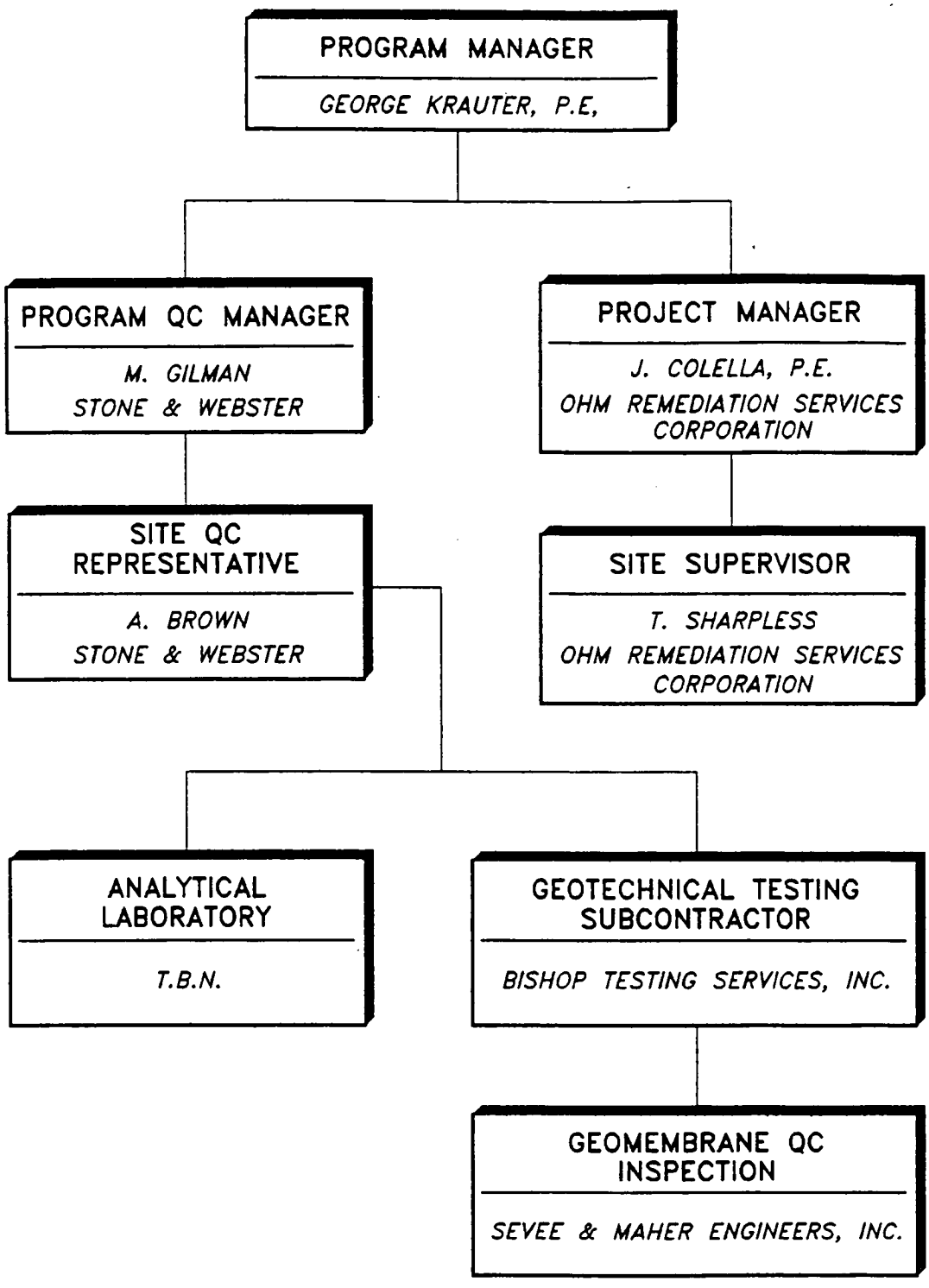

FIGURE 2–1

QC ORGANIZATION CHART
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION, BRUNSWICK, MAINE

PREPARED FOR

DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
LESTER, PENNSYLVANIA

OHM Remediation Services Corp.

DRAWING NUMBER 16285–A12
APPROVED BY
CHECKED BY
DRAWN BY M.WARNICK 2/22/95
OHM CORPORATION PITTSBURGH, PA
X–REF
PLOT SCALE: 1" = 1'

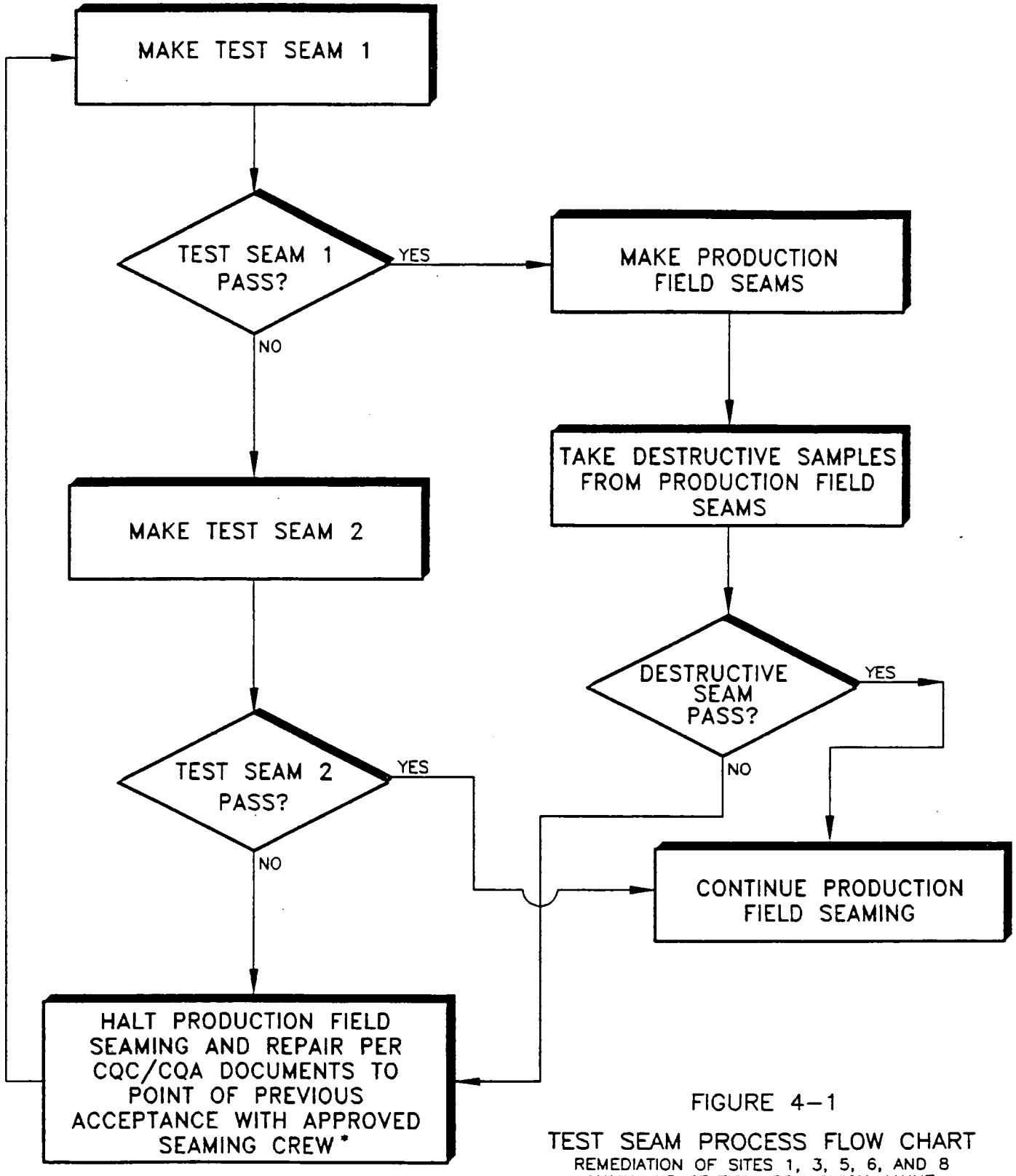

FIGURE 4-1

TEST SEAM PROCESS FLOW CHART
REMEDIATION OF SITES 1, 3, 5, 6, AND 8
NAVAL AIR STATION, BRUNSWICK, MAINE

PREPARED FOR

DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
LESTER, PENNSYLVANIA

OHM Remediation Services Corp.

*NOTE:
SEAMING CREW FAILING TO PREPARE ACCEPTABLE TEST STRIPS MAY REQUIRE RETAINING.

X-REF | OHM CORPORATION PITTSBURGH, PA | DRAWN BY M. WARNICK 2/22/95 | CHECKED BY | APPROVED BY | DRAWING NUMBER 16285-A11

PLOT SCALE: 1" = 1'

APPENDIX A

PROFESSIONAL PROFILES

GEORGE E. KRAUTER, P.E.

Special Qualifications

- Thirty-five years of program management experience, including 14 years on DOE and DOD CPFF/FFP contracts involving up to 190 personnel and $200 million.
- Sixteen years of experience in managing all facets of HTRW investigations, design, and remedial actions, including five HTRW project involving cradle-to-grave remediation for USACE.
- Directed 40 professionals and 150 craft in managing a $30 million per year CPAF task order contract for engineering and construction of HTRW facilities at DOE's Hanford reservation--commended by DOE management for being the smoothest run program at Hanford.
- Extensive experience with CERCLA, RCRA, OSHA, and NEPA and state regulations that are being applied to ongoing work.

Education

M.S., Physics, Naval Postgraduate School
B.S., Civil Engineering, Rensselaer Polytechnic Institute
B.S., Engineering, U.S. Naval Academy

Licenses and Registrations

Professional Engineer - Pennsylvania

Relevant Experience

As Program Manager for OHM's LANT DIV RAC, Mr. Krauter has total responsibility and accountability for the successful operation of the contract. Specifically, this includes ensuring effective program communications, committing company resources to accomplish program and project order objectives, receiving task orders, providing program-wide continuity for the technical direction of projects, planning and scheduling work activities, resolving workload conflicts on a program-wide basis, managing program-wide costs and contractual requirements, QA/QC, and fulfilling administrative and financial contractual reporting requirements.

Stone & Webster Environmental Technology & Services (1991 - Present)

Project Sponsor/Director, USACE - Norfolk District, Radford Army Ammunition Plant - Directs 15 personnel performing more than 25 tasks on five different FFP contracts, including PA/SI, RI/FS, Remedial Design, Title II Services, public participation, NEPA compliance, and federal/state permitting. Manages technical/contractual oversight, QA/QC, and health and safety.

- Provides accountability to USACE by serving as principal point of contract for $40 million in remediation services and capital expenditures.

- Ensures effective cost and quality control by interpreting, planning, and forecasting work using proven corporate management systems and procedures.

Task Manager, CPFF Contracts, DOE Savannah River - Provided management/technical expertise to complete tasks related to two CPFF contracts for DOE Savannah River (DOE-SR).

- Ensured effective planning and tracking of decommissioning tasks by developing management systems in accordance with client requirements.

- Satisfied DOE-SR's regulatory concerns by directing 20 environmental professionals in performing environmental audits to ensure compliance with RCRA, CERCLA, NEPA, Clean Air Act, Clean Water Act, and NESHAP.

Project Manager, HTRW Projects - Managed 25 engineers spread across five teams in developing Independent Cost Estimates for HTRW projects at three major DOE sites in Oak Ridge.

ICF-Kaiser (1989 - 1991)

Program Manager, DOE Richland - Directed detailed engineering, design, and construction of more than $200 million of waste management facilities for the tank farm upgrade at the Hanford reservation. Managed 40 professional and 150 craft labor, providing overall technical and administrative responsibility for a CPAF contract involving seven major tasks valued at $30 million per year.

- Successfully satisfied client concerns by developing the "smoothest run program at Hanford, which should serve as a model for all programs administered jointly by KEH and WHC" (DOE Richland management).

Project Manager, DOE Feed Materials Production Center Fernald - Managed independent reviews of RI/FS reports for five operable units involving remediation of radioactive and hazardous wastes including pits, ponds, lagoons, and drum storage areas containing uranium, thorium, arsenic, mercury, TCE, waste oils, PCBs, and spent solvents.

- Ensured the client could expedite remediation of contaminated sites by determining the applicability/effectiveness of 30 different innovative technologies.

IT Corporation (1985-1989)

Program Manager, Hazardous Waste Remedial Action Program (HAZWRAP) - Directed a CPFF $10 million per year contract involving more than 60 professionals and six subcontractors, including SB/SDBs, in performing SI and RI/FS at various military bases. Oversaw field investigations, drilling/laboratory subcontracts, and preparation of remedial investigation reports for contaminants including petroleum, solvents, VOCs, and PCBs.

- Improved project health and safety by effectively managing the implementation of a comprehensive Health & Safety Program.

Project Manager, Feed Materials Production Center Fernald - Managed the efforts of approximately 30 force account personnel in directing the construction of an automated handling system for the removal of more than 50,000 cubic feet of thorium containing dry sludges from three elevated storage silos.

- Reduced potential exposure to personnel by building the system into a standard 20-foot shipping container operated under negative pressure.

- Demonstrated strong management skills by accomplishing this $3 million project on schedule and within budget.

Project Manager, Shipping Port Atomic Power Station - Managed the efforts of 35 force account personnel in removing asbestos from radioactively contaminated areas. Removed 430 cubic yards of asbestos insulation from tanks, vessels, piping, ducting, and equipment.

- Identified uncertainties and critical path activities of this $3 million contract by developing detailed work procedures in accordance with OSHA and state regulations.

Project Manager, Nuclear Source Fabrication Facility - Directed 15 force account personnel in site planning and restoration. Developed the survey plan, removal plan, sampling plan, health and safety plan, detailed work procedures, and the final release of the site by the Nuclear Regulatory Commission. Met schedule and budget requirements.

- Supported site restoration by decontaminating equipment and facilities, removing and packaging radioactive materials, and overseeing facility demolition.

- Provided significant storage/disposal cost savings by developing an innovative method for reducing the volume of transuranic waste, yet achieving a 100% acceptance of "repackaged" drums.

- Managed final site restoration including backfilling and landscaping after NRC acceptance.

Program Manager, 3M Company - Managed 85 subcontractor and force account personnel in the characterization of 250 sites nationwide, including sites in Massachusetts and Rhode Island. Seventy of these sites required cleanup of polonium which had been released from faulty static eliminators.

- Effectively controlled mobilization, materials handling, and subcontractors in supporting up to eight sites throughout the U.S. for this $3 million project.

- Satisfied 100% of client's goals by successfully completing the project under extremely tight schedule requirements - commended by the client for timely assistance in identifying problem sites and remediation approaches.

- Met regulatory concerns by working closely with the Nuclear Regulatory Commission and state representatives to ensure cleanup; developed health and safety plans.

Quadrex (1981-1985)

Manager of Projects - Directed a staff of 30 involved in engineering, design, and installation activities in support of numerous nuclear power plant modification projects for various utility clients. These projects ranged in size up to $4 million and involved both force account and subcontractor personnel.

- Planned and tracked major projects by developing a management controls system (MIS) and providing training to Project Managers.

TRW (1979-1981)

Project Manager, DOE's Remedial Action Program - Managed 30 professionals to review plans for Formerly Utilized Sites Remedial Action program (FUSRAP) projects, and prepared other Program Documents for DOE. Determined remedial approach, developed schedules/estimates for remediation, and planned specialty subcontractor activities.

U.S. Navy Civil Engineer Corps (1958-1979)

Deputy Officer in Charge of Construction, Europe - Directed the construction of projects annually averaging $26 million and provided the design of new facilities and modifications. Held full contract authority and was the senior member for selection and negotiation contract boards.

- Restructured and organized resources to accommodate an unexpected 30% increase in workload without requiring additional resources.

- Received Meritorious Service Medal for accomplishments in design and construction.

Officer in Charge, Naval Nuclear Power Unit - Managed 25 professionals and 35 craft who directed the development of the Environmental Impact Assessment, the Safety Analysis Report, and the Removal Plan for the PM-3A reactor decommissioning.

- Completed project on schedule and within budget by managing the preparation of detailed critical path schedules and detailed work procedures.

- Ensured effective remediation by directing the removal of 5,000 square yards of contaminated soil.

JOSEPH W. COLELLA, P.E.

Mr. Colella has over 22 years of professional experience in engineering design and project management, specializing in civil and geotechnical projects in the fields of hazardous waste disposal and associated permitting. As manager of engineering at OHM, Mr. Colella is responsible for ensuring the smooth flow of engineering projects from the initial design phase to implementation. This includes scheduling, budgeting, technical oversight, interfacing with regulatory agencies, and acting as client liaison.

Experience

Mr. Colella is presently working as a project manager on two projects for OHM's LANTDIV contract. One project is a removal action at a previous disposal area at the Camp Allen Landfill, Area B, in Norfolk, Virginia; the other is in the installation of a ground water treatment plant, force main, and ground water extraction wells to remove and treat a ground water plume at the NAS Brunswick. Both projects include preparing work plans, cost estimates and schedules, and performing necessary field work.

Mr. Colella has served as program manager for OHM's Wright-Patterson Air Force Base (WPAFB) Installation Restoration Program Hazardous Waste Cleanup Contract initiated (in June 1991), and the Wright-Patterson Air Force Base Spill Response Contract (initiated in March 1993). He had total responsibility and accountability for the successful operation of the contract. Specifically, this included ensuring effective program communications; committing company resources to accomplish program and project order objectives; receiving task orders; providing program-wide continuity for the technical direction of projects; planning and scheduling work activities; resolving workload conflicts on a program-wide basis; managing program-wide cost and contractual requirements; QA/QC; and fulfilling administrative and financial contractual reporting requirements.

Mr. Colella managed the following projects under the WPAFB Contract:

- The investigation and installation of a groundwater/free-product removal and treatment system to remove free-product jet fuel and to treat associated groundwater.
- The operation and maintenance of a temporary leachate collection system.
- The management of waste generated from the Landfill 8 and Landfill 10 remedial investigations.

Mr. Colella serves as the Program Manager for the United States Army Toxic and Hazardous Materials Agency (USATHAMA) Total Environmental Program Support Contract. His duties are the same as those under the WPAFB Contract. Mr. Colella managed the following projects under this contract.

- A remedial investigation at a facility in Massachusetts.
- Site investigations at two sites in Wisconsin.
- A range sweep operation to locate and remove unexploded ordnance at a site in Ft. Meade, Maryland.
- The feasibility study of an Army munitions plant in Illinois.
- A feasibility study of an Army facility in Massachusetts.

His past work experience has ranged from performing site evaluations, preparing conceptual designs, final designs, and preparing construction and bid specifications. Projects he has been involved with include hydrological studies, embankment and dam design, synthetic liner design, development of operating procedures, and development and reviewing environmental quality data for disposal sites.

- While working as a manager for a major engineering firm, Mr. Colella was responsible for completion of several projects which entailed scheduling, budgeting, technical oversight, and client coordination. Projects he was involved in consisted of the designing and permitting of several municipal solid waste disposal sites with double liner and leachate collection system, construction inspection of a municipal waste transfer station, groundwater assessments at several gasoline stations, and environmental assessments/audits for real estate transfers.

- As a project manager for a major hazardous waste remediation firm, his responsibilities included scheduling, budgeting, technical oversight, and client coordination on various projects involving a wide matrix of chemicals. Key projects included:

  - Project manager for an investigation to determine the contamination from a waste oil pond at the Kaiser Aluminum plant in Ravenwood, West Virginia. The project involved reviewing alternatives to remediate the area, and installing a new lined pond.

  - Project manager to design a groundwater collection system at a Martin Marietta plant in Colorado. The project objective was to collect contaminated groundwater before it got into a pond.

  - Task force leader to review the use of stabilization/fixation procedures for various remediation projects.

- Mr. Colella supervised, directed, and coordinated a geotechnical section in all activities relating to the disposal of utility, industrial, and hazardous wastes in stabilized or secure landfills. His responsibilities included all aspects of the engineering design for residual and secure landfills, the environmental monitoring of operating residual landfills, quality control work for operating residual landfills, monitoring the development of operating residual and secure landfills, conceptual and cost estimating work for new sites and technical support to the marketing group. On several projects, the engineering work ranged from concept to final design for the landfill and the processing facility site work.

- Mr. Colella was responsible for directing and coordinating project team activities related to analysis, design, permitting, and/or construction inspection of civil engineering projects for industrial clients in an engineering firm. His work focused on waste management at coal processing facilities and subsurface investigations for waste management at industrial sites.

Academic Background

M.S., Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania, 1976 (evening program)
B.S., Civil Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania, 1972

Specialized Training

OSHA site safety and related training
Center for Professional Development, New Brunswick, New Jersey Short Course, "Design of Hazardous Waste Landfills"
ASCE Continuing Education "The Effective QA/QC Program: How to Do It"

Professional Registrations

Professional Engineer, Pennsylvania, Texas, Virginia, West Virginia, and Iowa

Professional Affiliations

American Society of Civil Engineers
Society of Military Engineers
Society of Mining Engineers of AIME

THOMAS A. SHARPLESS, SR.

Mr. Sharpless joined OHM in 1988 with 22 years of direct, on-scene field experience in oil- and chemical-cleanup activities; hazardous-chemical, waste-site cleanup and disposal activities; developing site- and spill-safety plans; heavy-equipment operation; and field construction. His on-scene experience has included supervision of multidisciplinary oil- and chemical-cleanup personnel. The contaminated media with which he has been involved are air, water, soil, containers, oil, and chemicals. Mr. Sharpless is an approved Response Manager under the USEPA Zone I contract.

Experience

Since joining OHM, Mr. Sharpless has been involved in numerous projects. His experience is illustrated in the following project overview:

- Served as response manager: Supervised a tank cleaning project for a major petroleum corporation. The task required cleaning five aboveground fuel storage tanks each of 1.5 million-gallon capacity and three underground fuel storage tanks each of 1-million-gallon capacity. The contaminants involved were aviation fuel, gasoline, and asphalt trailings. The job was completed with a crew of 9 persons. Mr. Sharpless also provided safety guidelines on the site. The project started in August 1990 and concluded in December 1990.

- Served as Response Manager: Responded to a radioactive emergency cleanup with a crew of eight for the USEPA. The requirement was to plan and supervise a labpacking operation, inventory all chemicals, and direct the proper removal and disposal of hazardous materials. The contaminants uncovered were 2,000 units of radioactive materials, mercury, heavy metals, flammables, acids, shock-sensitive materials and many unknowns. Mr. Sharpless maintained strict quality control and site-safety measures on this project.

- Served as site supervisor: Supervised cleanup operations at an overturned truck accident in Elkton, Maryland. Mr. Sharpless directed and assisted in the operations by constructing dams to prevent 1,500 gallons of gasoline from migrating into the Little North East Creek. Mr. Sharpless has responded to similar incidents involving acetone, used oil, benzene, chlorine, liquid nitrogen, white ink, butylacrylate, and heating fuel in and around North East, Maryland.

- Served as response manager: Took charge of an underground tank removal project in northern New Jersey. The tanks, which stored heating fuel and gasoline, were excavated, removed, and disposed of by sheeting and cutting. The surrounding soil was sampled, the extent of its contamination was determined, and the soil was also disposed. Upon completing remediation, the 7-man crew restored the site to full compaction rates.

- Supervised a crew of 30 persons on a train derailment project in Elkton, Maryland. A chemical fire and chemical runoff resulted which migrated into the North East River. The hydrochloric acid was contained, the fire suppressed, and a dam constructed on the river. The condition was successfully corrected.

- Directed the response and cleanup of an emergency involving a multivehicle accident of Interstate Highway 95 in Maryland. This incident involved cars and tank trucks carrying oil and other fuel. Mr. Sharpless was responsible for mobilizing a crew and equipment, securing the site, and performing oil and fuel cleanup, as well as site restoration.

- Supervised a crew of 30 on a train-derailment project in Elkton, Maryland, which involved a chemical fire and run-off into the North East River; supervised containment of hydrochloric acid, suppression of the fire, and construction of a dam on the river.

- Supervised a four-man crew for a major tank-excavation project for a power company in Pennsylvania which involved hoppers and tanks containing grease and fat; responsible for a magnetometer investigation to determine tank sizes and locations and soil excavation for tank access, sampling, and overpacking.

- Served as general foreman for a six-man crew involved in the USEPA emergency-response cleanup of a defunct paint factory in September 1988; supervised overpacking of lead, arsenic, paint material, and asbestos.

- Supervised a seven-man crew during an underground tank-removal project in northern New Jersey which involved tanks containing heating fuel and gasoline; excavated and removed tanks and disposed of them using sheeting and cutting techniques; sampled contaminated soil, determined extent of contamination, disposed of contaminated soil, and restored the site.

- Serving as general foreman in October 1988, supervised an eight-man crew during an emergency-response removal project involving a 7,000-gallon storage tank and approximately 300 drums containing PCP and other flammable acids at a facility in Germantown, New Jersey; supervised tank removal, drum-crushing, storage, and chemical shipment.

- Responded as part of a cleanup crew in December 1963 to a Pan American Airline crash in Elkton, Maryland; duties included site cleanup, fire control, and search-and-rescue efforts.

- Responded to a train derailment in August 1965 involving propane tanks which resulted in an explosion and fire requiring a major cleanup effort.

- Supervised a crew of 20 at a B&O Railroad train derailment in Leslie, Maryland, in June 1966 which involved a sulfur dioxide leak requiring immediate containment in order to prevent migration to the North East River.

In addition, Mr. Sharpless has responded to similar incidents involving acetone, oil, benzene, chlorine, liquid nitrogen, white ink, butylacrylate, and heating fuel in and around northeast Maryland from 1968 through 1988.

Prior to joining OHM, Mr. Sharpless served as a Deputy Fire Marshal. He determined the area of origin and causes of fires, collected evidence, photographed fire scenes, processed evidence, arrested suspects, testified in district and circuit courts, and compiled detailed reports of all investigations. In addition, his work included follow-up inspections for correction of violations. He was a member of the bomb squad and assisted in the investigation of all explosive devices reported to the state.

As a forest ranger, Mr. Sharpless was responsible for the suppression and investigation of all wild fires in northern Maryland. He conducted a training-needs analysis for 20 northeastern states. He was also in charge of the Fire Prevention Program (Smokey the Bear) for the same states. He served as an instructor of fire-investigation techniques.

As a forestry supervisor, he supervised forest-fire suppression, law enforcement, and investigation of fires in six counties of northern Maryland. He provided assistance to the United States Forest Service for campaign fires in six western states.

Specialized Training

OSHA 40-hour Training, 1988
OSHA 8-hour Refresher Training, Current
OSHA 8-hour Supervisory Training
Bomb Technicians and Investigators Training, Fraternal Order of Police, Cecil Lodge No. 2, 1985-1988
Maryland Arson Investigation Training, 1985
OHM site-safety and related training

MICHAEL I. GILMAN

In addition to 18 years of Engineering experience, Mr. Gilman presently holds a lead QA position at Stone & Webster Engineering Corporation. In this position, he has implemented a wide variety of QA programs involving services such as QA program review, vendor monitoring, and field inspection. His quality engineering work has included performing assessments of numerous plant QA programs, review of technical documents, preparation of inspection plans, QA procedure system development, procedure review, and continuing education. Mr. Gilman is experienced in trend analysis with the development of systems and forms to ensure the recording, transmission, and adequacy of quality data, and the use of computer and statistical techniques to collect, process, and analyze data.

