U.S. Department of Veterans Affairs

CULPEPER NATIONAL CEMETERY

CULPEPER, VA

PRE-PLACED CRYPT CONVERSIONS AT SECTION 4

PROJECT NO. 839-CM-3027

SPECIFICATIONS
BID SET
JULY 20, 2015

PREPARED BY:

LEAD DESIGN CONSULTANT/ LANDSCAPE ARCHITECT:
MTR LANDSCAPE ARCHITECTS, LLC
101 BELLEVUE RD., PITTSBURGH, PA 15229

IRRIGATION SPECIALISTS:
AQUA ENGINEERING,
FORT COLLINS, CO

ENGINEER:
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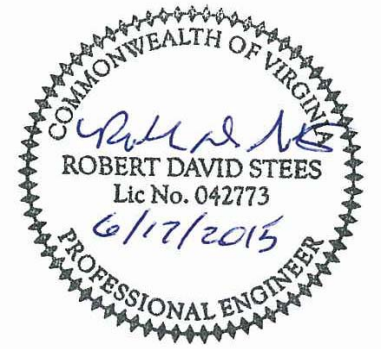
SIGNATURE PAGE

Lead Consultant/ Landscape Architect:
Melissa R. Marshall, RLA, MTR Landscape Architects, LLC
Sections covered by this seal include:

01 00 02 General Requirements
01 32 16.16 Network Analysis Schedules
01 33 23 Shop Drawings, Product Data and Samples
01 42 19 Reference Standards
01 45 29 Testing Laboratory Services
01 57 19 Temporary Environmental Controls
03 30 53 Cast-In-Place Concrete (short form)
03 48 21 Pre-cast Concrete Burial Cryps
31 20 11 Earth Moving (short form)
32 12 16 Asphalt Paving
32 30 00 Site Furnishings
32 90 00 Planting

Civil Engineer: Brian Morgan, LPE, KCI Technologies
Sections covered by this seal include:

33 41 00 Storm Utility Drainage Piping
33 46 00 Sub-drainage



Electrical Engineer: Robert Stees, KCI Technologies
Sections covered by this seal include:

26 05 11 Requirements for Electrical Installations
26 05 11 Low Voltage Electrical Power Conductor or Cables

26 05 26 Grounding and Bonding for Electrical Systems

26 05 33 Raceway and Boxes for Electrical Systems

Irrigation Designer: J.D. Leonard, Aqua Engineering
Sections covered by this seal include:

32 90 00 Planting Irrigation

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B-1.1	Existing Conditions Plan Detail
	SITE PLANNING
D-1.0	Demolition and Temporary Construction Facilities
L-1.0	Erosion and Sedimentation Control Plan
L-1.1	Erosion and Sedimentation Control Details
L-2.0	Crypt Site Plan
L-2.1	Layout Plan
L-2.2	Burial Numbering Plan
L-3.0	Grading Plan
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SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

1.1 GENERAL INTENTION

A. Contractor shall completely prepare site for construction, including demolition and removal of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for Pre-Placed Crypt Conversion - Section 4 at Culpeper National Cemetery and irrigate the cemetery grounds as required by drawings and specifications.

B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.

C. Offices of MTR Landscape Architects, as Architect-Engineers (A/E), may render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officers through the Contracting Officer’s Representative (COR) or his duly authorized representative.

D. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.

E. All employees of general contractor and subcontractors shall comply with security requirements as established by the COR, and be identified by name and employer. They shall be restricted from unauthorized access to cemetery property other than the job site.

F. Prior to commencing work, general contractor shall provide proof that a OSHA certified “competent person” (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.

G. Training:

1. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified

Construction Safety course and/or other relevant competency training, as determined by VA CO.

2. Submit OSHA training records of all employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

A. GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to:

1. Site preparation and erosion control,
2. Earthwork, grading and subsurface drainage,
3. Provision and installation of crypts (includes provision of crypts, excavation, crypt placement, and backfilling)
4. Landscape planting and Turf, sod only.
5. Signage and site furnishings
6. Irrigation System

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

A. AFTER AWARD OF CONTRACT, _4_ bond paper set(s) of specifications and drawings will be furnished.

B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from digital files furnished by the Issuing Office.

1.4 CONSTRUCTION SECURITY REQUIREMENTS, IF APPLICABLE

A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor’s employees shall not enter the site without following the procedures approved by the COR.
2. For working outside the “regular hours” as defined in the contract, The General Contractor shall give 3 days’ notice in writing to the COR so that appropriate arrangements can be made with the cemetery. This notice is separate from any notices required for utility shutdown described later in this section.
4. VA reserves the right to close down or shut down the project site and order General Contractor’s employees off the premises in the

event of a national emergency. The General Contractor may return to the site only with the written approval of the COR.

C. Guards:

1. The General Contractor shall provide unarmed guards at the project site when theft or vandalism warrants.

D. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.

1.5 FIRE SAFETY

A. Applicable Publications: Publications listed below form part of this Article to the extent referenced. Publications are referenced in text by basic designations only.

1. American Society for Testing and Materials (ASTM):

E84-2009a	Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA):

10-2010	Standard for Portable Fire Extinguishers
30-2008	Flammable and Combustible Liquids Code
51B-2009	Standard for Fire Prevention During Welding, Cutting and Other Hot Work
70-2008	National Electrical Code
241-2009	Standard for Safeguarding Construction, Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926	Safety and Health Regulations for Construction

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COR/Cemetery Director for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractor’s beginning work, they shall undergo a safety briefing provided by the General Contractor’s competent person per OSHA requirements. This briefing shall include information on the construction limits, safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of NCA equipment, etc.

Documentation shall be provided to the COR that individuals have undergone the Contractor’s safety briefing.

C. Site and Building Access: Maintain free and unobstructed access to emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

E. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.

F. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.

G. Dispose of waste and debris in accordance with NFPA 241. Remove from site weekly.

H. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.6 OPERATIONS AND STORAGE AREAS

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the COR. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the COR and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work.

C. The Contractor shall, under regulations prescribed by the COR, use only established roadways. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or the road bearing capacity, or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the

Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

D. Working space and space available for storing materials shall be as shown on the drawings. Contractor parking will be only in areas and on roadways designated and agreed to by the COR in agreement with the Cemetery.

E. Workmen are subject to rules of the Cemetery applicable to their conduct.

F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.

1. Do not store materials and equipment in other than assigned areas.
2. Provide unobstructed access to the Cemetery areas required to remain in operation.

G. Sequence of Construction: To insure such executions, the Contractor shall furnish the COR with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, the Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to the Cemetery Director, COR and Contractor. All warranty items, certificates and testing results shall be submitted and approved before Contractor may submit request for final inspection.

H. Restroom Building and Committal Shelter will be used during performance of work. The Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Cemetery’s operations will not be hindered. The Contractor shall permit access to Cemetery personnel through other construction areas which serve as routes of access to such affected areas and equipment within the cemetery. Coordinate alteration in work areas occupied by Cemetery Staff so that Cemetery operations will continue during the construction period.

I. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the

drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. The temporary fencing shall encompass the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Remove the fence when directed by COR. Orange tree protection fencing may be substituted for chain link around irrigation trenching, subject to CO/COR approval. No trenches shall be open over night unless securely closed and fenced.

J. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the COR, and Cemetery Director’s prior knowledge and written approval. Refer to Specification Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for additional requirements.
2. The Contractor shall submit a request to interrupt any such services to both COR and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. The Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Cemetery. Interruption time approved by the Cemetery and COR may occur at other than Contractor's normal working hours.

4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

K. Abandoned Lines: All service lines which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. Refer to technical specifications for additional demolition requirements of each utility.

L. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
2. Minimize the cutting of roadways. Eliminate road cutting unless absolutely necessary.Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.

M. Coordinate the work for this contract with other construction operations as coordinated with the cemetery director and concurred by the COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

N. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the COR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the committal services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period.

1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas before these dates.
2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of the site where alterations are to occur and areas which are anticipated routes of access, and furnish a signed report to the COR. This report shall list by spaces:
   1. Shall note any discrepancies between drawings and existing conditions at site.
   2. Shall designate areas for working space, materials storage and routes of access to areas the cemetery where alterations occur and which have been agreed upon by Contractor and COR.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS") and "CHANGES" In the contract.

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of involved. They shall furnish a report on site conditions as compared with conditions of same as noted in first condition survey report.
   1. Re-survey report shall also list any damage caused by the Contractor to site elements including roadways, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:

2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
3. Protect the interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, any indicated surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.8 ENVIRONMENTAL CONTROLS

A. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
   1. Dampen debris to keep down dust.
B. Final Cleanup: Remove and clean up all unneeded construction related structures, materials and debris prior to requesting final inspection. Remove construction sign after the project is inspected and accepted. Comply with all Federal, State and local codes and requirements to properly dispose of all waste generated from this construction project.

1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the COR.
B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the COR may

have the necessary work performed and charge the cost to the Contractor.(FAR 52.236-9)

C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. The contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

1.10 RESTORATION

A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any plumbing, gas, or electric work without approval of the COR. Minimize or eliminate open cut of the roadway. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (mechanical and electrical, landscape, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services which are indicated on drawings and which are not scheduled for discontinuance or abandonment.

D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with FAR clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.11 PHYSICAL DATA

A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by KCI Engineering of New York

(FAR 52.236-4)

B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration conducted by Froehling and Robertson are shown diagrammatically in a copy of the geotechnical report, which is an Appendix to these specifications and shall be considered part of the contract documents.

C. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, including approved scheduling bidders will be permitted to make subsurface explorations of their own at site.

1.12 PROFESSIONAL SURVEYING SERVICES

A professional land surveyor or civil engineer registered in the State of Virginia, whose services are retained and paid for by the Contractor, shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.13 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the COR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the COR may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

B. Establish and plainly mark center lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land

surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.

D. During progress of work, the Contractor shall have lines, grades, locations and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
   1. Lines of grave plot documentation.
   2. Lines of elevations of all swales and interment areas.
   3. Lines and elevations of roads, streets and parking lots.
   4. Lines and elevations and location of top of pre-placed crypts.
   5. Lines and elevations of grade over pre-placed crypts.
   6. Northing/Easting coordinate locations and elevation depth below finished grade of all water, sanitary, storm, gas, and irrigation.
   7. Northing/Easting coordinate locations for each gravesite grid monument.

E. Upon completion of the work, the Contractor shall furnish the COR with reproducible drawings, in AutoCAD form, at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.14 AS-BUILT DRAWINGS

A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, which will include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR's review, as often as requested.

C. The Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after acceptance of the project by the COR.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

E. Color coded irrigation controller charts shall be submitted and approved by COR prior to request for final inspection. Charts shall show all installed irrigation information per controller and shall also show valves, line size, heads, type, brand name, flow, pressure, and other pertinent information.

1.15 USE OF ROADWAYS

A. For hauling, use only established public roads and designated permanent roads on Cemetery property and, when indicated such Contractor constructed temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at the Contractor's expense following approved plans that include: construction, operation, maintenance and restoration. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.16 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet or porta-potty as shown on drawings. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.17 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT

A. Use of newly installed mechanical and electrical equipment to provide irrigation water will be permitted subject to compliance with the following provisions:

1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again

immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.

3. All installed systems must be operated as a complete system and be fully maintained by the contractor until being accepted by the government.

B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.

C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

1.18 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government will not supply utilities but will make all reasonably required amounts of utilities available to the Contractor by metered connection from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable utility services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any used utilities..

B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of utilities as hereinafter specified.

1. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

2. Electricity (for Construction and Testing): Furnish all temporary electric services.

   a. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices,

electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.

3. Water (for Construction and Testing): Furnish temporary water service.
   a. Obtain water by connecting to the Cemetery irrigation distribution system. Backflow preventer may not be required at connections to the irrigation system.
   b. If potable water is required and convenient connection is available the contractor may connect to the Cemetery potable water distribution system. The contractor shall install meters and reduced pressure backflow preventer at each connection at his own expense.
   c. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from the Cemetery's system.
4. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.

1.19 TESTS

A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

B. Conduct all tests required in various sections of specifications in presence of an authorized representative of the COR. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed.

D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a

reasonably short period of time during which operating and environmental conditions remain reasonably constant.

E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.20 INSTRUCTIONS

A. The Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified if not defined in the technical specifications of the contract.

B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: the Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. If not in the technical sections, instructions for different items of equipment that are component parts of a complete system shall be given in an integrated, progressive manner. All instructors for every piece of component

equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

D. If not otherwise specified, all training shall be a minimum of 8 hours to instruct and train the cemetery staff for using the newly installed equipment and system.

1.21 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Signface shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50mm x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the COR.

D. Detail Drawing of construction sign showing required legend and other characteristics of sign is a part of this specification.

E. See Sheet L-5.0

1.22 CONSTRUCTION DIGITAL IMAGES

A. During construction period through completion, furnish Department of Veterans Affairs daily color digital photographs of construction progress (5 to 10 images per day.) Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.

B. Photographs are to be taken with a digital camera, minimum 6 megapixels, with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color, a maximum of 1 MB and a minimum of 250 KB and no reduction in actual picture size.
   1. Compressed size of the file shall be no less than 80% or the original with no loss of information.
   2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example: 839-CM3-027 - _10-01-2015_0001. Use underscore, not spaces in digital file names.

C. The digital photo files shall become property of Government and will be sent through e-mail as part of the daily record and submitted on CD-ROM or USB thumb drive at the conclusion of the construction period, prior to requesting final inspection. The CD-ROM shall or thumb drive shall also contain an index of all the images contained therein, in either a TCT or Microsoft Word format.
   1. The images shall be forwarded electronically to the COR/Project Manager via email to NAME@va.gov within 2 days of when the photo was taken. Identify the content of each picture by a caption incorporated in the photo.
   2. The following information shall be on the identity-label for photographs:

D. The following information shall be on the identity-label for photographs:

CEMETERY NAME
LOCATION;
PROJECT TITLE;
PROJECT NUMBER;
DATE TAKEN;
CONSTRUCTION COMPANY;
CONTRACT NUMBER.

1.23 HISTORIC PRESERVATION

A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

1.24 PROJECT HEALTH AND SAFETY PLAN

A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:

1. Organizational structure (including Responsible Persons)
2. Site Characterization and Job Hazard Identification
3. Site Control and Security
4. Training
5. PPE
6. Heat Stress
7. Spill Containment
8. Decontamination
9. Emergency Response
10. Trench Safety

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SECTION 01 32 16.16

NETWORK ANALYSIS SYSTEM (BAR CHART SCHEDULE)

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The contractor shall develop a bar chart schedule, hereafter called “the schedule” using Microsoft Project software, latest version, and utilizing the work breakdown structure (WBS) to sufficient sublevels demonstrating completion of the contract work within the contract duration. The Contractor shall keep the schedule up-to-date in accordance with the requirements of this section. The Contractor shall utilize the schedule for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The schedule will be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR’S REPRESENTATIVE:

A. The contractor shall designate an authorized representative in the firm who will be responsible for the preparation of the schedule, review and report of progress of the project with, and to, the Contracting Officer and COR.

1.3 COMPUTER PRODUCED SCHEDULES:

A. The contractor shall provide to VA monthly schedules generated from monthly project updates. The Contractor will provide to VA electronic copies of the schedule. These must be submitted with and support the contractor’s monthly payment request.

1.4 THE SCHEDULE SUBMITTAL:

A. The contractor shall provide detailed WBS for the proposed project. The schedule will contain sufficient work activities/events based on the WBS to adequately present the accomplishment of the work based on real time production rates for said activities. VA will review and approved the sufficiency of the activities listed.

B. Within 10 calendar days after receipt of the Contract Award, the Contractor shall submit for the Contracting Officer's review and approval the schedule. Each activity/event on the schedule shall contain as a minimum, but not limited to, activity/event description, duration, start

dates, finish dates, budget amounts, and predecessor and successor relationships. Work activity/event relationships shall be restricted to finish-to-start, only, without lead or lag constraints. Logic events (nonwork) will be permitted where necessary to reflect proper sequence among work events, but must have zero duration.

C. The schedule shall reflect the Contractor's methodology to completing the project. The schedule in its original form shall contain no contract changes or delays that may have been incurred during the schedule development. It shall reflect the Contractors **“AS BID”** or **“DAY 1”** schedule. Changes and /or delays shall be entered at the first monthly update after the schedule has been approved.. The Contractor should provide his requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

D. Within 10 calendar days after receipt of the complete project network diagram, the Contracting Officer will do one or both of the following:

1. Notify the Contractor concerning his actions, opinions, and objections.
2. If required schedule a meeting with the Contractor for joint review, correction or adjustment of the proposed schedule. Within 10 calendar days after the joint review, the Contractor shall revise and shall submit a revised schedule to the Contracting Officer. The revised schedule will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved. This approved schedule shall constitute the approved schedule until subsequently revised in accordance with the requirements of this section.

1.5 WORK ACTIVITY/EVENT COST DATA

A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Overhead, profit and general conditions shall be pro-rated on all work activities/events for the entire project length. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in the General conditions.

1.6 NETWORK DIAGRAM REQUIREMENTS:

A. Show on the schedule the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the schedule, the Contractor shall show activities/events as:
   1. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
   2. Contracting Officer Technical Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
   3. Interruption of VA Cemetery utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
   4. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
   5. VA inspection and acceptance activity/event with a minimum duration of five (5) work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.

B. Break up the work into activities/events of duration no longer than sixty (60) work days each. The duration for VA approval of any required submittal, shop drawing, or other submittals will be 5 workdays. The construction time as determined by the schedule from start to finish for any sub-phase, phase or the entire project shall not exceed the contract duration.

C. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed.

1.7 PAYMENT TO THE CONTRACTOR:

A. Monthly, the contractor may submit the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made. The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved schedule

unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include:

1. the approved schedule,
2. a listing of all project schedule changes. These must be submitted with and support the contractor’s monthly application and certificate for payment request documents.

B. An updated schedule submitted with the progress payment does not constitute a contract change without the written consent of the Contracting Officer.

C. When the Contractor fails to furnish to the Contracting Officer the required information which, in the sole judgment of the Contracting Officer, is necessary for processing the monthly progress payment, the Contractor shall not be paid for that period.