Experience

As Program Quality Control Manager for OHM's LantDiv RAC, Mr. Gilman is responsible for the enforcement of Corporate QA/QC policies and contract provisions. He works closely with the Program Manager, Mr. George Krauter, to coordinate QA/QC activities at each site to ensure they are carried out properly in support of on-going site operations. Mr. Gilman's role and responsibilities at the Program level include:

- Establishing and administering all quality matters for OHM for the LantDiv RAC
- Designating a project QC Manager for each Delivery Order
- Reviewing and approving Delivery Order QC plans
- Authorizing stop work if work activities or planning activities violate OHM quality guidelines or LantDiv RAC contract requirements
- Developing and implementing a Delivery Order specific quality control plan
- Interfacing directly with Government Quality Assurance personnel
- Conducting daily QC meetings
- Supervising performances of site QC activities
- Ensuring that QC testing is performed in accordance with specifications, and in a timely manner
- Requiring corrective actions for any item or activity which does not meet specifications or quality standards
- Modifying/halt work if activities violate LantDiv or OHM quality standards or contract requirements
- Preparing required QC certifications and documentation

Stone and Webster Environmental Technology & Services

As Section Manager of the QA Department of Stone & Webster Engineering Corporation's Cherry Hill office, he is responsible for providing guidance in the implementation of all phases of the QA programs for nuclear and fossil power plants, environmental assessment, management, and remediation, and government projects. These projects include:

- Department of the Navy - Newport News Shipbuilding
- Department of the Navy - North Div Naval Facilities Engineering Command BRAC
- Delmarva Power & Light
- New Jersey Turnpike
- Salem Generating Station - Units 1 and 2
- Hope Creek Generating Station
- River Bend Station
- Nine Mile Point Nuclear Station - Unit 2
- Calvert Cliffs Nuclear Power Plant
- Limerick Generating Station
- Fort Calhoun

Mr. Gilman has served as the Project Manager responsible for QA and other supporting department activities for services provided to a major shipyard involved in the construction and overhaul of naval vessels.

Since joining Stone & Webster, he has been assigned to the Cherry Hill office as Supervisor, QA Department Representative, QA Engineer, and Lead Engineer, and to the Boston office as an Engineer in the Reports Group of the Quality Systems Division.

Prior to joining Stone and Webster, Mr. Gilman worked in manufacturing engineering on several government projects for GTE Sylvania, the Foxboro Company, and a plastic molding manufacturer for which his responsibilities were to provide industrial engineering support for the assembly of electronic equipment, and quality control inspection and testing.

Education

M.S., Business Administration, Drexel University
B.S., Industrial Engineering, Northeastern University

Specialized Training

Hazardous Waste Operations Courses, both worker and supervisory training (per OSHA 1910.120)

Licenses and Registrations

American Society for Quality Control - Certified Quality Engineer
American Society for Quality Control - Member
American Nuclear Society - Delaware Valley Section - Member
American Institute of Industrial Engineers - Member

ALAN F. BROWN

Mr. Brown is a Registered Professional Engineer with 15 years of experience in civil and geotechnical engineering studies related to hazardous waste and civil engineering projects. His experience includes engineering, design, and construction management for a wide range of projects associated with power and industrial development, including foundation elements, roads, waterfront structures, pipeline, and landfill facilities.

Experience

Mr. Brown has experience in specification preparation, construction inspection and management, and contract administration. His experience also includes the preparation of engineering reports documenting the results of site investigations. Mr. Brown has experience in the design, implementation, and management of field activities required to complete site characterization studies, environmental investigations, and construction projects.

Mr. Brown has expertise in the development and implementation of sitting investigations for hazardous waste, civil and pipeline projects. Mr. Brown's expertise also includes subsurface sampling and installation of groundwater monitoring wells. Other expertise includes water pressure, dye and pressuremeter testing in the field. He also has a complete knowledge of laboratory testing techniques for soil and rock. Mr. Brown is also experienced with the installation of foundation elements such as spread footings and caissons, as well as foundation support elements including rock bolts, rock anchors, grout bag underpinning, and rock excavation.

As a Lead Engineer in the areas of general civil engineering and design on public works projects, Mr. Brown's experience includes the engineering support of landfill closure studies, groundwater investigation programs and highway design projects. Mr. Brown's expertise includes the site characterization and soil support recommendations associated with open cut and directionally drilled gas pipeline crossings. His work also includes environmental permitting, grant application processes, utility relocation and on-site inspection to assure design conformance. Mr. Brown's landfill experience includes the geotechnical assessment of municipal landfill closure plans, including the analysis of cap material, gas ventilation, and groundwater monitoring equipment. He has analyzed analysis of alternative landfill closure schemes, including clay liners and geo-fabric for conformance with state regulations.

Mr. Brown's public works expertise includes the development of a municipal groundwater observation well network involving agency coordination, public sector research, and field investigations, including the location of potential observation wells and determining if the wells still function.

Mr. Brown's background also includes management of construction contracts for a variety of civil engineering and hazardous waste projects. His extensive experience includes cost estimation, scheduling, and activity coordination as well as change order negotiation and on-site verification of in-place quantities. Mr. Brown also has worked as an on-site field representative to ensure contract conformance. He has been successful at maintaining client schedules and preventing cost overruns.

Academic Background

M.S., Civil Engineering/Construction Management, Northeastern University, Boston, Massachusetts; 1994
B.S., Civil Engineering, Northeastern University, Boston, Massachusetts; 1979

Specialized Training

OSHA Certificate of Training, 8-Hour Waste Site Supervisory Training
OSHA Certificate of Training, 40-Hour Waste Site Worker Protection

Licenses, Registrations, and Certifications

Civil Engineer, Civil - Massachusetts, 16953 - 1993, Current
Civil Engineer, Civil - New Hampshire, 8113 - 1991, Current

Professional Affiliations

Member, Boston Society of Civil Engineers

Computer Hardware/Software Capabilities

Lotus 1-2-3, Lotus Free-Lance, WordPerfect 5.1/IBM PC, IGDS, and World Mapping/Intergraph

Publications

Deltufo, A.M., Taylor, P.K., and Brown, A.F., "Installation of Category I Caissons," ASCE Spring Convention, Denver, Colorado, 1985.

BISHOP TESTING SERVICES, INC.

P.O. BOX 397 TOPSHAM, MAINE 04086 (207) 729-0077

January 24, 1995

OHM Corp.
1000 RIDC Plaza
Suite 600
Pittsburgh, PA 15238-2928

Attention: Joe Colella

RE: Remediation Sites 1,3,5,6,8 & Eastern Plume
BNAS #91-C-0034

Gentlemen:

Thank you for the opportunity to submit a proposal for testing and inspection services on this project. Please find enclosed a fee schedule which includes daily rates for on-site inspection and unit rates for lab testing. There will be no charge for travel and mileage.

As you may know, we have been working with superintendents Dave Bartosik and Tom Sharpless providing the testing on this project since its inception. Our office and lab facility in Topsham is located only 7 miles from the Naval Air Station. All inspectors are licensed soil and ACI certified concrete field technicians. We have 4 nuclear density gauges available.

All field testing will be performed by our personnel except for the QA/QC of the geomembrane installation. This inspection will be conducted by Carl Burdick of Sevee & Maher Engineers (Cumberland, Maine). Carl is a registered professional engineer and is certified by the National Institute for Certification in Engineering Technologies for Level II inspection of geomembrane installation. His inspection experience of 3.4 million square feet of geo-membrane includes Mt. Carberry Secure Landfill at James River Corp. and Sawyer Environmental Recovery Facility Secure III.

All lab testing will be performed in our lab except for permeability testing and geomembrane tests. The permeability

tests will be conducted in the lab of Sevee & Maher Engineers. The lab manager has 5 years experience in performing these tests. The tests on the geomembrane will be conducted by the Pittsburgh Testing Lab division of PSI. As you may know, PTL is highly proficient in this area.

Although this firm is not accredited with a national program, as an independent testing agency established in 1982, we have demonstrated the capability to perform lab and field testing in accordance with ASTM standards, job specifications and industry standards. As recently as November 1993, the lab was accredited by the Army Corps of Engineers. We have worked on projects at BNAS for thirteen years. A letter of certification submitted for each project has always been accepted by the ROICC office. Further, David Kinney, an experienced registered professional engineer, is a principal of this firm.

Thank you for your consideration. Let me know if you have any questions or need additional information.

Sincerely,

Sam Bishop
President

rbw

BISHOP TESTING SERVICES, INC.

Aviation Physiology Training Bldg.	Brunswick Naval Air Station	Diaz
Aircraft Ground Equipment Facility	B.N.A.S	Lawlor
Operational Control Center	B.N.A.S.	Reed & Reed
Aircraft Maint. Training Bldg.	B.N.A.S.	Reed & Reed
Airfield Pavement Repairs	B.N.A.S.	Pine State
Inboard Runway & Taxiway I	B.N.A.S.	H.C. Crocker
Health-Education Bldg.	Portland	Maine Medical Center
Kennebec Valley Medical Center	Augusta	Carlson Corporation
St. Andrews Hospital	Boothbay Harbor	HBE Corporation
Radiation Therapy Institute	Bath	SMRT Architects
High School	Brunswick	Harriman Associates
Elementary School	Oxford	Languet
Primary School	Windham	RCL
Middle School	Gray	SMRT Architects
Landfill Closings	Boothbay & Waldoboro	Kimball Chase
Landfill Closing	Wiscasset	Woodard & Curran
Transfer Station	Wiscasset	Woodard & Curran
Transfer Station	Jay	Wright-Pierce
Water Treatment Facility	Livermore Falls	Whitman & Howard
Wastewater Treatment Facility	Farmington	Whitman & Howard
Wastewater Treatment Plant	Wiscasset	Wright-Pierce
Wastewater Treatment Facility	Lisbon Falls	Wright-Pierce
Wastewater Treatment Plant	Brunswick	Bruns. Sewer District
Resource Recovery Plant	Portland	Weyher-Livsey
Wastewater Treatment Facility	Damariscotta	Wright-Pierce
Harraseeket Inn	Freeport	Granger Northern
Topsham Fair Mall	Topsham	Group Design
Arrow Hart Expansion	Brunswick	Arrow Hart
L.L. Bean Expansion	Freeport	L.L. Bean
Consolidated Warehouse	Bath	Bath Iron Works
Athletic Facility	Brunswick	Bowdoin College
Science Library	Brunswick	Bowdoin College
Memorial Library	Westbrook	RCL
Sagadahoc County Courthouse	Bath	D.L. Poulin
Building 200 - Phases 1 & 2	VA-Togus	Veterans Administration
Maine Veterans Homes	Scarborough/S.Paris	SMRT Architects
Knox County Jail	Rockland	SMRT Architects
Androscoggin County Jail	Auburn	Granger Northern
Kennebec County Jail	Augusta	Reed & Reed
Cumberland County Jail	Portland	SMRT Architects
Apron, Taxiway & Runway 18	Portland Jetport	Tilcon
Turnpike Bridge Deck & Widening	Kennebunk	Reed & Reed
6 M Gallon Water Tanks (4)	Augusta & Waterville	Natgun
9 M Gallon Water Storage Tank	Westbrook	Natgun
Wal-Mart Retail Stores (12)	Statewide	Wal-Mart
Motor Vehicle Facility	Augusta	TFH Architects
Student Union Building	Castine	Languet
Marine Research Facility	Boothbay Harbor	Granger Northern

SEVEE & MAHER ENGINEERS, INC.
Waste Management and Geohydrologic Consultants

February 10, 1995 021001.pro

Mr. Sam Bishop
Bishop Testing Services
P.O. Box 397
Topsham, ME 04086

Subject: Qualifications Package for Third Party CQA of Geomembrane Installation

Dear Sam:

As you requested, Sevee & Maher Engineers, Inc. (SME) is pleased to present its qualifications to act as the Geosynthetic Quality Assurance Consultant for the geomembrane installation associated with the Brunswick Naval Air Station project. SME has over 8,000,000 square feet of similar experience with quality assurance of geosynthetic materials. Carl Burdick, of our office, will be on-site during the membrane installation and be the Geosynthetic Quality Assurance Resident Engineer. A copy of Carl's resume is attached.

In addition, Carl is a registered Professional Engineer in the State of Maine, and is certified by the National Institute for Certification in Engineering Technologies (NICET) for Level II of HDPE geomembrane materials installation inspection. Carl has been selected by NICET to participate in the development of the Level III certification testing. He has managed several million dollars of landfill construction projects.

Mr. Peter Maher will be the Geosynthetic Quality Assurance Managing Engineer. Mr. Maher has the authority to commit the resources of SME to assure successful completion of the project. He is a Professional Engineer registered in the State of Maine.

4 Blanchard Road • P.O. Box 85A • Cumberland Center, ME 04021 • (207) 829-5016 • FAX (207) 829-5692

His specific responsibilities will include review and monitoring of the project to assure contractual obligations are fulfilled, and that QA/QC procedures are complete.

If you have any questions concerning this letter, please call me.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

R. Hodsdon For

James S. Atwell, P.E.

Attachment

CARL J. BURDICK

EDUCATION

University of Maine - B.S. in Civil Engineering, 1989
Special Courses:
- Seepage, Drainage and Flow Nets, 1990
  University of Maine
- Hazardous and Solid Waste, 1991
  University of Maine
- Geosynthetic Lining Systems for Landfills, 1991
  Geosynthetics '91
- Introduction to Geosynthetics, 1991
  Geosynthetics '91
- Landfill Design: Liner System Materials, Installation and Quality Assurance, 1992, University of Florida
- Landfill Design: Cell Design and Construction, 1994, University of Florida

PROFESSIONAL REGISTRATION, CERTIFICATION, AND AFFILIATION

Professional Engineer # 7835, State of Maine
Geosynthetic Materials Installation Inspection, National Institute for Certification in Engineering Technologies
- Level II - HDPE, Geonets, Geotextiles
- Level I - Geogrids, GCLs

Nuclear Testing Equipment, Troxler Electronics Laboratories, Inc.
North American Geosynthetic Society, 1990
International Geotextile Society, 1990

EMPLOYMENT HISTORY

Currently from 1988 - Sevee & Maher Engineers, Inc.,
Project Engineer

1987 to 1988 - James W. Sewall Company, Old Town, Maine
Survey Crew

EXPERIENCE

Mr. Burdick has been involved with waste management, design, and construction activities in the State of Maine and New Hampshire for six years. During his employment with James W. Sewall Company, he was responsible for assisting and directing both engineering and property line surveys. As a project engineer with Sevee & Maher Engineers, Inc., he has been responsible for the design, implementation, and construction monitoring of state-of-the-art landfill installation.

Assignments in his various areas of expertise have included:

- Design of three 8-acre industrial/municipal waste landfill cells. As project engineer for designing a state-of-the-art secure landfill which includes a double geosynthetic liner, leak detection system with both soil and geonet drainage media, leachate collection system and underdrain system.

Experience (continued)

- Construction management and liner installation. Monitoring of geosynthetic lined landfills. The monitoring included quality assurance testing of liner manufacturing, liner installation, soils preparation and soils installation. Geomembrane material installation monitoring consisted of seaming test welds, non-destructive seam testing, destructive seam testing and visual seam/liner monitoring. Soil material installation monitoring consisted of drainage soil gradation/hydraulic conductivity testing, soil compaction effort, and soil placement over geosynthetic material.

- Monitoring of geomembrane-lined wastewater lagoon repairs. This geomembrane repair and drainage enhancement project consisted of dewatering underlying soils, installation of an enhanced drainage system and repair of overlying 80-mil geomembrane.

- Design and construction monitoring of a 10-acre landfill closure. This project included slope stabilization, installation of a landfill cap, and erosion control. The landfill was a bark and ash pile with paper mill sludge lagoons. The last open lagoon was covered with a geotextile and soil to aid in cap stabilization.

- Evaluating the destructive seam testing specification used in liner installation at an industrial/municipal landfill. The report detailed prior seam testing results of over 200 destructive tests and evaluated state-of-the-art testing specifications on the prior seaming results.

- Surveying progress and record drawings for several construction projects. The direction and implementation of timely surveys have detailed precise locations for points of interest located with landfill limits. All surveys referenced construction benchmarks and located points in X, Y, and Z coordinates.

- Geosynthetic inspection experience:

Geomembrane	
HDPE	3,400,000 SF
CSPE	200,000 SF
Geotextile	
Woven	300,000 SF
Non-woven	1,000,000 SF
Geonet	1,000,000 SF
Geocomposite	200,000 SF
Geogrids	100,000 SF
Total	6,200,000 SF

PRESENTATIONS

August 1991, Landfill Measurements, presented for the New Hampshire Department of Environmental Services.

APPENDIX B

PROJECT SPECIFICATIONS

SECTION 01010

GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCE

The publication listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

41 CFR 60.4	Construction Contractors - Affirmative Action Requirements

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-18, Records

a. Report of subcontracts G
b. Work performed by Contractor G
c. Certification of Contractor required insurance G
d. Schedule of prices G
e. As-built drawings G
f. Quantity Surveys G

1.2.1.1 Report of Subcontracts

Provide, for contracts greater than $10,000, in accordance with paragraph entitled "Affirmative Action Compliance."

1.2.1.2 Work Performed by Contractor

Provide in accordance with the paragraph entitled, "Description of Work Performed by the Contractor."

1.3 GENERAL INTENTION

It is the declared and acknowledged intention and meaning to remediate Sites 1 & 3, 5, 6, 8 and Eastern Plume, complete and ready for use.

1.4 GENERAL DESCRIPTION

The work includes the removal of structures, utilities, footbridge, fencing, and buried valves and boxes; the items detailed below; and incidental related work.

a. Provision of a soil/bentonite slurry wall around a portion of the landfill limit at Sites 1 and 3 and construction of a low permeability cover system over the landfill.
b. Provision of groundwater extraction systems at the landfill and Eastern Plume which entails providing extraction wells, well pumps and associated piping to a common groundwater treatment facility.
c. Provision of a groundwater treatment facility which consists of metals pretreatment of Sites 1 and 3 groundwater for removal of iron and manganese and treatment of all groundwater through greensand filters followed by ultraviolet oxidation.
    1. Provide and pay for all chemicals used in process operations, during start-up and prove-out.
    2. Provide and pay for all sampling and laboratory testing as specified herein.
    3. Provide and pay for all solid waste disposal cost during the one-year operation and maintenance period including sludge disposal.
    4. Operation and maintenance of the treatment facility for a period of 1 year following start-up of the treatment system, including mowing of grass at Sites 1 and 3.
d. Excavate, containerize, and transport asbestos-contaminated material from Site 5 to Sites 1 and 3 where it will be placed as subgrade fill beneath the new landfill cap in a designated asbestos disposal area.
e. Excavate and transport construction debris from Sites 6 and 8 to Sites 1 and 3 where it will be placed as subgrade fill beneath the new landfill cap. Asbestos-contaminated materials are reportedly buried at Site 6; this material must be containerized, transported, and placed at the designated asbestos disposal area at Sites 1 and 3.

1.5 LOCATION

The work shall be located at the Naval Air Station (NAS) Brunswick, Brunswick, Maine, approximately as shown. The exact location will be indicated by the Contracting Officer.

1.6 GOVERNMENT REPRESENTATIVES

a. The work will be under the general direction of an officer of the Civil Engineer Corps, United States Navy or another officer or representative of the Government, designated in block 26 of Standard Form 1442. Except in connection with the Disputes Clause of this contract, this designated person has complete charge of and exercises full supervision over the work so far as it affects the interests of the Government.
b. For the purposes of the Dispute Clause, the "Contracting Officer" is the Commander, Naval Facilities Engineering Command, or his representatives warranted for this purpose. Any claim submitted under the Dispute Clause shall be submitted to the Contracting Officer in care of the person designated in block 26 of Standard Form 1442 as the representative of the Contracting Officer authorized to receive the claim.
c. The provisions of this paragraph or provisions elsewhere in this contract regarding supervision, approval, or direction by the Contracting Officer or the designated person

shall not relieve the Contractor of responsibility for accomplishing the work, with regard to sufficiency or time of performance, except as otherwise provided.

1.7 AFFIRMATIVE ACTION COMPLIANCE

Notice of requirement for affirmative action to ensure equal employment opportunity (Apr 1984):

(Applies when the amount of the contract is in excess of $10,000.)

a. The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

b. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
0.6 percent	6.9 percent

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

c. The Contractor's compliance with Executive Order 11246 as amended, and the regulations in 41 CFR 60.4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60.4. Compliance with the goals will be measured against the total work hours performed.

d. The Contractor shall provide written notification to the Director, Office of Federal Contract Compliance Programs, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the--

1. Name, address, and telephone number of the subcontractor;
   (i) Employer identification number of the subcontractor;
2. Estimated dollar amount of the subcontract;
3. Estimated starting and completion dates of the subcontract; and
4. Geographical area in which the subcontract is to be performed.

e. As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Cumberland and Sagadahoc Counties, Maine. (FAR 52.222-23)

1.8 ORAL MODIFICATION

No oral statement by any person other than the Contracting Officer or his representative, as provided in the Contract Clause entitled "Changes," will in any manner or degree modify or otherwise affect the terms of this contract.

1.9 INSURANCE

1.9.1 Minimum Requirements

The Contractor shall procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence.
b. Automobile liability: $200,000 per person; $500,000 per occurrence, $20,000 per occurrence for property damage.
c. Workmen's compensation: As required by Federal and State workers' compensation and occupational disease laws.
d. Employer's liability coverage: $100,000, except in States where workers compensation may not be written by private carriers
e. Others as required by State law.

1.9.2 Insurance--Work on a Government Installation (SEP 1989)

a. The Contractor shall, at its own expense, provide and maintain during the entire performance period of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.
b. Before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.
c. The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor shall maintain a copy

of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request. (FAR 52.228-5)

1.10 NO WAIVER BY THE GOVERNMENT

The failure of the Government in any one or more instances to insist upon strict performance to any of the terms of this contract or to exercise any option herein conferred shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon such terms or option on any future occasion.

1.11 SCHEDULE OF PRICES

1.11.1 Data Required

Within 5 days after award of the Contract, the Contractor shall prepare and deliver to the Officer in Charge of Construction a schedule of prices (construction contract) on the forms furnished for this purpose. The schedule of prices shall consist of a detailed breakdown of the contract price, giving the quantities for each of the various kinds of work; the unit prices; and the total prices therefore. The required schedule must be based on the actual breakdown of the bid price. The format, content, and number of copies required will be prescribed by the Officer in Charge of Construction and will be subject to his approval. The submission of the required data shall not otherwise affect the contract terms.

1.11.2 Submittal Instructions

Furnish four copies of the schedule of prices in accordance with the paragraph entitled "Data Required." Identify costs for the building, and include all work out to the 5-foot line. Work to the 5-foot line shall include all construction encompassed within a theoretical line 5 feet from the face of the exterior walls and shall include building equipment and attendant construction placed beyond the 5-foot line. Identify the cost for site work and include all work not defined as work to the 5-foot line. Payments will not be made pursuant to the Contract Clause entitled "Payments to Contractor" until the schedule of prices has been submitted to and approved by the Contracting Officer.

1.12 PRE-AWARD SURVEY, COMPUTER MONITORING AND CONTROL SYSTEM (CMCS)

1.12.1 Operationally Proven Installations

Before award, the contractor must demonstrate that the controls system installer has operationally proven installations which demonstrate his ability to satisfy the requirements of this contract. Specifically these installations shall demonstrate the installer's ability to:

a. Provide and test "Computer Ready" component(s).
b. Provide and test general purpose digital computer component(s).
c. Provide and test the monitoring and control applications component(s).

1.12.2 Submittals Required for Pre-Award Survey

a. List of proven installations including location, owners name, point of contact, telephone number and date installation was put into full operation (turned over to owner).
b. Owners' approval for government investigation of proven installations, as described below.

1.12.3 Government Site Investigation Required For Pre-Award Survey

The government site visit shall include the following:

a. Three representatives of the Contracting Officer
b. Two day visit
c. Meeting area
d. Speak with System Operators
e. Speak with System Maintenance Personnel
f. Review Trouble Log and Maintenance Contract

1.13 PAYMENTS TO THE CONTRACTOR

Payments made in accordance with the Contract Clause entitled "Payments Under Fixed-Price Construction Contract" will be made on submission of itemized requests by the Contractor and will be subject to reduction for overpayments or increase for underpayments on preceding payments to the Contractor.

1.13.1 Payment for Materials Off-site

Pursuant to the paragraph entitled "Payments to the Contractor", payments may be made to the Contractor for materials stored off construction sites. However, the following conditions must be met:

a. The conditions described in the paragraph entitled "Payments to the Contractor."
b. The material must be within a distance of 50 miles by streets and roads.
c. The materials shall be adequately insured and protected from theft and exposure.
d. The materials shall not be susceptible to deterioration or physical damage in storage or in transit to the jobsite. Items such as steel, machinery, pipe and fittings, and electrical cable are acceptable for progress payments; items such as gypsum wallboard, glass, insulation, and wall coverings are not. Payments will not be made for materials in transit to the jobsite or storage site.

1.13.2 Obligation of Government Payments

The obligation of the Government to make any of the payments required under any of the provisions of this contract shall, in the discretion of the Officer in Charge of Construction, be subject to:

a. Reasonable deductions on account of defects in material or workmanship; and
b. Any claims which the Government may have against the Contractor under or in connection with this contract. Any overpayments to the Contractor shall, unless otherwise adjusted, be repaid to the Government upon demand.

1.14 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

Requests for payment in accordance with the terms of the contract shall consist of:

a. The Contractor's invoice on the form furnished for this purpose, which shall show, in summary form, the basis for arriving at the amount of the invoice; and
b. The contract performance statement on the form furnished for this purpose, which shall show, in detail, the estimated cost percentage of completion and value of completed performance for each of the construction categories stated in this contract. The format, content, and number of copies required will be prescribed by the Officer in Charge of Construction and will be subject to his approval. The submission of the required data will not otherwise affect the contract terms.

1.15 EQUITABLE ADJUSTMENTS - WAIVER AND RELEASE OF CLAIMS

a. Whenever the Contractor submits a claim for equitable adjustment under any clause of this contract which provides for equitable adjustment of the contract, such claim shall include all types of adjustments in the total amounts to which the clause entitles the Contractor, including, but not limited to, adjustments arising out of delays or disruptions or both caused by such change. Except as the parties may otherwise expressly agree, the Contractor shall be deemed to have waived: (1) any adjustments to which he otherwise might be entitled under the clause where such claim fails to request such adjustments; and (2) any increase in the amount of equitable adjustments additional to those requested in his claim.
b. The Contractor agrees that, if required by the Contracting Officer, he shall execute a release, in form and substance satisfactory to the Contracting Officer, as part of the supplemental agreement setting forth the aforesaid equitable adjustment. The Contractor further agrees that such release shall discharge the Government, including its officers, agents, and employees, from any further claims, including, but not limited to, further claims arising out of delays and/or disruptions caused by the aforesaid change.

1.16 AS-BUILT RECORDS

1.16.1 As-Built Drawings

Maintain at the jobsite two sets of full-size Contract Drawings marked to show any deviations which have been made from the Contract Drawings, including buried or concealed construction and utility features revealed during the course of construction. Record the horizontal and vertical location of all buried utilities that differ from the Contract Drawings. These drawings shall be available for review by the Contracting Officer at all times. Upon completion of the work, deliver the marked sets of prints to the Contracting Officer. Requests for partial payments will not be approved if the

marked prints are not current, and request for final payment will not be approved until the marked prints are delivered to the Contracting Officer.

1.17 QUANTITY SURVEYS

a. The Government will make original and final surveys and compute the quantities of work performed or finally in place.

b. The Contractor shall furnish surveys and computations, as necessary, to determine the quantities of work performed or placed during each period for which a progress payment is to be made. Original field notes, computations, and other records for the purpose of layout and progress surveys shall be furnished promptly to the Contracting Officer at the site of the work and will be used by the Contracting Officer to the extent necessary in determining the proper amount of progress payments due the Contractor. The Contractor shall retain a copy of the original notes, computations, and records furnished to the Contracting Officer. Unless waived by the Contracting Officer in each specific case, the Contractor shall make quantity surveys under the direction of the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 STATION REGULATIONS

The Contractor and his employees and subcontractor shall become familiar with and obey all station regulations, including fire, traffic, and security regulations. All personnel employed on the station shall keep within the limits of the work (and avenues of ingress and egress) and shall not enter any restricted areas unless required to do so and are cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

3.1.1 Working Hours

Regular working hours shall consist of an 8 1/2-hour period established by the Contracting Officer between 6:45 a.m. and 4:15 p.m., Monday through Friday, excluding Government holidays. The Contractor shall make application for work outside regular working hours 15 calendar days prior to such work in accordance with the paragraph entitled "Work Outside Regular Hours."

3.1.2 Work Outside Regular Hours

If the Contractor desires to carry on work outside regular hours, including Saturdays, Sundays, and Government holidays, an application shall be delivered to the Officer in Charge of Construction. The Contractor shall allow ample time to enable satisfactory

arrangements to be made by the Government for inspecting the work in progress. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Officer in Charge of Construction. All utility cutovers shall be made after normal working hours or on Saturdays, Sundays, and Government holidays. Anticipated costs shall be included in the bid.

3.2 ORDER OF WORK

The Contractor shall schedule his work so as to cause the least amount of interference with station operations. Work schedules shall be subject to the approval of the Officer in Charge of Construction. Permission to interrupt any station roads, railroads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

3.3 WORK BY THE CONTRACTOR

3.3.1 Performance of Work by the Contractor (APR 1984)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least twenty (20) percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government. (FAR 52.236-1)

3.3.2 Description of Work Performed by Contractor

In addition to the requirements of the paragraph entitled "Performance of Work by the Contractor (APR 1984)" and prior to the commencement of work at the site, furnish to the Contracting Officer a description of the work to be performed with the Contractor's own organization and the percentage of the total amount of work to be performed under the contract which this represents. Consider the value of materials as part of the work performed by the Contractor only if the materials are to be installed on the site by the Contractor's own organization.

3.4 EXISTING WORK

a. The removal or altering in any way of existing work shall be carried on in such a manner as to prevent injury or damage to any portion(s) of the existing work which remain(s).

b. All portions of existing work which have been altered in any way during construction operations shall be repaired or replaced in kind and in a manner to match existing or adjoining work, as approved by the Contracting Officer. All work of this nature shall be performed by the Contractor at the Contractor's expense and shall be performed as directed by the Officer in Charge of Construction. At the completion of all operations, existing work shall be in a condition equal to or better than that which existed before the new work started.

3.5 SANITATION

Adequate sanitary conveniences of a type approved for the use of persons employed on the work shall be constructed, properly secluded from public observation, and maintained by the Contractor in such a manner as required or approved by the Officer in Charge of Construction. These conveniences shall be maintained at all times without nuisance. Upon completion of the work, the conveniences shall be removed by the Contractor from the premises, leaving the premises clean and free from nuisance.

3.6 PUBLIC RELEASE OF INFORMATION

a. The Contractor shall not publicly disclose any information concerning any aspect of the materials or services relating to this bid, contract, or purchase order without the prior written approval of the Contracting Officer.

b. The Contractor shall insert the substance of clause "(a)" of this paragraph in each subcontract and purchase order related to the project.

3.7 SPECIFICATIONS AND STANDARDS

The specifications and standards referenced in this project specification, including addenda, amendments, and errata listed, will govern in all cases where references thereto are made. In case of differences between these specifications or standards and this project specification or its accompanying drawings, this project specification and its accompanying drawings will govern to the extent of such differences. Otherwise, the referenced specifications and standards will apply. The requirement for packaging, packing, marking, and preparation for shipment or delivery included in the referenced specifications will apply only to materials and equipment that are furnished directly to the Government and not to materials and equipment that are to be furnished and installed by the Contractor.

3.8 OPTIONAL REQUIREMENTS

Where a choice of materials or methods, or both, is permitted in this contract, the Contractor will be given the right to exercise the option unless otherwise required by the specification.

3.9 GENERAL PROVISIONS

Any reference within this project specification to a General Provision shall be understood to be a reference to the Contract Clause(s) or the General Paragraph(s) addressing the subject matter of the particular reference.

-- End of Section --

SECTION 01011

ADDITIONAL GENERAL PARAGRAPHS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.59	Hazard Communication

CORPS OF ENGINEERS (COE)

COE 1-1-11	1985 Network Analysis Systems, October 15
COD EM-385-1-1	1992 Safety and Health Requirements Manual

MILITARY SPECIFICATIONS (MIL)

MIL-S-16165	(Rev. E) Shielding Harnesses, Shielding Items and Shielding Enclosures for Use in the Reduction of Interference from Engine Electrical Systems

MILITARY STANDARDS (MIL-STD)

MIL-STD-461	(Rev. C) (Notice 2) Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	(Notice 6) Electromagnetic Interference Characteristics

1.2 PROJECT INFORMATION

1.2.1 Contract Drawings, Maps, and Specifications (SEP 1987)

a. Five sets of large-scale Contract Drawings and specifications will be furnished to the Contractor without charge except applicable publications incorporated into the technical sections by reference. Additional sets will be furnished on request at the cost of reproduction. One set of reproducibles will be furnished the Contractor. The work shall conform to the specifications and the following contract drawings identified on the following index of drawings.

b. Omissions from the Contract Drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the

Contract Drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work but they shall be performed as if fully and correctly set forth and described in the Contract Drawings and specifications.

c. The Contractor shall check all Contract Drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Figures marked on Contract Drawings shall in general be followed in preference to scale measurements. Large scale Contract Drawings shall in general govern small scale Contract Drawings. The Contractor shall compare all Contract Drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

(DFARS 252.236-7002)

1.2.2 Drawing Numbers

NAVFAC DRAWING NO.	TITLE
2160928	TITLE SHEET
2160929	BORING LOGS
2160930	BORING LOGS
2160931	BORING LOGS
2160932	BORING LOGS
2160933	BORING LOGS
2160934	BORING LOGS
2160935	BORING LOGS
2160936	BORING LOGS
2160937	BORING LOGS AND TEST PITS
2160938	SYMBOLS AND ABBREVIATIONS
2160939	HAUL ROUTE PLAN
2160940	EXISTING CONDITIONS PLAN
2160941	EXISTING CONDITIONS PLAN
2160942	EXISTING CONDITIONS PLAN
2160943	SITES 1 & 3 SLURRY WALL LOCATION AND CONSTRUCTION GRADING PLAN
2160944	SITES 1 & 3 SLURRY WALL LOCATION AND CONSTRUCTION GRADING PLAN
2160945	SITES 1 & 3 INTERPRETIVE SUBSURFACE PROFILES AT SLURRY WALL ALIGNMENT
2160946	SITES 1 & 3 INTERPRETIVE SUBSURFACE PROFILES AT SLURRY WALL ALIGNMENT
2160947	SITES 1 & 3 SUBGRADING, GAS VENT & EROSION AND SEDIMENTATION CONTROL PLAN
2160948	SITES 1 & 3 SUBGRADING, GAS VENT & EROSION AND SEDIMENTATION CONTROL PLAN
2160949	SITES 1 & 3 DRAINAGE PLAN

2160950	SITES 1 & 3 DRAINAGE PLAN
2160951	SITES 1 & 3 FINAL GRADING PLAN
2160952	SITES 1 & 3 FINAL GRADING PLAN
2160953	SITES 1 & 3 DETENTION BASIN OUTLET PIPE PLAN/PROFILE
2160954	SITES 1 & 3 ROADWAY PLAN/PROFILE
2160955	SITES 1 & 3 ROADWAY PLANS/PROFILES
2160956	SITES 1 & 3 ROADWAY PLAN/PROFILE
2160957	SITES 1 & 3 LANDFILL CAP SECTION & PROFILE
2160958	SITES 5, 6, & 8 SITE 5 EXCAVATION & EROSION AND SEDIMENTATION CONTROL PLAN
2160959	SITES 5, 6, & 8 SITE 6 EXCAVATION & EROSION AND SEDIMENTATION CONTROL PLAN
2160960	SITES 5, 6, & 8 SITE 8 EXCAVATION & EROSION AND SEDIMENTATION CONTROL PLAN
2160961	GROUNDWATER PIPELINE PLAN/PROFILE
2160962	GROUNDWATER PIPELINE PLAN/PROFILE
2160963	GROUNDWATER PIPELINE PLAN/PROFILE
2160964	GROUNDWATER PIPELINE PLAN/PROFILE
2160965	GROUNDWATER PIPELINE PLAN/PROFILE
2160966	GROUNDWATER PIPELINE PLAN/PROFILE
2160967	GROUNDWATER PIPELINE PLAN/PROFILE
2160968	GROUNDWATER PIPELINE PLAN/PROFILE
2160969	GROUNDWATER PIPELINE PLAN /PROFILE
2160970	EXTRACTION WELL DETAILS
2160971	CIVIL DETAILS
2160972	EROSION & SEDIMENTATION CONTROL DETAILS
2160973	CIVIL DETAILS
2160974	CIVIL DETAILS
2160975	CIVIL DETAILS
2160976	CIVIL DETAILS
2160977	CIVIL DETAILS
2160978	CIVIL DETAILS
2160979	CIVIL DETAILS
2160980	CIVIL DETAILS
2160981	EROSION CONTROL MEASURES - SECTIONS & DETAILS
2160982	EROSION CONTROL MEASURES - GENERAL NOTES
2160983	EROSION CONTROL MEASURES - GENERAL NOTES
2160984	EROSION CONTROL MEASURES - GENERAL NOTES
2160985	HORIZONTAL ROADWAY GEOMETRY AND COORDINATES AT SITES 1 & 3

2160986	GROUNDWATER TREATMENT BUILDING SITE GRADING AND EROSION & SEDIMENTATION CONTROL PLAN
2160987	GROUNDWATER TREATMENT BUILDING SANITARY SEWER PLAN/PROFILE
2160988	GROUNDWATER TREATMENT BUILDING WATER MAIN REMOVAL AND EXTENSION PLAN
2160989	GROUNDWATER TREATMENT BUILDING GENERAL ARRANGEMENT PLAN
2160990	GROUNDWATER TREATMENT BUILDING GENERAL ARRANGEMENT PLAN & SECTIONS
2160991	GROUNDWATER TREATMENT BUILDING EXTERIOR ELEVATIONS
2160992	GROUNDWATER TREATMENT BUILDING BUILDING SECTIONS & CEILING PLAN
2160993	GROUNDWATER TREATMENT BUILDING STRUCTURAL PLAN
2160994	GROUNDWATER TREATMENT BUILDING STRUCTURAL PLAN & SECTION
2160995	GROUNDWATER TREATMENT BUILDING STRUCTURAL SECTIONS
2160996	GROUNDWATER TREATMENT BUILDING STRUCTURAL SECTIONS & DETAILS
2160997	GROUNDWATER TREATMENT BUILDING MISCELLANEOUS STRUCTURAL DETAILS
2160998	GROUNDWATER TREATMENT BUILDING MISCELLANEOUS STRUCTURAL DETAILS
2160999	GROUNDWATER TREATMENT BUILDING MISCELLANEOUS STRUCTURAL DETAILS
2161000	GROUNDWATER TREATMENT BUILDING PROCESS TANK DETAILS
2161001	GROUNDWATER TREATMENT BUILDING PIPING & INSTRUMENTATION SYMBOLS
2161002	GROUNDWATER TREATMENT BUILDING PIPING & INSTRUMENTATION DIAGRAM
2161003	GROUNDWATER TREATMENT BUILDING PIPING & INSTRUMENTATION DIAGRAM
2161004	GROUNDWATER TREATMENT BUILDING PIPING PLAN
2161005	GROUNDWATER TREATMENT BUILDING PIPING SECTIONS & DETAILS
2161006	GROUNDWATER TREATMENT BUILDING PIPING SECTIONS & DETAILS
2161007	GROUNDWATER TREATMENT BUILDING PIPING SECTIONS & DETAILS

2161008	GROUNDWATER TREATMENT BUILDING PIPING SECTIONS & DETAILS
2161009	GROUNDWATER TREATMENT BUILDING PLUMBING & AIR PIPING PLAN
2161010	GROUNDWATER TREATMENT BUILDING PLUMBING PLAN & ISOMETRICS
2161011	GROUNDWATER TREATMENT BUILDING HEATING & VENTILATION PLAN
2161012	GROUNDWATER TREATMENT BUILDING HEATING & VENTILATION PLAN & SECTION
2161013	GROUNDWATER TREATMENT BUILDING ELECTRICAL LEGEND
2161014	GROUNDWATER TREATMENT BUILDING ELECTRICAL ONE LINE DIAGRAM MCC-1
2161015	GROUNDWATER TREATMENT BUILDING ELECTRICAL ONE LINE DIAGRAM MCC-2
2161016	GROUNDWATER TREATMENT BUILDING ELECTRICAL ELEMENTARIES
2161017	GROUNDWATER TREATMENT BUILDING POWER & LIGHTING PLAN
2161018	GROUNDWATER TREATMENT BUILDING POWER & LIGHTING PLAN & DETAILS
2161019	GROUNDWATER TREATMENT BUILDING LIGHTING DETAILS
2161020	GROUNDWATER TREATMENT BUILDING CONDUIT & CABLE BLOCK DIAGRAM
2161021	GROUNDWATER TREATMENT BUILDING HANDHOLE SCHEDULE & DETAIL
2161022	GROUNDWATER TREATMENT BUILDING ELECTRICAL DETAILS
2161023	GROUNDWATER TREATMENT BUILDING ELECTRICAL DETAILS
2161024	GROUNDWATER TREATMENT BUILDING ELECTRICAL DETAILS
2161025	GROUNDWATER TREATMENT BUILDING INSTRUMENTATION & POWER SCHEDULES
2161026	GROUNDWATER TREATMENT BUILDING CONTROL PANEL & ANNUNCIATOR
2161027	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-100 THRU I-103
2161028	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-104 THRU I-107
2161029	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-108 THRU I-110B
2161030	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-111 THRU I-114

2161031	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-115 THRU I-118
2161032	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-119 THRU I-122
2161033	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-123, I-150 THRU I-152
2161034	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-153 THRU I-156
2161035	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-157 THRU I-160
2161036	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-161 THRU I-164
2161037	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-165 THRU I-168
2161038	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-169 THRU I-172
2161039	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-173 THRU I-176
2161040	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-177 THRU I-180
2161041	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-181 THRU I-184
2161042	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-185 THRU I-188
2161043	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-189 THRU I-192
2161044	GROUNDWATER TREATMENT BUILDING CONTROL LOOPS I-193, I-194
2161045	GROUNDWATER TREATMENT BUILDING LOGIC DIAGRAMS
2159809	GROUNDWATER TREATMENT BUILDING LOGIC DIAGRAMS
2161700	GROUNDWATER TREATMENT BUILDING ELECTRICAL DETAILS

1.2.3 Boring Logs

NAVFAC Drawing Nos. 2160929 through 2160937 indicate the information obtained by Government investigation. The Government does not guarantee that borings indicate actual conditions, except for the exact locations and the time that they were made.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-18, Records

a. Accident prevention plan G

1.4 INFORMATION REQUIRED OF THE CONTRACTOR

1.4.1 Subcontractors and Personnel

Reference is made to the clause of the Contract Clauses entitled "Subcontracts (Labor Standards)." In addition to the data required by that clause, provide a list of the key personnel of the Contractor and subcontractors (including addresses and telephone numbers) for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.5 PROJECT SCHEDULE AND TIME CONSTRAINTS

1.5.1 Commencement, Prosecution, and Completion of Work (APR 84)

The Contractor shall be required to (a) commence work under this contract within 15 calendar days after award of the contract, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 850 calendar days after the required commencement of work. The time stated for completion shall include final cleanup of the premises, 30-day start-up and one-year Operation and Maintenance periods.

(FAR 52.212-3)

1.5.1.1 Definitions

a. The date the Contracting Officer signs the SF 1442 is the date of the award of the contract.
b. A period of 15 days, after which contract time commences, is to allow for the mailing of the SF 1442 and the Contractor's submission and approval of the required bonds, Certificates of Insurance and Certification as to the percentage of work to be performed by the Contractor.
c. The contract time for the purpose of fixing the completion date shall begin to run 15 days from the date of award on the SF 1442, regardless of when the performance and payment bonds are executed.

1.5.2 Liquidated Damages - Construction (APR 84)

1.5.2.1 Failure to Complete Work

If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of $4,800.00 for each day of delay.

(FAR 52.212-5(a))

1.5.2.2 Contractor Liability with Government Termination

If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

(FAR 52.212-5(b))

1.5.2.3 Contractor Liability Without Government Termination

If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

(FAR 52.212-5(c))

1.6 DIVISION OF WORK

1.6.1 Government-Installed Work

The government will provide all telephone wiring and telephone equipment for the groundwater treatment building and Weapons Compound area. The Contractor is responsible for providing the conduit for the telephone wiring for the groundwater treatment building and for the Weapons Compound Area.

PART 2 PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 FACILITIES AND SERVICES

3.1.1 Availability of Utilities Services

Pursuant to the clause of the Contract Clauses entitled "Availability and Use of Utility Services," reasonable amounts of the following utilities will be made available to the Contractor without charge: Electricity and potable water.

The point at which the Government will deliver such utilities or services and the quantity available shall be as directed by the Contracting Officer. The Contractor shall pay all costs incurred in connecting, converting, and transferring the utilities to the work. The Contractor shall make connections, including providing backflow-preventing devices on connections to domestic water lines, provide transformers, and make disconnections.

Contractor utility connections shall not interfere with normal base traffic outside the area of work.

3.1.2 Contractor's Storage Area

The clause of the Contract Clauses entitled "Operations and Storage Areas" and the following apply:

3.1.2.1 Storage Size and Location

The open site available for storage shall be as directed by the Contracting Officer.

3.1.3 Temporary Buildings

Locate these where directed by the Contracting Officer.

3.1.3.1 Maintenance of Temporary Facilities

Suitably paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.1.3.2 Contractor Quality Control Records and Field Office

Provide on the jobsite an office with approximately 200 square feet of useful floor area for the exclusive use of the Contractor's quality control representative. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4-foot by 8-foot plan table, a standard size office desk and chair, and working communications facilities. Provide either a 1,500-watt radiant heater and a window-mounted air conditioner rated at 9,000 Btu's minimum or a window-mounted heat pump of the same minimum heating and cooling ratings. Provide a door with a cylinder lock and windows with locking hardware. Furnish all necessary utilities. Locate as directed. Contractor quality control records shall be filed in the office and available at all times to the Government. After completion of the work, remove the entire structure from the site.

3.2 RESTRICTIONS ON EQUIPMENT

3.2.1 Electromagnetic Interference Suppression

a. Electric Motors: Motors shall comply with MIL-STD-461 relative to radiated and conducted electromagnetic interference. A test for electromagnetic interference will not be required for motors that are identical physically and electrically to those that have previously met the requirements of MIL-STD-461. An electromagnetic interference suppression test will not be required for electric motors without commutation or sliprings having no more than one starting contact and operated at 3,600 revolutions per minute or less.

b. Contractor's Construction Equipment: Equipment used by the Contractor shall comply with MIL-S-16165 for internal combustion engines and MIL-STD-461 for other devices capable of producing radiated or conducted interference.

c. Tests for Electromagnetic Interference Suppression: Conduct tests on electric motors and the Contractor's construction equipment in accordance with MIL-STD-461 and MIL-STD-462. The test location shall be reasonably free from radiated and conducted interference. Furnish the testing equipment, instruments, and personnel for making the tests; a test location; and other necessary facilities.

3.2.2 Radio Transmitter Restrictions

Conform to the restrictions and procedures for the use of radio transmitting equipment, as directed. Do not use transmitters without prior approval.

3.3 RESTRICTIONS ON OPERATIONS

3.3.1 Restrictions Upon Interrupting Utility Services

The clause of the Contract Clauses entitled "Schedules for Construction Contract"; the paragraph of Section 01010, "General Paragraphs," entitled "Order of Work"; and the following apply:

a. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

b. Interruption to Water, Sanitary Sewer, Storm Sewer, Telephone Service, Electric Service, and Fire Alarm: These shall be considered utility cutovers pursuant to the paragraph of Section 01010, "General Paragraphs," entitled "Work Outside Regular Hours." This limit includes time for deactivation and reactivation. Lay temporary water services before constructing new water lines.

3.3.2 Security Requirements

No employee or representative of the Contractor will be admitted to the work site without satisfactory proof of United States citizenship or specifically authorized admittance to the work site by the Officer in Charge of Construction.

3.3.2.1 Extraordinary Security Requirements

The clause of the Contract Clauses entitled "Identification of Employees" shall apply. Identification badges will be furnished without charge, if required, but application for and use of badges will be as directed. Immediately report instances of lost or stolen badges to the Contracting Officer.

3.3.3 Accident Prevention Plan

Submit in writing an Accident Prevention Plan in accordance with Contract Clause entitled "Accident Prevention" and the current edition of the U.S. Army Corps of Engineers "Safety and Health Requirements Manual" COE EM 385-1-1 in effect on the date of the solicitation. Prepare the Accident Prevention Plan following the guidelines found in Table 1-1, page 3 of COE EM 385-1-1. The Accident Prevention Plan shall also include a hazard communication program complying with the requirements of 29 CFR 1926.59 and COE EM 385-1-1. For each major phase of the work, prepare an activity hazard analysis as required by COE EM 385 1-1, using the format and information shown in Figure 1-1, page 5 of COE EM 385-1-1. The Contractor shall meet in conference with the Contracting Officer to discuss and develop mutual understandings relative to the overall safety program. Work at the construction site will not be permitted until the Accident Prevention Plan is approved by the Contracting Officer.

3.4 ACTIONS REQUIRED OF THE CONTRACTOR

3.4.1 Materials and Equipment to Be Salvaged

The clause of the Contract Clauses entitled "Salvage Materials and Equipment" applies to existing materials and equipment to be removed but to remain the property of the Government. They are listed in this paragraph. Remove and handle the material and equipment without damage and deliver into storage on the station at the delivery point designated in this paragraph:

MATERIALS AND EQUIPMENT	DELIVERY POINT
Buried Valves and Boxes	Public Works, Bldg. 8
Fencing	On station as directed

3.4.2 Location of Underground Facilities

Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated in locations to be traversed by piping, ducts, and other work to be installed. Verify the elevations before the new work is laid closer than the nearest manhole or other structure at which an adjustment in grade could be made. For additional work required by reason of conflict between new and existing work, an adjustment in contract price will be made in accordance with the clause of the Contract Clauses entitled "Differing Site Conditions."

3.4.3 Station Permits

Obtain these pursuant to the paragraph of Section 01010, "General Paragraphs," entitled "Station Regulations." Permits are required for, but are not necessarily limited to, welding, digging, and burning. Allow 7 calendar days for processing of the application.

3.4.4 Storm Protection

If a warning of gale force winds is issued, take precautions to minimize any danger to persons, and protect the work and any nearby Government property. Precautions shall include, but are not limited to: closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work if storms of lesser intensity pose a threat to the work or any nearby Government property.

3.4.5 Unforeseen Hazardous Material

If material, not otherwise identified as hazardous, is encountered which may be dangerous to human health if disturbed during construction operations, the Contractor shall stop that portion of the work and avoid coming in contact with the material. The Contractor shall immediately notify the Contracting Officer concerning the possible existence of hazardous material. The intent is to identify materials such as friable and nonfriable asbestos, polychlorinated biphenyls (PCBs) and paint containing lead. Within 14 calendar days, the Government will perform testing to determine if the material is hazardous. If the material is not hazardous or poses no danger, the Contracting Officer will direct the Contractor to proceed without change. If the material is hazardous and must be disturbed or handled to accomplish the work, the Contracting Officer will direct a change pursuant to the Contract Clauses entitled "Changes" and "Differing Site Conditions."

-- End of Section --

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	1989 Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	1991 (Rev. A) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	1991 (Rev. A) Evaluating and Qualifying Agencies and Inspecting Bituminous Paving Materials
ASTM D 3740	1988 Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	1990 Evaluation of Testing and Inspection Agencies as Used in Construction
ASTM E 543	1989 (Rev. A) Determining the Qualification of Nondestructive Testing Agencies

NAVAL ENERGY AND ENVIRONMENTAL SUPPORT ACTIVITY (NEESA)

NEESA 20.2-047B	1988 Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-18, Records

a. Quality Control (QC) plan G

Submit a QC plan within 30 calendar days after award of the Contract, that complies with the requirements of this Section and Section 01410, "Soil Sampling and Analysis."

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Deliver the following to the Contracting Officer:

a. Combined Contractor Production Report/Contractor Quality Control Report (1 sheet): Original and 1 copy by 10:00 AM the next working day after each day that work is performed;
b. QC Specialist Reports: Originals and 1 copy, by 10:00 AM the next working day after each day that work is performed;
c. Testing Plan and Log, 1 copy, at the end of each month;
d. Monthly Summary Report of Field Tests: Original and 1 copy attached to Contractor Quality Control Report at the end of each month;
e. QC Meeting Minutes: 1 copy, within 2 calendar days of the meeting;
f. Rework Items List: 1 copy, by the last working day of the month; and
g. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, a QC Plan, a QC Plan meeting, a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval except those designated for Contracting Officer approval, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program shall cover construction operations on-site and off-site and shall be keyed to the proposed construction sequence.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to manage and implement the QC program. The only duties and responsibility the QC Manager shall have on this Contract is managing and implementing the QC program. The QC Manager is required to attend the QC Plan meeting, attend the Coordination and Mutual Understanding Meeting, conduct the QC

meetings, perform the three phases of control, perform submittal review and approval except those designated for Contracting Officer approval, ensure testing is performed and prepare QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC specialists. No work or testing may be performed unless the QC Manager is on the work site. The QC Manager shall report directly to an officer of the firm and shall not be the same individual as, nor be subordinate to, the project superintendent or the project manager.