1.8 PAYMENT AND PROGRESS REPORTING:

A. Biweekly progress meetings will be held with the Contracting Officer or Contracting Officer's Representative, the Contractor and others as deemed necessary by the contracting officer. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Bar chart.
4. Percentage for completed and partially completed activities/events.
5. Logic and duration revisions required by this section of the specifications.
6. Activity/event duration and percent complete shall be updated independently.

1.9 RESPONSIBILITY FOR COMPLETION:

A. Whenever it becomes apparent from the progress meetings that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
3. Reschedule the work in conformance with the specification requirements.

B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the revisions shall be incorporated by the Contractor into the schedule before the next update, at no additional cost to the Government.

1.10 CHANGES TO THE SCHEDULE:

A. Within 10 calendar days after VA acceptance and approval of any updated schedule, the Contractor will submit a revised schedule and a list of any activity/event changes including predecessors and successors for any of the following reasons:

1. Delay in completion of any activity/event or group of activities / events, indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Bar chart as the direct cause for delaying the project beyond the acceptable limits.
2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
3. The schedule does not represent the actual prosecution and progress of the project.
4. When there is, or has been, a substantial revision to the activity/event costs of the schedule regardless of the cause for these revisions.

B. Revisions made under this paragraph that affects the previously approved schedule for Government furnished equipment, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, must be furnished in writing to the Contracting Officer for approval.

C. Contracting Officer's approval for the revised schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the Contracting Officer’s Representative.

D. The cost of revisions to the Bar chart resulting from contract changes will be included in the cost of the change.

E. The cost of revisions to the schedule not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION:

A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Bar chart data and supporting evidence as the Contracting Officer may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.

B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within 10 calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.

C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under Article, CHANGES, in the Section, GENERAL CONDITIONS. The Contractor shall include, as a part of each change order proposal, all revisions, duration-in work days, changes, and cost changes, for work in question and its relationship to other activities on the approved schedule.

D. All delays due to non-work activities/events such as RFIs, WEATHER, LABOR STRIKES, and similar non-work activities/events shall be analyzed on a case by case basis.

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.

1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.

1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:

A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.

1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.

1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by the COR on behalf of the Contracting Officer.

1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall

refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.

A. Submit samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.

B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter can be sent through email or via FedEx or UPS and shall contain the list of items, name of Cemetery, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.

1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.

2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Cemetery, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
5. Laboratory test reports shall be sent directly to COR for appropriate action.
6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.

D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples

shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
2. Reproducible shall be full size.
3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1-10. Samples ,shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted to

MTR Landscape Architects, LLC_

101 Bellevue Road, Pittsburgh, PA 15229

for review and recommendation to the VA for approval.

1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COR.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

A. The specifications and standards cited in this solicitation can be examined at the following location:
United States Department of Veteran Affairs
Technical Information Library
http://www.cfm.va.gov/til/

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AAN American Nursery and Landscape Association
http://www.anla.org

AASHTO	American Association of State Highway and Transportation Officials http://www.transportation.org/Pages/default.aspx
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
AGC	Associated General Contractors of America http://www.agc.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
CFR	Code of Federal Regulations http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
DOE	U.S. Department of Energy http://www.energy.gov/
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.envirotestinglabs.com/
FHA	Federal Highway Administration http://www.fhwa.dot.gov/

GSA	General Services Administration http://www.gsa.gov
ICC	The International Code Council http://www.iccsafe.org/Pages/default.aspx
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org\
MHI	Material Handling Industry of America http://www.mhi.org/
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org/
NBS	National Bureau of Standards See - NIST
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NIOSH	The National Institute for Occupational Safety and Health http://www.cdc.gov/niosh/
NIST	National Institute of Standards and Technology http://www.nist.gov
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.cement.org/
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
SWRI	Sealant Waterproofing and Restoration Institute http://www.swrionline.org/
UL	Underwriters' Laboratories Incorporated http://www.ul.com
USDA	U.S. Department of Agriculture http://www.usda.gov

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 02, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

A. Section 01 00 02, GENERAL REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-11	Sieve Analysis of Fine and Coarse Aggregates
T96-02(R2006)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-10	The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
T104-99(R2007)	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T180-10	Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
T191-02(R2006)	Density of Soil In-Place by the Sand-Cone Method

C. American Society for Testing and Materials (ASTM):

A325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A370-12a	Definitions for Mechanical Testing of Steel Products
A490-12	Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12	Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-12	Compressive Strength of Hydraulic Cement Mortars
C138/C138M-12a	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-13	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-12	Slump of Hydraulic Cement Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C33OM-09	Lightweight Aggregates for Structural Concrete
C567/C567M-11	Density Structural Lightweight Concrete
C780-12a	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11	Sampling and Testing Grout
C1064/C1064M-12	Freshly Mixed Hydraulic Cement Concrete
C1077-13	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-12	Compressive Strength of Masonry Prisms

C1364-10b	Architectural Cast Stone
D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-07	Deep Foundations Under Static Axial Compressive Load
D1188-07	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-12	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-12a	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E94-04(2010)	Radiographic Examination
E164-08	Contact Ultrasonic Testing of Weldments
E329-11c	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-13	Agencies Performing Nondestructive Testing
E709-08	Guide for Magnetic Particle Testing
E1155-96(2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07 Structural Welding Code-Steel

1.4 REQUIREMENTS

A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the COR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the COR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.

B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional

tests requested by COR. When it appears materials furnished or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of COR to such failure.

C. Written Reports: Testing laboratory to submit test reports to COR and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

A. General: The Testing Laboratory is to provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed is as identified herein including, but not be limited to, the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide part time observation of fill placement and compaction and field density testing in crypt areas, any pavement patching areas and utility trenches to verify that earthwork compaction obtained is in accordance with contract documents.

3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556 AASHTO T191, or ASTM D2167 to be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they must provide satisfactory explanation to the COR before the tests are conducted.
   a. Pavement Subgrade: One test for each 335 m^2 (400 square yards), but in no case fewer than two tests.
   b. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

C. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

3.3 LANDSCAPING

A. Topsoil: Provide one soil test for each 2,500 CY topsoil from either stockpile source or borrow source.

1. Sample: Prepare as required by testing lab.
2. Testing reports shall include the following at minimum:
   a) pH
   b) Organic matter
   c) USDA soil texture classification
   d) Soluble salts
   e) Percentage of foreign materials such as rock, roots, and vegetation.

f) Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Magnesium, and Calcium.

g) Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful plant and turfgrass growth. Amendment / fertilization recommendations should be provided separately for landscape plants and turf sodding. Recommendations for turf shall be for the highest quality installation.

3. The topsoil shall be improved with soil amendments as recommended by the soil testing lab and approved by the COR. Topsoil shall be amended to meet the requirements of 32 90 00 PLANTING for parameters including but not limited to pH and organic matter content. Test amended soil a second time to verify that it meets the specified requirements.
4. Costs of soil amendment and testing will be by Contractor, including follow up tests if needed.
5. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
6. Submit laboratory test report of topsoil to Architect-Engineer and CO/COR.

B. Organic Soil Amendment (compost): Provide one test for each source. Tests shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists.

1. Sample: Prepare as required by testing lab.
2. Testing Parameters: Refer to 32 90 00 Planting.
3. Submit laboratory test report of organic amendment to AE and COR.

C. Submit laboratory test report of topsoil to CO/COR.

3.4 ASPHALT CONCRETE PAVING

A. Aggregate Base Course:
   1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
   2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
   3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt Concrete:
   1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
   2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
   3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.5 SITE WORK CONCRETE

A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.6 CONCRETE

A. Batch Plant Inspection and Materials Testing:
   1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by COR.

2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:
1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. // After good concrete quality control has been established and maintained as determined by COR make three cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's

pour for each concrete type. // Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.

4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
    a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
    b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity;

record maximum wind velocity; record maximum temperature of surface of hardened concrete.

11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the

overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.

19. Other inspections:
    a. Grouting under base plates.
    b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows: Compressive strength test to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COR. In test report, indicate the following information:
    a. Cylinder identification number and date cast.
    b. Specific location at which test samples were taken.
    c. Type of concrete, slump, and percent air.
    d. Compressive strength of concrete in MPa (psi).
    e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
    f. Weather conditions during placing.
    g. Temperature of concrete in each test cylinder when test cylinder was molded.
    h. Maximum and minimum ambient temperature during placing.
    i. Ambient temperature when concrete sample in test cylinder was taken.
    j. Date delivered to laboratory and date tested.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, and solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
   1. Adversely affect human health or welfare.
   2. Unfavorably alter ecological balances of importance to human life.
   3. Affect other species of importance to humankind.
   4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. This Section includes the protection, and preservation of existing trees and gravesite monuments that are affected by execution of the Work, whether temporary or permanent construction. ALL trees on Cemetery property that are not indicated to be removed are to be protected according to the standards of this section.

1.2 DEFINITIONS

A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.

B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.

C. Sediment: Soil and other debris that has been eroded and transported by runoff water.

D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.

E. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage

ditches, storm sewers, creeks, and/or "waters of the United States" and require a permit to discharge water from the governing agency.

F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.

G. Sanitary Wastes: Domestic Sanitary Sewage.

H. Arborist: licensed arborist certified by ISA certified Arborist with five (5) years minimum experience in the field of urban forestry and remediation of construction damage.

I. Caliper: Diameter of the trunk at 6" above the soil for trees up to 6" in caliper and diameter at 12" above the soil for trees up to 12" caliper.

J. Diameter: Diameter at breast height (dbh), which is the average tree diameter at 4.5 feet from the ground on the uphill side of the tree.

K. Damage to trees:

1. Soil compaction.
2. Broken root tissue.
3. Broken overstory tissue.
4. Actions and/or inactions by Contractor’s forces resulting in signs of stress including, but not limited to, defoliation and chlorosis.

L. Supersonic Air Tool (Airspade): High speed specialized tool that loosens and removes soil by means of highly compressed air without damaging roots.

M. Significant Damage: Damage that might reasonably be expected to endanger the long term health and/or form of the tree, as determined by the Landscape Architect, CO/COR or Arborist.

N. Wheel Saw: 3 inch wide mechanical trencher, Bobcat model WS24 or equal as approved by Landscape Architect.

O. Tree Protection Zone:

1. The area defined by the drip line of the outer extent of the canopy of a tree, or within ten (10) feet of the outside diameter of a tree’s trunk, or within tree protection fence area as shown on plans, whichever is larger.

1.3 QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances and note any corrective action taken.

1.4 REFERENCES

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. U.S. National Archives and Records Administration (NARA):
33 CFR 328 Definitions, Waters of the United States.

C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: http://www.epa.gov/npdes/stormwater
2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): http://www.epa.gov/owow/
3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA’s Office of Solid Waste and Emergency Response: http://www.epa.gov/epaoswer/osw/laws-reg.htm
4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: http://www.epa.gov/oilspill/
5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA’s Superfund website: http://www.epa.gov/superfund/index.htm
6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA’s Polychlorinated Biphenyl (PCB) Homepage: http://www.epa.gov/pcb/
7. Air quality requirements for construction activities; refer to EPA’S Air Program Mobile Sources Page: http://www.epa.gov/ebtpages/airmobilesources.html
8. Asbestos requirements for construction activities; refer to EPA’s Asbestos Management and Regulatory Requirements Website: http://www.epa.gov/fedsite/cd/asbestos.html
9. National Environmental Policy Act (NEPA) requirements for construction activities
10. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: http://endangered.fws.gov/
11. National Historic Preservation Act

D. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
   1. State Office/Department of Environmental Quality.
   2. Local Office/Department of Environmental Quality.
   3. The Construction Industry Compliance Assistance Center: http://www.cicacenter.org/index.cfm
   4. The National Environmental Compliance Assistance Clearinghouse: http://cfpub.epa.gov/clearinghouse/

E. Publications listed herein are part of this specification to extent referenced.
   1. Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance, ANSI A300, December, 1994.
   2. ANSI Z133.1 - 1994, Tree Care Operations - Safety Requirements Standards.
   3. International Society of Arboriculture (ISA) "Guide for Establishing Values of Trees and Other Plants," prepared by the Council of Tree and Landscape Appraisers (CTLA).

1.6 SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the Contractor shall furnish the following:
   1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, meet with the Contracting Officer’s Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, prepare and submit to the COR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
      a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
         1) Ensuring adherence to the Environmental Protection Plan.
         2) Manifesting hazardous waste to be removed from the site.
         3) Training the Contractor's environmental protection personnel.
      b. Description of the Contractor's environmental protection personnel training program.
      c. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control,

noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

d. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

e. Procedures to provide environmental protection that complies with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

f. Permits, licenses, and the location of the solid waste disposal area.

g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and/or mandated state agency, and the Department of Veterans Affairs.

h. Environmental Monitoring Plans for the job site including land, water, air, and noise.

i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Within 20 days after the date of its submittal, the COR shall approve the Contractor’s Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.

C. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.7 TREE PROTECTION

A. The Contractor shall be responsible for the installation and maintenance of all tree protection fencing and other tree protection

measures within the Tree Protection Zone. Tree protective fencing shall remain undisturbed until all construction activities have been completed. The Contractor shall remove fencing upon completion of construction.

4. If protective fencing is damaged, the Contractor shall immediately execute the necessary repairs to re-establish the protective fencing to original configurations.

B. No construction activity, including staging and stockpiling, shall start until all tree protection measures and procedures as indicated are completed.

C. The following construction activities are prohibited within Tree Protection Zones:

1. Storage of any construction materials, equipment, stockpiling, excavation or fill, soil, gravel, etc.
2. Equipment or vehicle parking.
3. Masonry set up, clean up or washout.
4. Dumping of any chemicals, (i.e. paint thinner from cleaning brushes), wash-out materials from cleaning equipment, concrete or mortar remainder, trash, garbage, or debris of any kind.
5. Burning within or in proximity to protected areas
6. Felling trees into protected areas.
7. Trenching or grading within the Protection Zone of protected trees for any purpose without notifying the COTR and AE 10 days in advance of operation in writing. This includes but is not limited to the following: silt fence, sediment erosion control, utilities, site lighting, irrigation, drainage, curbs, and footings.
8. Contractor shall prevent any contamination of the soil within the Protection Zone by construction materials, debris, silt, fuel, oils, concrete, or any other chemical substance. Contractor shall notify the COTR of any such spills, compaction, or other disturbance within the Protection Zone and take immediate action using methods approved by the COTR.
9. Excessive foot traffic

D. The following restrictions apply to the Tree Protection Zones:

1. Any grading, construction, demolition, or other work that is expected to encounter tree roots shall be made in consultation with the CO/COR.

2. Any roots 2 inches in diameter or less that sustain damage during construction shall be exposed to sound tissue and cleanly pruned close to the tree side of the excavation. Clean cuts shall be made at all times. The cutting of tree roots greater than 2 inches in diameter must be approved and supervised by a licensed arborist.
3. Trees to be removed adjacent to the tree root protection zones shall be cut near ground level and the stump ground out to avoid damaging existing roots by pulling and breaking.
4. Any digging that must occur within Protection Zones must utilize alternative excavation methods including, but not limited to hand excavation or air spading. This includes planting operations.
5. Within the Protection Zones, precautions will be taken to avoid compaction of the soil, including such methods as:
   a. Using hand methods in lieu of heavy equipment.
   b. Using low-pressure vehicles; No use of tracked or skid-steer vehicles
   c. Establishment of temporary haul roads for vehicular traffic. Vehicles and equipment shall not leave the temporary haul roads.
6. If temporary access or haul roads through the protection zone are required, contractor shall install construction mat.

E. Failure to comply with protection zone requirements can result in immediate work stoppage.
1. All delays and costs due to correction of non-compliance and work stoppage shall be at the Contractor's expense.
2. Penalty for noncompliance with tree protection requirements: $500 per incident.
3. In addition, if violations occur within tree Protection Zones the COR may require the Contractor to hire a licensed arborist to observe work in Protection Zones and make recommendations at no additional expense to the Government.

1.8 PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract and after the project is complete. Confine construction activities to areas defined by construction limits, the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut,

deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, land forms, wetlands or wetland buffers without prior approval from the COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.

1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Prior to construction, mark/fence/protect monuments, works of art, and any other markers to remain. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
   a. Protect trees and shrubs to remain on site to protect from damage per contract details.
   b. All damage to existing trees and shrubs shall be immediately repaired by trimming, cleaning, and painting with antiseptic tree paint.
   c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Erosion and Sedimentation Control Plan.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
   a. Reuse or conserve the collected topsoil sediment as directed by the COR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING short form

b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.

5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown on the Erosion and Sedimentation Control Plan to avoid violating water quality in accordance with federal and state regulations. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, straw waddles, fiber rolls, until permanent drainage and erosion control facilities are completed and operative.
6. Manage and control borrow and spoil areas to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
7. Protect adjacent areas from despoilment by temporary excavations and embankments.
8. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
10. Handle discarded materials other than those included in the solid waste category as directed by COR, Federal, State and local code and regulations.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.

D. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Virginia Air Pollution Control Law and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials at all times, including weekends, holidays, and hours when work is not in progress.
2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, , or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

E. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

1. Perform construction activities involving repetitive, high-level impact noise only between 7:00 a.m. and 6:00p.m unless otherwise permitted by local ordinance or the COR. Repetitive impact noise on the property shall not exceed the following Decibel A-scale (dBA) limitations:

Time Duration of Impact Noise	Sound Level in dBA
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
   a. Maintain maximum permissible construction equipment noise levels as measured with an A-scale decibel measuring device at 15 m (50 feet) (dBA):

CATEGORY OF EQUIPMENT			
EARTHMOVING		MATERIALS HANDLING	
EQUIPMENT STYLE	SOUND LEVEL dBA	EQUIPMENT STYLE	SOUND LEVEL dBA
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	NOT PERMITTED
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

   b. Provide soundproof housings or enclosures for noise-producing machinery.
   c. Use efficient silencers on equipment air intakes.
   d. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
   e. Line hoppers and storage bins with sound deadening material.
   f. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 75 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighted sound level of a

General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construction mat: In general, vehicle traffic is prohibited in Protection Zones. If equipment access is required through Protection Zones, provide the following:
   1. Use only turf-tired vehicles, no tracked vehicles allowed.
   2. For one-time traffic, provide 1-inch thick plywood construction matting to protect soil from compaction and rutting.
   3. If vehicles will drive over an area more than once, provide heavy construction matting consisting of the following: geotextile fabric with 8-inch thickness of coarsely shredded wood chips on top. Respread or add mulch as needed to maintain the specified thickness.
   4. Completely remove all construction mat materials as soon as possible.