1.5.1.2 Qualifications

A graduate of a four-year accredited college program in one of the following disciplines: Engineering, Construction Management, Engineering Technology, Building Construction, Building Science with a minimum of 5 years experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this Contract.

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC manager except that a degree from a two-year college program is acceptable.

1.5.3 QC Specialists Duties and Qualifications

Provide a separate QC specialist at the work site for each of the areas of responsibilities, specified below, who shall assist and report to the QC Manager and who may perform production related duties in addition to performing the three phases of control and preparing documentation required in this Contract. QC specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings, and perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility at the frequency specified below.

Qualification/Experience in Area of Responsibility	Area of Responsibility	Frequency
Slurry Wall Contractor Representative - 3 year minimum	Installation and QC Testing	Full-time during slurry wall construction
Independent Geomembrane Inspector and Tester- 3 Year minimum	Installation and QC Testing	Full-time during geomembrane installation

Provide a Submittal Reviewer qualified in the disciplines being reviewed, other than the QC Manager, to review and certify that the following submittals meet the requirements of this Contract:

Qualification/Experience in Submittal Discipline	Submittals to be reviewed	
	Spec Section No.	SD No. & Submittal
Laboratory Analysis/Familiar with Laboratory QC Procedures	01680	SD-10 Laboratory Tests
Steel Design, Structural Steel	05500, 13121	SD-02, SD-04, SD-05
Concrete Design, Concrete Foundations, Concrete Reinforcement	03300	SD-02, SD-04
Heating and Ventilating	15483, 15621, 15850	SD-02, SD-04
Sprinkler System, Fire	15330	SD-02, SD-04, SD-05
Process Piping and Valves	15410	SD-02
Instrumentation, Programmable Controllers, and Computers	16900, 13717	SD-02, SD-04
Electrical	16480	SD-02, SD-04

1.6 QC PLAN

1.6.1 Requirements

Provide for approval by the Contracting Officer, a QC plan that covers, both on-site and off-site work and includes, the following:

a. A chart showing the QC organizational structure and its relationship to the production side of the organization.
b. Names and qualifications, in resume format, for each person in the QC organization.
c. Duties, responsibilities and authorities of each person in the QC organization.
d. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.
e. A letter signed by an officer of the firm appointing the QC Manager and stating that he/she is responsible for managing and implementing the QC program as

described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

f. Procedures for reviewing, approving and managing submittals. Provide the name of the person in the QC organization authorized to review and certify submittals prior to approval.

g. Testing laboratory information required by the paragraphs entitled "Accredited Laboratories" or "Testing Laboratory Requirements," as applicable.

h. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test. The testing plan for water quality monitoring shall comply with "CLP SOW for Organics Analysis" document number OLM01.2, January 1991, EPA OSWER-9950.1 "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (1986), and EPA 548/G-89/004 "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," specifically elements of a field sampling program.

i. Procedures to identify, record, track and complete rework items.

j. Documentation procedures, including proposed report formats.

k. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and requires separate control requirements. As a minimum, if approved by the Contracting Officer, consider each section of the specifications as a definable feature of work. However, at times, there may be more than one definable feature of work in each section of the specifications.

l. A personnel matrix showing, for each section of the specification, who will review and approve submittals, who will perform and document the three phases of control, and who will perform and document the testing.

1.6.2 Preliminary Work Authorized Prior to Approval

The only work that is authorized to proceed prior to the approval of the QC plan is mobilization of storage and office trailers and surveying.

1.6.3 Approval

Approval of the QC plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC plan and operations as necessary to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify his/her submitted qualifications.

1.6.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes must be approved by the Contracting Officer.

1.7 QC PLAN MEETING

Prior to submission of the QC plan, meet with the Contracting Officer to discuss the QC plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC plan requirements prior to plan development and submission.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, but prior to the start of construction, meet with the Contracting Officer to discuss the QC program required by this Contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used for documentation, administration for on-site and off-site work, and the coordination of the Contractor's management, production and QC personnel with the Contracting Officer. As a minimum, the Contractor's personnel required to attend shall include the project manager, project superintendent, QC Manager, and QC specialists. Minutes of the meeting shall be prepared by the QC Manager and signed by both the Contractor and the Contracting Officer.

1.9 QC MEETINGS

After the start of construction, the QC Manager shall conduct QC meetings once every two weeks at the work site with the project superintendent and QC specialists. The QC Manager shall prepare the minutes of the meeting and provide a copy to the Contracting Officer within two working days after the meeting. The Contracting Officer may attend these meetings. The QC Manager shall notify the Contracting Officer at least forty-eight hours in advance of each meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;
b. Review the schedule and the status of work:
   - Work or testing accomplished since last meeting
   - Rework items identified since last meeting
   - Rework items completed since last meeting;
c. Review the status of submittals:
   - Submittals reviewed and approved since last meeting
   - Submittals required in the near future;
d. Review the work to be accomplished in the next two weeks and documentation required. Schedule the three phases of control and testing:
   - Establish completion dates for rework items
   - Preparatory phases required
   - Initial phases required
   - Follow-up phases required
   - Testing required
   - Status of off-site work or testing
   - Documentation required;
e. Resolve QC and production problems; and

f. Address items that may require revising the QC plan:
- Changes in QC organization personnel
- Changes in procedures.

1.10 THREE PHASES OF CONTROL

The QC Manager shall perform the three phases of control to ensure that work complies with Contract requirements. The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each definable features of work: A definable feature of work is a task which is separate and distinct from other tasks and requires separate control requirements.

1.10.1 Preparatory Phase

Notify the Contracting Officer at least two work days in advance of each preparatory phase. Conduct the preparatory phase with the QC specialists, the superintendent, and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;
b. Review the Contract drawings;
c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;
d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;
e. Examine the work area to ensure that the required preliminary work has been completed;
f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;
g. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted; and
h. Discuss construction methods.

1.10.2 Initial Phase

Notify the Contracting Officer at least two work days in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with the QC Specialists, the superintendent, and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report. Repeat the

initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:

a. Establish the quality of workmanship required;
b. Resolve conflicts;
c Review the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met; and
d. Ensure that testing is performed by the approved laboratory.

1.10.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the daily Contractor Quality Control Report:

a. Ensure the work is in compliance with Contract requirements;
b. Maintain the quality of workmanship required;
c. Ensure that testing is performed by the approved laboratory; and
d. Ensure that rework items are being corrected.

1.10.4 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.11 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01300, "Submittals."

1.12 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.12.1 Testing Laboratory Requirements

Provide an independent testing laboratory qualified to perform sampling and tests required by this Contract. When the proposed testing laboratory is not accredited by an acceptable accreditation program as described by the paragraph entitled "Accredited Laboratories," submit to the Contracting Officer for approval, certified statements signed by an official of the testing laboratory attesting that the proposed laboratory meets or conforms to the following requirements:

a. Sampling and testing shall be under the technical direction of a Registered Professional Engineer (P.E) with at least 5 years of experience in construction material testing.
b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C 1077.
c. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D 3666.
d. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D 3740.
e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A 880. Laboratories shall meet the requirements of ASTM E 329.
f. Laboratories engaged in nondestructive testing (NDT) shall meet the requirements of ASTM E 543.
g. Laboratories engaged in water quality testing shall be in accordance with NEESA 20.2-047B.

1.12.2 Accredited Laboratories

Acceptable accreditation programs are the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO) program, the American Association for Laboratory Accreditation (A2LA) program, and/or by NEESA. Furnish to the Contracting Officer, a copy of the Certificate of Accreditation, Scope of Accreditation and latest directory of the accrediting organization for accredited laboratories. The scope of the laboratory's accreditation shall include the test methods required by the Contract. Laboratories performing chemical analysis shall submit documentation of current NEESA certification and must maintain this certification throughout the period of performance of the project.

1.12.3 Inspection of Testing Laboratories

Prior to approval of non-accredited laboratories, the proposed testing laboratory facilities and records may be subject tc inspection by the Contracting Officer. Records subject to inspection include equipment inventory, equipment calibration dates and procedures, library of test procedures, audit and inspection reports by agencies conducting laboratory evaluations and certifications, testing and management personnel qualifications, test report forms, and the internal QC procedures.

1.12.4 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.12.5 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.13 QC CERTIFICATIONS

1.13.1 Contractor Quality Control Report Certification

Each Contractor Quality Control Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.13.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

1.13.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract."

1.14 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.14.1 Contractor Production Report

Reports are required for each day that work is performed and shall be attached to the Contractor Quality Control Report prepared for the same day. Account for each

calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Production Reports are to be prepared, signed and dated by the project superintendent and shall contain the following information:

a. Date of report, report number, name of contractor, Contract number, title and location of Contract and superintendent present.
b. Weather conditions in the morning and in the afternoon including maximum and minimum temperatures.
c. A list of Contractor and subcontractor personnel on the work site, their trades, employer, work location, description of work performed and hours worked.
d. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:
   - Was a job safety meeting held? (If YES attach a copy of the meeting minutes)
   - Were there any lost time accidents? (If YES attach a copy of the completed OSHA report)
   - Was trenching/scaffold/high voltage electrical/high work done? (If YES attach a statement or checklist showing inspection performed)
   - Was hazardous material/waste released into the environment? Meetings held and accidents that happened.
e. A list of equipment/material received each day that is incorporated into the job.
f. A list of construction and plant equipment on the work site including the number of hours used, idle and down for repair.
g. Include a "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

1.14.2 Contractor Quality Control Report

Reports are required for each day that work is performed and for every seven consecutive calendar days of no-work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Quality Control Reports are to be prepared, signed and dated by the QC Manager and shall contain the following information:

a. Identify the control phase and the definable feature of work.
b Results of the Preparatory Phase meetings held including the location of the definable feature of work and a list of personnel present at the meeting. Indicate in the report that for this definable feature of work, the drawings and specifications have been reviewed, submittals have been approved, materials comply with approved submittals, materials are stored properly, preliminary work was done

correctly, the testing plan has been reviewed, and work methods and schedule have been discussed.

c. Results of the Initial Phase meetings held including the location of the definable feature of work and a list of personnel present at the meeting. Indicate in the report that for this definable feature of work the preliminary work was done correctly, samples have been prepared and approved, the workmanship is satisfactory, test results are acceptable, work is in compliance with the Contract, and the required testing has been performed and include a list of who performed the tests.

d. Results of the Follow-up Phase inspections held including the location of the definable feature of work. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, and that required testing has been performed and include a list of who performed the tests.

e. Results of the three phases of control for off-site work, if applicable, including actions taken.

f. List the rework items identified, but not corrected by close of business.

g. List the rework items corrected from the rework items list along with the corrective action taken.

h. Include a "remarks" section in this report which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the QC Organization and corrective action taken by the Contractor.

i. Contractor Quality Control Report certification.

1.14.3 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC specialist reports shall include the same documentation requirements as the Contractor Quality Control Report for their area of responsibility. QC specialist reports are to be prepared, signed and dated by the QC specialists and shall be attached to the Contractor Quality Control Report prepared for the same day.

1.14.4 Testing Plan and Log

As tests are performed, the QC Manager shall record on the "Testing Plan and Log" the date the test was conducted, the date the test results were forwarded to the Contracting Officer, remarks and acknowledgement that an accredited or Contracting Officer approved testing laboratory was used. Attach a copy of the updated "Testing Plan and Log" to the last daily Contractor Quality Control Report of each month.

1.14.5 Rework Items List

The QC Manager shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Contractor Rework Items List" to the last daily Contractor Quality Control Report of each month. The Contractor shall be responsible for including on this list items needing rework including those identified by the Contracting Officer.

1.14.6 As-Built Drawings

The QC Manager is required to review the as-built drawings required by Section 01010, "General Paragraphs," to ensure that as-built drawings are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. The QC Manager or QC Specialist assigned to an area of responsibility shall initial each deviation and each revision. Upon completion of work, the QC Manager shall furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.14.7 Report Forms

The following forms, which are attached at the end of this section, are acceptable for providing the information required by the paragraph entitled "Documentation." While use of these specific formats are not required, any other format used shall contain the same information:

a. Combined Contractor Production Report and Contractor Quality Control Report (1 sheet), with separate continuation sheet;
b. Testing Plan and Log; and
c. Rework Items List.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SITEWORK

SECTION 02214

SOIL-BENTONITE SLURRY WALL

PART 1 GENERAL

1.1 SUMMARY

This section includes the provision of all plant, labor, and materials necessary for the construction of the soil bentonite slurry wall.

1.2 REFERENCES

AMERICAN PETROLEUM INSTITUTE (API)

API RP 13A-90	Specification for Oil-Well Drilling-Fluid Materials
API RP 13B-1-90	Standard Procedure for Field Testing Water Based Drilling Fluids

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117-87	Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing
ASTM C 136-84a	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 143-90	Test Method for Slump of Portland Cement Concrete
ASTM D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 5084-90	Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeater
ASTM E 11-87	Method for Checking Wire Cloth Sieves to Determine Whether They Conform to Specification

1.3 RELATED REQUIREMENTS

Section 02220, "General Excavation, Filling, and Backfilling," Section 02102, "Clearing and Grubbing," Section 02736, "Geotextiles," and Section 02990, "Excavation, Handling, Disposal of Contaminated Material," apply to this section with the additions and modifications specified herein.

1.4 DEFINITIONS

1.4.1 Water

Water used for mixing with bentonite to make bentonite water slurry (slurry).

1.4.2 Bentonite

Pulverized natural unadulterated premium grade sodium cation montmorillonite to mix with source water to make bentonite water slurry and trench or borrow soils to make soil bentonite backfill.

1.4.3 Bentonite Water Slurry (Slurry)

Stable colloidal suspension of pulverized bentonite in water used to maintain trench stability during excavation, and to add to trench soil cuttings or soil borrow and bentonite to produce soil bentonite backfill (backfill).

1.4.4 Slurry Wall Trench (Trench)

Three foot minimum width continuous trench excavation by slurry trench method of excavation and backfilled with soil bentonite backfill with hydraulic conductivity of less than $1.0X10^{-7}$ cm/sec.

1.4.5 Slurry Trench Method of Excavation

Method of constructing a vertical walled trench by keeping the trench filled with slurry. The slurry in the trench provides lateral support for the side walls of the trench. The trench is excavated to its full depth under the slurry. The slurry is displaced by soil bentonite backfill.

1.4.6 Trench Cuttings

Soil material removed from the trench during excavation. The material will be used to produce soil bentonite backfill. Excess or unsuitable materials will be used as common borrow below the landfill cap.

1.4.7 Soil Bentonite Backfill (Backfill)

Engineered mixture of soil trench cuttings, 2% bentonite by weight, and bentonite water slurry mixed to a homogenous consistency used as a low permeability backfill for the completed slurry wall.

1.4.8 Working Platform

The surface on which the equipment shall operate to excavate and backfill the trench in order to complete the slurry wall. The elevation of this surface along the alignment of the slurry wall shall be such that it does not cause slurry in any part of the open trench excavation to be more than 3 feet below the top of the trench.

1.4.9 Backfill Remote Mixing Pad

A working surface constructed at a remote location from the slurry wall alignment in which the soil bentonite backfill will be proportioned and mixed. The soil trench cuttings or soil borrow will be transported to this pad for mixing and the resulting backfill will be transported back to the trench and placed in the trench to form the completed slurry wall.

1.4.10 Slurry Ponds

Ponds constructed for the purpose of storage of mixed slurry. Earthwork for slurry ponds constructed within the limits of the landfill must consist of fill only; excavation below existing grades will not be permitted.

1.4.11 Groundwater Level

Elevation of groundwater as observed in piezometers and monitoring wells. Slurry will be maintained at least 3 feet above groundwater level at all times.

1.5 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals".

1.5.1 SD-02, Manufacturer' Catalog Data

Bentonite. G

1.5.2 SD-08, Statements

a. Qualifications of Contractor. G

b. Field quality control plan to be used during construction of the slurry wall. G
c. Quality control report forms. G
d. Description of construction procedures and methods, including: G
   1. Construction maintenance, and removal of working platforms, remote mixing pad and haul roads.
   2. Description and list of major equipment to be used during construction.
   3. Description of slurry mixing batch plant, remote mixing pad, and slurry holding ponds or tanks layouts, including pumps, valves, and supply lines.
   4. Material and equipment storage.
   5. Trench excavation and soil cuttings transportation.
   6. Backfill mixing, including methods for measuring quantity of bentonite added per batch, and method of proportioning of soil cuttings to provide homogeneity of the full vertical soil profile for each batch.
   7. Methods for reducing free water in cuttings, if needed, to provide backfill mix batches that meet the specified requirements.
   8. Backfill transportation and placement.
   9. Disposal of excess soil trench cuttings, soil borrow, and slurry.

1.5.3 SD-10, Test Reports

Water source including chemical analysis, if source is other than potable water collected from the new hydrant installed in the water main east of the landfill. G

1.5.4 SD-12, Field Test Reports

Results of Field Quality Control testing during construction. G

1.5.5 SD-13, Certificates

Certificate of Compliance for each shipment of bentonite. G

1.6. CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Unit price bid for the completed slurry wall will be on a square foot (length times depth of completed slurry wall) basis. The square footage for bid purposes will be the face area of the installed slurry wall between station 0+00 and 22+25. The bid should be prepared based on 107,308 square feet of completed slurry wall. The depth of trench for payment purposes will be from the minimum working platform elevation as indicated on the drawings, and the approved bottom of the trench. No payment will be made for the lead-in trench or over-excavation. The unit cost for the slurry wall should include all work incidental to construction of the slurry wall, including: operation and maintenance

of slurry wall construction equipment, slurry mixing plant and operations, trench excavation, backfilling, mixing, transportation, and trench backfilling, maintenance and cleaning of working platform and remote mix pad, and slurry and excess soil disposal. General excavation and filling to construct the working platform should be included as a separate lump sum pay item. Mobilization and demobilization should be a separate lump sum pay item, and should include construction of the remote mixing pad.

b. Surface elevations are as indicated.

c. The approximate locations of known surface and subsurface utilities and obstructions are indicated. Underground utilities must be located and identified by the contractor.

d. Subsurface soil material character is indicated by the boring logs. The borings are believed to be representative of the subsurface conditions but only represent points on the slurry wall alignment. The Contractor should anticipate variations in depth and distribution of soil types.

e. Groundwater levels indicated by the boring logs were those existing at the time of the subsurface investigations were made and do not necessarily represent groundwater elevations at the time of construction.

f. Water source will be provided by Naval Air Station Brunswick from the new hydrant installed into the existing water main east of the landfill. A sample of the water will be provided to the Contractor upon request.

1.7 QUALIFICATIONS OF SLURRY WALL CONTRACTOR

1.7.1 Contractor's qualifications to substantiate slurry trench construction experience, including names and locations of previous slurry trench wall installations, and name and experience of slurry trench superintendent who will be responsible for the installation of the trench. Contractor shall have sufficient experienced personnel to carry out the operations specified and a slurry trench superintendent to supervise construction. The Contractor must demonstrate that he has successfully constructed at least 10 trenches of similar or greater depth and length using continuous soil bentonite slurry trench methods.

1.7.2 Contractor's Slurry Wall Superintendent

a. Minimum 5 years of continuous experience with slurry trench construction.
b. Supervised at least 1,000,000 sq. ft. of soil bentonite slurry wall installations.
c. Knowledgeable about:
   1. The use, testing, and control of bentonite as a bentonite water slurry.
   2. The proper mixing methods required to mix the slurry and backfill material.
   3. Slurry trench excavation and equipment operations.
   4. Slurry wall construction equipment and quality control testing requirements.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Water

a. Clean and free of excessive amounts of deleterious substances that could adversely affect the properties of the slurry or backfill.
b. Relatively low in hardness, near neutral or slightly high pH (pH of 7-10) and low in dissolved salts to allow proper hydration of bentonite.
c. The water source supplied by Naval Air Station Brunswick conforms to the above requirements. If another source is used, certification of the above characteristics must be submitted for approval.

2.1.2 Bentonite

a. Pulverized natural unadulterated premium grade sodium cation montmorillonite.
b. Bentonite shall be in conformance with API RP 13A with a minimum yield of 90 barrels per ton.
c. Bentonite shall not contain polymers or other additives.
d. Conformance based on submission of manufacturer's catalog certificate and specification and certificate of compliance for each truckload.

2.1.3 Additives

a. Admixtures of the type used in the control of oil-field drilling muds such as softening agents, dispersants, retarders or plugging or bridging agents will not be permitted.

2.1.4 Slurry

a. Stable colloidal suspension of bentonite in water.
b. Controlled in accordance with API RP 13B.
c. Characteristics in accordance with the attached schedule.

2.1.5 Backfill Mix

a. Composed of slurry and selected soils obtained from trench cuttings or approved soil borrow source.
b. Soil for use in the backfill mix shall be friable and free from roots, organic matter, or other deleterious materials or substances which may adversely affect the backfill.

Frozen soil shall not be used. Stockpiles of soils shall be managed and protected to eliminate the addition of free water into the backfill.

c. The mixture of soil, 2% bentonite, and slurry to prepare backfill must be in accordance with gradation limits established in the attached schedule.
d. Requirements for backfill hydraulic conductivity, slump, and unit weight are specified in the attached schedule.

2.2 EQUIPMENT

2.2.1 Excavation Equipment

a. Equipment for excavation of the slurry trench shall consist of mechanical or hydraulic operated backhoe or clamshell (or combination) capable of excavating trench as indicated. In recognition of the potential for isolated variations in key depth, the Contractor's equipment must be capable of excavation at least 10 feet greater than the maximum depth indicated.
b. Trench excavation equipment must be capable of excavation of a 3.0 foot wide minimum trench width in one pass. The minimum width of excavation bucket or clamshell must be equal to minimum specified trench width. The Contractor shall have means available to remove sediment or other deleterious debris which occurs in the trench beyond the reach of his excavation equipment.

2.2.2 Slurry Batching Plant

a. Slurry should be made in a flash or paddle mixer, and can not be made in the trench.
b. The slurry batching plant shall consist of equipment necessary to mix, recirculate, and pump slurry from the slurry storage ponds or tanks, and must include all mixers, pumps, compressors, pipe and supply lines, and valves, and storage tanks (if used).
c. Slurry storage ponds or tanks shall have sufficient capacity to allow 24 hours hydration of bentonite in slurry prior to introduction in the trench or for use in backfill preparation.
d. Slurry shall be agitated or recirculated in storage pond or tanks to maintain a homogenous mix.

2.2.3 Backfill Remote Mixing Pad

a. Backfill shall be made at a remote mixing pad at a location as indicated. No backfill will be mixed beside the trench.
b. The remote mixing pad will be constructed of reinforced concrete or equal to facilitate repeated controlled batch mixing without degradation or incorporation of the underlying materials.

c. Earthwork for construction of the remote mixing pad must consist of fill only. Excavation below existing grades will not be permitted.
d. Equipment for mixing of backfill at the remote mixing pad shall consist of mechanical blenders, dozers, disk harrows, or other suitable means of producing a homogenous backfill mix meeting the specified properties.
e. The remote mix pad will require storage for excavated trench materials. Excavated material shall be stockpiled at the location indicated.

2.2.4 Backfilling Equipment

Backfill will be placed to the top of the backfill slope at the trench. Equipment used for backfilling will be designed and operated so as to not place unnecessary loads adjacent to the open trench. No backfill will be dropped through the slurry. The placement method will ensure that no foreign materials can be dislodged or otherwise incorporated as part of the placement process.

PART 3 EXECUTION

3.1 WORKING PLATFORM PREPARATION

Prior to excavation of slurry wall, the working platform and perimeter haul road will be prepared as indicated and described in Sections 02220, 02102, 02736, and 02990, and any haul roads from the working platform/perimeter road to the remote mixing pad will be constructed. The haul roads will permit transfer of excavation cuttings and prepared backfill to and from the trench. The working platform surface will be maintained and kept free of excessive amounts of debris and slurry at all times.

3.2 TRENCH EXCAVATION

3.2.1 The estimated profile and description of the overburden soils through which the trench is to be excavated are as indicated.

3.2.2 After construction of the working platform, perimeter road, haul roads, remote mixing pad, assembly of the slurry batching plant and preparation of hydrated slurry, excavate the slurry trench in the sequence and to the dimensions as follows:

a. Minimum trench width: 3.0 ft.
b. Excavate the trench to sufficient depth to provide at least a 3.0 ft. key into the homogenous gray silty clay.
c. The minimum depth of trench to provide a 3.0 ft. key into the homogeneous gray silty clay is as indicated. Actual excavation depth will be determined based on visual observation of the trench cuttings. The excavation will not be less than the indicated depths.

d. The key depth will be confirmed with measurements taken from the working platform surface to the bottom of the trench using the sounding method (weighted cable). Measurements will be made at the top of the key (to be determined by examination of trench cuttings) and at the bottom of the key to confirm the required key depth.
e. A lead-in trench east of Station 0+00 may be constructed as indicated to allow a gradual transition for backfilling purposes from the working platform to the bottom of the trench at Station 0+00. The bottom of the lead-in trench will be sloped at 2H:1V (horizontal to vertical).
f. Excavate to the required design depth at Station 0+00 and then continue excavation to the required depth in a continuous manner along the alignment of the trench to Station 24+25.
g. The working platform will be graded to ensure excavation equipment produces a vertical trench.
h. A minimum separation of 25 feet will be maintained between the excavation and toe of backfill.
i. Quality control requirements for the trench are presented in the attached schedule.

3.3 SLURRY PREPARATION AND PLACEMENT

3.3.1. Slurry Preparation

a. Prepare slurry using a suitable flash or paddle mixer to provide a stable colloidal suspension of bentonite and water.
b. The Contractor will provide ponds, tanks, or other storage of sufficient size to permit 24 hours of hydration of all slurry prior to use in trenching or backfill mixing.
c. Slurry will not be made in the trench.
d. Continue mixing water and bentonite slurry until bentonite particles are fully hydrated based on stabilized Marsh Funnel viscosity readings and slurry appears homogenous.
e. Slurry shall meet the quality control requirements specified in the attached schedule.

3.3.2 Slurry Placement

a. Introduce slurry into trench at the same time trenching is begun and maintain in the trench during excavation until completely backfilled.
b. Maintain the stability of the excavated trench at all times for its full depth.
c. Maintain slurry level at least 3 ft. above groundwater level.
d. Do not allow slurry level to drop more than 3 ft. below slurry trench working platform surface and maintain as close to the working platform elevation as practical.

e. Have personnel, equipment, and materials ready to raise the slurry level at any time, including weekends, nights, and holidays.

3.3.3 Slurry Cleaning

Slurry containing excessive suspended material as indicated by a slurry density exceeding 85 pcf, shall be recirculated and suspended material separated and removed by use of airlifting and stilling ponds, screens, cyclones, or other appropriate methods. The contractor must have equipment on site to remove slurry from the trench. Slurry density will be maintained at less than 90 pcf at all times. Should the slurry density exceed 85 pcf, the Contractor will commence desanding or other operations to control slurry density and maintain at less than 90 pcf.

3.4 TRENCH CLEANING

3.4.1 Trench Continuity

Upon completion of excavation, pass excavating tools horizontally and vertically over completed excavated section to confirm trench continuity.

3.4.2 Trench Cleaning

a. Remove any loose material or cuttings from trench bottom during excavation with the excavation tools.
b. Remove any loose material subsequent to excavation operations by excavation tools or other suitable means such as air lift pumps.

3.5 BACKFILL MIXING AND PLACEMENT

3.5.1 Backfill Mixing

a. Backfill mixing will be performed at a remote mixing pad, or in a mechanical blender or pug mill, and will not be performed adjacent to the trench at the working platform.
b. Materials will be stockpiled, batched, and mixed to ensure homogeneity of the full vertical soil profile. This will be necessary to achieve the gradation requirements.
c. Mix and blend soil trench cuttings or borrow material, slurry, and 2 percent dry bentonite by total weight in mechanical blenders or by windrowing, disk harrowing, or bulldozing and blading.
d. Mix only the quantity of backfill that is needed. Do not mix excessive amounts of backfill.
e. Mix and blend each batch in such a manner as to produce the required backfill gradation and properties specified in the attachment.

f. Thoroughly mix backfill materials into a homogenous mass, free from lumps or pockets of fines, sand, or gravel.
g. Sluice materials with slurry as needed to meet the slump and density requirements during blending operations. Sluicing with water will not be permitted.
h. Prepared backfill shall not be allowed to dry or become excessively wet (as measured by slump testing), or freeze prior to placement in the trench.
i. Should soil profiles vary significantly from those shown, such that the design requirements identified in the attachment cannot be met, immediately discontinue excavating and mixing operations and notify the Contracting Officer.

3.5.2 Backfill Mix Placement

a. Prior to placement of each batch of backfill, the slump and material fines content determinations must be performed and completed, and found to be in compliance with specified values.
b. Place continuously from the beginning of the trench in the direction of the excavation, to the end of the trench.
c. Proceed in such fashion that the backfill surface below the slurry maintains a uniform slope.
d. Free dropping of backfill material through the slurry will not be permitted.
e. Place initial backfill by lowering it or pushing it into the beginning of the lead-in trench. Additional backfill may then be placed in such manner that backfill enters the trench by sliding down the forward face of the previously placed backfill.
f. Do not drop or deposit backfill in any manner that will cause segregation.
g. Mound backfill approximately 2 feet above working platform grade as backfilling progresses to accommodate consolidation.
h. Do not cap backfill or slurry trench with borrow soil during slurry wall construction operations.
i. Allow backfill in trench to consolidate for 2 months minimum prior to backfilling with cap materials. Top off trench with freshly mixed backfill as needed to keep the backfill surface 2 feet above the working platform.

3.6 CLEANING AND DISPOSAL OF EXCESS BACKFILL AND SLURRY

a. During completion of backfilling, siphon or pump off slurry in the trench and plac in a pond or tank for temporary storage. Do not allow slurry to overflow trench in an uncontrolled manner. Monitor final placement to ensure that slurry is being fully displaced by the backfill at the end of the trench and that no slurry is trapped.
b. After completion of excavating and backfilling, place remaining excavated soil cuttings or borrow soil material as common borrow below the landfill cap.
c. No slurry shall be left in ponds. Stabilize remaining excess slurry by controlled spreading and blading or disking to dry, or add cement as needed to stabilize, and spread within th

limits of the landfill. Excess backfill shall be spread within the limits of the landfill and shall not be spread in a thickness greater than 6 inches.

d. Clean and level (remove) the slurry ponds and clean remote mixing pad. Demolish any standing walls in the remote mixing pad greater than 2 feet in height.

3.7 FIELD QUALITY CONTROL

3.7.1 Quality Control Tests During Placement

a. Quality control tests conducted for materials, slurry, backfill, and the trench excavation shall be performed by a qualified independent soil testing service.
b. The required tests, testing frequency, and specified test result values are presented in the attached schedule.
c. Perform material tests using an on-site laboratory provided for that purpose.
d. Hydraulic conductivity and gradation analyses on backfill shall be performed on representative backfill samples collected simultaneously. This testing may be performed in an off-site testing laboratory.
e. Preliminary results on the hydraulic conductivity testing of backfill shall be available within 3 days after sampling, with final results within 5 days after sampling. Final results of the gradation testing shall be available one day after sampling.
f. All persons performing soils tests on-site shall be trained technicians familiar with the performance and results of the tests.
g. Immediately (same day) furnish the results of all slurry tests and unit weight, slump, and fines content determination on backfill.

3.7.2 Documentation

Record results of all tests on forms accepted by submittal.

3.7.3 Equipment Calibration

Calibrated equipment for each test prior to first field quality control test in accordance with the appropriate references specified in Paragraph 1.2 of this Section.

QUALITY CONTROL PROGRAM

SOIL/BENTONITE SLURRY WALL

SUBJECT	STANDARD	TYPE OF TEST	MINIMUM FREQUENCY	SPECIFIED VALUES
MATERIALS Water	--	- pH - Hardness - Dissolved salts	Per water source or as changes occur	As required to properly hydrate bentonite.
MATERIALS Bentonite	API Std. 13A	Manufacturer certificate of compliance	One per truckload	Natural unadulterated premium grade sodium cation montmorillonite (no polymers). Min. 90 barrel yield.
SLURRY Prepared for placement into the trench	API Std. 13B-1	- Viscosity	2 sets per shift per pond	V ≥ 40 sec - Marsh @ 68 deg. F.
	API Std. 13B-1	- Filtrate Loss	2 sets per shift per pond	Loss ≤25 cc in 30 min. @ 100 psi.
	API Std. 13B-1	- pH	2 sets per shift per pond	pH = 7-10.
SLURRY In Trench	API Std. 13B-1	- Density	3 tests per shift.	Density = 64-90 pcf and at least 20 pcf lighter than backfill mix.
	API Std. 13B-1	- Viscosity	3 tests per shift.	V ≥40 sec - Marsh @ 68 deg. F.
	API Std. 13B-1	- Filtrate Loss	3 tests per shift. (For each test, one sample at/near trench bottom at point of trenching, one representative near point of trenching, and one representative away from point trenching.)	Loss ≤25 cc in 30 min. @ 100 psi
BACKFILL MIX At remote mixing pad	API 13B-1	- Density	2 per shift.	110-125 pcf and 20 pcf ≥ slurry unit weight.

QUALITY CONTROL PROGRAM

SOIL/BENTONITE SLURRY WALL

SUBJECT	STANDARD	TYPE OF TEST	MINIMUM FREQUENCY	SPECIFIED VALUES
	ASTM C 143	- Slump	1 per batch and 1 per 100 cy min.	Slump 3 to 6 inches.
	ASTM C 117	- Material Fines Content	1 per batch and 1 per 100 cy min.	20% to 40% by weight passing Std. No. 200 sieve.
	ASTM D 5084-90	- Hydraulic Conductivity	1 per 500 cy.	k $\leq 1.0X10^{-7}$ cm/sec.
	ASTM 02216 and ASTM C 136	- Gradation	1 per 500 cy. (simultaneous with hydraulic conductivity).	20% to 40% by weight passing Std. No. 200 sieve.
BACKFILL MIX At trench	--	- Slope	1 per 20 L.F. of trench.	Uniform (5H:1V to 9H:1V).
TRENCH Profile	--	Measurement of trench bottom	1 per 20 L.F. of excavation.	Min. Specified key depth.
Continuity	--	Movement of Excavation tools	Each cut.	Continuous trench.
Key	--	Examine cuttings	Continuous during key excavation.	Homogenous gray silty clay - 3.0 ft. minimum.
Width	--	Minimum bucket width	Start of construction and when bucket changed.	3.0 ft. minimum.
Alignment	--	Surveyed	Staked 50 ft. on center.	Required Alignment.

-- End of Section --

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	1987 Test Method for Material Finer Than No. 200 Sieve in Mineral Aggregates by Washing
ASTM C 136	1984 (Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1557	1978 (R 1990) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2487	1990 Classification of Soils for Engineering Purposes
ASTM D 2922	1981 (R 1990) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	1988 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

T27-88	1988 Standard Specifications for Transportation Materials and Methods of Sampling and Testing "Sieve Analysis of Fine and Coarse Aggregate"

CORPS OF ENGINEERS (COE) ENGINEERING MANUAL

EM1110-2-1906, Appendix VII	Permeability Tests

STATE OF MAINE DEPARTMENT OF TRANSPORTATION (MDOT)

Division 700 Standard Specifications, Highways, and Bridges, "Materials"

1.2 RELATED REQUIREMENTS

Sections 02102, "Clearing and Grubbing," and 02990, "Excavation, Handling, and Disposal of Contaminated Material," apply to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.2 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3.3 Cohesive Materials

Materials classified as GC, SC, ML, CL, MH, and CH (ASTM D 2487). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.3.4 Cohesionless Materials

Materials classified as GW, GP, SW, and SP (ASTM D 2487). Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.3.5 Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the

maximum density obtained by the test procedure described in ASTM D 1557 for general soil types.

1.3.6 Excavation

The removal of soil, rock, hard material or construction debris to obtain a specified depth or elevation.

1.3.7 Fill

Specified material placed at specified degree of compaction to obtain an indicated grade or elevation.

1.3.8 Subgrade

The material in excavation cuts or embankment fills immediately below any subbase, pavement, landfill cover system, or other improvement. Also, as a secondary definition, the level below which work is referenced.

1.3.9 Unsatisfactory Soil

Peats, highly organic soils, and soils which when left in place are too wet to compact.

1.3.10 Demolition Debris

Wood, concrete, asphalt debris exclusively from NAS Brunswick.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-01, Data

Settlement platform elevation data within 2 days of each survey. G

1.4.2 SD-08, Statements

Prior to removal of material from Contractor supplied borrow sources, submit the following for each source:

a. documentation of mining and/or other borrow site permits as required by regulatory agencies having jurisdiction; G
b. estimated available and required volume of specified soil; and G
c. a borrow source quality control plan, as described in Source Quality Control in Part 2 of this Section, outlining the method proposed to track material represented

by each source quality control sample, from excavation through processing, storage, transportation, and placement. G

1.4.3 SD-10, Test Reports

Laboratory test results of the soil materials proposed for the work.

a. Grain-size analyses results (ASTM C-117, C-136), including percent passing information for each sieve designation and grain-size curve. G
b. Moisture-density relationship test (ASTM D-1557) results, including density versus moisture content curve. G
c. Permeability tests results (COE 1110-2-1906, App. VII) on drainage sand and gas vent sand, including graph of density versus permeability. G

Test results shall be submitted by the Contractor prior to earthwork operations involving material from the source being tested.

1.4.4 SD-12, Field Test Reports

During construction, submit copies of field test reports as specified in Field Quality Assurance of this Section.

a. Grain-size analysis results including percent passing information for each sieve designation and grain size curve. G
b. Moisture-density relationship test results (when test is required), including density versus moisture content curve. G
c. Results of permeability test results, if additional testing is required. G
d. Field density and moisture content test results (ASTM-D-2922, D-3017). G

1.5 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.
b. Pipes or other underground obstructions, except those indicated, will not be encountered.
c. Ground water elevations indicated by the boring logs were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevations at the time of construction.
d. Blasting will not be permitted. Remove material in an approved manner.

1.7 QUALITY ASSURANCE AND QUALITY CONTROL

1.7.1 Codes and Standards

Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.7.2 Contractor Provided Independent Soil Testing Service:

a. Provide an independent soil testing service for quality control during source testing and prequalifying and to measure compaction and permeability of materials placed. Testing service must demonstrate geotechnical testing experience and shall have sufficient facilities to perform the required quantity of tests at a rate commensurate with the proposed work schedule. The testing service shall provide access to the Contracting Officer for observation of the facilities and methods used in the geotechnical testing. Source testing is described in Part 2 of this Section.
b. Contractor shall provide assistance to the testing service to include sampling of soil materials and provide split samples, when requested.

1.7.3 Contractor Provided Registered Land Surveyor

Provide Land Surveyor registered in the State of Maine to perform and seal surveys for location and elevations of the work including settlement platforms.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

With the exception of landfill subgrade fill, all soil materials shall be free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials.

2.1.1 Vegetative Material

a. MDOT 615.02 Loam Materials (modified).
b. Well graded with a maximum stone size of 2 inches and a minimum percent by weight passing the No. 200 standard sieve of 35 percent.
c. Capable of supporting root and plant growth.

2.1.2 Drainage Sand

Drainage sand shall be a uniformly graded sand meeting the following requirements:

a. Provide a minimum compacted permeability of $1x10^{-3}$ cm/sec.
b. Meet the gradation listed below.

Drainage Sand

Sieve Designation	Percent by Weight Passing
1/2 inch	100
No. 4	80-100
No. 10	35-85
No. 40	0-25
No. 200	0-5

2.1.3 Gas Vent Sand

The gas vent sand shall consist of a well graded sand meeting the following requirements:

a. Provide a minimum compacted permeability of $1x10^{-3}$ cm/sec.
b. Conform to the gradation requirements listed for the drainage sand (paragraph 2.1.2 of this section).

2.1.4 Drainage Stone

MDOT specification 703.22 Type C. Crushed stone or uncrushed material, meeting the following gradation:

Sieve Designation	Percent by Weight Passing
1 inch	100
3/4 inch	90-100
3/8 inch	0-75
No.4	0-25
No. 10	0-5

2.1.5 Aggregate Base

MDOT specification 703.06(a) Type B. Screened or crushed gravel of hard durable particles. The gradation of the portion passing a 3-inch sieve shall meet the following:

Sieve Designation	Percent by Weight Passing
4 inch	100
1/2 inch	35-70
1/4 inch	25-60
No. 40	0-25
No. 200	0-5

2.1.6 Aggregate Subbase

MDOT specification 703.06(b) Type D. Sand or gravel of hard durable particles. Maximum stone size of 6 inches. The gradation of that portion that passes a 3 inch sieve shall meet the following:

Sieve Designation	Percent by Weight Passing
1/4 inch	25-70
No. 40	0-30
No. 200	0-7

2.1.7 Common Borrow

MDOT 703.18 Common Borrow (modified). Soil suitable for embankment construction with a maximum 6-inch stone size. The moisture shall be sufficient to provide the required compaction and stable embankment.

2.1.8 Filter Sand

Filter layer between vegetative material and drainage sand layers. Well graded and meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing
No. 4	100
No. 10	50-100
No. 40	15-100
No. 100	5-75
No. 200	0-30

2.1.9 Gravel Borrow

MDOT 703.20 Gravel Borrow (modified). Gravel borrow shall consist of a uniformly graded granular material having no stones with a maximum dimension of over 3 inches and meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing
3 inch	100
1/4 inch	0-70
No. 200	0-10

2.1.10 Sand Bedding Material

MDOT 703.05 Aggregate for Sand Leveling (modified). Sand of hard durable particles, meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing
3/4 inch	100
3/8 inch	85-100
No. 20	25-80
No. 200	0-5

2.1.11 Sand Borrow

Sand of hard durable particles meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing
1 inch	100
No. 4	85-100
No. 40	40-90
No. 200	20-40

2.1.12 Crushed Stone

MDOT 703.31 Crushed Stone. Crushed stone shall be obtained from rock of uniform quality and shall consist of clean, angular fragment of quarried rock, free from soft or disintegrated pieces or other objectional matter. The stone shall meet the following gradation requirements:

Sieve Designation	Percent by Weight Passing
2-1/2 inch	100
2 inch	95-100
1 inch	0-30
3/4 inch	0-5

2.1.13 French Drain Stone

MDOT 703.24 Stone for French Drains. Shall consist of hard, durable rock and conform to the following gradation requirements:

Sieve Designation	Percent by Weight Passing
6 inch	90-100
1-1/2 inch	0-40
No. 4	0-5

Gradation test shall conform to AASHTO T27 except that the total sample shall be sieved and the minimum weight of the sample shall be 120 pounds.

2.1.14 Riprap

Riprap shall consist of sound, durable rock which will not disintegrate by exposure to water or weather. Field stone, rough quarry stone, or blasted ledge may be used. The maximum stone size shall not exceed 6 inches in any dimension, and the 50 percent of the stone (d_{50}) shall be 4 inches in size.

2.1.15 Landfill Subgrade Fill

Landfill subgrade fill shall consist of excavated construction debris, asbestos-containing-material, and common borrow. The fill shall have a maximum particle size of 4 feet in one dimension and 1 foot in the remaining dimensions.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch-minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi otherwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a

minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 SOURCE QUALITY CONTROL

2.3.1 General

a. Provide source testing of all soil materials proposed for use. Sampling and testing shall be performed by the Contractor.
b. Prepare source quality control plans for all soil materials and submit for approval. These plans shall specifically address:
   1) Quality control sampling locations and depths within the area necessary to meet the testing requirements.
   2) Tests proposed for each sample.
   3) Estimated length of time between sampling and submittal of written test results.
   4) Delineation of borrow volumes represented by each sample.
   5) Description of the method used to track borrow volumes represented by each sample from excavation through processing, transportation, and placement.
   6) Proposed schedule for testing, excavation, and placement of borrow.

2.3.2 Testing Requirements

Collect samples at the borrow source(s) during borrow study phase and construction phase for determination of the following parameters, and demonstration of specification compliance by the Contractor's testing service:

2.3.2.1 Common Borrow and Vegetative Material

a. Borrow Study Phase:
   1) Gradation (ASTM C-117 and C-136) at a minimum frequency of 3 tests per material.
   2) Moisture-density relationship (ASTM D-1557), minimum 1 test per material.
b. Construction Phase:
   1) Gradation as determined by ASTM C-117 and C-136 at a frequency of 1 test per 20,000 cubic yards (minimum), or portion thereof, of borrow material from each borrow source.
   2) Moisture-density relationship for common borrow as determined by ASTM D 1557-78 (Proctor tests) for each change in material.

2.3.2.2 Drainage Sand, Gas Vent Sand, Filter Sand, Sand Borrow, Aggregate Base, and Aggregate Subbase

a. Borrow Study Phase:
   1) Gradation (ASTM C-117 and C-136) at a minimum frequency of 5 tests per material.
   2) Moisture-density relationship (ASTM D-1557), minimum 2 tests per material.
   3) Remolded permeability of drainage sand and gas vent sand as determined by the constant head or falling head method described in the U.S. Army Corps of Engineers Engineering Manual 1110-2-1906 (Appendix VII, Chapters 3 and 4). Tests shall be conducted at moisture contents and densities developed for Proctor curve so as to determine range in densities that produce specified permeabilities. Minimum 2 tests per material.

b. Construction Phase:
   1) Natural moisture content (ASTM D-2216) at a frequency of 1/1000 cubic yards.
   2) Gradation (ASTM C-117 and C-136) at a frequency of 1/5,000 cubic yards.
   3) Moisture-density relationship (ASTM D-1557) at a frequency of 1 test per each change in material.
   4) If variations in drainage sand or gas vent sand are encountered, remolded permeability tests shall be performed at the new moisture-density relationships developed on the changed materials.

2.3.2.3 Drainage Stone, Sand Bedding Material, Riprap, Crushed Stone, and French Drain Stone

a. Borrow Study Phase:
   1) Gradation (ASTM C-117 and C-136) at a minimum frequency of 3 tests per material.
   2) Moisture-density relationship (ASTM D-1557) performed on sand bedding material only, minimum 3 tests.

b. Construction Phase:
   1) Moisture-density relationship of sand bedding material (ASTM D-1557) at a frequency of 1/5000 cubic yards.
   2) Gradation (ASTM C-117 and C-136 or AASHTO T27) at a frequency of 1/1000 cubic yards.

2.3.2.4 Reporting and Additional Testing Requirements

a. Additional sampling and testing may be required during borrow study or construction phase if, in the Contracting Officer's opinion, significant variability in borrow characteristics is encountered.
b. Submit 3 copies of the report.
c. Failing test samples as determined by the Contracting Officer shall be replaced with new samples and retested at no additional cost until a passing test is achieved.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Clearing and Grubbing

Refer to Section 02102, "Clearing and Grubbing."

3.1.2 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade using a vibratory roller. Operate the roller in a systematic manner to ensure four passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material under buildings or pavements shall be undercut as directed by the Contracting Officer to and replaced with suitable fill.

3.1.3 Monitoring Wells

Extend all existing monitoring wells located within the boundaries of the work. Details are shown on the Contract Drawings.

3.1.4 Settlement Platforms

a. Prior to placing any fill material, install settlement platforms at locations shown on the Drawings.
b. Settlement platforms shall be surveyed by a Land Surveyor registered in the State of Maine.
c. Survey platform elevations prior to any fill placement and once per week during landfill subgrade placement.
d. Survey platform elevations twice per month during construction activities preceding final capping of landfill.
e. Abandon platforms as specified in paragraph 3.4 of this section.

3.2 PROTECTION

3.2.1 Protection Systems

It is the Contractor's responsibility to maintain safe sideslopes. Provide shoring, bracing, and sheeting where sloping is not possible either because of space restrictions or stability of material excavated. Excavations deeper than 20 feet must be designed by a registered Professional Engineer.

3.2.2 Site Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Contaminated water, such as that at the landfill should be diverted in the excavations whenever possible. If contaminated water must be pumped, the collected water shall be disposed of within the limits of the landfill at the completion of the excavation. Pumping systems will require appropriate decontamination.

3.2.2.1 Surface Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

3.2.2.2 Subsurface Drainage

Base on site surface and subsurface conditions, available soil, and hydrological data. Remove water by pumping or other methods to prevent softening of surfaces exposed by excavation. Use filters on dewatering devices to prevent removal of fines from soil. Provide erosion control at outlet of piping to prevent erosion. Operate dewatering system continuously until construction work below existing water levels is complete. After placement of slabs and initial backfill, water level may be allowed to rise, but never above one foot below the prevailing level of excavation or backfill.

3.2.3 Underground Utilities

Locations of the existing utilities indicated are approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities.

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations,

soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with backfill material and compact to required density as specified for excavations of same classification.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Cold Weather Protection

a. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 °F.
b. Do not place fill or backfill on frozen soil or use frozen material to backfill.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after bedding material placement. Pipe bedding material shall consist of sand bedding material for pipe diameters of 4-inches or less and drainage stone for pipe diameters greater than 4-inches.

3.3.4 Excavation of Contaminated Soil and Debris

Refer to Section 02990, "Excavation, Handling, and Disposal of Contaminated Material" for requirements.

3.4 FILLING AND BACKFILLING

3.4.1 General

a. Prior to placement of cover materials, remove settlement platform pipes within 3 feet below subgrade elevation. Settlement platforms shall not be dismantled without approval by the Contracting Officer.
b. Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.
c. Backfill excavations as promptly as work permits, but not until acceptance of the construction below finished grade by the Contracting Officer.
d. Before compaction, moisten or aerate each lift as necessary to provide the moisture content required to meet the specified permeability and compaction requirements.
e. The Contractor is responsible for providing the required compaction between all materials placed.

3.4.2 Backfill Around Structures

a. Place the material uniformly around a structure to approximately the same elevation in each lift.
b. Take care to prevent wedging action of backfill against structures.

3.4.3 Lift Thicknesses

Place backfill and fill materials in loose lifts of the following maximum thicknesses:

a. Drainage Sand: 12 inches
b. Gas Vent Sand: 12 inches
c. Aggregate Base: 6 inches
d. Aggregate Subbase: 12 inches
e. Common Borrow: 12 inches
f. Landfill Subgrade Fill: 24 inches
g. Filter Sand: 12 inches
h. Vegetative Material: 12 inches
i. Gravel Borrow: 12 inches
j. Sand Borrow: 12 inches
k. Sand Bedding Material: 6 inches

3.4.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact trench backfill under structures and paved areas in 6-inch lifts to top of trench and in 6-inch lifts to one foot over pipe outside structures and paved areas.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.6 COMPACTION

Expressed as a percentage of maximum density.

3.6.1 General Site

Control soil compaction during construction to meet required percent maximum dry density for each soil and/ or condition.

3.6.2 Moisture Requirements

a. Provide moisture control to the extent that the soil mix remains in a workable state during placement.

b. Where subgrade or layer of soil material must be moisture-conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material at such a rate as to avoid free water from appearing on surface during or subsequent to compaction operations.

c. Remove or scarify and air dry, soil material that is too wet to permit compaction to specified density.

d. Excessively wet soil that has been removed may be stockpiled or spread and allowed to dry. Assist drying by disking, harrowing or pulverizing, until moisture content is reduced to a satisfactory value, as determined by moisture-density relation tests.

3.6.3 Density Requirements

Material compaction requirements are specified as follows:

	Material	Test Method	Required Percent of Maximum Dry Density
a.	Common Borrow	ASTM D-1557	
	Below Pavements/Roadways		Min. 90%
	Untraveled ways		Min. 88%
b.	Aggregate Base	ASTM D-1557	
	Below Slabs/Structures		Min. 95%
	Below Pavements/Roadways		Min. 95%
	Adjacent to Structures		Min. 92%
c.	Aggregate Subbase	ASTM D-1557	Min. 95%
d.	Filter Sand	ASTM D-1557	
	Below Landfill Cap		Min. 90%
	Below Pavements/Roadways		Min. 95%
f.	Sand Borrow	ASTM D-1557	Min. 90%
g.	Sand Bedding Material	ASTM D-1557	
	Below and Adjacent to Pipes		Min. 90%
	Above Pipes		Min. 85%

h. Landfill subgrade fill shall be compacted with a heavy vibratory roller making a minimum of 4 passes per lift.

i. Drainage Sand. Drainage sand shall be compacted to an in-place density such that it meets the minimum permeability requirements of $1x10^{-3}$ cm/sec. The compaction requirements will be established during the borrow study as outlined in Paragraph 2.3.2 of this Section.

j. Gas Vent Sand. Gas vent sand shall be compacted to an in-place density such that it meets the minimum permeability requirement of $1x10^{-3}$ cm/sec. The compaction requirements will be established during the borrow study as outlined in Paragraph 2.3.2 of this Section.

3.7 FINISH OPERATIONS

3.7.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.7.2 Seed

Provide as specified in Section 02930, "Turf" and on the Contract Drawings.

3.7.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

Take the number and size of samples required to perform the specified tests.

3.9.2 Material Thickness

The Contractor shall maintain daily logs of measurements of lifts, soil characteristics, and other observations. Installation of a layer measured at 90 percent or less of the required thickness will not be accepted. A running average of 100 percent of the requir d thickness shall be maintained. Thickness of common borrow, vegetative material, filter sand, drainage sand, gas vent sand, landfill subgrade fill, and aggregate base at structures shall be checked at 100 foot grid intervals. Thickness of gravel borrow, sand borrow, drainage stone, sand bedding material, aggregate base and subbase at roadways areas shall be checked at a minimum once per 100 linear feet of material placed.

3.9.3 Testing

Perform the following tests for each material used. Provide additional tests for each source change.

3.9.3.1 Density Tests

The Contractor's Quality Control Manager shall measure compaction as in-place density using ASTM D-2922-81 and according to the following schedule of frequency:

Material	Minimum Frequency
a. Common Borrow	5/acre/lift
b. Drainage Sand	5/acre/lift
c. Sand Borrow	5/acre/lift
d. Gas Vent Sand	5/acre/lift
e. Gravel Borrow	5/acre/lift
f. Aggregate Base	
Below Slabs/Structures	1/500 sf/lift
Below Pavements	1/1000 sf/lift
Adjacent to Structures	1/500 sf/lift
g. Aggregate Subbase	1/1000 sf/lift

3.9.3.2 Moisture

The Contractor's Quality Control Manager shall measure moisture content at the locations chosen for density testing and at other locations deemed appropriate by th Contracting Officer. Moisture content shall be measured by nuclear methods, ASTM D 3017-78.