B. Trunk protection – trees over 12” caliper: Protect the trunk of the tree from accidental mechanical damage when operating equipment within the Protection Zone by attaching scrap lumber to the trunk with nylon webbing straps. Do not affix by means of nails, screws, lag bolts or any other device which penetrate the bark. If such banding is required to remain for a period greater than four months, check the tension of the straps and loosen them if they become tight to prevent damaging the trunk of the tree.

C. Plastic Protection Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart. Safety orange color, nonfading. Fencing shall be 4 feet high with 3 foot wide access gates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Pre-construction Walkthrough

1. Prior to the start of construction and preservation work, conduct pre-construction review of construction extent and protection requirements. Any potential conflicts shall be brought to the COR's and Landscape Architect's attention.
2. Identify all equipment access routes and areas to receive construction mat for COR approval.
    a. Equipment pathways shall avoid protection zones, except as approved by COR. Vehicles circulating within the Protection Zone shall only drive on a prepared construction mat.
3. Identify areas to be trenched or excavated.
4. Identify trees to receive trunk protection.
5. Locate proposed material and soil storage areas. Review locations for demolished materials and new materials.
6. Identify any trees to be pruned to facilitate equipment access, if applicable. Identify direction of fall for any trees to be removed, if applicable.

B. Pre-construction watering
    1. All trees in the vicinity of construction activities shall be thoroughly watered two weeks prior to the start of construction.

3.2 TREE PROTECTION

A. Construction within the Protection Zone shall be performed in a manner that avoids injury to trees and their roots as much as possible.
    1. Install construction mat where vehicles must travel through Protection Zones.
    2. Secure all over hanging branches to prevent accidental damage when practical. Tree branches that interfere with construction may be trimmed to clear final grade by a maximum of 9 feet over sidewalks and 14 feet over pavement. Trimming of branches and the cutting of roots shall be in accordance with accepted arboricultural practices and be performed by the Contractor's qualified Arborist.
    3. Tree wounds and cuts shall not be painted with any type of tree paint or other substances.
    4. Install trunk protection for trees over 12 inches in caliper.

3.3 DEMOLITION

A. Special demolition procedures within Protection Zones or adjacent to the designated Protection Zones shall be as follows:

1. Do not pile or load debris adjacent to existing protected trees.
2. If roots are encountered during removal of structures, protect or prune as described in this section.

3.4 EXCAVATION

A. Special Precautions: Protection of existing trees adjacent to excavation involves four areas of operations: careful excavation, selective root relocation and/or removal, protection of tree trunk and branches, and backfill of excavation.

B. Excavation in Protection Zones

1. Hand dig and/or use supersonic air tool to excavate to a depth of 12 inches, below which mechanical methods may be used. Use extreme care when hand digging to leave roots intact.
2. Expose all roots larger than 1″ in diameter. Care shall be taken so as not to cause damage to the roots. Notify COR if roots larger than 1″ are encountered.
3. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or wrap with wet burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil. If several roots form a tight cluster, leave as much soil attached to the roots as is practical. Do not leave trench open for more than 4 hours. Replace soil and soak with water to pack.
4. Excavated dirt shall be placed away from any adjacent trees or Protection Zones when there is sufficient room. If no room exists, dirt may be placed on plywood to contain the fill and to minimize compaction and mechanical damage to surface roots.
5. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and relocate them without breaking.
6. Do not cut roots larger than 1 inch diameter without approval from CO/COR. Cut smaller roots that cannot be relocated and that interfere with construction with sharp pruning instruments; do not break or chop.

3.5 GRADING

A. Match existing grades except as noted. Notify COR and obtain approval if unforeseen circumstances require adjustment of finish grades.

3.6 TREE PRUNING

A. All pruning to be done by a licensed Arborist and only if approved by COR. Prune branches that directly interfere with construction and only with approval from COR.

B. Pruning Standards: Prune trees according to ANSI A300 (Part 1)and as follows:

1. Type of Pruning: Cleaning.
2. Cut branches and roots with sharp, clean pruning instruments; do not break or chop.
3. Chip removed tree branches and dispose of off-site legally.

3.7 TREE REPAIR

A. Tree repair recommendations must be provided by a licensed Arborist.

B. Provide COR reports of damage and recommended remediation on a daily basis if damage occurs.

C. Promptly provide remedial action to trees damaged by construction operations within 48 hours. Prune or otherwise treat damaged trunks, limbs, and roots according to Arborist's written instructions. Remedial actions shall be at Contractor’s expense. Damage that is not addressed within 48 hours may be remediated by the VA at the Contractor’s expense.

D. Remedial maintenance activities which may be required in lieu of or in addition to other penalties shall include, but are not limited to, the following:

1. Repair: Crown pruning, root pruning, fertilization, mulching, aeration, soil replacement, soil removal, watering, cabling, and bracing.
2. If trees are damaged, penalties still apply and are in addition to remedial measures.

3.8 MAINTENANCE AND RESTORATION

A. Water trees thoroughly immediately after any excavation or vehicle traffic and every 2 weeks thereafter in dry weather (less than 1 inch of natural rainfall per week), until irrigation system is fully functional.

B. If the soil within the Protection Zone becomes compacted during construction due to vehicle traffic or materials storage, perform vertical mulching to aerate surface soil.

a. Perform vertical mulching wherever construction matting was used.
b. Perform vertical mulching within the Protection Zone and no closer than 36 inches (900 mm) to tree trunk.

c. Drill 2 inch diameter holes 12 inches deep using a power auger. Start beyond the tree’s structural root plate and drill on a 18 x18 inch grid within the critical root zone. If large woody roots are encountered, avoid root damage by slightly moving the drill hole. Backfill the holes with compost or composted mulch.

C. Repair damaged turf with new sod to match existing turf.

D. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

3.9 DISPOSAL OF WASTE MATERIALS

A. Burning is prohibited at all times.

B. Disposal: Remove cuttings from Government's property and dispose of legally.

C. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition as approved by the COR. The site shall be left meeting the requirements of the local and state environmental requirements associated with the (SWPPP) Storm Water Pollution Protection Plan as submitted. Cleaning shall include off-cemetery disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies cast-in-place concrete.

1.2 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 TOLERANCES:

A. ACI 117.

B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS:

A. ACI SP-66 ACI Detailing Manual

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Concrete Mix Design.

C. Shop Drawings: Reinforcing steel: Complete shop drawings.

D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

117R-06.....Tolerances for Concrete Construction and Materials
211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete
211.2-98(R2004).....Proportions for Structural Lightweight Concrete
301-05.....Specification for Structural Concrete
305R-06.....Hot Weather Concreting
306R-2002.....Cold Weather Concreting
SP-66-04 .....ACI Detailing Manual
318/318R-05.....Building Code Requirements for Reinforced Concrete
347R-04.....Guide to Formwork for Concrete

C. American Society for Testing And Materials (ASTM):

A185-07.....Steel Welded Wire, Fabric, Plain for Concrete Reinforcement

A615/A615M-08.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A996/A996M-06.....Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

C31/C31M-08.....Making and Curing Concrete Test Specimens in the Field

C33-07.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens

C94/C94M-07.....Ready-Mixed Concrete

C143/C143M-05.....Standard Test Method for Slump of Hydraulic Cement Concrete

C150-07.....Portland Cement

C171-07.....Sheet Material for Curing Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.Air Content of Freshly Mixed Concrete by the Volumetric Method

C192/C192M-07.....Making and Curing Concrete Test Specimens in the Laboratory

C231-08.....Air Content of Freshly Mixed Concrete by the Pressure Method

C260-06.....Air-Entraining Admixtures for Concrete

C330-05.....Lightweight Aggregates for Structural Concrete

C494/C494M-08.....Chemical Admixtures for Concrete

C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

D1751-04.Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D4397-02.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

A. Wood, plywood, metal, or other materials, approved by COR, of grade or type suitable to obtain type of finish specified.

2.2 MATERIALS:

A. Portland Cement: ASTM C150, Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.

C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick.

D. Fine Aggregate: ASTM C33.

E. Mixing Water: Fresh, clean, and potable.

F. Air-Entraining Admixture: ASTM C260.

G. Chemical Admixtures: ASTM C494.

H. Welded Wire Fabric: ASTM A185. Flat sheets.

I. Sheet Materials for Curing Concrete: ASTM C171.

J. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.

K. Liquid Densifier/Sealer: 100 percent active colorless aqueous siliconate solution.

2.3 CONCRETE MIXES:

A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.

B. Compressive strength at 28 days shall be not less than 3500 psi.

C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.

D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.

E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio
35 (5000)[1,3]	375 (630)	0.45	385 (650)	0.40
30 (4000)[1,3]	325 (550)	0.55	340 (570)	0.50
25 (3000)[1,3]	280 (470)	0.65	290 (490)	0.55
25 (3000)[1,2]	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

* Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

F. Air-entrainment is required for all exterior concrete. Air content shall conform with the following table:

TABLE I - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in) = #67	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING:

A. Store, batch, and mix materials as specified in ASTM C94.
1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.
2. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK:

A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.

B. Treating and Wetting: Treat or wet contact forms as follows:
   1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
   2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
   3. Use sealer on reused plywood forms as specified for new material.

C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:
   1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
   2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

Detail concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 PLACING CONCRETE:

A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COR before placing concrete. Provide screeds at required elevations for concrete slabs.

B. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.

C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.

D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.

E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COR.

3.4 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COR.

3.5 FORM REMOVAL:

Forms shall remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.6 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by COR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.7 PRECAST CONCRETE ITEMS:

Precast concrete items, not specified elsewhere, shall be cast using 5000 psi air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

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SECTION 03 48 21
PRECAST CONCRETE BURIAL CRYPTS
(DOUBLE DEPTH LAWN CRYPT)

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section is to furnish all labor, materials, manpower, tools and equipment required to complete the manufacturing and installation of the precast concrete burial crypts as specified and/or shown, including but not limited to the work to:

1. Fabricate
2. Transport and deliver to site
3. Unload units on dunnage or gravel
4. Store and/or install precast concrete burial crypts (units or crypts)
5. Install sub base foundation and drainage
6. Install units in the prepared crypt fields
7. Backfill between and around the crypts
8. Install sand and/or backfill on top of crypts
9. Compact fill materials
10. Topsoil
11. Provide additional Materials:
    a. Three (3) OSHA -approved crypt lid lifting apparatus
    b. Five (5) extra concrete crypt lids
    c. A device to easily retrieve and lower the inside shelf by one man without entering the crypt.
12. Other Associated Work

1.2 DESIGN OVERVIEW

A. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the Drawings. Design requirements shall be as follows:

1. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter.
2. All designs will require that the manufacturer provide fabrication drawings stamped by a Professional Engineer indicating that the design meets or exceeds the structural requirements contained herein.
3. Alternative crypt component designs may be proposed if all the following requirements are met:

a. Comply with the design criteria and the functional tests of this specification.
b. All provisions of this specification shall apply to any proposed alternative design.
c. The Government may accept or reject part or all of any proposed alternative design. The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.3 RELATED WORK

A. Excavation and Backfill: 31 20 11 EARTH MOVING(short form)
B. Materials Testing and Inspection during Fabrication and Construction: Specification Section 01 45 29 TESTING LABORATORY SERVICES.
B. Subbase Foundation and drainage: 33 46 00 SUB-DRAINAGE

1.4 SUSTAINABILITY REQUIREMENTS

A. Blended Cement: It is the intent of this specification to reduce CO2 emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement typically included in conventional construction. Provide the following submittals:
1. Copies of concrete design mixes for all installed concrete.
2. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project.
3. Quantities in cubic yards of each installed concrete mix.
B. Biobased Material: For products designated by the USDA's BioPreferred® program, provide products that meet or exceed USDA recommendations for biobased content, subject to the products compliance with performance requirements in this Section. For more information regarding the product categories covered by the BioPreferred® program, visit http://www.biopreferred.gov.

1.5 REGULATORY REQUIREMENTS FOR RECYCLED CONTENT

A. Products and Materials with Post-Consumer Content and Recovered Materials Content:
1. Contractor is obligated by contract to satisfy Federal mandates for procurement of products and materials meeting recommendations for post-consumer content and recovered materials content; the list of designated product categories with recommendations has been compiled by the EPA - refer to http://www.epa.gov/wastes/conserve/tools/cpg/products/

2. Materials or products specified by this section may be obligated to satisfy this Federal mandate and Comprehensive Procurement Guidelines program.
3. The EPA website also provides tools such as a Product Supplier Directory search engine and product resource guides.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Bid documents shall include documentation that manufacturer has a minimum of three years of experience with pre-casting units of similar type. Current plant certification for the location(s) that will be producing units for this project from the National Precast Concrete Association (NPCA) shall be provided as a submittal prior to any work being performed.

B. Provide a written stamped certification from a licensed Structural Engineer that certifies that the units being manufactured conform to the specified design and performance requirements.

C. Installation Qualifications: Provide written documentation that verifies:
   1. The installer has been regularly engaged, for at least three years, in installation of pre-cast concrete similar to this project.

D. Fabricate crypts to the interior dimensions described below.
   1. Replace or repair units that do not comply with the individual dimensions and tolerances.

E. Prior to, or in the initial stage of crypt production, furnish at the site:
   1. Proposed shelf removal tool.
   2. Two (2) perimeter crypts.
   3. One (1) interior crypt.
      a. The three (3) crypts shall:
         1) Demonstrate acceptable quality of construction.
         2) Be used to conduct the on-site buried crypt functional load test as described herein below.

F. Functional Load Tests: Functional on-site load tests will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional tests will consist of following loading conditions:
   1. Confined Loading: An interior unit between two perimeter units shall:

a. Be placed in a hole dug in the ground on site and covered with 600 mm (24 inches) of soil or covered to the maximum depth as shown on the plans, whichever is greater.
   1) The soil will be compacted to Standard Proctor (AASHTO T-99) density along the sides of 95% and reduced density over the lid, both as shown on the plans.
      a) Impact type of equipment shall not be used on the sides of the crypts as they can cause conditions that exceed the design parameters.
b. An axle load of 5500 kg (12,000 lbs.) shall be passed over the covered crypts for a minimum of 10 times in repetition as follows:
   1) In a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts.
c. The crypts shall then:
   1) Be fully excavated, exposed and the lids removed to allow careful examination inside and outside.
      a) The crypts must not show any signs of stress or cracking.

2. Shelf Load Testing for the intermediate shelf shall be as follows:
   a. Apply load to individual support struts. Use one worker with a minimum weight of 90kg (200 lbs.)
      1) Worker shall carefully walk on individual supports to confirm structural integrity and load bearing capability.
         a) Worker shall adhere to all safety regulations while performing test.
   b. Upon completion of shelf load testing, the inside shelf shall be removed by the removal tool as follows:
      1) Without entering the crypt and by one man.
      2) Inspected, and lowered back into the crypt in the 2nd interment position.
      3) The inside shelf must not show any signs of stress, cracking or deflection.
3. Demonstrate the removal and replacement process for the inside shelf. The functioning of the shelf removal tool shall be approved by the NCA Crypt Specialist.

G. Commence production of crypts only after the written submittal(s) are approved and on-site load testing and demonstration have been scheduled for witnessing by the NCA Crypt Specialist.

1.7 DESIGN CRITERIA

A. Design Criteria (Double Depth Crypt): All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.

1. The units shall be of the following type, style, and size:
   a. Type: Precast concrete.
   b. Style: One-piece box with separate outer lid and the following:
      1) A removable one-piece inside shelf
      2) Four casket risers or two casket support bars
      3) Drain Holes 100 mm (4-inch) diameter in the floor bottom as follows:
         a) Two drain holes at opposite ends when there are casket risers.
         b) Three drain holes at opposite ends and in middle, when there are two support bars.
   c. Crypt interior size: Interior minimum dimensions are as follows:
      1) 750 mm (30″) minimum width at the inside bottom floor and for the full height of the crypt
      2) 2.2 m (86″) minimum length along the inside bottom floor and for the full height of the crypt
      3) 640 mm (25″) minimum clear height from the highest part of the inside shelf to the underside of the lid
      4) 640 mm (25″) minimum clear height from the lowest part of the inside shelf to the top of the casket risers
      5) 20 mm (3/4″) minimum height casket risers from the crypt floor spaced 500 mm (20″) from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.
   e. Crypt height and wall thickness:
      1) Exterior maximum height dimension: 1.6 m (60") including the lid.
      2) Crypt wall thickness: 50 mm minus 12mm (2-inches minus 1/2 inch) for inside shelf bearing.
      3) Perimeter crypts are allowed thicker walls where additional reinforcing is included.
      4) Crypt wall sections at support slots originated from the top for the inside shelf may be of lesser thickness.
   f. Layout:

1) Crypts shall fit in a 920 mm by 2450 mm (3-foot by 8-foot) plot or a lesser plot size as noted on the plans.
2) The lesser plot size shall govern. If the proposed crypts will not fit into the designed/indicated plot size, with adequate room for the between crypt backfill, or if a different plot size is suggested, the Contractor, at no cost to the Owner, shall prepare a revised Layout/Size Plan and submit it for review and approval by the COR.

2. Load Conditions for design of units shall be as follows:
   a. A burial depth with soil cover as indicated on the plans.
   b. A center point load of 2700 kg (6,000 lbs.) on one square foot, prior to burial.
   c. Passage of a wheel axle load of 5500 kg (12,000 lbs.) after burial.
   d. A 900 mm (3-foot) tall pile of excavated material on top of or adjacent to buried crypts.
3. Submit to the Contracting Officer's Representative COR for approval the following:
   a. Two sets of design documentation showing structural design of the units. **In addition, the Contractor shall provide one additional set to NCA Crypt Specialist.**
      1) This documentation shall include dimensions, methods of construction, and calculations.
   b. The Structural Engineer that stamps the design calculations and drawings shall provide:
      1) Written recommendations indicating the extent of voids that are allowable in the produced units, without causing any degradation of loading capacity from the design load values.
      2) Written recommendations on the conditions where repairs will be allowed, and materials and methods to be used for repairs.
      3) Written statement that all repairs to the units shall only be allowed if they are performed according to the written recommendations of the Structural Engineer.