3.9.3.3 Permeability

The Contractor's Quality Control Manager will measure the permeability of remolded samples taken from the drainage sand and gas vent sand.

a. Drainage Sand: For each acre the mean of the 5 required permeability tests must equal or be greater than $1x10^{-3}$ cm/sec with no test less than $5x10^{-4}$ cm/sec.
b. Gas Vent Sand: For each acre the mean of the 5 required permeability tests must equal or be greater than $1x10^{-3}$ cm/sec with no test less than $5x10^{-4}$ cm/sec.
c. Testing Frequency: At the rate of five tests/acre, the Contractor's Quality Control Manager will select samples for laboratory permeability testing. Sample locations will be randomly selected. Remolded permeability of the drainage sand and gas vent sand shall be determined by the constant or falling head method described in U.S. Army Corps of Engineers Engineering Manual 1110-2-1906 (Appendix VII, Chapters 3 and 4).

3.9.4 Deficient Areas of Work

a. If, in the opinion of the Contracting Officer and the Contractor's Quality Control Manager, based on reports of testing service and inspection, the subgrade or fills do not meet specified density or thickness, or are outside the specified permeability range, the Contractor shall undertake necessary corrective actions at his expense. Rejected areas may be retested prior to the Contractor taking additional corrective actions. If reworking a block fails testing again (once), the Contractor shall remove the rejected area and reconstruct it with new material.

b. Reworking and removal of drainage sand above the geomembrane must be done with extreme care under full- time observation of the Contractor's Quality Control Manager.

-- End of Section --

SECTION 02511

ASPHALT CONCRETE PAVING AND INCIDENTAL CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T30	1984 (R 1987) Mechanical Analysis of Extracted of Aggregate
AASHTO T230	1968 (R 1986) Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1559	1989 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	1988 Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2950	1991 Density of Bituminous Concrete in Place by Nuclear Method

FEDERAL SPECIFICATIONS (FS)

FS TT-P-115	(Rev. F) Paint, Traffic (Highway, White and Yellow)

STATE HIGHWAY SPECIFICATION (SHS)

SHS MDOT	State of Maine, Department of Transportation, Standard Specifications Highways and Bridges, Revision of October 1990

1.2 DESCRIPTION

This section includes the provision of all plant, labor, and materials necessary for the preparation of the subgrade and the construction thereon of a subbase course, a base course, a prime coat, a surface course, paint striping and incidental construction. Provide all work and

materials in accordance with the applicable requirements of the SHS MDOT. Divisions and Sections mentioned herein refer to those specifications. Paragraphs in SHS MDOT titled "Method of Measurement" and "Basis of Payment" shall not apply. Where the term "Engineer" is used in SHS MDOT it shall be construed to mean the Quality Control Manager.

1.3 RELATED REQUIREMENTS

Section 02220, "General Excavation, Filling, and Backfilling" applies to this section with the additions and modifications specified herein.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-08, Statements

a. Asphalt Mix Delivery Record

1.4.1.1 Required Record Data

Record and submit the following information pertaining to the delivery of mix to the job site:

(1) Truck No:

(2) Time In:

(3) Time Out:

(4) Tonnage and Discharge Temperature:

(5) Mix Type:

(6) Location:

(7) Stations Placed:

Record the above information for each load and submit daily on Government furnished forms. Placement will not be permitted unless the Contractor has a working asphalt thermometer on site.

1.4.2 SD-10, Test Reports

a. Trial batch reports
b. Mix design

1.4.2.1 Mix Design

Submit results of all laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to the date of material placement.

1.4.3 SD-12, Field Test Reports

a. Omitted
b. Pavement

Submit reports for testing specified under paragraph titled "Field Quality Control."

1.4.4 SD-13, Certificates

a. Paving materials
b. Guard (Guide) rails
c. Omitted
d. Traffic signs

Submit certificates, signed by the producer, that all paving materials and incidental construction items conform to specification requirements.

1.4.5 SD-14, Samples

a. Uncompacted sample of each mix type
b. Pavement cores

Submit 2 pavement cores if the in-place nuclear density method is used.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria.

1.5.1 Trench Pavement Repair

a. Unit price bid for asphalt concrete paving for trench pavement repair will be on a ton basis, complete in place. The unit price bid shall be full compensation for th required grade of asphalt concrete, seal cutting, excavating sawn-out pavement, resetting utility castings to proper grade, asphalt tack coat, and all work incidental to the construction of temporary and permanent trench pavement repair. The bid should be prepared based on 60 tons of permanent trench pavement repair and 50 tons of temporary trench pavement repair.

1.5.2 Permanent Pavement Repair (Resurfacing)

a. Unit price bid for asphalt concrete paving for road resurfacing will be on a ton basis, complete in place. The unit price bid shall be full compensation for the

requried grade of asphalt concrete, sweeping of existing pavement, resetting utility castings to proper grade, asphalt tack coat, and all work incidental to the resurfacing of a paved road. The bid should be prepared based on 550 tons of road resurfacing.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials in accordance with the applicable requirements of the SHS MDOT, except where specified otherwise.

2.1.1 Subgrade

Preparation of subgrade shall be in accordance with Division 200, Section 203.

2.1.2 Aggregate Subbase

Materials for construction of the subbase shall be in accordance with Division 700, Subsection 703.06, Type E.

2.1.3 Aggregate Base

Materials for construction of the base course shall be in accordance with Division 700, Subsection 703.06, Type A.

2.1.4 Binder Course

Materials for the construction of the binder course shall be in accordance with Division 700, Subsection 703.09, Grading B.

2.1.5 Tack Coat

Materials for the construction of the tack coat shall be in accordance with Division 700, Subsection 702.04, Emulsified Asphalt, Grade RS-1.

2.1.6 Surface Course

Materials for construction of the surface course shall be in accordance with Division 700, Subsection 703.09, Grading C.

2.1.7 Striping

Materials for paint striping shall be in accordance with Division 700, Subsection 708.03.

2.1.8 Guard (Guide) Rails

Materials for construction of the guard (guide) rails shall be in accordance with Division 700, Subsection 710.04.

2.1.9 Traffic Signs

Provide traffic signs in accordance with Division 700, Section 719.

2.2 COMPOSITION OF MIXTURE REQUIREMENTS

2.2.1 Mixture Properties

Gradation of mineral aggregate shall be as specified. The percentage of bituminous material provided in the bituminous mixtures shall be within the limits specified. Mixtures shall have the following physical properties:

Test Property	Values
Stability (50-Blows)	Not less than 500 pounds
Flow (0.01 inch)	Not more than 20 nor less than 8
Percent Air Voids	Not less than 4 nor more than 6 for binder course; not less than 3 nor more than 5 wearing course
Percent Voids in Mineral Aggregates	See Table I

TABLE I

MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE (VMA)

U.S.A. Standard Sieve Designation	Nominal Maximum Particle size, In.	Minimum VMA Percent
No. 4	0.187	18
3/8 inch	0.375	16
1/2 inch	0.500	15
3/4 inch	0.750	14
1 inch	1.000	13

2.2.2 Quantity of Bituminous Material

Mix asphalt cement with aggregates of corresponding mixes in the following proportions:

ASPHALT CEMENT PERCENT BY WEIGHT OF TOTAL MIX

Binder Course	Surface Course
4-8	5-9

PART 3 EXECUTION

3.1 CONSTRUCTION

Provide construction in accordance with the applicable requirements of the SHS MDOT, except where indicated or specified otherwise.

3.1.1 Subgrade

Preparation of subgrade shall be in accordance with Division 200, Section 203.

3.1.2 Aggregate Subbase

Methods of construction of the aggregate subbase shall be in accordance with Division 300, Section 304.

3.1.3 Aggregate Base

Methods of construction of the base aggregate course shall be in accordance with Division 300, Section 304.

3.1.4 Surface Course

Methods of construction of the surface course shall be in accordance with Division 400, Section 401.

3.1.5 Tack Coat

Methods of construction of the tack coat shall be in accordance with Division 400, Section 409.

3.1.6 Striping

Provide paint striping in accordance with Division 600, Section 627. Allow bituminous pavement to cure for at least 21 days before paint is applied. Pavement shall be thoroughly clean and entirely free of loose sand, stones, dust, oil, grease, water, and other substances that will be deleterious to the paint or will adversely affect the adhesion of the paint. Do not apply paint during high wind (over 15 miles/hr) or high humidity (over 70 percent). Apply paint only when ambient temperature is 40 degrees F or above and rising but not more than 95 degrees F. Dimensions and arrangement of striping shall be

as indicated. Apply paint to a wet film thickness of 0.015 inch (15 mils) by means of conventional traffic line striping equipment. Traffic shall not be permitted to use the painted areas for a minimum of 30 minutes after painting of lines has been completed.

3.1.7 Guard (Guide) Rails

Methods of construction of the guard (guide) rails shall be in accordance with Division 600, Section 606.

3.1.8 Temporary Trench Pavement Repair:

After trenching operations are complete the Contracting Officer may order temporary pavement repair. Repair pavement as follows:

a. Material: MDOT 703.09, Grading B hot bituminous pavement.
b. Clean surfaces of existing pavement which will be bonded to the temporary pavement.
c. Place material to a compacted depth of 2 inches.
d. Maintain temporary pavement smooth, free from potholes and to required grade.
e. Periodically inspect temporary pavement areas and repair as necessary, especially during the winter months when the temporary pavement remains in place for an extended period. The Contracting Officer shall have the authority to order repair by the Contractor to areas which are, in his opinion, in unsatisfactory condition.

3.1.9 Permanent Trench Pavement Repair

a. Saw edges of existing pavement to provide a vertical bonding face.
b. Remove temporary paving and sawn-out existing paving.
c. Reset manhole frames and covers.
d. Apply a tack coat to the sawn edges.
e. Apply variable depth aggregate base, then 2-inch binder course (MDOT 703.09 Grading B) and 2-inch surface course (Grading C).
f. Roller compact both courses, compacting the final surface course to meet existing pavement surfaces exactly.

3.1.10 Permanent Pavement Repair

a. Where temporary paving has been placed:
   1. Reset manhole frames and covers.
   2. Apply a 1-inch surface course to the entire road surface.
   3. Roller compact surface course.
b. When temporary paving is absent:
   1. Saw edges of existing pavement to provide a vertical bonding face.
   2. Remove sawn cut existing paving and surface material to 12 inches of aggregate base; or install 12 inches aggregate base if not in place.
   3. Reset manhole frames and covers.
   4. Apply a tack coat to the sawn edges.

5. Apply a 2-inch binder course over the trench and roller compact.
6. Apply a 2-inch surface course over the entire road surface.

3.1.11 Traffic Signs

Install traffic signs in accordance with Division 600, Section 645.

3.2 FIELD QUALITY CONTROL

Sample shall be taken by the Contractor as specified herein at the expense of the Contractor. Testing shall be conducted by an independent testing laboratory selected by the Contractor and approved by the Contracting Officer. The independent testing laboratory shall be manned by qualified technicians supervised by a registered professional soils engineer, not employees of the Contractor and shall be otherwise equipped to perform all tests in accordance with the standards specified herein.
All tests shall be performed at the Contractor's expense. All materials and material sources will be approved by the Contracting Officer 2 days prior to the use of such material in the work. The Contractor shall replace the pavement where sample cores have been removed.

3.2.1 Sample and Core Identification

Place each sample and core in a container and securely seal to prevent loss of material. Tag each sample for identification. The tag shall contain the following information:

a. Contract No.
b. Sample No.
c. Quantity
d. Date of Sample
e. Sample Description
f. Source/Location/Stations Placed
g. Intended Use

3.2.2 Testing

3.2.2.1 Trial Batch

Submit current bituminous design reports for all mix types proposed for use on the project.

3.2.2.2 Bituminous Mix Testing

Take two samples per day per mix type at the plant or from the truck. Test the uncompacted mix for extraction in accordance with ASTM D 2172 and sieve analysis in accordance with AASHTO T30. Test the samples for stability and flow in accordance with ASTM D 1559. If two consecutive tests fail to meet requirements of the specifications, placement operations shall cease and a new trial batch shall be submitted for approval prior to resumption of placement operations.

3.2.2.3 Testing of Pavement Course

a. Density: Determine density of the pavement by testing cores obtained from the binder and surface course in accordance with AASHTO T230. Take three cores at locations designated by the Contracting Officer for each 200 tons, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to the laboratory and provide test results within 48 hours of each days placement of paving materials.
b. Thickness: Determine thickness of the binder and surface course from cores taken for the density test.
c. Straightedge Test: Test the compacted surface of the binder course and surfac course with a straightedge as the work progresses. Apply the straightedge parallel with and at right angles to the center line after final rolling. Unevenness of the binder course shall not vary more than plus or minus 1/4 inch in ten feet; variations in the surface course shall not vary more than plus or minus 1/4 inch in ten feet. Any portion of the pavement showing irregularities greater than that specified shall be corrected as directed by the Contracting Officer.

3.2.2.4 Alternate Testing Method for Pavement Courses

At the Contractor's option the following in-place testing method may be used to determine density and thickness in lieu of the testing specified above. Frequency of testing shall be the same. If the in-place nuclear method to determine density is used, take two pavement cores at locations designated by the Contracting Officer and turn over to the Government to verify pavement thickness.

a. Density: Determine density of the pavement by in-place testing using Nuclear Method in accordance with ASTM D 2950.
b. Thickness: Determine thickness of the finished pavement by use of the following equation:

$$t = \frac{W}{0.75d}$$

Where t = pavement thickness, in inches.
W = average weight per square yard of mixture actually used in the work.
d = compacted density as measured by nuclear density device.

--End of Section--

SECTION 02720

STORM DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M198	1975 (R 1986) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M252	1990 Corrugated Polyethylene Drainage Tubing
AASHTO M294	1990 Corrugated Polyethylene Pipe, 12- to 36 in. Diameter

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	1988 Concrete Pipe Handbook
ACPA 01-103	1990 Concrete Pipe Installation Manual

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3	1984 Ladders - Fixed - Safety Requirements

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA MRE	1991 Manual for Railway Engineering (Fixed Properties)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	1987 Cast Iron Soil Pipe and Fittings
ASTM A 497	1990 (Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 525	1991 (Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A 615	1990 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 746	1986 Ductile Iron Gravity Sewer Pipe
ASTM A 760/A 760M	1991 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762/A 762M	1991 Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 798	1988 Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 819	1990 Steel Sheet, Aluminum-Coated Type 2 for Storm Sewer and Drainage Pipe
ASTM A 849	1990 Posted-Applied Coatings, Pavings, and Lining for Corrugated Steel Sewer and Drainage Pipe
ASTM B 745/B 745M	1990 (Rev. A) Corrugated Aluminum Pipe for Sewers and Drains
ASTM B 788	1988 Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
ASTM C 4	1962 (R 1986) Clay Drain Tile
ASTM C 12	1991 Installing Vitrified Clay Pipe Lines
ASTM C 14	1990 Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 32	1973 (R 1990) Sewer and Manhole Brick (Made from Clay or Shell)
ASTM C 62	1991 Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76	1989 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 139	1973 (R 1989) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 150	1989 Portland Cement
ASTM C 270	1989 Mortar for Unit Masonry

ASTM C 361	1990 Reinforced Concrete Low-Head Pressure Pipe
ASTM C 412	1990 Concrete Drain Tile
ASTM C 425	1991 Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	1985 (Rev. A) (R 1990) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 444	1990 Perforated Concrete Pipe
ASTM C 476	1983 Grout for Masonry
ASTM C 478	1990 (Rev. B) Precast Reinforced Concrete Manhole Sections
ASTM C 506	1990 Reinforced Concrete Arch, Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	1990 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 564	1988 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	1991 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 923	1989 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D 2564	1991 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2680	1990 Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2729	1989 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 2855	1990 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3034	1989 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D 3212	1989 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 4101	1982 (R 1988) Propylene Plastic Injection and Extrusion Material
ASTM F 402	1988 Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 405	1989 Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 477	1990 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 794	1991 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	1991 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	1990 Structural Welding Code Steel

FEDERAL SPECIFICATIONS (FS)

FS TT-C-490	(Rev. C) (Am. 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS RR-F-621	(Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441	(Rev. B) Paint, Epoxy-Polyamide

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-5	1989 Installation of Polyvinyl Chloride (PVC) Sewer Pipe

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Concrete piping including fittings and jointing materials
b Corrugated steel piping including fittings and jointing materials
c. Composite plastic piping including fittings and jointing materials
d. Corrugated plastic piping including fittings and jointing materials
e. Subsurface drainage piping including fittings and jointing materials

1.2.2 SD-04, Drawings

a. Precast concrete structures
b. Metal items

1.2.3 SD-13, Certificates

a. Pipeline and fittings, including factory-applied linings and joint materials
b. Cast-iron frames, covers, and gratings
c. Precast concrete structures

Submit certificates attesting that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the frequency or intervals specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.2.4 SD-14, Samples

a. Pipeline materials

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.3.1.3 Cement, Aggregates, and Reinforcement

Store as specified in Section 03300, "Cast-In-Place Concrete."

1.3.2 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care not to damage coating on pipe and fittings; if damaged, make repairs. Carry, do not drag pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE AND CULVERT MATERIALS

2.1.1 Concrete Piping

2.1.1.1 Concrete Pipe and Fittings

Storm drainage pipe shall be reinforced concrete pipe conforming to ASTM C 76, Class V. Circular pipe with elliptical reinforcement shall have a readily visible line no less than 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe.

2.1.1.2 Jointing Materials for Concrete Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443. Gaskets shall be suitable for use with sewage.

2.1.1.3 Joint Sealants

Provide primers and lubricants as recommended by the manufacturer. Concrete pipe joints shall be suitable for use with the joint sealants specified.

a. Butyl gaskets.
b. ASTM C 443 rubber O-ring gaskets.
c. AASHTO M198, Type B preformed plastic gaskets.

2.1.2 Corrugated Steel Piping

2.1.2.1 Corrugated Steel Pipe and Fittings

ASTM A 760/A 760M, Type I, annular and 0.064 sheet thickness. Steel sheet for pipe shall be zinc-coated. Bituminous coating shall conform to ASTM A 849, Type A-1. Fabricate fittings of the same material as the pipe with strength not less than that of the

pipe, and having the same size and shape of corrugations as the pipe. Helically corrugated pipe and fittings, when used with hugger-type coupling bands, shall have factory-rolled annular corrugations at each end.

2.1.2.2 Jointing Materials for Corrugated Steel Piping

Coupling bands shall be as specified in ASTM A 760/A 760M unless otherwise specified. Connecting angles shall be omitted and the circumference of the band shall be such that when coupled, a 3-inch lap will be provided. Coupling bands shall be bituminous coated to a minimum thickness of 0.05 inch. For tightening each coupling band, provide four 1 1/2-inch diameter zinc-coated steel rod hoops with silo lugs. Gaskets shall be cylindrical in shape, fabricated of 3/8-inch thick by 6 1/2-inch minimum width rubber, diameter of cylindrical gasket shall be 10 percent less than the nominal pipe diameter. Coupling bands may also be hugger type, having a flat central section with a corrugated section near each end designed to mesh with the annular corrugation on the pipe, and with two-bolt steel bar-and-strap connector.

2.1.3 Composite Plastic Piping

2.1.3.1 ABS Composite Plastic Pipe and Fittings

Acrylonitrile-Butadiene Styrene (ABS) or Poly(Vinyl Chloride) (PVC) composite pipe and fittings, ASTM D 2680.

2.1.3.2 Jointing Materials for ABS Composite Plastic Piping

ASTM D 2680 solvent cement and primer or ASTM D 3212 elastomeric gasket joints. Ends of pipe and fittings shall be suitable for either Type SC or Type OR joints.

2.1.4 Corrugated Plastic Piping

2.1.4.1 Pipe and Fittings

Corrugated, high density polyethylene pipe (HDPE) conforming to AASHTO M252 or AASHTO M294, Type PC-3408.

2.1.4.2 Joints and Jointing Materials

Manufacturer's recommendations for HDPE joints.

2.1.5 Piping Beneath Railroad Right-Of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of AREA MRE, unless otherwise specified. For casing pipe provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.1.6 Subsurface Drainage Piping Materials

2.1.6.1 Corrugated Heavy Duty Tubing

ASTM F 405, with slotted perforations around the circumference and length of pipe. Maximum slot widths of 1/16 inch.

2.1.6.2 Requirements Governing Piping

Use nonperforated fittings of the same material and strength where necessary, that conform to the applicable specifications specified for fittings.

2.2 CONCRETE MATERIALS

Provide as specified in Section 03300, "Cast-In-Place Concrete."

2.3 MISCELLANEOUS MATERIALS

2.3.1 Drainage Structures

Construct of solid concrete masonry units or concrete, except that airfield catch basins, headwalls, gutters, top of curb inlets, and bases shall be concrete. Precast structures may be provided in lieu of cast-in-place concrete except for airfield catch basins, headwalls, and gutters. Pipe-to-wall connections shall be mortared to produce smooth transitions and watertight joints or provided with ASTM C 923 resilient connectors. Bases shall have smooth inverts accurately shaped to a semicircular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering branches into the manhole shall have a circular curve in the manhole invert of as larg a radius as the size of the manhole will permit.

2.3.1.1 Precast Concrete Structures

ASTM C 478, except as specified herein. Provide a minimum wall thickness of 6 inches. ASTM A 615 reinforcing bars. ASTM A 497 welded wire fabric. ASTM C 443 r AASHTO M198, Type B gaskets for joint connections. Provide a 4-inch layer of clean gravel bedding with a maximum size of 2 inches.

2.3.2 Masonry Materials

Shall conform to the following specifications and other requirements specified hereunder.

2.3.2.1 Brick

ASTM C 32, Grade MS, or ASTM C 62, Grade SW, except that the absorption test will be waived.

2.3.2.2 Concrete Masonry Units

ASTM C 139.

2.3.2.3 Mortar

ASTM C 270, Type M.

2.3.2.4 Water

Water for masonry mortar shall be fresh, clean, potable.

2.3.2.5 Grout

ASTM C 476.

2.3.3 Metal Items

2.3.3.1 Frames, Covers, and Gratings

Shall be cast iron conforming to FS RR-F-621, H-20 LOADING.

2.3.3.2 Drainage Structure Steps

Zinc-coated steel conforming to ANSI A14.3. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes or catch basins less than 4 feet deep.

2.4 FLARED ENDS

Flared end sections shall be same material as pipe material except that only reinforced concrete flared ends shall be provided for concrete pipe.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to pipeline installation except where specific exception is made under paragraph entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building , unless otherwise indicated on the drawings.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02220, "General Excavation, Filling and Backfilling."

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell ends in the upgrade direction. Adjust spigots in bells to produce a uniform space. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper chalking or installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.1.4 Connections to Existing Lines

Notify Contracting Officer in writing at least 10 days prior to date that connections are to be made. Obtain approval of the Contracting Officer before interrupting service. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Concrete Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9. Make joints with the gaskets previously specified for joints with this piping. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when th pipe is pulled up to within one inch of closure, remove the pipe and remake the joint.

3.1.2.2 Installation of Corrugated Metal Piping

Install corrugated steel pipe, and fittings in accordance with the general requirements for installation of pipelines and with the recommendations of ASTM A 798 except as otherwise specified in the other subparagraphs hereunder.

a. Pipe Laying: Handle pipe carefully so as not to damage coating. If damage occurs, give damaged areas of pipe and couplings an application of coating equal to that specified for the pipe ; remove pipe on which coating has been damaged to such extent that satisfactory repairs cannot be made and replace with new, as determined by the Contracting Officer.
b. Jointing: Make standard coupling band watertight joints using the coupling bands previously specified for this purpose. In making pipe joints, keep space between pipe and coupling free from dirt and grit so that corrugations will fit snugly. While tightening the coupling band, tap it with a soft-head mallet of wood, rubber, or plastic to take up slack and ensure a tight joint. Assemble standard coupling band joints in accordance with the recommendations of the pipe manufacturer.

3.1.2.3 Installation of ABS or PVC Composite Plastic Piping

Install pipe and fittings in accordance with the "General Requirements for Installation of Pipelines" and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint; assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.4 Installation of Corrugated Plastic Piping

Install pipe and fittings in accordance with the "General Requirement for Installation of Pipelines" and with the recommendations of the HDPE pipe manufacturer.

3.1.2.5 Installation Beneath Railroad Right-Of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping by the boring and jacking method in accordance with the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5, of AREA MRE.

3.1.2.6 Installation of Subsurface Drainage Piping

Laying and jointing shall be in accordance with paragraph entitled "General-Requirements for Installation of Piping" of this section, except as specified hereinafter, and with the additional requirements specified hereinafter.

a. Laying and Jointing: The laying of pipe and tile shall proceed upgrade from the lower end of the line, and shall have a uniform pitch to the outlets. Lay drain tile with 1/8- to 1/4-inch open joints. Joints between the tile shall be covered with one thickness of the jointing material specified; material shall ov rlap the joint not less

than 4 inches on each side and shall cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. Provide vertical pipe at the high points in each drain run, for testing purposes. Connect the vertical pipe sections into the drains by means of tees, and extend to the height indicated. Fit the upper hub ends with screwed plugs. Make joints in cast-iron sections with fiber gaskets and 1-to-2 portland cement mortar.

3.1.3 Concrete Work

Perform cast-in-place concrete work in accordance with Section 03300, "Cast-In-Place Concrete."

3.1.4 Manhole and Catch Basin Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent drainage sections. For changes in direction of drains and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. For precast concrete construction, make joints between sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Give a smooth finish to inside joints of precast concrete manholes and catch basins. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the paragraph entitled, "Concrete Work." Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as required to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding beyond into the manhole. Use resilient connectors as specified for pipe connectors to concrete manholes.

3.1.5 Metal Work

3.1.5.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron and steel to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide rabbets, lugs, and brackets wherever necessary for fitting and support.

3.1.5.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, MIL-Q-24441 to a minimum dry film thickness of 3.0 mil; and apply a top coat, MIL-P-28578 to a minimum dry film thickness of 1.5 mils, color optional. Do not paint surfaces subject to abrasion.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01011, "Additional General Paragraphs." Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

3.2.2 Pipeline Testing

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least the lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When the water table is 2 feet or more above top of pipe at upper end of pipeline section to be tested, measure infiltration using a suitable weir or other acceptable device. When the water table is less than 2 feet above top of pipe at upper end of pipeline section to be tested, make exfiltration test by filling the line to be tested with water so that the head will be at least 4 feet above top of pipe at upper end of pipeline section being tested. Allow filled pipeline to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, re-establish the head and measure amount of water needed to maintain this water level during a 2-hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed 500 gallons per inch of diameter per day per mile of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-Through Device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:
   (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
   (2) A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
   (3) Center bored and through bolted with a 1/4-inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.
   (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection Measuring Device: Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved by the Contracting Officer prior to use.

c. Pull-Through Device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

d. Deflection Measuring Device Procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.

e. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03300, "Cast-In-Place Concrete."