B. Design Criteria (Concrete Lids):
   1. To be removable and replaceable.
   2. Lid lifting shall be from top positioned hot-dipped galvanized anchors (4-required per lid) with the lifting bowls filled with well washed rounded stone//.

a. Furnish the cemetery with three (3) OSHA approved and tag certified wire rope lifting devices for removing the lid. No chain lifting devices allowed.

C. Design Criteria (Inside shelf):
1. One piece rigid construction
2. Fully conceal the lower casket with a rigid barrier
3. Weigh 18 kg (40 lbs.) or less
4. Allow for easy casket lowering belt removal
5. Capable of holding 180 kg (400 lbs.) indefinitely.
6. The entire inside shelf should be rigid, non-brittle, non-deteriorating, and have a maximum 6 mm (1/4 inch) gap from all shelf edges to the crypt wall to create a visual barrier.
7. Have one lifting hole in the middle about 50 mm (2-inches) from the edge 19 mm (3/4-inch) maximum diameter.

D. Design Criteria (Inside Shelf Removal Tool(s):
1. Be constructed so one man can easily retrieve and install the shelf from ground level without entering the crypt.
a. Demonstrate the use and functionality of said tool at the crypt buried load testing, for the conditions that will occur at the cemetery during the interments at the crypt sections(s).

E. Design Criteria (Quad Crypt):
1. An alternate concrete Quad unit (one piece) may be used as an approved equal in lieu of two (2) double depth lawn crypt units. The Quad units shall conform to all other specified herein including:
a. The shared interior concrete wall thickness may be increased to allow for a gap between lids as deemed appropriate to meet layout requirements.

F. Design Criteria (Oversized Crypt):
1. Oversized crypts shall conform to all provisions of this section with the exception that the Interior dimensions and Wall thickness are as follows:
a. 1065 mm by 2335 mm (42-inches by 92-inches) inside clear span
b. Oversized crypt wall thickness: 65 mm – 12 mm (2-1/2 inches minus 1/2 inch) for inside shelf bearing.

G. Miscellaneous manufacturing requirements:

1. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning 12 mm (1/2 inch) down from top.
2. The design of casket risers, whether individual spots or bars crossing the bottom, shall allow the casket to rest a minimum of 19 mm (3/4 inch) above the inside floor of the crypt and above the top of the inside shelf in order to aid in casket lowering straps removal. In addition, rests location shall not exceed 530 mm (21 inches) from crypt centerline.
3. The crypt outside lifting wire shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire once crypt has been installed.

1.8 ALLOWABLE TOLERANCES

A. Tolerances of individual units shall be as follows:
1. Variation in overall crypt outside dimensions of unit (height, length and width): 3 mm (1/8″) plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.
2. Variation in thickness of precast panels and elements: 1.5 mm (1/16″) plus or minus.
3. Maximum height differential in final placement in the ground: 6 mm (1/4″) above or below design grade.
4. Cracks greater than 0.75 mm (0.030 inches) in width are cause for crypt rejection. With evidence of fiber or steel reinforcement, any cracking 0.75 mm (0.030″) or lesser width that does **not** extend thru wall is acceptable. Any cracking 0.4 mm (0.016 inch) or lesser that extends thru wall is acceptable. All other cracks are cause for rejecting crypts that shall be repaired or removed and replaced at no cost to VA.

1.9 SUBMITTALS

A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, furnish to the COR and the NCA Crypt Specialist the following:
1. Samples: deliver to the site for testing and inspection:
a. Two perimeter crypts and one interior crypt.

B. Submit a detailed concrete Mix Design of Self Consolidating Concrete (SCC) with a ***15% minimum requirement*** of a cement substitute of fly ash and/or other pozzalons.

C. Submit Shop Drawings:

1. Installation Narrative:
   a. Method of transportation.
   b. Method of handling and placement.
2. Production Drawings:
   a. Elevation view of each unit.
   b. Plan view of unit.
   c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.
   d. Section, details and location of specialty lid lifting anchors, caps, and lid lifting system.
   e. Dimensions and finishes.

D. Submit Product Design Data:
1. Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.
2. Loadings for Design Calculations:
   a. Initial handling and erection stresses.
   b. Dead and live loads specified.
   c. Other loads specified for units as applicable.
   d. Deflection of precast members.
   e. Product test reports:
      1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the COR immediately after the strength tests have been completed. The tests shall be as specified herein.
      2) Prior to backfilling over crypts and at contractor expense, the COR may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.
      3) Based on failed testing, the COR may request more frequent testing to ensure quality of the product and pozzalons content is present, again at contractor expense.
3. Manufacturer’s Literature and Data:
   a. Each type of anchorage, angle, and fastener.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. Provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Transportation, storage and handling of units without damage is required. Any damage caused by accident or negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting wire system to transport crypts. On the job site, forklift handling of crypts may be approved by the COR only following:

1. Verification that the structural design is adequate.
2. Verification by the manufacturer and demonstration that the field procedures will cause no crypt damage.
3. Submission of written safety procedures to be followed so the procedure is maintained as SAFE.

B. Storage:

1. Units may be stored within crypt fields being constructed on gravel, or at other designated locations(s) on site, as long as they are set on blocking, gravel or other approved methods to prevent damage or plugging of the bottom drainage holes.

C. Markings and Identifications:

1. Markings, including logos, trademarks and proprietary information are prohibited on surfaces of crypts.
2. Date of manufacture (month, day, and year) shall be written on the box and lid with permanent ink or an equivalent marking.

1.11 COORDINATION

A. Coordinate the manufacture, delivery, storage and installation of the units with related work.

1.12 GUARANTEE

A. After erection, completed work will be, subject to terms of Article, GUARANTEE in Division 01, GENERAL CONDITIONS, except guarantee period is extended to five years.

1.13 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic

designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

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B. American Association of State Highway and Transportation Officials

T99-01(2011)	Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop.
T180-01(2011)	Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop.

C. American Concrete Institute:

ACI Manual of Concrete Practice 2011 Edition.

ACI 318-05	Building Code Requirements for Structural Concrete

D. American Society for Testing and Materials (ASTM):

A36/A36M-12	Standard Specification for Carbon Structural Steel.
A153/A153M-09	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
A615/A615M-13	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A1064/A1064M-13	Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
C31/C31M-12	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
C33/C33M-13	Standard Specification for Concrete Aggregates
C39/C39M-14	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen
C78/C78M-10e1	Standard Test Method for Flexural Strength for Concrete (Using Simple Beam with Third-Point Loading)
C150/C150M-12	Standard Specification for Portland Cement.
C172/C172M-14	Standard Practice for Sampling Freshly Mixed Concrete.
C260/C260M-10a	Standard Specification for Air-Training Admixtures for Concrete.
C494/C494M-13	Standard Specification for Chemical Admixtures for Concrete

C595/C595-13	Standard Specification for Blended Hydraulic Cement.
C1017/C1017M-13	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
C1116/C1116M-10a	Standard Specification for Fiber-Reinforced Concrete.
C1157/C1157M-11	Standard Performance Specification for Hydraulic Cement
C1399/C1399M-10	Standard Test Methods for Obtaining Residual-Strength of Fiber-Reinforced Concrete.
C1602/C1602M-12	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Precast Concrete: All crypts shall be of concrete with the following:
   1. A minimum 28 days compressive strength of 35 MPa (5,000 psi)
   2. Self-Consolidating Concrete (SCC) containing structural fiber with an inverted slump between 550 mm and 700 mm (22″ and 28″)
   3. A minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids
   4. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
   5. Normal weight Aggregates: ASTM C 33
   6. Water: ASTM C1602
   7. Chemical Admixtures:
      a. Water reducers, accelerating and retarding: ASTM C 494
      b. Air Entraining: ASTM C260
      c. Admixtures for flowing concrete: ASTM C1017
      d. Admixtures with no standard designation shall be used only with approval of VA.
   8. Prohibited Admixtures: Calcium Chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.

B. Reinforcement:
   1. Welded Steel Wire Fabric: ASTM A1064.
   2. Steel Wire Reinforcement: ASTM A82, cold drawn.
   3. Steel Reinforcement: ASTM A615 Grade 60, deformed.
   4. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A36, zinc coated ASTM A153 hot-dipped galvanized finish G90.
   5. Fiber: Macrofiber complying with ASTM C1116

C. Form Coatings:
   1. Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.

D. Paint:
   1. Use commercial Concrete & Garage Floor Epoxy Acrylic Paint for crypt concrete lid & inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal. The use of an approved equivalent spray paint product, if approved by the NCA Crypt Specialist, shall only be for use on the interior crypt numbers.

2.2 FABRICATION

A. General:
   1. Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.

B. Finishes:
   1. Surface holes 6 mm (1/4″) and smaller caused by air bubbles, normal color variations, normal form joint marks, small chips 6mm (1/4″) and smaller and spalling no more than 0.1 square meter (one square foot) total per unit are permitted.
   2. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.
   3. The lid lifting system shall be as follows:
      a. Top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 65 mm (2-1/2″) diameter minimum recessed bowl of depth sufficient to easily connect lifting device as designated compatible by anchor manufacturer.
      b. Anchors to be installed at locations to ensure maximum lid lifting stability.
      c. The lifting bowl will be filled with rounded stone as indicated on the drawings, to facilitate removal in the winter.
   4. Concrete shall have no evidence of segregation of materials.

C. Reinforcement:
   1. Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads.
   2. Reinforcing steel shall be free of dirt, mill scale, rust, oil, grease, ice, snow, water and placed within approved tolerances in

accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.

D. Concrete Placement:
   1. Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
   2. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.

E. Curing:
   1. 75% of specified concrete compressive strength shall be attained before transportation of units to the cemetery or storage site.
   2. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally.
   3. Units shall be properly cured in accordance with the applicable provisions of the current ACI Manual of Concrete Practice.

F. Surface Treatment and Corrective Work:
   1. Units that have minor chipping of edges and corners shall be repaired by a method approved by the COR.
   2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.
   3. Any corrective work beyond what the COR determines is minor, shall be handled according to written procedures from the Structural Engineer that stamped the design for the units. Otherwise, the units shall be removed and replaced.

2.3 TESTING AND INSPECTION

A. Contractor’s Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including:
   1. Removal of lids
   2. Number painting inside crypts
   3. Replacement of the lids for inspection by the COR.
      a. The COR reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements.

PART 3 - EXECUTION

3.1 CRYPT FIELD QUALITY ASSURANCE

A. Testing: The contractor shall procure an independent qualified testing agency to perform concrete tests during crypt production and prepare test reports.

1. Concrete Cylinder testing for compressive strength:
   a. Three cylinders per day of crypt production to be taken in accordance to ASTM C172 as applicable to SCC.
   b. Strength to exceed 35 MPa (5000 psi) after 28 days curing in accordance to ASTM C31 & C39.
   c. Test inverted slump when cylinders are made.
2. Beam testing to confirm design flexure strength:
   a. Once at the beginning of crypt production, a minimum of three beams with fiber shall be taken for testing of Flexural Performance of Fiber-Reinforced Concrete in accordance with ASTM C78 and C1399. All beams' flexural strength shall exceed the crypt design flexural strength requirements and residual strength of fiber reinforced concrete, and shall exceed capacity of conventionally reinforced concrete wall design as submitted by the Structural Engineer and approved by VA. Fiber Manufacturer shall verify type and dosage rate of the test beams are identical in crypt production.
3. A single verification test of fly ash in the crypt concrete mix required at the discretion of the COR.

3.2 GENERAL LAYOUT CONTROL

A. A professional registered Land Surveyor shall establish sufficient lines, grades and control for the horizontal placement, slope of the base and top, and vertical alignment for the sides of units in accordance with the design drawings.

3.3 PREPARATION

A. Before beginning installation, inspect work of other trades insofar as it affects the work of this section. Commencing installation of units will be construed as accepting as suitable the work of other trades.

B. Verify by survey, rough grading of aggregate for first row of crypts to be installed in a field. Provide a certification by the professional surveyor to the COR that the rough grading for the base stone for the first row of crypts to be installed, as well as that the survey control points for crypt setting have been set according to the plans, prior to

the Contractor starting to set crypts in the field. The Surveyor shall indicate to the COR where the control points are located and how they are protected.

C. Verify by testing, compaction of prepared subgrade and subbase to meet Standard Proctor (AASHTO T-99).

D. Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.4 HANDLING, INSTALLATION AND PAINTING

A. Handling:

1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, or placed on gravel until erected. Use of approved designed OEM lifting cable system that has been deemed to be safe for handling the units shall be used during the setting process, where workers are nearby.
2. Lift units with suitable lifting devices at points provided by manufacturer.
3. Provide temporary wood bracing to comply with manufacturer’s recommendations to keep crypt bottom off ground during storage.

B. Installation and Painting:

1. Install units by competent erector crews trained and certified as competent by units manufacturer.
2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids or other parts of the crypt that show damage from bouncing during transport shall be replaced by the contractor at no cost to the Owner.
3. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.
4. After crypt installation and prior to backfill, remove lids with the specified lifting apparatus for crypt inspection by the COR inspector and numbering. Numbers furnished by NCA shall be painted on the outside of the crypt lids and on the upper inside crypt short wall, both at the headstone end. Numbers shall be permanent paint as specified and approximately twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application **within 10 seconds** of surface cleaning. After completion of inspection and marking, the Contractor shall replace

the lids. Any damage to lids or crypts will be the responsibility of the contractor.

3.5 PROTECTION OF WORK

A. Use all means necessary to protect units from being damaged during and after installation.

3.6 REPLACEMENT AND REPAIR

A. Remove and replace units that the COR has determined are damaged, cracked beyond tolerances, broken, improperly fabricated, or otherwise defective and are structurally unsound and unacceptable.

B. Units having minor defects not affecting serviceability or appearance may be repaired when approved by NCA Inspector.

C. Proposed repair work shall be sound, permanent, and flush with adjacent surfaces and submitted for approval by NCA Crypt Specialist.

D. Replacements and repairs shall be done at no additional cost to the Government.

3.7 BACKFILLING AND CRYPT FIELD PROTECTION

A. Prior to the backfill being placed between the crypts, a professional registered Land Surveyor shall:

1. Survey the in place crypts and provide a written certification that they are, within allowable tolerances installed:
   a. At the design locations
   b. Properly aligned
   c. At correct elevations and slopes

B. The following documents shall be provided to the COR:

1. An electronic drawing of the as-built conditions for the installed crypts.
2. A paper copy at appropriate scale so the crypt field is fully shown on a maximum sheet size of 600 mm x 900 mm (24” x 36”) with all indications of variances in the placement from the design drawings shown.
3. A written certification that during the manufacturing, handling, setting, and or crypt numbering process that each of the lifting bowls were operated using the designed lifting device, and that any excessive concrete debris has been removed to allow free operation of the lifting bowls. A description of when in the process each of the lifting bowls were used shall also be provided.

C. When all of the crypts in a specific field are installed as indicated in the design drawings and details, and the surveyor has so certified,

the COR will approve the Contractor proceeding with the backfill between the crypts. The Contractor is responsible for insuring that the crypts do not move during the backfill operations, including but not limited to providing adequate blocking at the base of the units, if deemed necessary, to prevent them from moving during the backfill operations.

D. Protect installed crypt units during backfill operations.

E. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall:
   1. Contain no materials that will cause a concentrated point load.
   2. The perimeter wall backfill shall be compacted to Standard Proctor (AASHTO T-99) to 95% density to the level equal to the top of the crypts.
   3. Shall be compacted without using large vibratory equipment near crypts as impact loading may cause damage or failure of the crypt.

F. Backfill between the crypts where gap is less than 50mm (2-inches) shall be as follows:
   1. Install approved (rounded) gravel that meets the specified gradation into gaps between crypts leaving no voids.
      a. At COR’s discretion, a non-rounded stone may be considered as a substitute for the rounded stone. The COR may accept the (non-rounded) stone only following demonstration, through an approved submittal process, that rounded stone is not available for less than 4 times the cost of a cut/crushed angular (non-rounded) aggregate substitute. Largest size for the non-rounded stones shall not exceed the gradation size for the rounded stones. (A smaller gradation size will be required for the non-rounded stones to insure that the stones are not larger that their rounded counterparts.)The non-rounded stone shall only be considered when with the largest size of the stone passing a sieve size does not exceed the allowable stone size for the rounded stone gradations. The non-rounded stone may be approved when the size is as described above, and with a successful demonstration that filling gaps between crypts leaves no voids, because the stones fall into place without bridging as should occur when using rounded stones.
   2. Use rodding to assure no bridging occurs and void areas are eliminated.

3. No sand allowed.
4. As a resource saving measure, the use of angular stone of suitable gradation (typically the same stone used as drainage stone for below the crypts) shall be allowed in the space between the head and foot of the crypts only, if the Contractor demonstrates a successful method of placement that prevents the larger angular stone from spreading into the gaps along the long sides of side by side crypts.

Aggregate Size No.	Grading Requirements - Amounts finer than Each Sieve (Square Openings), Mass Percent					
	12.5 mm (1/2")	**9.5 mm (3/8")**	**4.75 mm (No. 4)**	**8.36 mm (No. 8)**	**1.18 mm (No. 16)**	**300 µ (No.50)**
8	100	85 to 100	10 to 30	0 to 10	0 to 5	
89	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5

G. Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of 50 mm (2 inches) of identification sand, soil to specified level, and 152 mm (6 inches) minimum of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% density (Standard Proctor (AASHTO T-99).

H. No equipment over the crypts should exceed crypt design loads as specified herein 5500 kg (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over or alongside crypts unless impact loads are shown not to exceed crypt design loads.

I. Immediately during crypts install, mark the crypt field edges with temporary driven 5-foot tall lathes & signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state ***"5500-kg axel load maximum. Keep 9 m away"***(***"12,000-lb axle load maximum. Keep 10 yards away")*** and placed minimum 15 m (50-ft) apart.

J. Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.

K. Finish grading and prepare topsoil as indicated on plans.

L. Do not store or stockpile any stone, sand, backfill, crypts or any other material over 1200 mm (4-feet) high within 9 m (10 yards) of ground on top of installed crypts. Affected crypts subject to said loading condition as determined by the COR shall be inspected for

possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor’s expense.

M. Do not allow any vehicle that exceeds a 5500 kg (12,000-lb) axle load, 2700 kg (6000-lb) wheel load or equivalent pressure per square inch to traverse or park within 9 m (10 yards) of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor’s expense.