--End of Section--

SECTION 02736

GEOTEXTILES AND GEOGRIDS

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1388	1964 (rev 1975) Test Methods for Stiffness of Fabrics
ASTM D 4101	1982 (rev 1988) Specification for Propylene Plastic Injection and Extrusion Materials
ASTM D 4218	1982 (rev 1986) Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique
ASTM D 1777	1964 (rev 1975) Method for Measuring Thickness of Textile Materials
ASTM D 3776	1985 (rev 1990) Test Methods for Mass Per Unit Area (Weight) of Woven Fabric
ASTM D 4632	1986 Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
ASTM D 3786	1986 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method
ASTM D 4833	1988 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4533	1985 Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4751	1987 Test Method for Determining the Appar nt Opening Size of a Geotextile
ASTM D 4491	1989 Test Methods for Water Permeability of Geotextiles by Permittivity

CORPS OF ENGINEERS, CIVIL WORKS CONSTRUCTION GUIDE (COE CW)

COE/CW 02215 1977 Method for Determination of Material Open Area

GEOSYNTHETIC RESEARCH INSTITUTE (GRI)

GRI GG1 1987 Geogrid Tensile Strength

GRI GG2 1987 Geogrid Junction Strength

1.2 DESCRIPTION

Furnish and install woven and non-woven geotextile fabric and geogrid at the locations and in the manner shown on the Drawings, indicated in this Section or as directed by the Contracting Officer. Geotextile fabric is required for drainage pipes, under riprap and at other locations shown on the Contract Drawings. Geogrid is required at one of the permanent slurry wall roadway crossings.

1.3 RELATED REQUIREMENTS

Section 02220, "General, Excavation, Filling, and Backfilling" applies to this section with the additions and modifications specified herein.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300 "Submittals".

1.4.1 SD-02 Manufacturer's Catalog Data.

a. Non-woven Geotextile G
b. Woven Geotextile G
c. Geogrid G

1.5 DEFINITIONS

1.5.1 Geosynthetic material

Term used encompassing all woven geotextiles, non-woven geotextiles, and geogrids.

1.5.2 Geotextiles

Term used encompassing all woven and non-woven geotextiles.

1.5.3 Geogrid

Term used encompassing a deformed or nondeformed gridlike polymeric material formed by intersecting ribs joined at the junctions and used for soil reinforcement.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Non-woven Geotextile Fabric

The non-woven geotextile shall meet the following requirements:

a. Produced by heat bonding, needle punching or by the use of external adhesives.
b. The network of fibers shall be bonded so the fibers will retain their relative position with respect to each other.
c. Fibers may be based on polypropylene, polyvinylidene chloride, nylon or polyester.
d. Resistant to rot, mildew, insects, salt water, rodents and any other biological and chemical substances commonly encountered in the ground.
e. Meet the following physical properties:

NON-WOVEN GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	MIN. AVERAGE ROLL VALUES PERMISSIBLE
Thickness (mils)	ASTM D 1777	50
Weight (oz./s.y.)	ASTM D 3776	4
Grab Strength (lbs)	ASTM D 4632	90
Grab Elongation (%)	ASTM D 4632	50
Mullen Burst Strength (psi)	ASTM D 3786	200
Puncture Resistance (lbs.)	ASTM D 4833	65
Trapezoidal Tear Strength (lbs.)	ASTM D 4533	45
Apparent Opening Size	ASTM D 4751	70-100
Permeability Coefficient (cm/sec) Permittivity	ASTM D 4491	0.2

2.1.2 Woven Geotextile Fabric

The woven geotextile shall be fabricated from monofilaments of polypropylene, resistant to ultraviolet degradation, and shall meet the following physical requirements:

WOVEN GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	MIN. AVERAGE ROLL VALUES PERMISSIBLE
Modulus (load at 10% elongation)	ASTM D 4632	125
Grab Strength (lbs)	ASTM D 4632	300
Mullen Burst Strength (psi)	ASTM D 3786	600
Trapezoidal Tear Strength (lbs.)	ASTM D 4533	115
Puncture Resistance (lbs)	ASTM D 4833-88	145

2.1.3 Geogrid

The geogrid shall meet the following requirements:

a. Regular grid structure consisting of biaxial continuous sheet of select polypropylene material.
b. Aperture geometry and rib and juncture cross-section sufficient to permit significant mechanical interlock with reinforced material
c. High flexural rigidity, high tensile modulus, and high continuity of tensile strength through all ribs and junctions.
d. Resistant to ultraviolet degradation and all forms of biological or chemical damage normally encountered in the reinforced material.
e. Meet the following physical properties:

GEOGRID PROPERTIES

PROPERTY	TEST METHOD	MINIMUM OR NOMINAL VALUE PERMISSIBLE
Aperture size[1]	I.D. Calipered[2]	
MD (in)		1.0 (nom)
CMD (in)		1.3 (nom)
Open area (%)	COE Method[3]	70 (min)
Thickness	ASTM D 1777-64	
ribs (in)		0.03 (nom)
junctions (in)		0.11 (nom)
Flexural rigidity (mg/cm)	ASTM D 1388-64[4]	250,000 (min)
Tensile modulus (lb/ft)	GRI GG1-8[5]	14,000 (min)
Junctions	GRI GG2-87[6]	
strength (lb/ft)		750 (min)
efficiency (%)		90 (min)
Polypropylene (%)	ASTM D 4101 Group 1/Class 1/ Grade 2	98 (min)
Carbon black (%)	ASTM 4218	0.5 (min)

Notes:

1. MD dimension is along roll length. CMD dimension is across roll width.
2. Maximum inside dimension in each principal direction measured by calipers.
3. Percent open area measured without magnification by Corps of Engineers method as specified in CW 02215 Civil Works Construction Guide, November 1977.
4. ASTM D 1388-64 modified to account for wide specimen testing.
5. Secant modulus at 2% elongation measured by Geosynthetic Research Institute test method GG1-87 "Geogrid Tensile Strength." No offset allowances are made in calculating secant modulus.
6. Geogrid junction strength and junction efficiency measured by Geosynthetic Research Institute test method GG2-87 "Geogrid Junction Strength."

PART 3 EXECUTION

3.1 INSTALLATION

Install woven and non-woven geotextiles and geogrid as follows:

a. Place in the manner and at the locations shown on the Contract Drawings.
b. Reject all geosynthetic material with defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

c. Place woven geotextile with the long dimension parallel to the centerline of the collection pipes and lay all geosynthetic materials smooth and free of tension, stress, folds, wrinkles, or creases.

d. Provide a minimum width of 12 in. of overlap for bedding fabric applications.

e. For placement on embankment slopes, meet the following:
   1. Place geotextile as continuous sections from the anchor trench to the bottom of slope (no end splicing).
   2. Overlap sections a minimum width of 12 inches or sew sections together as recommended by the manufacturer.

f. In the presence of wind, weight the materials with sandbags until final covers are installed.

g. Take care to assure that any underlying materials are not damaged during placement of geosynthetic materials.

h. Take care to assure that stones, mud, and dirt are not entrapped in the geotextile during placement and seaming operations.

i. Overlap joints and seams shall be measured as a single layer of cloth.

j. Turn geotextile fabric down and bury a minimum of 2 feet at all exterior limits or as indicated on the Contract Drawings.

k. Place so that the upstream strip of geotextile will overlap the downstream strip.

l. Protection of geosynthetic materials:
   1. Exercise necessary care while transporting, storing and installing the geosynthetic material to prevent damaging it.
   2. Protect from prolonged direct exposure to sunlight.
   3. Repair all damaged areas of the geosynthetic material by placing another piece of fabric of sufficient size to extend a minimum of 2.0 feet beyond the limits of the damage in all directions over the damaged area. Sew repairs to geotextiles as described below.
   4. Do not leave exposed more than 5 days without being covered by backfill or geomembrane liner.
   5. When required, sew overlaps and repairs to damaged geotextiles using a portable machine to provide a seam strength of at least 90 percent of the geotextile strength.
   6. Do not expose geotextile to precipitation prior to being installed. Remove wrappings protecting geosynthetic material rolls less than one hour prior to unrolling.

m. Bridging of geosynthetic material is not allowed.

--End of Section--

SECTION 02737

VERY LOW DENSITY POLYETHYLENE (VLDPE) GEOMEMBRANE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 638	1989 Test Method for Tensile Properties of Plastics.
ASTM D 746B	1979 Brittleness Temperature of Plastics and Elastomers by Impact.
ASTM D 751	1989 Method of Testing Coated Fabrics.
ASTM D792	1986 Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
ASTM D 1004	1966 Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1204	1984 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
ASTM D 1603	1976 Test Method for Carbon Black in Olefin Plastics.
ASTM D1693	1970 Test Method for Displacement Environmental Stress-Cracking of Ethylene Plastics.
ASTM D3083	1989 Specifications for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining - Type IV Dumb-bell at 2 ipm.
ASTM D4545	1986 Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes.

FEDERAL TEST METHOD STANDARD (FTMS)

FTMS 101C	Method 2065, Puncture Resistance.

1.2 DESCRIPTION

Furnish all labor, materials, and equipment to install VLDPE geomembrane in conformity with the Contract Drawings and as specified in this section.

1.3 RELATED REQUIREMENTS

Section 02220, "General Excavation, Filling and Backfilling," and Section 02738, "Geosynthetic Clay Liner (GCL)", and Section 02736, "Geotextiles" apply to this section with additions and modifications specified herein.

1.4 SUBMITTALS

Submit the following in accordance with Section 1300, "Submittals."

1.4.1 SD-04, Drawings

Panel layout with seam locations and details for approval before material shipment G

1.4.2 SD-06, Instructions

Cold/wet weather seaming procedures for approval before start of installation G

1.4.3 SD-08, Statements

1.4.3.1 Experience

Experience information for the following before material shipment as specified in Quality Control in Part 1 of this section:

a. Manufacturer's experience information for approval before material shipment G
b. Installer's experience information for approval before material placement G

1.4.3.2 Warranties

Submit warranties for the following:

a. Shipment Warranty for approval before material shipment specified in Manufacturer's Warranty in Part 1, Paragraph 1.8 of this Section G
b. Warranty before acceptance of installed liner as specified in Manufacturer's Warranty in Part 1, Paragraph 1.8 of this Section G
c. Installer's warranty G

1.4.4 SD-10, Test Reports

Quality control testing reports before material shipment as specified in Source Quality Control in Part 2 of this Section. G

1.4.5 SD-12, Field Test Reports

Field Technical Service reports during installation and before acceptance as specified in Field Quality Control in Part 3 of this Section G

1.4.6 SD-13, Certificates

a. Supplier's and manufacturer's certificates for approval before material shipment as specified in Quality Control in Part 1 of this Section G
b. Site preparation certificate before start of installation as specified in Quality Control in Part 1 of this Section G

1.5 DELIVERY, STORAGE, AND HANDLING OF GEOMEMBRANE

1.5.1 Identification Requirements

Using indelible marking, identify each roll with:

a. Manufacturer's name
b. Manufacturer's batch code
c. Physical dimensions (thickness, length, width)
d. Roll number.
e. Date of fabrication.
f. Directions for unrolling and unfolding.

1.5.2 Packing and Storage Requirements

Individually package in heavy cardboard or in wooden crates, fully enclose and protect to prevent damage during shipment. Identify each package in the same fashion as the sheet within and show the date of shipment. Store indoors in original, unopened protective covering. Store outdoors on a pallet protected from direct sun rays and provide heat reflective opaque cover to create free flowing air space between crate and cover.

1.6 PROJECT CONDITIONS

1.6.1 Temperature Constraints

1.6.1.1 Extrusion or Fusion Bonding of Field Seams

a. Take ambient temperature readings at no longer than two-hour intervals, two feet above the liner, using thermocouples or other acceptable means.
b. If ambient temperature, as described above, is measured above 105 degrees F, seaming shall proceed with increased caution because of difficult working conditions.
c. If ambient temperature, as described above, is measured between 105 degrees F and 40 degrees F, seaming may proceed without additional constraints.
d. If ambient temperature is below 40 degrees F, additional constraints will be imposed in accordance with the approved cold weather procedures.

1.6.1.2 Cold/Wet Weather Seaming

a. Submit for approval cold\wet weather procedures for seaming when temperatures drop below 40 °F during rain events or any time other than from April 15 to November 1.
b. Cold\wet weather procedures include but are not limited to the following:
   1. Preheating sheets
   2. Drying sheets
   3. Providing liner protection with coverings
   4. Changing test frequencies
   5. Bridging
   6. Increasing trial welding

1.7 QUALITY CONTROL

1.7.1 Manufacturer's Qualifications

Manufacturer has produced and has had in service use of similar geomembrane materials for not less than 1 year, and has installed at least 10 million square feet of VLDPE or HDPE geomembrane.

1.7.2 Installer's Qualifications

Installer has:

a. placed at least 1 million square feet of VLDPE or HDPE geomembrane using dual hot wedge fusion seaming methods, and
b. has installed pipe boots and other penetration fabrications on projects totalling at least 1 million square feet using extrusion welding by both the company and its field and boot specialists, respectively.

1.7.3 Certifications

Submit the following certificates:

a. Certificate stating that manufacturers resin suppliers used resin containing less than 2% clean recycled polymer by weight, a specific gravity between 0.90 to 0.925 and a melt index between 0.1 to 1.1 gram/10 min.
b. Manufacturer's certificate for the geomembrane.
c. Installer's certificate that site preparation is acceptable for geomembrane installation and warranty.

1.7.4 Contractor Provided Independent Geomembrane Inspector

a. Contractor shall provide an independent geomembrane inspector and geomembrane testing laboratory experienced in the placement and testing of geomembrane liners or covers. The geomembrane inspector shall oversee the installation and Quality Control testing of the geomembrane.
b. Contractor shall cooperate with the efforts and schedules of the work performed by the geomembrane inspector and shall provide assistance to the inspector to include sampling of geomembrane materials, when requested.

1.8 WARRANTIES

1.8.1 Manufacturer's Warranty

a. Warrant that liner:

1. Will not develop cracks or holes from normal service for 20 years from delivery date.
2. Is immune to chemical attack and degradation by chemicals specified in the manufacturer's literature.

b. Should defects or service degradation of the above warranty occur, the manufacturer shall:
   1. Refund the pro-rata part of the unexpired term of the warranty of the original cost of such product, or repair or replace materials at the then-current price.
   2. Credit the lesser of:
      a. The pro-rata part of the original sales price of the material repaired or replaced for the unelapsed period of the warranty.
      b. Or the pro-rata part of the then-current price of the material repaired or replaced to the unelapsed period of the warranty.

c. Warranty shall continue in effect on the repaired or replaced material for the unelapsed term of the original warranty.

d. Contracting Officer will present in writing to manufacturer and installer claim for alleged breach of warranty within 30 days after alleged defect is noticed.

1.8.2 Installer's Warranty

Warrant liner was installed in accordance with the technical specifications and accepted good practice.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Very Low Density Polyethylene (VLDPE) Geomembrane

2.1.1.1 Description

The geomembrane shall conform to the properties shown in Table 02737. No additives, fillers or extenders are permitted unless otherwise specified. Two percent carbon black in resin is required for ultraviolet resistance.

2.1.1.2 Extrusion Joining Resin

Resin shall be black and produced from the same material as the sheet resin. Physical properties shall be the same as those of the resin used in the manufacture of the liner. Color natural resin through addition of 2.0 to 3.5 percent master batch colorant before use.

2.1.2 Other Materials

2.1.2.1 Pipe Boots, Vents, Patches

Same material and thickness as the geomembrane.

2.1.2.2 Mechanical Fastenings

Material, size, and type as detailed on the Drawings or approved Shop Drawings.

2.2 SOURCE QUALITY CONTROL

Furnish factory quality control test data on rolls to be shipped for material thickness, tensile strength and tear resistance and furnish test data on fabricated seams.

2.3 SOURCE QUALITY ASSURANCE

Prior to geomembrane installation the Contractor's Independent Geomembrane Inspector shall obtain random samples 3 feet long by roll width from rolls delivered to the site at locations selected by the Geomembrane Inspector and at a rate of one sample per 40,000 s.f. or one per 4 rolls. Samples are to be sent by the Geomembrane Inspector to the Contractor's Independent Geomembrane Testing Service to determine specific gravity, carbon black content, thickness and tensile characteristics. Acceptance criteria shall be that the samples meet the required values listed in Table 02737. Test results shall be received within 24 hours of sampling and must be received prior to material installation.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Remove all sharp objects, debris or foreign matter, creating a smooth surface. Provide slightly rounded corners at directional changes in the area to be covered and in the anchor trench so as to avoid sharp bends in the geomembrane. Surface must be free of standing water and in a dry condition. Maintain surface requirements during geomembrane installation, including anti-desiccation measures as necessary.

3.2 FIELD SEAMS

3.2.1 Panel Layout

Contractor shall submit drawing identifying location of all panels and seams.

3.2.2 Preparation

Clean dust and dirt from areas to become seam interfaces. Conform to requirements under Temperature Constraints in Article entitled Project Conditions in Part 1 of this Section.

3.2.2.1 Extrusion Bonded Seams

For extrusion bonded seams, roughen slick sheet surfaces to become seam interfaces with a hand-held disk grinder and conform to the following:

a. The grinder grit paper should be no coarser than #80 or finer than #100.
b. Grinding depth must roughen membrane surface but must not exceed 10% of the membrane thickness.
c. The grinder marks shall not appear beyond 1/8 inch on each side of the extrudate after seaming. Place cap strip or patch, over entire seam length where excessive grinding (greater than 1/8 inch beyond weld or greater than 10% of membrane thickness) occurs.
d. Do not grind membrane more than 10 minutes before placement of extrudate to prevent surface oxidation of the surface.

3.2.2.2 Fusion Bonded Seams

a. For hot wedge fusion-bonded seams, sheet surface should not be roughened by grinding or other means. Surfaces to be bonded must be clean and dry.
b. Sheet shall be dry. Seaming shall not occur over fully saturated subgrade soil without appropriate procedures and precautions, as the heat will draw water to the seam.

3.2.3 Seaming Methods

a. Make maximum use of large panels unless special requirements are necessary for liner configuration and termination.
b. To the maximum extent possible, field seams shall be made parallel to the slope (i.e., up and down) as opposed to horizontally along the slope. Where horizontal seams are necessary, the higher elevation membrane shall overlap the lower elevation membrane. The number of seams shall be minimized in corners and odd-shaped geometric locations. Horizontal seam should not be less than 5 feet from the toe of slope.
c. Overlap adjacent sheets a minimum of 4 inches.
d. Use the dual hot wedge fusion bonding method to seam geomembrane panels together and techniques as follows:

    1. Each seaming unit shall include a thermometer giving machine temperature at the metal surface.
    2. Maintain seaming unit at a recordable temperature determined by on-site conditions.
    3. Seaming unit temperature shall not vary more than 50 degrees F. above or below recommended temperatures.
    4. Press liners together mechanically.

e. Use extrusion welding method for repairs or patches and in areas where use of the dual hot wedge is not feasible (e.g., pipe and manhole penetrations) with the following techniques:
    1. Soften liner material by heated air.

2. Air Temperature Impinging on Sheet: 420 degrees F. to 680 degrees F.
3. Installation supervisor shall determine exact temperature used based on scrap welds.
4. Directly following heat application, extrude a 1 ½ inch minimum width resin strip between overlapped sheets. For flat welds and for flat fillet welds extrude a 1 ½-inch minimum width resin strip centered over the exposed overlap edge.
5. Extrusion Die Resin Temperature: 428 degrees F. to 536 degrees F.
6. Firmly press overlapped sheets together by mechanical means to form the extrusion joint.

3.2.4 Seaming Wrinkles

Seam wrinkles as follows:

a. Cut fishmouths or wrinkles along the top ridge of the wrinkle, and overlap for a flat surface.
b. Seam the cut fishmouths or wrinkles where the overlap is greater than 3 inches.
c. Where the overlap is less than 3 inches, patch with oval or round patch extending a minimum of 6 inches in all directions.

3.2.5 Patching

Patch holes and areas to be repaired as follows:

a. Use extrusion or fusion welding to bond materials.
b. Clean liner material of all dirt, dust and other foreign material.
c. Roughen smooth surfaces and heat material as required.
d. Cut patch in oval or round shape, extending a minimum of 6 inches beyond hole, in all directions.

3.3 PIPE BOOTS, VENTS, AND PATCHES

a. Construct as shown on the Contract Drawings and as recommended by manufacturer.
b. Use seaming techniques to the membrane as recommended by the manufacturer.
c. Install all devices to provide an effective, watertight seal.

3.4 MECHANICAL FASTENINGS

a. Construct mechanical fastenings and sealing details as shown on the Contract Drawings, and as recommended by manufacturer.
b. Sealing materials and contact adhesives must be compatible with membrane and chemical environment of installation and as recommended by manufacturer.
c. Install all devices to provide an effective watertight seal.

3.5 FIELD QUALITY ASSURANCE

3.5.1 Contractor's Geomembrane Inspector

The Contractor's Geomembrane Inspector will:

a. Observe all non-destructive seam tests described under Field Quality Control.
b. Observe each roll of liner material for defects.
c. Review the manufacturer's quality control certificate for each roll delivered to the site.
d. Cut coupons, conduct field destructive testing of seam samples and forward passing samples to independent laboratory for testing. Perform air testing at boots.
e. Conduct photographic documentation of the geomembrane installation.
f. Keep a logical record of documentation of geomembrane installation. This will include panel placement log, seam testing and inspection log, and liner repair log.

3.5.2 Laboratory Testing

The following is required for laboratory testing:

a. From each 12 in. seam sample coupon submitted for destructive testing to the Contractor's indpendent geomembrane inspector's laboratory, five shear tests and five peel tests will be run, each on a strip of material. Shear tests will be ASTM D 4545-86, 6.1.2 or equivalent and peel tests will be ASTM D 4545-86, 6.1.1 or equivalent.
b. Seam samples submitted to the independent laboratory for testing shall conform to the pass/fail criteria for all peel and shear tests.
c. The shear strength (tensile strength) of 4 of the 5 specimens obtained from each sample shall be equal to or exceed 80% of the mean tensile stress at yield of the parent material.
d. The peel test of 4 of the 5 specimens obtained from each sample shall exhibit a Film Tear Bond (FTB) and have a peel seam separation of 10% or less. The peel seam separation is the area of the seam separation expressed as a percentage of the original fused area.

3.6 FIELD QUALITY CONTROL

3.6.1 Manufacturer's Technical Service

a. Provide liner manufacturer technical representative at job site to ensure compliance with installation directions:
   1. When all membrane installation begins.
   2. At substantial completion of the installation.
   3. After written notification from the Contracting Officer that installation is not in conformance with manufacturer's recommended procedures or specifications.
b. Technical representative shall:
   1. Observe work.

2. Report in writing to Contractor and Contracting Officer any unsatisfactory conditions or recommendations for improvement in procedures.

3.6.2 Tests

3.6.2.1 Test Welds

a. Run a test weld from each seaming machine a minimum of 3 times per day, at the beginning of the day, around mid-day, and near the end of the day. In addition, test welds shall be run when a new operator takes over or whenever the welding machines are shut off and allowed to cool down, or when machines are idle for more than 60 minutes. If the ambient temperature, as defined in Project Conditions, Part 1 of this Section, drops 20 degrees or more in 2 hours, a test weld shall also be performed. If seaming is conducted under wet conditions a test weld shall also be performed.

b. Welding by the seaming machine and/or operator being tested shall be discontinued until passing tests have been achieved.

c. Test strip should be at least 48 in. for extrusion welds and 96 in. for hot wedge welds measured along the length of the seam and extended at least 6 in. on each side of the seam. Run test weld under the same conditions that exist for welding of the seam.

1. The test weld shall be cut in 12 in. coupons and be distributed to:
   - the installer to perform field testing.
   - the Contractor's Geomembrane Inspector for field testing/screening purposes.
   - Contracting Officer for project files.
2. Each sample coupon shall be marked with test weld date, time, ambient temperature, welding machine number, and operator's name.
3. For field testing/screening, a passing test weld for peel shall exhibit Film Tear Bond (FTB) with no brittle cracking and have a peel separation of 10% or less.
4. For field testing/screening, a passing test weld for shear shall exhibit necking of the parent material prior to any necking or splitting of the weld.

3.6.2.2 Dual Hot Wedge Air Channel Seams

a. The hot wedge develops 2 welds separated by an air channel. This channel will be used for air testing in both field seams and seams created during manufacturing. The first phase of the test shall be to establish continuity along the entire length of the seam. This will be done by sealing one end of the seam, inserting a manometer (consisting of a hollow needle, pressure gauge and air valve) into the air channel, and pumping air through the channel. The opposite end shall then be inspected for passage of air. Once continuity is established, the opposite end of the seam from the manometer shall be sealed and the channel shall be pumped to 30 psi. The initial start pressure is read once the air in the air channel has had a chance to stabilize at the ambient liner temperature (up to a 5 minute wait). Once the pressure has stabilized (no lower than 25 psi) the test can start. The pressure shall not drop more than 3 psi in 5 minutes. Any leaks found shall be repaired by extrusion welding and

vacuum tested. The hole made by the manometer needle will be patched and the patch will be vacuum or spark tested.

b. If the air channel is found to be plugged during the continuity test, then the plug shall be located. The pressure test shall be conducted on each side of a plug. It may be necessary to cut away the plug and patch the area after the pressure test.

c. Subject to approval, those dual hot wedge seams not feasible for air pressure testing shall be 100% vacuum tested.

3.6.2.3 Extrusion Seams (Flat Seams and Fillet Seams):

a. Vacuum Test: Perform vacuum test using vacuum test box or other approved vacuum method where feasible along extrusion or fusion bonds (i.e., patches, pipe boots, etc.)
   1. Spread soap solution over seam being tested, press vacuum box down and apply suction for 30 seconds.
   2. When the vacuum box is moved along the seam during testing, maintain a 3 inch overlap with section tested.
   3. The appearance of bubbles in rapid succession during the test is indicative of a leak.
   4. Repair and retest structural faults in the welded seam.

3.6.2.4 Destructive Tests

a. Samples:
   1. Take random weld samples at locations selected by the Contractor's Geomembrane Inspector and/or the Contracting Officer at a frequency of 1 sample per 500 feet of welded seam, or at a minimum of 1 per seam, including patches with a seam.
   2. The weld sample shall be cut in 12 in. coupons and be distributed to the following:
      - the installer to perform Construction Quality Control (CQC) testing.
      - the Contractor's Geomembrane Inspector for field testing/screening purposes and independent laboratory for testing as specified under Quality Assurance. Laboratory test results shall be received within 24 hours of sampling.
      - the Contracting Officer for archive filing.
   3. Each sample coupon shall be marked with date, location of sample, orientation with respect to machine direction, and welding machine number.

b. Field Testing:
   1. For field testing/screening, a passing test weld for peel shall exhibit Film Tear Bond (FTB) with no brittle cracking of 10% or less.
   2. For field testing/screening, a passing test weld for shear shall exhibit FTB with necking of the parent material prior to any necking or splitting of the weld.

c. Patches and Repairs:
   1. If the sample of the seam tested fails the criteria, cut samples 10 feet on both sides of failing sample. Send second sample to testing laboratory for analysis.

2. If the criteria is not achieved for the second samples, follow the same procedure outlined above until the entire area of inadequate seaming is identified.
3. Place a patch over the entire failed area of the seam.
4. All repairs require 100% passing by non-destructive vacuum box testing.

d. Visual Inspection:
Visually inspect all seams and geomembrane panels in-place for holes, blemishes, pores, penetrations or other detrimentation defects.

3.7 PROTECTION OF GEOMEMBRANE

a. Vehicle traffic in direct contact with the installed geomembrane is not allowable and should be reported immediately to the Contracting Officer.
b. Placement of soil and pipes above installed liner must be done so in a manner so as to not nick, cut, scrape, puncture or otherwise damage the geomembrane.
c. Reasonable care must be taken at all times to protect the geomembrane from any activity with potential to damage the installed geomembrane.
d. All damaged areas noted must be repaired and brought to the attention of the Contracting Officer and the Contractor's Geomembrane Inspector.

3.8 CLEANUP

a. Dispose of all trash and waste.
b. Remove all excess material and equipment.
c. Leave the premises in a neat and acceptable condition.

Table 02737

PHYSICAL PROPERTIES OF VLDPE GEOMEMBRANE

PROPERTY	TEST METHOD	REQUIRED VALUE
Structure		Geomembrane
Polymer Type	-	Very Low Density Polyethylene
Thickness (mil)	ASTM D 751-89	40
Minimum Tensile Properties (each direction)	ASTM D 638-89 Type IV Dumb-bell at 2 ipm	
1. Tensile Strength at Break (pounds/inch width)		140
2. Elongation at Break (%)		780
Tear Resistance Initiation (pound minimum)	ASTM D 1004-66, Die. C	16
Puncture Resistance (pounds minimum)	FTMS 101C Method 2065	52
Specific Gravity	ASTM D792-86	0.90-0.925
Dimensional Stability (%)	ASTM D1204-84	-2-3
Low Temperature Brittleness (no failure to this temperature)	ASTM D746B-79	-94 °F
SEAM STRENGTH (pounds/inch minimum)		
Shear	ASTM D4545-86 6.1.2	40
Peel	ASTM D4545-86 6.1.1	35
ENDURANCE PROPERTIES (minimums)		
Carbon Black Content (%)	ASTM D1603-76	2
Soil Burial Resistance (% strength retained)	ASTM D3083-89	90
Environment Stress Crack (minimum hours)	ASTM D1693-70	1500
Carbon Black Dispersion	ASTM D3015-85	A1,A2, B-1

–End of Section–

SECTION 02738

GEOSYNTHETIC CLAY LINER (GCL)

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM D 4643	1987 Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method
ASTM D 3776 OPTION C	1985 Test Method for Mass Per Unit Area of Woven Fabric
ASTM D 4632	1986 Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
ASTM D 5084	1991 Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

1.2 DESCRIPTION

Furnish all labor, materials, and equipment to install GCL in accordance with the Drawings and as specified in this section.

1.3 RELATED REQUIREMENTS

Section 02220, "General Excavation, Filling, and Backfilling," and Section 02737, "Very Low Density Polyethylene (VLDPE) Geomembrane," apply to this section with the additions and modifications specified herein.

1.4 SUBMITTALS

The following in accordance with Section 1300, "Submittals."

1.4.1 SD-04, Drawings

Panel layout with seam locations and details for approval before material shipment G

1.4.2 SD-06, Instructions

Installation details distinctive to manufacturer's product G

1.4.3 SD-08, Statements

1.4.3.1 Experience

Experience information for the following as specified in Quality Control in Part 1 of this Section.

a. Manufacturer's experience information for approval before material shipment G
b. Installer's experience information for approval before material shipment G

1.4.3.2 Warranties

a. Shipment Warranty for approval before material shipment specified in Manufacturer's Warranty in Part 1, Paragraph 1.7 of this Section G
b. Warranty before acceptance of installed liner as specified in Manufacturer's Warranty in Part 1, Paragraph 1.7 of this Section G

1.4.4 SD-10, Test Reports

Quality control testing reports before material shipment as specified in Source Quality Control in Part 2 of this Section G

1.4.5 SD-12, Field Test Reports

Field Technical Service reports during installation and before acceptance as specified in Field Quality Control in Part 3 of this Section G

1.4.6 SD-13, Certificates

a. Suppliers and manufacturers certificates for approval before material shipment as specified in Quality Control in Part 1 of this Section G
b. Site preparation certificate before start of installation as specified in Quality Control in Part 1 of this Section G

1.5 DELIVERY, STORAGE, AND HANDLING OF GCL

1.5.1 Handling

During all stages of shipping, handling, and storage of these materials, care must be taken to prevent puncturing or other damage to the rolls, and to protect against wetting of the rolls.

1.5.2 Identification Requirements

Using indelible marking, identify each roll with:

a. Name of manufacturer.
b. Lot number.
c. Dimensions (thickness, length, width and weight).
d. Roll number.
e. Date of fabrication.

1.5.3 Packing and Storage Requirements

Individually package in plastic cover material to prevent damage during shipment. Identify each package in the same fashion as the roll within and show the date of shipment. Store indoors in original unopened protective covering in a safe, dry area. Store outdoors on a pallet in a safe, dry area. If stored outdoors for an extended period, cover with a heavy protective tarpaulin.

1.6 QUALITY CONTROL

1.6.1 Manufacturer's Qualifications

a. Production and in service use of GCL products for not less than 1 year.
b. At least 10 million square feet of GCL product has been manufactured and installed.

1.6.2 Installer's Qualifications

Has installed at least 1 million square feet of GCL products by both company and its field representative.

1.6.3 Certifications

a. Manufacturer's and supplier's certificates for the GCL.

b. Installer's certificate that site subgrade preparation is acceptable for GCL installation and warranty.

1.7 WARRANTIES

1.7.1 Manufacturer's Warranty

a. Warrant that GCL will not leak in excess of the value in Table 02738-1 from normal service for 20 years from delivery date.
b. Should defects or service degradation of the above warranty occur, the manufacturer shall:
   1. Refund the pro-rata part of the unexpired term of the warranty of the original cost of such product.
   2. Or repair or replace materials at the then-current price.
   3. Credit the lesser of:
      a. The pro-rata part of the original sales price of the material repaired or replaced for the unelapsed period of the warranty.
      b. Or the pro-rata part of the then-current price of the material repaired or replaced to the unelapsed period of the warranty.
c. Warranty shall continue in effect on the repaired or replaced material for the unelapsed term of the original warranty.
d. Contracting Officer will present in writing to manufacturer and installer claim for alleged breach of warranty within 30 days after alleged defect is noticed.

1.7.2 Installer's Warranty

a. Warrant liner for a period of (5) years to the owner against improper installation. The warranty shall include the following:
   1. Problems associated with improperly compacted or prepared subgrade, damage due to construction vehicles on the GCL, puncture of the GCL caused by improper materials in the subgrade or the cover, or any other instances which are determined to be the result of improper installation procedures and not in accordance with the technical specifications.
   2. Complete excavation and removal of the cover material and existing GCL and replacement with new material to restore the site to its original condition.

1.8 PROJECT CONDITIONS

1.8.1 Weather Constraints

The GCL must be installed in a dry condition and covered in a dry condition.

PART 2 PRODUCTS

2.1 GCL MATERIALS

The GCL shall meet the following requirements:

a. The GCL is prefabricated in a manufacturing facility with a uniform layer of natural sodium bentonite.
b. The bentonite used in the manufacture of the GCL must be demonstrated to meet the testing and acceptance criteria listed in Table 02738-2. The testing shall be performed on the materials obtained from the finished GCL product.
c. The bentonite shall be sandwiched between woven and non-woven polypropylene geotextiles that are needlepunched together. No glues or adhesives may be used in lieu of the needlepunch.
d. The finished GCL shall be demonstrated to meet or exceed all of the testing procedures and acceptance criteria listed in Table 02738-2.
e. 9 inch overlap marks shall be marked longitudinally on the GCL by the manufacturer to assist in obtaining proper overlap.
f. The bentonite shall have a minimum free swell of 16 cubic centimeters per 2 grams.
g. The GCL shall have a minimum hydrated angle of internal function of 26 degrees and a minimum hydrat interface friction angle between the woven GCL surface and 40-mil smooth VLDPE of 14 degrees.

TABLE 02738-1

COMPOSITE PRODUCT DATA*

MASS PER UNIT AREA (ASTM D3776 OPTION C)	16 oz./sf
HYDRAULIC CONDUCTIVITY (WATER) (ASTM D5084)	$5x10^{-9}$ cm/s (maximum)
REQUIRED OVERLAP	9 in.

* minimum value unless noted

TABLE 02738-2

COMPONENT TECHNICAL SPECIFICATIONS*

PROPERTY	TEST METHOD	VALUE
Bentonite		
Moisture Content	ASTM D4643	12% (Maximum)
Non-woven Geotextile		
Weight	ASTM D3776	6.0 oz./sy
Grab Strength	ASTM D4632	6 lb.
Grab Elongation	ASTM D4632	89%
Woven Geotextile		
Weight	ASTM D3776	3.25 oz./sy
Grab Strength	ASTM D4632	95 lbs.
Grab Elongation	ASTM D4632	20%

* minimum value unless noted

2.2 SOURCE QUALITY CONTROL

Furnish factory quality control test data on rolls to be shipped for clay mass per unit area, clay free swell, grab strength of the geotextile components, and internal and interface shear strength test data.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The following requirements apply prior to GCL placement:

a. Installation of the GCL shall not begin until a proper subbase has been prepared and approved by the Contracting Officer and the installer certifies that subgrade preparation is acceptable for GCL installation and warranty. The prepared surface shall be free from loose earth, exposed rock larger than 1 inch in diameter, rubble and other foreign matter, creating a smooth surface.
b. Provide slightly rounded corners at directional changes in the area to be covered and in the anchor trench so as to avoid sharp bends in the GCL.
c. Surface must be free of standing water and in a dry condition.
d. Maintain surface requirements during GCL installation, including antidesiccation measures as necessary.

3.2 HANDLING AND PLACEMENT

The GCL may be deployed as follows:

a. Deploy GCL in strict accordance with good construction practice and in particular in such a manner as to prevent any damage to the material.
b. Place panels with the woven side up.
c. Place GCL from the highest elevation to the lowest to facilitate drainage in the event of precipitation.
d. For deployment, insert a steel support pipe through the roll care. Attach the slings or lifting chains at one end of the support pipe and at the other end to the bucket of a front end loader or lifting device. A spreader bar should be used to support and spread the slings. The bar and support pipe must be long enough to prevent drainage t the edges of the liner during hoisting.
e. Panels may be pulled up from the bottom of the slope to the anchor trench or anchored first and then roll slowly lowered downslope.

3.3 FIELD SEAMS

3.3.1 Panel Layout

Contractor shall provide drawing identifying location of all panels and seams.

3.3.2 Preparation

a. Clean dust and dirt from areas to become seam interfaces.
b. Keep sheet dry.

3.3.3 Seaming Methods

a. Once the first run has been laid, lay adjoining runs with a 9-inch minimum overlap on the longitudinal seams and 24 inches on end seams.
b. Remove all dirt, gravel or other debris from the overlap area.
c. Place seam overlap on the bottom such that the direction of flow is from the top sheet to the bottom to form a shingle effect.
d. On slopes, maintain continuous runs from crest to toe with the GCL longitudinal direction running perpendicular to the toe.
e. Orientate seams perpendicular to the toe of the slope at all times. Seams at th base of the slope must be a minimum of 5 feet away from the toe.
f. In the event a roll end seam or joint cannot be avoided and occurs on a slope, construction adhesive shall be used in the lap area, with the overlap increased to 3 feet in a rainlap orientation.
g. Where recommended by the product manufacturers, place granular bentonite along all seams and overlap areas from the panel edge to the lapline at a minimum rate of a quarter pound per lineal foot.

3.4 PIPE PENETRATIONS AND REPAIR

3.4.1 Sealing Penetrations

a. Pack granular bentonite sealing compound provided by the manufacturer, around the circumference of the pipe.
b. Slit panel with a "pie" configuration where the pipe is to protrude, and place the panel over the penetration.
c. Place additional bentonite around the cut edges.
d. Place an additional skirt of GCL over the penetration to prevent the bentonite from being displaced.

3.4.2 Damage Repair

a. Appropriately mark rolls or pieces damaged during shipping, handling r deployment, or those with manufacturing flaws in the material. Set aside or remove damaged materials from the site to avoid use.

b. Where material rips or tears on the slope, make repairs by exposing the affected area, removing all foreign objects or soil, and by then placing a patch over the damaged area with a minimum overlap of 12 inches on all edges.
c. Place accessory bentonite between the patch and the repaired material at a rate of one quarter pound per lineal foot of edge, spread in a 6-inch width. Patch seams shall be secured with a nontoxic, water soluble adhesive glue as approved by the Contracting Officer and the manufacturer.
d. Remove prematurely hydrated GCL from the site and provide new material.

3.5 PROTECTION OF GCL

a. Cover the GCL with the geomembrane liner on the same day of placement, as dictated by the project requirements.
b. To prevent premature hydration or contraction during hot or arid conditions, install only the amount of GCL that can be placed, inspected, repaired and covered in the same day.
c. Cover any edges or panels of GCL left unprotected with a heavy, waterproofing tarp which is adequately secured and protected with sand bags or other ballast.
d. No vehicles should drive on the GCL until proper cover has been placed to the manufacturer's specified depth.
e. Any damaged areas noted must be repaired and brought to the attention of the Contracting Officer and the Contractor's Quality Control Manager.

3.6 FIELD QUALITY ASSURANCE

a. Cooperate with the efforts and schedules of the work performed by the Contractor's Quality Control Manager.
b. The Contractor's Quality Control Manager shall:
   1. Observe each roll of liner material for defects.
   2. Review the manufacturer's quality control certificate for each roll delivered to the site.
   3. Conduct photographic documentation of the GCL installation.
   4. Keep a logical record of documentation of GCL installation. This will include panel placement log, inspection log, and GCL repair log.

3.7 FIELD QUALITY CONTROL

a. Provide liner manufacturer technical representative at job site to ensure compliance with installation directions:
   1. When GCL installation begins.
   2. At substantial completion of the installation.
   3. After written notification from the Contracting Officer that installation is not in conformance with manufacturer's recommended procedures or specifications.

b. Contractor's Quality Control Manager shall observe all installation of GCL and report progress to Contracting Officer.

3.8 CLEANUP

a. Dispose of all trash and waste.
b. Remove all excess material and equipment.
c. Leave the premises in a neat and acceptable condition.

--End of Section--

SECTION 02831

FENCE, CHAIN LINK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94	1990 Ready-Mixed Concrete
ASTM F 883	1990 Padlocks

FEDERAL SPECIFICATIONS (FS)

FS RR-F-191	(Rev. K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specification)
FS RR-F-191/1	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
FS RR-F-191/2	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates) (Detail Specification)
FS RR-F-191/3	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) (Detail Specification)
FS RR-F-191/4	(Rev. D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) (Detail Specification)

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-02, Manufacturer's Catalog Data

a. Chain-link fencing components
b. Accessories

1.2.2 SD-13, Certificates

a. Fabric
b. Posts
c. Braces
d. Tension wires
e. Gates
f. Padlocks

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 CHAIN-LINK FENCING AND ACCESSORIES

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

2.1.1 Fabric

FS RR-F-191/1; Type I, zinc-coated steel, 9-gauge. Mesh size, 2 inches. Provide twisted and barbed at both selvages. Height of fabric, as indicated.

2.1.2 Gates

FS RR-F-191/2; Type II, double swing. Shape and size of gate frame, as indicated. Framing and bracing members, round steel alloy. Steel member finish, zinc-coated. Gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade except that steel pipe frames shall be 1.90 inches od, 0.120 inches minimum wall thickness. Gate fabric, as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Gate latches, plunger bar type. Gate leaves more than 8 feet wide shall have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding will not be permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

2.1.3 Posts and Braces

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces Class 1, steel pipe, Grade A in minimum sizes listed in FS RR-F-191/3 for each class and grade.

2.1.4 Fencing Accessories

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.1.5 Concrete

Provide as specified in Section 03300, "Cast-in-Place Concrete."

2.1.6 Grout

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.1.7 Padlocks

ASTM F 883, with chain.

PART 3 EXECUTION

3.1 SITE PREPARATION

3.1.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation. Compact fill used to establish fence line.

3.1.2 Excavation

Excavate to dimensions indicated for concrete-embedded items, except in bedrock. If bedrock is encountered, continue excavation to depth indicated or 18 inches into bedrock, whichever is less, with a diameter in bedrock a minimum of 2 inches larger than outside diameter of post. Clear post holes of loose material. Dispose of waste material on station, as directed. For installation of fencing at Sites 1 and 3, any soil containing waste material or that is contaminated shall be placed within the landfill cover limits.

3.2 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10-feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.2.2 Post Setting

Set posts plumb. Allow concrete and grout to cure a minimum of 72 hours before performing other work on posts.

3.2.2.1 Earth and Bedrock

Provide concrete bases of dimensions indicated except in bedrock. Compact concrete to eliminate voids, and finish to a dome shape. In bedrock, set posts with a minimum of 1-inch of grout around each post. Work grout into hole to eliminate voids, and finish to a dome shape.

3.2.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member.

3.2.4 Top and Bottom Tension Wires

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.2.5 Fabric

Pull fabric taut and secure fabric to top wire and bottom wire, close to both sides of each post and at maximum intervals of 24 inches on center. Secure fabric to posts using stretcher bars, ties or clips spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is 2 inches above ground level. Install fence fabric to provide approximately 2-inch deflection at center of fabric span between two posts, when a force of approximately 30 pounds is applied perpendicular to fabric. Fabric should return to its original position when force is removed.

3.3 ACCESSORIES INSTALLATION

3.3.1 Post Caps

Install post caps as recommended by the manufacturer.

3.3.2 Supporting Arms

Design supporting arms to accommodate top rail. Supporting arms shall face outward and upward at approximately a 45-degree angle to increase the overall height of th fence one foot. Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts.

Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.

3.3.3 Barbed Wire

Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames sufficiently above top member to carry three strands of 12-gauge barbed wire in horizontal alignment with barbed wire strands on the fence to increase the overall fence height one foot. Pull each strand taut and securely fasten each strand to each supporting arm or extended member. Secure wires in accordance with fence manufacturer's recommendations.

3.3.4 Gates

Install swing gates to swing through 90 degrees from closed to open.

3.3.5 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.4 SECURITY

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with Contracting Officer and cognizant Security Officer.

3.5 CLEANUP

Remove waste fencing materials and other debris from the station.

--End of Section--

SECTION 02930

TURF

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	1980 Respiratory Protection

AMERICAN SOD PRODUCERS ASSOCIATION (ASPA)

ASPA GSS	1988 Guideline Specifications for Sodding

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	1990 Agricultural Liming Materials
ASTM D 977	1991 Emulsified Asphalt
ASTM E 11	1987 Wire-Cloth Sieves for Testing Purposes
ASTM D 4427	1984 Peat Samples by Laboratory Testing

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000-SUBPART Z	Toxic and Hazardous Substances

DEPARTMENT OF AGRICULTURE (DOA)

DOA FSA	January 1985 Federal Seed Act Rules and Regulations of the Secretary of Agriculture
DOA SSIR	April 1984 Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service

1.2 DEFINITIONS

1.2.1 Pesticide

Soil fumigants, herbicides, insecticides and fungicides.

1.2.2 Stand of Turf

95 percent ground cover of the established species.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Erosion control materials
b. Wood cellulose fiber mulch

Include physical characteristics, and recommendations.

1.3.2 SD-10, Test Reports

a. Topsoil composition tests

Submit reports for test specified in DOA SSIR.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storag , and handling.

1.4.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.4.2 Storage

1.4.2.1 Seed, Lime, and Fertilizer Storage

Store in cool, dry locations away from contaminants.

1.4.3 Handling

Do not drop or dump materials from vehicles.

1.5 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.5.1 Planting Dates

1.5.1.1 Permanent Seed

Sow seed from April 1 to July 1 for spring planting and from August 15 to September 15 for fall planting.

1.5.2 Restrictions

Do not plant when the ground is frozen, snow covered, or muddy.

1.6 EXTENT OF WORK

Provide seedbed preparation, topsoiling, fertilizing, seeding, and mulching of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

PART 2 PRODUCTS

2.1 PERMANENT SEED

2.1.1 Classification

State-approved of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with DOA FSA and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Composition

Seed	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
Creeping Red Fescue	85	80	1
Crownvetch	85	80	1

Flatpea	85	80	1
Tall Fescue	85	80	1
Redtop	85	80	1

Planting Season	Variety		Percent (by Weight)
Spring	Creeping Red Fescue	24	17
4/1 to 7/1	Crownvetch	35	
	or Flatpea		53
Fall	Tall Fescue	36	26
8/15 to 9/15	Redtop	5	4

Proportion seed mixtures by weight.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify existing soil to conform to the requirements specified in paragraph entitled "Composition."

2.2.2 On-Site Topsoil

Reusable surface soil stripped and stockpiled on site if requirements specified for topsoil in paragraph entitled "Composition" are met.

2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.4 Topsoil Composition

Containing not less than 3 percent organic matter as determined by weight. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4-inch screen. Other components shall be within the following percentages:

Silt	25-50
Clay	10-30
Sand	20-35
pH	6 to 7.5
Soluble Salts	500 ppm maximum

2.3 pH ADJUSTERS

2.3.1 Lime

Agricultural grade ground limestone containing not less than 50 percent of total oxides, 50 percent calcium plus magnesium oxide, gradation, as follows: Minimum 75 percent passing 100-mesh sieve and 100 percent passing 20-mesh sieve.

2.3.2 Aluminum Sulfate

Commercial grade.

2.4 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

2.4.1 Peat

Peat moss derived from a freshwater site and conforming to ASTM D 4427 as modified herein. Shred and granulate peat to pass 1/2-inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.4.2 Sand

Clean and free of materials harmful to plants.

2.4.3 Perlite

Horticultural grade.

2.4.4 Vermiculite

Horticultural grade.

2.4.5 Composted Wood Derivatives

Ground bark, sawdust, or other wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.4.5.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.4.5.2 Nitrogen Content

Minimum percent based on dry weight:

Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.4.6 Calcined Clay

Granular particles produced from montmorillonite clay calcined to minimum temperature of 1200 degrees to the following gradation: minimum 90 percent passing 8-mesh screen, 99 percent retained on 60-mesh screen and, maximum 2 percent passing 100-mesh screen. Bulk density: 40 pounds maximum per cubic foot.

2.5 FERTILIZER

2.5.1 Commercial Grade Fertilizer

FS 0-F-241, Type I, Class 2, free flowing, uniform in composition with nitrogen-phosphorus potash ratio of 10 percent nitrogen, 20 percent phosphorus, and 20 percent potash.

2.5.2 Controlled Release Fertilizer with Hydroseeding

Nitrogen-phosphorus-potassium ratio of 16-7-12 plus 2 percent iron, composed of pills coated with plastic resin to provide continuous release of fertilizer for at least 6 months.

2.6 MULCHES

Free from, noxious weeds, mold, and other deleterious materials.

2.6.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment.

2.6.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Provide only marsh hay for lawn areas.

2.6.3 Wood Cellulose Fiber Mulch

Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight

basis: 9 to 15 percent moisture, pH range from 3.5 to 5.0. Use with hydraulic application of grass seed and fertilizer.

2.7 WATER

Suitable quality for irrigation.

2.8 EROSION CONTROL MATERIALS

2.8.1 Net

Heavy, twisted jute mesh, plastic net, biodegradable paper fabric with knitted yarns, or standard weave burlap.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Subgrade

After areas required to be turfed have been brought to the required subgrade, thoroughly till to minimum depth of 6 inches by scarifying, disking, harrowing, or other approved methods. Remove debris and stones larger than one inch in any dimension remaining on surface after tillage.

3.1.2 Topsoiling

Immediately prior to placing topsoil, scarify subgrade to a 2-inch depth for bonding of topsoil with subsoil. Spread topsoil evenly to a minimum depth of 4 inches. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.3 Fertilizer and Lime

Apply fertilizer at the rate of 800 pounds per acre. 18.4 pounds per 1000 square feet. Apply lime at the rate of 6,000 pounds per acre. 138 pounds per 1000 square feet.

3.1.3.1 Drill Seeding, Broadcast Seeding, and Drop Seeding

Incorporate fertilizer and lime into soil to a minimum depth of 4 inches. Application may be performed as part of the subgrade tillage operations.

3.1.3.2 Hydroseeding

Apply liquid fertilizer in amounts sufficient to promote the specified stand of turf. Apply lime manually during subgrade preparation.

3.2 PERMANENT SEEDING

3.2.1 Seed Application

Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed to average depth of 1/2 inch by means of spike-tooth harrow, cultipacker, or other approved device.

3.2.2 Seeding Seasons, Conditions, and Method

Immediately before seeding, restore soil to the proper grade. Do not seed when ground is muddy, frozen, snow covered, or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within 24 hours after seedbed preparation. Sow seed with approved sowing equipment using one or a combination of the following methods at the rate of 42 pounds per acre. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.3 Broadcast Seeding and Drop Seeding

Use broadcast or drop seeders. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils. Cover seed by spike-tooth harrow, raking, or other approved devices.

3.2.4 Drill Seeding

Use cultipacker seeders or grass seed drills. Drill seed uniformly to average depth of 1/2 inch and at a rate of 1 pound per 1,000 square feet.

3.2.5 Hydroseeding

Mix seed, fertilizer, and wood cellulose fiber in required amount of water to produce a homogeneous slurry. Add wood cellulose fiber after seed, water, and fertilizer have been thoroughly mixed and apply at the rate of 200 pounds per acre dry weight. When hydraulically sprayed on the ground, material shall form a blotterlike cover impregnated uniformly with grass seed. Immediately following the application of the slurry mix, make separate application of wood cellulose mulch at the rate of 750 pounds, dry weight, per acre. Cover shall allow rainfall or applied water to percolate to underlying soil.

3.2.6 Mulch

Spread evenly at the rate of 2 tons per acre. Anchor with netting.

3.2.7 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.8 Erosion Control Material

Install in accordance with manufacturer's instructions.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turfing operations. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

3.5 TURF ESTABLISHMENT PERIOD

3.5.1 Period Parameters

Turf establishment period will be in effect until turf has been mowed three times.

3.5.2 Maintenance During Turf Establishment Period

3.5.2.1 Mowing

Mow turfed area to an average height of 2 inches when average height of grass becomes 3 inches for spring planting and to an average height of 2 inches whenever the averag height of grass reaches 3 inches for fall planting.

3.5.2.2 Promotion of Turf Growth

Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, and perform other operations necessary to promote turf growth.

3.6 FIELD QUALITY CONTROL

3.6.1 Final Inspection and Acceptance

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final acceptance will be based upon a satisfactory stand of turf.

3.6.2 Replanting

Replant within specified planting dates areas which do not have a satisfactory stand of turf.

--End of Section--