3.8 INSPECTION AND ACCEPTANCE

A. Final inspection and acceptance will be by COR following receipt of:
   1. Recommendations from NCA Crypt Specialist and/or A/E team, as applicable.
   2. Electronic DWG files of each individual crypt field, with coordinates of the monument markers indicated, and each burial plot being indicated with a closed polygon, and corresponding NCA burial plot identification number, along with the section markers and number for the section.

- - E N D - - -

SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, applies to all sections of Division 26.

B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, and other items and arrangements for the specified items are shown on drawings.

C.

C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed; equipment or device of a kind mentioned which:
   a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.

b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. Labeled; equipment or device is when:
   a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
   b. The laboratory makes periodic inspections of the production of such equipment.
   c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified; equipment or product is which:
   a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
   c. Bears a label, tag, or other record of certification.
4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:
   1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C.

1.5 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1.6 EQUIPMENT REQUIREMENTS

A. Where variations from the contract requirements are requested in accordance with GENERAL CONDITIONS, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.7 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the Contracting Officer’s Representative (COR), placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 WORK PERFORMANCE

A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
   1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
   2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
   3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the COR. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.

D.

E. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 02, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interferences.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the NEC for all voltages specified.

C. Inaccessible Equipment:
   1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
   2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.10 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers,

individual breakers and controllers in switchboards, switchgear, control devices and other significant equipment.

B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.11 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.

F. Manuals: Submit in accordance with Section 01 00 02, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of

systems or equipment test, and furnish the remaining manuals prior to contract completion.

2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation and maintenance instructions.
   e. Safety precautions.
   f. Diagrams and illustrations.
   g. Testing methods.

G. Approvals will be based on complete submission of manuals together with shop drawings.

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SECTION 26 05 21
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.2 RELATED WORK

A. General electrical requirements that are common to more than one section in Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed Installation)

C. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-02.....Thermoset-Insulated Wires and Cables
83-03.....Thermoplastic-Insulated Wires and Cables
467-01.....Electrical Grounding and Bonding Equipment
486A-01.....Wire Connectors and Soldering Lugs for Use with Copper Conductors

486C-02.....Splicing Wire Connectors
486D-02.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-00.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-01.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-02.....Fittings for Cable and Conduit
1479-03.....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.

B. Single Conductor:
   1. Shall be annealed copper.
   2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
   3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:
   1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.

D. Color Code:
   1. Secondary branch circuit conductors shall be color coded as follows:

208/120 volt	Phase
Black	A
Red	B
Blue	C
White	Neutral

   2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
   3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:
      a. Solid color compound or solid color coating.
      b. Stripes, bands, or hash marks of color specified above.
      c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (3 inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no

tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES AND JOINTS

A. In accordance with UL 486A, C, D, E and NEC.

B. Branch circuits (No. 10 AWG and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.3 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with the NEC, and as specified.

B. Install all wiring in raceway systems. C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.
E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound. Provide firestopping for all conduit penetrations through fire rated assemblies.
H. Wire Pulling:
   1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
   2. Use ropes made of nonmetallic material for pulling feeders.
   3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Contracting Officer’s Representative (COR).
   4. Pull in multiple cables together in a single conduit.
I. No more than (3) single-phase branch circuits shall be installed in any one conduit.
J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.2 SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.
B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

3.3 CONTROL AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to

supply such systems and have suitable spare circuit breakers or space for installation.

D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL AND SIGNAL SYSTEM IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

3.5 FEEDER IDENTIFICATION

A. In each interior pulbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.3 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officer's Representative (COR):

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.4 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced. Publications are referenced in the text by the basic designation only.

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

B1-2001.....Standard Specification for Hard-Drawn Copper Wire

B8-2004.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA):

70-2008.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables

83-2003 .....Thermoplastic-Insulated Wires and Cables

467-2004 .....Grounding and Bonding Equipment

486A-486B-2003 .....Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.2 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.3 GROUND CONNECTIONS

A. Below Grade: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

2.4 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.5 SPLICE CASE GROUND ACCESSORIES

A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
2. Provide a supplemental ground electrode and bond to the grounding electrode system.

C. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. All conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded

conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

D. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

E. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

F. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

G. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.3 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

B. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.3 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

A. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. The specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the Contracting Officer’s Representative (COR) four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

70-08.....National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1-05.....Flexible Metal Conduit
6-07.....Rigid Metal Conduit
50-07.....Enclosures for Electrical Equipment
360-09.....Liquid-Tight Flexible Steel Conduit
467-07.....Grounding and Bonding Equipment
514A-04.....Metallic Outlet Boxes
514B-04.....Fittings for Cable and Conduit
651-05.....Schedule 40 and 80 Rigid PVC Conduit
651A-00.....Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07.....Electrical Metallic Tubing
1242-06.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):
TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 19 mm (3/4 inch) unless otherwise shown. B. Conduit:
1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
4. Flexible galvanized steel conduit: Shall Conform to UL 1.
5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

C. Conduit Fittings:
1. Rigid steel and IMC conduit fittings:
a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.

c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal material are not permitted.
e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Electrical metallic tubing fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
   d. Indent type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
3. Flexible steel conduit fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp type, with insulated throat.
4. Liquid-tight flexible metal conduit fittings:
   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.

c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

5. Direct burial plastic conduit fittings:
   a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
   b. As recommended by the conduit manufacturer.
6. Expansion and deflection couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:
1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1 1/2 by 1 1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
   1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.
   2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases to match the fire rating of the assembly with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

3.2 INSTALLATION, GENERAL

A. In accordance with UL, NEC, as shown, and as hereinafter specified.

B. Install conduit as follows:
   1. In complete runs before pulling in cables or wires.
   2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
   3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
   4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
   5. Mechanically and electrically continuous.
   6. Independently support conduit at 8’0” on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
   7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
   8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.

9. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

C. Conduit Bends:
1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

D. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

3.3 CONCEALED WORK INSTALLATION

A. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors 600 volts and below:
a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.

B. Conduit for Conductors 600 volts and below:
1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.

C. Align and run conduit parallel or perpendicular to the building lines.

D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

3.5 WET OR DAMP LOCATIONS

A. Unless otherwise shown, use conduits of rigid steel.

B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.

C. Unless otherwise shown, use rigid steel conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.6 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.7 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

3.8 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:
   1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
   2. Existing Construction:
      a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
      b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
      c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.9 BOX INSTALLATION

A. Boxes for Concealed Conduits:
   1. Flush mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)

E. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

F. On all Branch Circuit junction box covers, identify the circuits with black marker.

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SECTION 31 20 11
EARTH MOVING (SHORT FORM)

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration.

1.2 DEFINITIONS

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proof rolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to COR's approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trench work throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in ASTM D698

D. The term fill means fill or backfill as appropriate.

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements : Section 01 00 02, GENERAL REQUIREMENTS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 02, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 02, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

E. Report of Geotechnical Study, Appendix A of the Specifications

1.4 CLASSIFICATION OF EXCAVATION

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

B. Classified Excavation: Removal and disposal of all material not defined as rock.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Furnish to COR soil samples and certified laboratory tests of proposed off site or on site fill material.

1.7 APPLICABLE PUBLICATIONS

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

B. American Society for Testing and Materials (ASTM):

D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort

D1557-07.....Laboratory Compaction Characteristics of Soil

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fills: Materials approved from on site and off site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.

B. Granular Fill:

1. Drainage aggregate base for crypt field: Non-expansive crushed aggregate conforming to VDOT 57 Stone or approved equal.
2. Bedding for storm sewer pipe, VDOT 57 Stone
3. Pea stone fill: As described in pre-cast crypt section.
4. Aggregate Course for roadways: Conform to VDOT Specification Section 208.02(a) and shall consist of untreated Dense-graded Aggregate Materials No. 21A. Provide mixes in accordance with VDOT Section 208.05.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property.

B. Grubbing: Remove stumps and roots 76 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 76 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 914 mm (3 feet) below subgrade or finished embankment may be left.: Do not leave material within the burial profile up to 2438 mm (8 feet) below finished grade.

C. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m3 (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed. Topsoil stockpiles shall be restricted in height to maximum 4’.

1. Imported top soil shall be tested for chemicals, pesticides, fertilizers and organic content to verify suitability .
2. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are

approximately parallel unless otherwise indicated. Remove material from the Cemetery Property.

D. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

A. Shoring, Sheeting and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.
   1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
   2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COR.

B. Excavation Drainage: Operate pumping equipment and/or provide other materials, means and equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from COR. Approval by the COR is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the COR should be contacted to consider the use of flowable fill.

C. Trench Earthwork:
   1. Utility trenches (except sanitary and storm sewer):
      a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
      b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
      c. Support piping on undisturbed earth unless a mechanical support is shown.

d. The length of open trench in advance of pipe laying shall not exceed that which can be backfilled and stabilized daily.

2. Sanitary and storm sewer trenches:

a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (l2 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.

b. The bottom quadrant of the pipe shall be bedded on undisturbed soil or granular fill.

1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.

2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.

c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

d. Use granular fill for bedding where rock or rocky materials are excavated.

F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. All subgrades should be observed, evaluated and verified for consistency with the design bearing pressure by the geotechnical engineer after excavation. Low consistency soils may be encountered during excavation and localized undercutting and/or in-place stabilization of bearing subgrades may be required. To aid in identifying unsuitable soils, use a dynamic cone penetrometer (DCP) at the bottom of excavations. Remove subgrade materials that are determined by the COR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on meters (yardage) in cut section only. Excavation in areas intended to support crypts

should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Maintain good site drainage during earthwork operations.

G. Asphalt Paving Sub-grade: In necessary, prepare subgrade in accordance with VDOT Specification Section 305.

H. Asphalt Paving Sub-base: Prepare subbase in accordance with VDOT Specification Section 308.

I. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas 6 inches below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING

A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Controlled structural fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than three inches.

B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with granular fill material completed to mix requirements specified.

C. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.

D. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the COR. Maintain moisture content within three percentage points of the optimum moisture content as determined from the Standard Proctor density test Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Do not attempt to work soils when wet. Compact each layer to not less than 95 percent of the maximum density determined in accordance with the following test method ASTM D698.If construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils intended for structural support should be scarified and re-compacted.

E. Density Testing: Contractor shall provide ready access to newly-placed fill areas so that the Testing Agency can perform density testing using feet of fill placed at the site with a minimum of two tests performed for every lift. Density testing will be performed using a nuclear densometer for every 10,000 square feet of fill placement. Testing will also be performed every 100 linear feet along utility trenches, with a minimum of one test per lift.

3.4 GRADING

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.

C. Slope backfill outside the crypt field away from the crypts for a minimum distance of 1800 mm (7 feet).

D. Finish subgrade in a condition acceptable to the COR at least one day in advance of the paving or planting operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.

E. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS

A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by COR before sodding operation begins.

B. Finished Grading: Begin finish grading after rough grading has had sufficient time for settlement. Scarify subgrade surface in lawn areas to a depth of 100 mm (4 inches). Apply topsoil so that after normal compaction, dragging and raking operations (to bring surface to indicated finish grades) there will be a minimum of 6 inches of topsoil over all lawn areas; make smooth, even surface and true grades, which will not allow water to stand at any point. Shape top and bottom of

banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography. Solid lines within grading limits indicate finished contours. Existing contours, indicated by broken lines are believed approximately correct but are not guaranteed.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil,trash, and debris, and legally dispose of it off Cemetery property, in accordance with local, State and Federal regulations.

B. Place excess excavated materials suitable for fill and/or backfill on site where directed.

C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

D. Segregate all excavated contaminated soil designated by the COR from all other excavated soils. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.6 CLEAN-UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove debris, rubbish, and excess material from the Cemetery Property.

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate base course and asphalt wearing course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

B. The Contractor shall retain and reimburse a laboratory to perform said duties; or to obtain a certification from the authorized representative of the State; or to obtain certification from the asphalt paving producer. Certificate of compliance shall cover quality and gradation of aggregate base, quality and grades of asphalt course materials, and that the job-mixture meets or exceeds the State requirements.

1.2 RELATED WORK

A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Paragraph 3.3 and 31 20 11 EARTH MOVING (SHORT FORM).

C.Base course: Paragraph 3.4 and 31 20 11 EARTH MOVING (SHORT FORM).

1.3 INSPECTION OF PLANT AND EQUIPMENT

The COR shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor’s Registered Professional Land Surveyor specified in Section 01 00 02, GENERAL REQUIREMENTS shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Data and Test Reports:

1. Job-mix formula.

C. Certifications:
   1. Asphalt prime coat material certificate of conformance to Virginia State Highway Department requirements.
   2. Asphalt cement certificate of conformance to Virginia State department of Transportation requirements.
   3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.

D. One copy of VDOT Standard Specifications (Latest Version).

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

1.6 APPLICABLE PUBLICATIONS

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

B. American Association of State Highway and Transportation Officials (AASHTO):

HM29M	Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 29th Edition and AASHTO Provisional Standards, 2009 Edition
MP1	Specification for Performance Graded Asphalt
T 283	Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage

C. American Society for Testing and Materials (ASTM):

C29-07	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
C977-03	Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization
D3786	Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
D4355-07	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
D4632-08	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

D6390-05.....Standard Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures

D. Virginia Department of Transportation:

VDOT STANDARD SPECIFICATIONS (LATEST EDITION)

PRODUCTS

2.1 GENERAL

A. Hot mix asphalt materials shall conform to the requirements of the following and other appropriate sections of the latest version of the VDOT Standard Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA COR.

2.2 HOT MIX ASPHALT PAVING

A. Hot mix asphalt Surface Mix: SM 9.5A Hot Mix Asphalt Concrete meeting the requirements of Section 210 of the VDOT Standard Specifications (Latest Edition).

B. Base course: IM-19.0A Hot Mix Asphalt Concrete meeting the requirements of Section 210 of the VDOT Standard Specifications (Latest Edition).

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Tack coat: May be CRS-1, CRS-2, CRS-1h, or CSS-1 h in accordance with VDOT specification Section 310.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING HOT MIX ASPHALT MATERIALS

A. Provide hot plant-mixed asphalt paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE AND SUB-BASE PREPARATION

A. See Section 31 20 11 Earth Moving (Short Form)

3.4 PLACEMENT OF ASPHALT PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat where required, and allow to dry in accordance with the manufacturer’s recommendations as approved by the COR.

C. Receipt of hot mix asphalt materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
2. Do not commence placement of hot mix asphalt material when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
   a. No depressions which will retain standing water.
   b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 PATCHING

A. Hot Mix Asphalt Pavement: Sawcut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 300mm (12 inches) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing aggregate base course to provide new subgrade.

C. Patching: Fill excavated pavement with hot mix asphalt base mix for full thickness of patch; while still hot compact flush with adjacent pavement surface.

3.7 PROTECTION

Protect the asphalt paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 30 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
   1. Furnish and install the Gravesite Layout Markers at the specified locations.
   2. Furnish and install Burial Section Marker at specified location.

1.3 RELATED WORK

A. The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 03 30 53: CAST-IN-PLACE-CONCRETE (short form)

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:
   1. General: For each item specified in description of work or Part 2 - Products, provide information showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.
   2. Provide templates and rough-in measurements as required.
   3. Provide shop drawing for Burial Section Marker plus sample of engraving.
   4. Submit sample of granite for Burial Section Marker
   5. Submit sample of aluminum monument marker cap

1.5 REFERENCE STANDARDS

The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise herein.

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

B221-08 .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

B. American Welding Society (AWS):

D1.2-97..... Structural Welding Code Aluminum

C. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.1 MONUMENT MARKER

A. Monument markers shall be comprised of a bronze survey marker set into a cast-in-place concrete base.

a. Materials:

1) Monument Base: Cast-in-place concrete monument base, shall be a minimum of 24.1 MPa (3,500 psi) @ 28 days, reinforced as shown on details; dimensions as shown on Contract Documents.

2) Monument Marker: Domed-top, 89 mm (3 1/2") diameter, domed bronze concrete survey marker with integral locator magnet, and flared anchor post for securing to concrete.

B. Text and Cross-hairs: Text of monument marker cap as shown on Contract Drawings; text to match existing. Cross hairs shall be field engraved as shown on the Contract Drawings, aligned with the gravesite grid and engraved based upon Contractor-surveyed location data.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, those manufacturers that can demonstrate, during the submittal process, that they have provided these products as part of successful installations matching the specifications and drawings, at a minimum of three VA National Cemeteries.

2.2 BURIAL SECTION MARKER

A. Granite to match existing.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the COR.

3.2 PREPARATION

A. Stake alignment and locations for all site furnishings for review and approval by Resident Engineer. Verify that all elements in this section “fit” within location provided.

B. Install items rigid, plumb and true to lines and levels shown.

C. Assemble (if required) and install items as per manufacturer’s printed instructions, or approved shop drawings, unless otherwise specified or shown.

3.3 INSTALLATION

A. Monument Markers:

1. All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. Units will be installed in complete accordance with manufacturers' recommendations and as shown the Contract Drawings.
2. Cross-hairs on bronze monuments and marker shall be field inscribed, based upon accurate Contractor-survey: refer to Contract Drawings.
6. Furnish and install galvanized steel eyebolts with washers and nuts as indicated for the chain and lock attachment. Furnish and install the chain and padlock(s) and provide spare locks and keys to the Resident Engineer.

B. Burial Sectional Marker:

1. All material must be checked upon receipt at the job site prior to installation to check for any damage that may have occurred during transport. Unit will be installed in complete accordance with manufacturers' recommendations and as shown on the Contract Drawings.
2. Stake location as shown on drawings for COR approval prior to installation.
3. Protect and clean at completion of work.

3.4 CLEAN UP

A. Clean up area of excess material and debris. Clean above ground portions of all receptacles and other site improvements.

- - - E N D - - -

SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

1. Procurement of all applicable licenses, permits, and payment of required fees.
2. Coordination of Utility Locates public and private ("Call Before You Dig").
3. Maintenance period.
4. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK

A. Section 26 ELECTRICAL

B. Section 32 90 00 PLANTING

1.3 QUALITY ASSURANCE

A. Contractor:

1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed PVC pipe (3-inch and larger); centralized control systems; electrically operated remote control valves; and large radius rotary sprinklers (minimum 1-inch inlet with swing joint).
2. Contractor and project superintendent must be certified by control system manufacturer as a certified contractor for installation of control system wiring and grounding systems. Provide documentation from control system manufacturer regarding certification.
3. Contractor must be registered in Virginia.
4. Provide documentation of contractor qualifications with equipment submittals.

B. Equipment Manufacturer:
   1. Manufacturer regularly and presently manufactures the item as one of their principal products.

C. System Requirements:
   1. Full and complete coverage is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
   2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

A. Make submittal and provide number of copies per Specification Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.

B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, and control system components. Quantities of materials need not be included.

C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.

D. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

E. Testing: Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.

F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.

G. Record Drawings: Submit information listed in Part 3 of these specifications.

1.5 APPLICABLE PUBLICATIONS

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

B. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

C. American National Standard Institute (ANSI):

B40.1-91.....Gauges-Pressure Indicating Dial Type Elastic Element

D. American Society of Agricultural Engineers (ASAE):

S398 .....Sprinkler Testing and Performance Reporting.

E. American Society for Testing and Materials (ASTM):

B61-93.....Steam or Valve Bronze Castings

B62-93.....Composition Bronze or Ounce Metal Castings

D1785-91.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

D2241-89.....Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)

D2287-81.....Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

D2464-91.....Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D2466-90.....Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D2564-94.....Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings

D2855-96.....Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

D3350.....Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

F714.....Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F477-90.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F2164.....Field Leak Testing of Polyethylene Pressure Piping Systems

B209-96.....Aluminum and Aluminum-Alloy Sheet and Plate

F. American Water Works Association (AWWA):

C110-93.....Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids

C111-90.....Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.

C115-94.....Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges

C151-93.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids

C153-94.....Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.

C500-93.....Gate Valves for Water and Sewerage Systems

C504-87.....Rubber Sealed Butterfly Valves

C600-93.....Installation for Ductile-Iron water Mains and Their Appurtenances

C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service

G. Irrigation Association (IA): Technical Resources, Irrigation Best Practices & Standards

H. Manufacturers Standardization Society (MSS):
SP70-90.....Cast Iron gate Valves, Flanged and Thread Ends

I. National Electrical Manufacturers Association (NEMA):
250-85.....Enclosures for Electrical Equipment (1000 Volts Maximum); Revision 1, May 1986

J. National Electric Code: (latest edition 2011)

K. Uniform Plumbing Code: (latest edition)

1.6 RULES AND REGULATIONS

A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.

B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.

C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.7 DEMOLITION

A. Remove/salvage existing irrigation components as indicated on the drawings. Remove items in a manner that minimizes damage to components. Deliver only salvageable components to Cemetery. Properly dispose of other removed items.

B. Abandon existing irrigation pipe in place. If existing pipe is encountered during installation of new irrigation pipe, cut and remove two (2) feet of existing irrigation pipe on either side of the new irrigation pipe. Properly dispose of removed pipe.

1.8 AVAILABILITY AND USE OF UTILITY SERVICES

A. The government shall make NO utilities available to the Contractor from existing outlets and supplies. Upon completion of the irrigation system or completion of portions thereof, water will be available for flushing and testing of the new irrigation system. The contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.

B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer Representative, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.9 TESTING

A. Notify the Contracting Officer Representative five working days in advance of testing.

B. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.

C. Subsections of mainline pipe may be tested independently, subject to the review of the Contracting Officer Representative.

D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.

E. Volumetric Leakage Test – Gasketed Mainline Pipe:
   1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
   2. Purge all air from the pipeline before test.
   3. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
   4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
   5. Testing pump must provide a continuous 140-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.
   6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
   7. The amount of additional water pumped in during the test must not exceed:
      a. 0.96 gallons per 100 joints of 3-inch diameter pipe
      b. 1.28 gallons per 100 joints of 4-inch diameter pipe
   8. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
   9. Cement or caulking to seal leaks is prohibited.
   10. Contractor may sub-contract testing to pipeline testing company approved by Contracting Officer Representative.

F. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:
   1. Subject pipe to a hydrostatic pressure equal to the anticipated operating pressure of 90 PSI for 30 minutes.
   2. Cap all sprinkler risers.
   3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
   4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
   5. As an alternative to the visual inspection described in Item 4. above, the Contracting Officer Representative may request that a pressure drop test be performed:
      a. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.

b. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.

c. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.

6. Cement or caulking to seal leaks is prohibited.

7. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

G. Operational Test –Remote Control Valves, Lateral Piping and Sprinklers:

1. Activate each remote control valve in sequence from each controller using the remote control valve. Manual operation of the valves is not an acceptable method of activation. The Contracting Officer Representative will visually observe operation, water application patterns, and leakage.

2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.

3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.

4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.

5. Repeat test(s) until each lateral pass all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

H. Distribution Uniformity (DU):

1. Irrigation Audits

a. Complete an irrigation audit, to include 10 “representative” irrigation zones/test areas.

b. Identify the 10 areas to be tested based on cemetery site conditions in consultation with the cemetery foreman and/or irrigation personnel, irrigation auditor, NCA National Irrigation Specialist and Resident Engineer.

c. Test Area Selection Criteria:

1) Proximity to water source

a) Minimum one audit close to the source
b) Minimum one audit near farthest point of irrigation system from source.

2. Elevation
   a. Minimum one audit near the highest point on the site.
   b. Minimum one audit near the lowest point on the site.
3. Sprinkler Characteristics
   a. Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site;
   b. Minimum of one audit in an area with good sprinkler coverage based on the quality of turf;
   c. Minimum of one audit in an area with poor sprinkler coverage based on the quality of turf.
4. Final determination of the areas to be tested will be based on the recommendation of the Contractor and their understanding of the purpose and goals of performing these irrigation audits with final approval by the NCA National Irrigation Specialist. Submit a map indicating the locations of the zones to be tested.
5. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.
   a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.
      1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.
      2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
      3) If a site is being audited that consistently has winds above 10 mph, then the Contractor and National Irrigation Specialist will determine the best course of action to proceed as to the effect of the wind on the audits.
6. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.

a. Supply all data in a digital (MS Excel format) as well as paper report format to NCA via VA Resident Engineer.
b. Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
c. Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.

7. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the irrigation system is to be audited in its current condition. However, pressure is to be checked at the pressure regulating device on each valve tested by using a schrader valve compatible connection and liquid filled pressure gauge. If there is no pressure regulating valve, the closest sprinkler to the RCV will be checked using a pinot tube and liquid filled pressure gauge.
8. Based on the area being audited, the Contractor shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
9. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
   a. Number of catch cans used
   b. Size of the area tested
   c. Number of sprinklers tested
   d. Site conditions
      1) Spacing shall be consistent and in a square pattern throughout each testing area.
10. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
11. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.
12. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
    a. Rotor type sprinklers – a minimum of 10 minute run time and a maximum of a 30 minute run time;

b. Spray type sprinklers (pop ups) – a minimum of 5 minute run times and a maximum of 10 minute run times;
c. Rotary/stream type sprinklers – a minimum of 20 minute run time and a maximum of 60 minute run time.

13. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
14. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
    a. Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
    b. No flow meter information provided
    c. Reason – no flow meter present on site
    d. Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
15. On a copy of the irrigation plan accurately (within 1-foot) show the following:
    a. All sprinklers and associated valves for each test area;
        1) Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
        2) All catch cans (numbered per the worksheets) and associated data collected.
16. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location audited along with associated worksheets filled out as specified above.
17. If any conclusions can be drawn based on the area tested, distribution uniformity or precipitation rate, they should be explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.
18. Submit Entire audit report to Resident Engineer within 10 working days of the completed field work.

I. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each controller pedestal door and via a written report. Documentation should include satellite name or number, date of test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the Contracting Officer Representative.

J. Acceptance Test Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
2. Request approval to begin Acceptance Test from Contracting Officer Representative 5 days prior to testing.
3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from Contracting Officer Representative. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. If the fault is found to be due to factors outside of the contractor’s control (for example, mainline pipe break in area not being renovated) the evaluation period will continue. The time required to make the repair shall not be included in the evaluation period.

5. When the system has operated for 14 days without fault, contact the Contracting Officer Representative to schedule Final Inspection. Substantial completion consideration is only given after the 14 day test has been accepted.

1.10 CONSTRUCTION REVIEWS

A. The purpose of on-site reviews by the Contracting Officer Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.

1. Schedule reviews for irrigation system layout or testing with the Contracting Officer Representative as required by these specifications.
2. Impromptu reviews may occur at any time during the project.
3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.11 GUARANTEE/WARRANTY AND REPLACEMENT

A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.

B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Inspection by Contracting Officer Representative. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from Contracting Officer Representative.

C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.

D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

A. Coordinate construction of irrigation system with Contracting Officer Representative. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.

B. Install irrigation components in landscaped areas only.

C. Construction cannot proceed unless staking of irrigation mainline, isolation gate valve locations, quick coupling valve locations, remote control valve locations, sprinkler, and controller locations are reviewed and accepted by the Contracting Officer Representative.

D. Protection of Existing Monumentation and Gravesites: Contractor is responsible for staking location of piping in burial sections. Contractor and Contracting Officer Representative to document condition of existing monumentation prior to construction in each burial section. Protect existing monumentation using plywood or tarps erected between the trench and monumentation during construction. Upon completion of construction in each burial section, Contractor and Contracting Officer Representative to verify condition of monumentation. If existing monumentation has been disturbed or damaged during construction, Contractor must correct, repair or pay for the replacement of monumentation before finishing construction in the affected burial section.

PART 2 - PART 2 - MATERIALS

2.1 QUALITY

A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

A. Unless noted otherwise, use specified equipment. Contracting Officer Representative must approve equipment prior to construction. The Contactor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor’s.

B. Pipe sizes and pressure ratings referenced in the construction documents are a minimum and may be increased at Contractor’s option.

2.3 SLEEVING

A. Provide sleeve beneath hardscape for irrigation pipe and wiring. Provide separate sleeve beneath hardscape for wiring.

B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.

C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.

D. Size sleeves are as shown on the drawings. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

A. Mainline Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use solvent weld pipe equipped with factory installed reinforced gaskets for mainline pipe. Acceptable manufacturer for sch 40 PVC fittings is Spears or approved equal.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters not manufactured in Class 160.

3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
2. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 MAINLINE COMPONENTS

A. Backflow Preventer:

1. Backflow Preventer: Use a reduced pressure principal backflow prevention device, ductile iron valve body with fusion epoxy coating, bronze relief valve and trim, stainless steel springs, OS&Y and NRS shut-offs and rated for maximum 175 PSI working pressure. Valve setter to be compatible with backflow preventer. Acceptable manufacturer and model is Febco 880V, Wilkins 475 Series or approved equal.
2. Enclosure:
   a. Provide an insulated aluminum enclosure sized to house all components. Enclosure must open in such a manner to allow access to all components for maintenance. Enclosure must have marine grade aluminum alloy construction, 100% stainless steel hardware, flush-mounted locking mechanism and include all mounting hardware. Acceptable manufacturer is Hot Box, Safe-T-Cover, V.I.T. Products or approved equal.

B. Winterization Assembly:

1. As presented in the installation details.
2. Ball Valve: Use threaded carbon steel ball valve.
3. Valve Box: Use plastic (ABS) jumbo valve box with black lid and extension. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Master Valve Assembly:

1. As presented in the installation details.
2. Use a flanged, 150 ANSI, normally open, cast iron, 24 VAC, slow closing, solenoid activated control valve with Buna-N disc, stainless steel stem, nut and bronze disc guide seat. Acceptable manufacturer is Cla-Val, Griswold or approved equal.
3. Valve Box: Use plastic (ABS) jumbo valve box with black lid and extension. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

D. Flow Sensor Assembly:

1. As presented in the installation details.
2. Use insert style sensor as recommended by the control system manufacturer.
3. Valve Box: Use plastic (ABS) jumbo valve box with black lid and extension. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

E. Manual Drain Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure and mechanical joint ends meeting AWWA Standard C509. Acceptable manufacturers are NIBCO, Clow, Kennedy, Mueller or approved equal.
3. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

F. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure and mechanical joint ends meeting AWWA Standard C509. Acceptable manufacturers are NIBCO, Clow, Kennedy, Mueller or approved equal.

3. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

G. Air-Vacuum Relief Valve Assembly:

1. As presented in the installation details.
2. Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 2 PSI to 230 PSI. Use a continuous acting combination air and vacuum and air release valve. Acceptable manufacturer is Bermad, Crispin, Fresno, Waterman or approved equal.
3. Bronze Ball Valve: Use a valve rated to 235 PSI. Acceptable manufacturer is Nibco or approved equal.
4. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
5. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

H. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking vinyl cover. Acceptable manufacturer and model is Hunter HQ-5LRC, Rain Bird 5-LRC, Toro 474-44 or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco, Rain Bird or approved equal.
4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor or swing joint integrated anchor. Acceptable manufacturers are Harco, Lasco, Spears, or approved equal.
5. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

I. Flower Water Station Connection:

1. As presented in the installation details.

2. Curb Stop Valve: Brass body, 300 PSI minimum working pressure, ASTM-B-62, 1-inch female threaded connections with stop and waste feature. Acceptable manufacturer is Ford, Mueller, A.Y. McDonald or approved equal.
3. Pressure Regulator: Use an adjustable, bronze body pressure regulator with integral stainless steel strainer. Spring range 10-125 PSI, 1-inch inlet and outlet. Acceptable manufacturer and model is Apollo Series 36, Watts Model 223, Wilkins Model 600 or approved equal.
4. PVC Pipe: Use Class 200 PVC pipe per mainline specifications.
5. Valve Box: Use plastic (ABS) jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. As presented in the installation details.
2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm will be of nylon reinforced nitrile rubber. The valve will have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve’s internal bleed will prevent flooding of the valve box. The valve will house a fully encapsulated, one-piece solenoid. The solenoid will have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. Use 24 VAC 50/60 Hz solenoid compatible with a conventional 24 VAC voltage control wiring. Valve must have a flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve must open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve will have a self-cleaning stainless steel screen designed for use in dirty water applications. Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. Valve must have an

integral pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture and model are Hunter ICV, Rain Bird PESB, or Toro P-252 or approved equal.

3. Shut-off Valve: Use an angle valve AWWA C135 rated, ductile iron epoxy coated with stainless steel valve mechanism and restraint system. Acceptable manufacturers are Leemco LV212/218 and Harco swivel 90 lateral isolation valve.
4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
5. Valve Box: Use plastic (ABS) large valve box with black lid or combination of standard and round valve boxes with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
7. Install assembly over gravel sump as presented in the installation details.
8. Wire connectors: Use 3M DBR/Y-6.
9. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

B. Pop-Up Rotor Sprinkler Assembly:

1. As presented in the installation details.
2. Rotary Sprinkler: Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish part circle sprinklers with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Nozzle must be tested per ASAE S398.1 and be verified to deliver Distribution Uniformity of 80% or more and a Scheduling Coefficient of 1.2 or less at the specified offset spacing. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10 feet of elevation. Minimum pop-up height is 3 ½-inches. Acceptable manufacturer and model are Hunter I-25, Rain Bird 8005, Toro T7P-02 or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Lasco, Rain Bird, Spears or approved equal.

C. Pop-Up Spray Sprinkler Assembly:

1. As presented in the installation details.

2. Spray Sprinkler: Use a spray sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish sprinkler with pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Hunter Institutional Series, Rain Bird 1800-SAM-PRS, Toro 570Z-COM or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint with ½-inch inlet. Acceptable manufacturer is Spears, Lasco or approved equal.

2.7 CONTROL SYSTEM COMPONENTS

A. Control Units:

1. As presented in the drawings and installation details.
2. Basic Capabilities:
   a. 100% solid state electrical components with heavy duty, additional, surge protection for input and output circuits.
   b. Large capacity terminal block.
   c. 24 VAC transformer capable of operating nine solenoids simultaneously.
   d. Surge protection backed by 3-year lightning warranty.
   e. Battery backup of at least 14 days.
   f. Remote activation of each station from hand held radio.
   g. Minimum number of stations as shown on the drawings.
   h. Wall mounted stainless steel enclosure.
   i. Compatible with a master valve and flow sensor.
3. Acceptable manufacturer and model is Hydro Point ET-Pro3, Rain Bird ESP-LXMEF, Rain Master RME-Eagle or approved equal.
4. Rain Sensor: Compatible with controller. Use Mini-Clik or approved equal.
5. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
6. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
7. Lightning protection: Provide one 12″x36″x0.0625″ ground plate, one 5/8″x10 foot copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, two

6-inch plastic round valve boxes, and one CADWELD connector at each satellite or satellite controller group.

B. Controller Wire:

1. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
2. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of active control wire. Wire color shall be continuous over its entire length.
3. Splices: Use 3M DBR/Y-6 splices as recommended by control system manufacturer.
4. Valve Box: Use plastic (ABS) standard rectangular valve with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
5. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

2.8 OTHER COMPONENTS

A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.

B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Contracting Officer Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

B. Utility Locates ("Call Before You Dig"):
1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the Contracting Officer Representative one week in advance of review. The Contracting Officer Representative will identify modifications during this review.

3.2 LAYOUT OF WORK

A. Stake locations of sprinklers in existing burial sections. Use alleys as identified on the drawings.

B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.

C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer Representative.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.

B. Existing Survey Markers:
1. Protect markers during construction.
2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.

C. Existing Monumentation and Gravesites: At no time shall soil be allowed to pile on or around the existing gravesites and

monumentation. Use a tarp when excavation trenches in burial sections. Trenches in burial sections may not be open longer than 24 hours. Backfill material spoils must be removed immediately and not allowed to remain in burial sections after backfill is complete. Sod to be installed over all trenches within 4 days of trench backfill.

D. Minimum cover:
   1. 24-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
   2. 18-inches over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
   3. 22- to 28-inches over irrigation lateral pipe to sprinklers in preplaced crypt field. Lateral pipe must be installed 4-inches below crypt lid.
   4. 24-inches over low voltage control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
   5. 6-inches vertical separation between mainline pipe and lateral pipe installed in a common trench.
   6. 4-inch minimum horizontal separation between pipes and wiring in a common trench.
   7. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.

E. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer Representative.

F. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.

G. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the Contracting Officer Representative.

H. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

I. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:

1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.

J. Backfill mainline, lateral pipe and wiring in turf areas in the following manner:
   1. Backfill the trench and directional boring excavations by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.

K. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves where it is not installed using horizontal boring techniques.

L. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer Representative.

M. Resod all trenches and areas disturbed by construction of the irrigation system.

N. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer Representative for trench depth adjustments.

3.4 SLEEVING AND BORING

A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.

B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.

C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe are a minimum of twice the diameter of the pipe.

D. Directional boring slurry to be diposed of legally off site by the contractor.

3.5 ASSEMBLING PIPE AND FITTINGS

A. General:
   1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
   2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"

B. PVC Mainline Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:

a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

b. Ductile iron fittings will not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.

c. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.

b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
c. Snake pipe from side to side within trench.

2. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
2. PVC Threaded Connections:
a. Use only factory-formed threads. Field-cut threads are not permitted.
b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

E. Joint Restraint Harness:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer’s requirements.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Backflow Preventer:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Connect to irrigation mainline piping.

B. Winterization Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.

3. Brand “WA” in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Master Valve Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “MV” in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Flow Sensor Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “FS” in 2-inch high by 3/16-inch deep letters on valve box lid.

E. Manual Drain Valve Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “DV” in 2-inch high by 3/16-inch deep letters on valve box lid.

F. Isolation Gate Valve Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “GV” in 2-inch high by 3/16-inch deep letters on valve box lid.

G. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “AV” in 2-inch high by 3/16-inch deep letters on valve box lid.

H. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “QC” in 2-inch high by 3/16-inch deep letters on valve box lid.

I. Flower Water Station Connection:

1. As presented in the installation details, per manufacturer’s instructions.
2. Install where indicated in the irrigation plans.
3. Brand “FW” in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Mainline Pipe Flushing:

1. Thoroughly flush mainline before installation of Remote Control Valve or Valve-in-Head Sprinkler Assemblies.
2. Identify service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
3. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations or erode site.
4. Use a volume of water such that the velocity in the largest pipe flushing to this point is a minimum of 3 FPS.
5. Multiple points may be flushed simultaneously.
6. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
7. Contracting Officer Representative will review the flushing operation and clarity of water before stopping the flushing operation.
8. Disconnect pipe from service tee(s) and install remote control valve(s) or valve-in-head sprinkler(s).

B. Remote Control Valve Assembly:

1. Install per manufacturer's recommendations where indicated on the drawings.
2. Adjust valve to regulate the downstream operating pressure to 50 PSI for pop-up rotary sprinklers and 35 PSI for spray sprinklers.
3. Wire connectors and waterproof sealant will be used to connect low voltage control wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
4. Install only one remote control valve to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas. Group valve boxes together where possible equidistant from the adjacent valve boxes.

5. Attach ID tag with controller station number to control wiring at solenoid.
6. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Pop-Up Rotor Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install rotary sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 2-foot square piece of sod around all rotary sprinklers in areas to be seeded.

D. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install spray sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing pipe and fittings per manufacturer’s recommendations.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Unit:

1. Install control unit at location shown in the construction documents.
2. Install electrical connections per control system manufacturer's recommendations. Electrical connections are to be completed by control system manufacturer’s trained representative.
3. Lightning protection: Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections.
4. Attach wire markers to the ends of low voltage control wire cable inside controller. Label cable with the identification number per irrigation plan.
5. Install permanent receiver for hand held radio if not factory installed.
6. Install rain sensor and complete electrical connections to controller per control units manufacturer’s recommendations.
7. Create and program each new control unit with a “grow-in” and a peak season irrigation program.
8. Provide 8 hours of training for cemetery staff with manufacturer’s qualified representative.

B. Control Wire:

1. Route low voltage control cable in mainline trench.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box or valve-in-head sprinkler.
3. If a cable must be spliced, make splice with waterproof connectors and sealant installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand “WS” in 2-inch high by 3/16-inch deep letters on valve box lid.
4. Unless noted on plans, install wire parallel with and below mainline pipe.
5. Protect wire not installed with pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

3.9 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide two training sessions to operating personnel on proper operation and maintenance of the irrigation system. Training sessions should be for a period of not less than 8-hours each, scheduled on different days and cover aspects of maintaining, operating and repairing the new irrigation system components.
2. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
   a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
   b. Manufacturer’s Operation and Maintenance manuals.
   c. Manufacturer’s Technical Service Bulletins.
   d. Manufacturer’s Warranty Documentation.
   e. Recommended routine maintenance inspections for weekly, monthly and annual inspections, recommended actions for the inspections, recommended method for recording the findings of the inspections and proper winterization techniques.
   f. Predictive schedule for component replacement.
   g. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer Representative. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Create and program controller with a grow-in and a peak season irrigation schedule for the areas being irrigated by the controller.

2. Using the precipitation rate results of the Distribution Uniformity tests calculate the peak season run time for each station.
3. Verify operation of program.
4. Prepare a memorandum documenting the details and assumptions of the programming. Turn over memorandum to Contracting Officer Representative. Completion of the memorandum is a prerequisite for final inspection and operational testing of the irrigation system.

C. Colored Controller Charts:

1. Prepare a map diagram showing location of all valves, piping, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. “As-built” drawings must be approved before charts are prepared. Map diagram can be constructed using AutoCAD or PDF computer software. Adjacent lateral pipes to be of different color, use four different colors for lateral pipe.
2. Include legend listing components used for the controller. Include a separate sprinkler table listing station number, sprinkler manufacturer and model, zone capacity, and number of sprinklers on the zone.
3. Provide one colored full sized controller chart for each irrigation plan sheet showing the area covered by the controller. Provide four 11”x17” reduced colored charts of the actual “as-built” drawing. Chart must be readable at the reduced size.
4. Laminate one 11”x17” sized colored chart and place laminated chart in lid of each controller.

3.11 PROJECT RECORD DRAWINGS

A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, two complete sets of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded on Project Documents.

B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Special attention must be given to pipe routing and controller stationing.

C. At completion of installation, Contractor must hire a Professional Licensed Surveyor to survey/document locations of all sprinklers,

irrigation components enclosed within a valve box, controllers, flower water stations, wire splice boxes and “coordination points”. If necessary, Contractor must flag sprinklers for Surveyor. Surveyor must use “SPR” as attribute data for sprinklers, the branding in the valve box lid (for example “GV”, “AV”, “QC”) as the attribute data for components enclosed within a valve box, “CTLR” as the attribute data for controllers, “FWS” for flower water station, “WS” for wire splice boxes and “CP” for coordination points. Contracting Officer Representative will provide AutoCAD file for Surveyor showing coordination points to produce “Survey Drawing”. Surveyor is to use the AutoCAD files to develop and provide an AutoCAD file and PDF file of the Survey Drawing.

D. Prior to project completion, Contractor must provide the project redline drawings and the “Survey Drawing” AutoCAD files to Contracting Officer Representative for delivery to VA’s A/E representative. A/E will prepare “Record Drawings” by compiling the information on the Contractor redlines drawings and the “Survey Drawing”. Provision of this information prerequisite for Final Inspection.

E. After approval of the record drawings and prior to project completion provide 1 30” X 42” laminated drawing of the entire system for wall mounting, drawing need not be to scale.

3.12 MAINTENANCE

A. Operate and maintain irrigation system for a duration of 30 calendar days from Final acceptance. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

3.13 CLEANUP

A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

- - - END - - -

SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

A. This work consists of preparing all areas indicated on the Drawings for planting and grass sodding according to the specifications and furnishing and installing all plants, sod, fertilizer and soil amendments, and maintenance during establishment period as specified herein.

. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the Contracting Officer's Technical Representative (COR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.

B. Reference: ASPA (American Sod Producers Association) – Guideline Specifications to Sodding

C. Reference: American National Standards Institute (ANSI) Publications:
ANSI Z60.1-04 ..... Nursery Stock
ANSI Z133.1-06 ..... Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements

1.2 EQUIPMENT

Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

A. Section 31 20 11, EARTH MOVING (short form), Stripping Topsoil and Stock Piling

B. Section 31 20 11, EARTH MOVING (short form), Topsoil Materials.

C. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.

D. Section 32 84 00, PLANTING IRRIGATION.

E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 SUBMITTALS

A. Samples: Submit the following samples for approval before work is started:

Organic Mulch	2.3 kg (5 pounds) of each type to be used.
All pesticides required such as preemergence or	EPA approved labeling and MSDS sheet for each such product selected for use.

post emergence herbicides, insecticides, or fungicides.	

B. Pesticides: EPA approved labeling and MSDS sheet for each such product selected for use. Required for all pesticides, including but not limited to preemergence or post emergence herbicides, insecticides, and/or fungicides.
C. Nursery Source List: Within 21 days of contract award, submit a complete list of nursery sources for plants. Plants that do not meet the specified requirements when delivered to the site will be rejected and replaced at the Contractor’s expenses. No substitutions for plant species and/or varieties will be allowed without approval by the Landscape Architect and CO/COR.
D. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the CO/COR for approval:
   1. Plants (Department of Agriculture certification by State Nursery Inspector from the state in which the plants l originate declaring material to be free from insects and disease).
   2. Fertilizers: submit certificates of analysis for each type of fertilizer and tags from bags of fertilizer and/or amendments (if necessary) showing nutrients, percentage of composition, and weight.
   3. Sod
   4. Organic soil amendment: proof of EPA minimum heating requirements for pathogen/ weed seed destruction.
E. Manufacturer's Literature and Data:
   1. Antidesiccant
   2. Erosion control materials
   3. Pre-emergent herbicide
F. Licenses: Licenses of Arborist shall be submitted (one copy), to the COR.
G. See 01 45 29 Testing Laboratory Services for required soil and organic soil amendment tests. Submit results of testing.
   1. Amended soil (in place): Following the incorporation of amendments and additives, the Contractor shall provide a minimum of six (6)samples per forty thousand (40,0000) square feet, six inch (6”) depth by three inch (3”) diameter core samples of amended soil taken from the site for testing, analysis, and approval. The location of each sample shall be as directed by the AE from areas designated to receive turfgrass sod on the Contract Drawings. No sodding or planting operations shall occur until acceptance of the amended soil samples has been obtained. Contractor shall deliver samples to testing laboratories and shall have the testing

report sent directly to the COR. Tests shall be as directed in 01 45 29 Testing Laboratory Services

2. Certificates of conformance/compliance: Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles. Analysis shall include recommendations for quantity and application rate of amendments as corrective measures to adjust permeability/percolation/texture, salts or pH to acceptable levels. Soils analysis tests shall be from an independent soil testing laboratory. Soil samples for testing shall be taken from a minimum of four (4) separate areas as directed by the AE and COR.
3. Furnish the tags from bags of fertilizer and/or amendments used showing nutrients, percentage of composition, and weights upon completion of work.

1.5 DELIVERY AND STORAGE

A. Delivery:

1. Notify the COR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches with a breathable cover. Do not bend, bind, or tie plants in a manner that damages bark, breaks, branches, or destroys the plant’s natural shape. Do not drop ball and burlap plants during delivery. Do not prune prior to delivery..
3. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
4. During delivery: Protect sod from drying..
5. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Storage:

1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
2. Keep seed, lime, and fertilizer in dry storage away from contaminants.

3. Store plants not installed on the day of arrival at the site as follows:
   a. Shade and protect plants from the wind when stored outside.
   b. Heel in bare root plants.
   c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.
   d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

A. Perform landscape planting operations within the following dates: From March 1 to June 30 for spring and from September 1 to November 15 for fall unless otherwise approved by Landscape Architect, but not before irrigation system installed, tested, and approved.

B. Perform turfgrass sod installation operations when the soil is not frozen.

C. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting dates or conditions. Submit a written request to the COR stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

A. The Establishment Period for landscape plants and turfgrass shall begin immediately after installation, with the approval of the COR and continue for a period of time during the growing season sufficiently long (a minimum of 30 days) for the turfgrass and landscape plant materials to achieve an establishment condition and appearance satisfactory to the MSN Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free and Landscape Plant Materials shall be fully rooted, actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant and Turfgrass Establishment Period the Contractor shall:

1. Water all plants and turfgrass to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these

conditions is best determined on site by the MSN Agronomist in consultation with the Project Engineer.

2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COR in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
   a. Eradicate all weeds. Water, fertilize, sod, and perform any other operation necessary to promote the growth of turfgrass.
   b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses mow at heights as appropriate for species and cultivar as directed by the COR in consultation with the MSN Agronomist. Final mowing height is 65 mm (3.0 inch) for cool season turfgrasses and as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing.
7. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
8. Replant any areas void of turfgrass during an active growing season only.
   a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth. Unsatisfactory areas shall be re-sodded within 7 calendar days.

9. Complete remedial measures directed by the COR in consultation with the MSN Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

A. Landscape plant and turfgrass acceptance will occur after completion of the LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the PLANT AND TURFGRASS ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government until work has been satisfactorily completed, inspected and accepted.

B. Criteria for acceptance of landscape plants.
1. Planter beds and earth mound water basins are properly mulched and free of weeds.
2. Tree support stakes, guys, and turnbuckles are in good condition.
3. Total plants on site as required by specifications and required number of replacements have been installed.
4. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

C. Criteria for acceptance of turfgrass shall be as follows:
1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture and well rooted into the soil below so that gentle pulling of the turfgrass leaves by hand does not dislodge the sod. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
2. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT AND TURFGRASS WARRANTY

A. All work shall including the following:
1. A One Year Plant and Turfgrass Warranty will begin on the date that the Government accepts the plants and turfgrass but not before the end of the Landscape Plant and Turfgrass Establishment Period.
2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period and during an active growing season. A one year warranty for the plants and turfgrass that are

replaced will begin on the day the replacement work is completed and accepted.

3. Replacement of relocated plants that the Contractor did not supply is not required unless they die from improper handling and care during transplanting. Loss through Contractor improper handling, care, or negligence requires replacement in kind and size.
4. The Government will reinspect all replacement plants and turfgrass at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately and during an active growing season. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.
5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year, unless otherwise directed by the COR in consultation with the MSN Agronomist.

1.10 APPLICABLE PUBLICATIONS

A. NCA Handbook 3420 – Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor’s official reference guide to all establishment and preliminary maintenance practices employed during this construction project.

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

C. American National Standards Institute (ANSI) Publications:

ANSI Z60.1-04 ..... Nursery Stock
ANSI Z133.1-06 ..... Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements

D. Hortus Third, most current edition. A Concise Dictionary of Plants Cultivated in the U.S. and Canada.

E. American Society for Testing and Materials (ASTM) Publications:

C136-06 ..... Sieve Analysis of Fine and Coarse Aggregates
C516-08 ..... Vermiculite Loose Fill Thermal Insulation
C549-06 ..... Perlite Loose Fill Insulation
D977-05 ..... Emulsified Asphalt (AASTHO M140)
D1557-09 ..... Test Methods for Laboratory Compaction of Soil
D2028-97 (Rev. 2004) ... Cutback Asphalt (Rapid-curing Type)
D2103-08 ..... Polyethylene Film and Sheeting

D5851 (Rev 2006) ..... Planning and Implementing a Water Monitoring Program

F. Turfgrass Producers International:Turfgrass Sodding.

G. U. S. Department of Agriculture Federal Seed Act. Amended July 2011 ..... Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turfgrass material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 ORGANIC SOIL AMENDMENT

A. All areas to receive turfgrass seeding, or sodding may require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.

B. Organic soil amendment will be spread and incorporated into the finished subgrade at the depths indicated on the Contract Drawings in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.

1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1″) screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.
2. Acceptable types of Organic Soil Amendments include peat moss, humus or peat, well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges

Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-152 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Soluble Salts	< 6 Ds/m (mmhos/cm)
Water-Holding Capacity	152-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Provide tests of Organic Soil Amendment to demonstrate compliance with the parameters listed above and per requirements of 01 45 29 Testing Laboratory Services.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the COR/MSN Agronomist.

2.3 PLANTS

A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.

B. Balled and burlapped stock:
   1. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting. No soil is to be heaped on the top of plant root flares. Any plants delivered with such heaped soil over the root flare will have the soil removed before planting. If the root ball depth does not satisfy ANSI Z60.1 requirements after soil is removed, the plant will be rejected.
   2. Plants wrapped in inorganic burlap will be rejected from the job site.

C. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project.

D. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the COR, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

E. Provide nursery grown, Grade 1, plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.

F. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.

G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.

H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the COR in consultation with the MSN Agronomist authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 LABELS

Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.5 TOPSOIL

A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 6.0 nor more than 7.0, and should be best suited to the region, climate and plant material specific to the project.

B. Obtain material from stockpiles established under Section 31 20 11, EARTH MOVING, subparagraph, Stripping Topsoil that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters. Refer to 2.2 for organic content requirements and amendments.

C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the COR of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.6 SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 90 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve. Moisture is not to exceed 10%.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

F. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm. (.004in. and .59in.).
   1. Pine bark shall be aged sufficiently to break down all woody material. Pine bark shall be screened
   2. pH shall range between 4.0 and 7.0.
   3. Submit manufacturer’s literature for approval.

G. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.9 PLANT FERTILIZERS

A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.

B. For new plant material, provide a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.

C. For existing trees, provide a uniform free-flowing granular fertilizer bearing the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea.), 10% available phosphoric acid, and 10% potash.

2.10 TURFGRASS FERTILIZER

Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash. Liquid starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.11 MULCH

A. Mulch: Shredded hardwood tree bark, composted minimum one year, with shredding to produce an approved size ranging from fines to 2” with 50% over ¾”; pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; not exceeding 0.5 percent inert contaminants and free of twigs, limbs, wood shaving, saw dust, and foreign or toxic substances. Salinity to be less than 6 dS/m (mmhos/cm).

B. Mulch shall be stored as to prevent inclusion of foreign material.

2.12 EROSION CONTROL

A. Erosion control net material shall be Type A heavy, twisted jute mesh (65% open).All erosion control material is to be installed according to the manufacturer's recommendations.

2.13 STAKES AND GUYING STRAPS

A. Tree Staking Materials:

1. Staking and guying is Contractor’s option and is not required as part of this scope of work.
2. Stakes: 2″ hardwood free of defects that would impair strength.
3. Guying material shall be ¾″ flat woven polypropylene strap with 900 lb. break strength such as DeepRoot Arbor Tie (1-800-458-7668) or approved equal, black color.

2.14 WATER

Water shall not contain elements toxic to plant life. It shall be obtained // from site irrigation as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services at no cost to the Contractor

2.15 ANTIDESICCANT

Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.16 SOD

A. Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding. Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B.Sod composition shall match the existing turfgrass at the Cemetery: Fescue Blend: 33% FALCAN IV; 33% FALCAN TALL FRSCUE; 33% SHENANDOAD SPORT TALL FESCUE. 33% supplied by TRINITY Turf, inc, 3232 lee Highway, Weyers cave, VA 24486 or approved equal.

C. Sod composition shall **be approved in writing by the appropriate MSN Agronomist in coordination with the COR.**

2.17 HERBICIDES AND OTHER PESTICIDES

All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

PART 3 – EXECUTION

3.1 LAYOUT

Stake plant locations on project site for approval by the COR before any plant pits are dug. The COR may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION FOR TREE/PLANT PITS

A. Prior to excavating for plant pits, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.

B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the CO/COR may select other locations for plant material.

C. Do not use an auger or tree spade for planting pit excavation. Hand digging, machine digging, or other methods that create a plant pit with rough, loose sides are acceptable. Pits with smooth, hard sides are not acceptable.

D. Loosen plant pit subgrade to a depth of six inches with a prybar or shovel. Do not till.

E. Fill plant pits with water and allow to percolate before planting. Where pits will not drain in 24 hours and will affect the health of the plant, notify the Landscape Architect. Landscape Architect may direct relocation of the plant or recommend an underdrain connected to an outfall to provide positive drainage. If underdrains are needed an adjustment will be made to the contract amount.

3.3 SETTING PLANTS

A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants so that the root flare is 2″ higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil.

B. For balled and burlapped plants, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from

under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

D. Backfill balled and burlapped and container-grown plants with the soil removed from the planting hole to approximately half the depth of the ball and then tamp and water. It is desirable to use 100% percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material.

3.4 TREE STAKING

A. Tree staking is optional. Staking of trees is not required as part of the Scope of Work, and if performed will be at no additional cost. Should Contractor elect to perform staking, the methods and material will be as detailed on the Drawings as approved by the Landscape Architect. All trees to be set plumb for Final Acceptance. Do not use and install tree wrappings on trunks. All stakes and guy straps are to be removed after 1 year.

3.5 WATERING BAGS FOR TREES

A. Install per manufacturer’s directions. Refill with water once per week or as needed for plant establishment.

B. Watering bags to be left on trees for Final Acceptance.

3.6 MULCHING PLANTS

A. Mulch within 48 hours after planting to depths indicated on plans and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.

B. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.7 PRUNING

A. Prune new plants and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove the leader. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.

B. Existing trees to be pruned are shown on the drawings. Perform tree pruning and cavity work by a licensed arborist an arborist in accordance with ANSI Z 133.1. Remove dead wood 13 mm (1/2 inch) or more in diameter, branches interfering with or hindering the healthy growth of the trees, and diseased branches with a clean cut made flush with the branch collar. Cut back or remove branches as necessary to give the trees proper shape and balance. In

removing large limbs, make the initial cut on the underside at a safe distance from the trunk or lateral, to prevent ripping of bark. Ensure branches and trimmings do not endanger traffic or cause damage to property during removal. Section large branches or limbs that cannot be removed in one piece without endangering traffic or property. Lower sections by ropes. Repair any damage resulting from the Contractor's negligence during pruning. Workmen are not permitted to climb trees with climbing spurs. To promote proper healing, cut off flush with the branch collar stubs or limbs that have resulted from improper cuts or broken as a result of former pruning. Remove girdling roots.

3.8 TILLAGE FOR TURFGRASS AREAS

Thoroughly till the subsoil to a depth of at least 152 mm (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used. Remove all debris and stones larger than 25 mm (one inch) remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a 50 mm (one inch) depth and remove debris and stones. **Do not till in tree protection zones.**

3.9 FINISH GRADING

Refer to Specification Section 31 20 11 Earth Moving (short form) for finish grading requirements

3.10 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

A. Spread lime or other soil amendments as recommended by the soil test results.
B. Incorporate soil amendments into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation.
C. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft.
D. Starter fertilizer should be lightly mixed with the top ½ inch of soil.
E. Immediately restore the soil to an even condition before any seeding or sod placement.

3.11 SODDING

A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.
B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area. All sod should be rolled with a light-weight roller after being laid to eliminate air spaces between the sod and the firmed soil.

3.12 WATERING

A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 50 mm (2 inches). Supervise watering operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations. Keep soil surface constantly moist, not wet, until turfgrass plants are well established.

B. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the CO/COR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.13 PROTECTION OF TURFGRASS AREAS

Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.14 EROSION CONTROL MATERIAL

A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations lay the material evenly and smoothly and in contact with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.

C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.

D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 1200 mm (4 feet) longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 300 mm (one foot) intervals at the end. Firmly embed staples in the underlying soil.

E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Warranty Period.

3.15 RESTORATION AND CLEAN-UP

Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one

paved vehicular access route to each building clean at all times. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.16 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

--END--

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section shall address materials and installation for storm drain piping and conveyance systems that will carry flow from the crypt underdrains to the storm drainage system.

B. Section Includes:

1. Drainage pipe.
2. Nonpressure transition couplings.
3. Storm drainage structures.

1.2 DEFINITIONS

A. HDPE: High density polyethylene plastic.

1.3 SUBMITTALS

A. See Section 01 33 23 – Submittal Procedures.

B. Product Data for the following:

1. N-12 HDPE pipe.
2. Fused HDPE pipe.
3. Nonpressure transition couplings.
4. Storm drainage structures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store pipe and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle storm drainage structures according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 HDPE PIPE

A. N-12 HDPEPiping:

1. 10″ N-12 HDPE pipe meeting ASTM F 2468. Pipe shall have smooth interior and corrugated exterior walls and display

soil tight properties suitable for non-pressure applications.

B. Fused HDPE piping:

2. 10″ HDPE pipe meeting ASTM D 3350-08. Pipe shall have smooth interior and exterior walls.

2.2 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 TORM DRAINAGE STRUCTURES

A. Pre-cast concrete structures:

1. Pre-cast concrete drainage structures with frame and manhole cover in accordance with Virginia Department of Transportation specifications.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 20 11 "Earth Moving (short form)."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install N-12 HDPE storm drain piping in accordance with ASTM D 2321 and manufacturer’s recommendations.
3. Install fused HDPE piping in accordance with ASTM D 2321 and manufacturer’s recommendations.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join fused HDPE piping according to ASTM D 1290 using electrofusion methodology.
2. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 STORM DRAINAGE STRUCTURES

A. Install storm drainage structures in accordance with the Virginia Department of Transportation specifications.

3.6 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

- - - E N D - - -

SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall address materials and installation requirements for subsurface drainage systems that will serve as underdrains beneath the pre-placed crypts.

1.2 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.3 SUBMITTALS

A. See Section 013323 – Submittal Procedures

B. Product Data for the following:
   1. Perforated-wall pipe and fittings.
   2. Solid-wall pipe and fittings.
   3. Geotextile filter fabrics.
   4. Cleanout and cover.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

2.2 PIPING MATERIALS

A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated SDR 21 Pipe and Fittings:
   1. 4″, 6″, and 8″ perforated pipe meeting ASTM D 2672 with 2 rows of holes,120 degrees apart. Holes are 0.50 inches in diameter and 0.120 inches in width with a minimum inlet area of 1 square inch/foot.
   2. Couplings: Manufacturer’s standard push-on bell and spigot meeting ASTM D 2672.

2.4 SOLID-WALL PIPES AND FITTINGS

A. Solid-wall SDR 21 Pipe and Fittings:
   1. ″, 6″, and 8″ solid wall pipe meeting ASTM D 2672.
   2. Couplings: Manufacturer’s standard push-on bell and spigot meeting ASTM D 2672.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

2.6 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section 31 20 11 "Earth Moving (short form)."

2.7 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
   1. Structure Type: Nonwoven, needle-punched continuous filament.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

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

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 20 11 "Earth Moving (short form)."

3.3 PIPING APPLICATIONS

A. Underdrain Subdrainage Piping:
   1. Perforated SDR 21 pipe and fittings, with push-on bell and spigot joints within the stone bed.

3.4 CLEANOUT APPLICATIONS

A. In lawn areas within crypt fields to underdrain connection:
   1. At Grade: Cast Iron cleanouts.

3.5 UNDERDRAIN SUBDRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

C. Install drainage piping as indicated in Part 3 "Piping Installation" Article for subdrainage.

D. Add drainage course to full width of 12 inches and to top of pipe to perform tests.

E. After satisfactory testing, cover drainage piping with drainage course above top of pipe to top of trench.

F. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

3.6 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install couplings according to manufacturer's written instructions and other requirements indicated.
   1. Underdrain Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
   2. Lay perforated pipe with perforations down.
   3. Excavate recesses in trench bottom for fittings. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install SDR 21 piping according to ASTM D 2774 and ASTM F 1668.

3.7 PIPE JOINT CONSTRUCTION

A. Join solid wall SDR 21 pipe and fittings according to ASTM D 2774.

B. Join perforated SDR 21 pipe and fittings according to ASTM ASTM D 2774.

3.8 CLEANOUT INSTALLATION

A. Cleanouts for Subdrainage:
   1. Install cleanouts from piping to grade. Locate cleanouts as shown. Install fittings so cleanouts open in direction of flow in piping.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.10 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, perform testing using the low pressure air test method conforming to ASTM C 828 before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.11 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

-----END-----

APPENDIX A
REPORT OF GEOTECHNICAL STUDY

FROEHLING & ROBERTSON, INC.

Report of Geotechnical Study

Culpeper National Cemetery
305 US Avenue
Culpeper, Virginia
F&R Project No. 74S-0126r1

Prepared For:

KCI Engineering of New York, PC
255 East Avenue
Suite 302
Rochester, New York 14604

Prepared By:
Froehling & Robertson, Inc.
10909 Houser Drive
Fredericksburg, Virginia 22408

December 22, 2014 (revised July 15, 2015)

SINCE
1881

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881

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Fredericksburg, Virginia 22408
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F&R Project No. 74S-0126 December 22, 2014 (revised July 15, 2015)

Mr. Brian Morgan
KCI Engineering of New York, PC
255 East Avenue
Suite 302
Rochester, New York 14604

Reference: Culpeper National Cemetery
305 US Avenue
Culpeper, Virginia

Dear Mr. Morgan:

The purpose of this revised report is to present the final results of the subsurface exploration program and geotechnical engineering evaluation undertaken by Froehling & Robertson, Inc. (F&R) in connection with the Culpeper National Cemetery in Culpeper, Virginia. Our services were performed in general accordance with F&R Proposal No. 1574-00073 dated July 24, 2014 as authorized by you. The attached report presents our understanding of the project, reviews our exploration procedures, describes existing site and general subsurface conditions, and presents our geotechnical evaluations and recommendations.

We have enjoyed working with you on this project, and we are prepared to assist you with the recommended quality assurance monitoring and testing services during construction. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

Jolie A. Erickson, E.I.T.
Staff Engineer

Caleb M. Lange, P.E.
Geotechnical Engineer

Reviewed by: Donald J. Sipher, P.E.
Senior Geotechnical Engineer

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ASFE Document “Important Information about Your Geotechnical Engineering Report”

EXECUTIVE SUMMARY

This Executive Summary is provided as a brief overview of our geotechnical engineering evaluation for the project and is not intended to replace more detailed information contained elsewhere in this report. As an overview, this summary inherently omits details that could be very important to the proper application of the provided geotechnical design recommendations. This report should be read in its entirety prior to implementation into design and construction

- The site was explored by four soil test borings performed on November 19, 2014. Site subsurface conditions generally consist of surficial soils underlain by residual soils.
- We recommend that a maximum allowable bearing pressure of 1,500 pounds per square foot (psf) be used for support of any structures.
- Subsurface water was not encountered at any of the borings performed for this subsurface exploration.
- Auger refusal was not encountered within any of the borings performed at the site.

1.0 PURPOSE & SCOPE OF SERVICES

The purpose of the subsurface exploration and geotechnical engineering evaluation was to explore the subsurface conditions in the area of the new crypt field at Culpeper National Cemetery and provide geotechnical engineering design and construction recommendations.

F&R's scope of services included the following:

- Completion of four soil test borings to a depth of 15 feet below the existing ground surface;
- Perform infiltration testing at each of the four locations to a depth of 7 feet below the existing ground surface;
- Preparation of typed Boring Logs;
- Performing a geotechnical engineering evaluation of the subsurface conditions with regard to their suitability for excavation and grading purposes;
- Preparation of this geotechnical report.

Our scope of services did not include a survey of the boring location, quantity estimates, preparation of plans or specifications, or the identification and evaluation of wetland or other environmental aspects of the project site.

2.0 PROJECT INFORMATION

2.1 Site Description

Culpeper National Cemetery is located at 305 US Avenue in Culpeper, Virginia (Drawing 1, Appendix I). The project site consists of a landscaped, grassy area on the west side of the south section of the existing cemetery. The site topography generally slopes down from east to west.

2.2 Proposed Construction

Project information was provided by email and phone and included the design proposal dated May 23, 2014. We understand the geotechnical exploration is to be performed in support of the design required for the 3,000 pre-placed crypt conversion for Culpeper National Cemetery in Culpeper, Virginia. The plan for development includes burial crypt field installation within a 2½ acre area inside the cemetery.

Construction will include grading of the site as necessary for crypt installation and surrounding surface drainage. Subsurface information presented herein includes soil types, soil drainage capability, soil expansive qualities, and suitability of excavated onsite soil for reuse as fill.

3.0 EXPLORATION PROCEDURES

3.1 Subsurface Exploration

The exploration program was performed on November 19, 2014 and consisted of four soil test borings designated B-1 through B-4. The borings were drilled to a depth of 15 feet below existing site grades. The boring locations were provided by the client and staked in the field by F&R personnel by measuring from existing site features as the provided plan indicated. The approximate locations of the borings are shown on the attached boring location plan (Drawing No. 2, Appendix I). In consideration of the methods used in their determination, the boring locations shown on the attached boring location plan should be considered approximate.

The soil test borings were performed in accordance with generally accepted practice using a truck-mounted CME-55 rotary drill rig, equipped with an automatic hammer. Hollow-stem augers were advanced to pre-selected depths, the center plug was removed, and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. For these tests, a weight of 140 pounds is freely dropped from a height of 30 inches to drive the split-spoon sampler into the soil. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the last two increments are summed to obtain the Standard Penetration Resistance (N-value). The N-value provides a general indication of in-situ soil conditions and has been correlated with certain engineering properties of soils.

An automatic hammer was used to perform the Standard Penetration Test (SPT) on this project. Research has shown that the Standard Penetration Resistance (N-value) determined by an automatic hammer is different than the N-value determined by the safety hammer method. Most correlations that are published in the technical literature are based on the N-value determined by the safety hammer method. This is commonly termed N_{60} as the rope and cathead with a safety hammer delivers about 60 percent of the theoretical energy delivered by a 140-pound hammer freely falling 30 inches. Several researchers have proposed correction factors for the use of hammers other than the safety hammer to correct the values to be equivalent to the safety hammer SPT N_{60}-values. The correction is made using the following equation:

$$N_{60} = N_{field} \times C_E$$

N_{field} is the value recorded in the field and C_E is the energy ratio for the hammer utilized in the field. The guidelines provided in the Performance and Use of the Standard Penetration Test in Geotechnical Engineering Practice manual, published by the Center for Geotechnical Practice and Research at the Virginia Polytechnic Institute and State University, recommend that a correction

factor (C_E) be used to covert N_{field} values to N_{60} values, when using an automatic hammer. The N-values reported on the boring logs included in this report are the actual, uncorrected, field derived values (N_{field}). It is recommended that corrected N_{60} values be used for engineering analysis. We recommend that a correction factor (C_E) of 1.47 be used to convert N_{field} values to N_{60} values for the particular machine used for this investigation.

Prior to demobilization, the boreholes were backfilled with auger cuttings. Periodic observation of the backfilled boring should be performed, as the boring backfill could settle over time resulting in subsidence of the ground around the borehole.

Representative portions of the split-spoon and bulk soil samples collected throughout the exploration program were placed in glass jars and bags, respectively, and were transported to our laboratory. In the laboratory, the soil samples were evaluated by a member of our engineering staff, in general accordance with techniques outlined in the visual-manual identification procedure (ASTM D 2488). The soil descriptions and classifications discussed in this report and shown on the attached boring logs are based on visual observation and should be considered approximate. Copies of the boring logs, as well as classification procedures, are provided in Appendix II.

Soil samples recovered from this project will be stored at F&R's office for a period of 60 days. The samples will be discarded after 60 days, unless prior notification is provided to us in writing.

3.2 Laboratory Testing

Our proposal included laboratory testing to aid in identifying and evaluating soils that may affect building design or construction. In accordance with our proposal, the following tests were performed on representative soil samples collected during our subsurface exploration.

- 8 Natural Water Content (ASTM D 2216)
- 2 Atterberg Limits (ASTM D 4318)
- 2 Particle Size Distribution (with Hydrometer) (ASTM D 6913)
- 1 Corrosive Test (AASHTO T288), (AASHTO T289), (AASHTO T290), (EPA SM(20)4500Cl-CM)
- 2 pH Tests

The laboratory test results are shown in Section 4.4.

3.3 Infiltration Testing

Water infiltration testing was performed in accordance with generally accepted practices within two feet of each boring location, B-1 through B-4. For the infiltration test, the bore hole was cased with a six-inch PVC pipe, to a depth of seven feet. The PVC pipe was placed vertically in the bore hole, and the annular space was backfilled with in-situ material.

A Geotechnical engineer began infiltration testing after a 24-hour period. Water levels were measured to the nearest sixteenth of an inch. All measurements were recorded and reported as inches per hour.

To begin the testing, the PVC pipe was filled with water and measurements were recorded every 60 minutes. This procedure was then repeated three more times for a total of four one-hour tests. The infiltration rate of underlying soils may be reported either as the average of all four tests or the value of the last test. The infiltration rate is reported as the value of the last test, and the results are listed in Section 4.5.

4.0 REGIONAL GEOLOGY & SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on the Geologic Map of Virginia (1993), the project site lies within the Piedmont Physiographic Province of Virginia. The soils within the project site are mapped as an Upper Triassic-aged (201.3 to 237 million year old) Newark Supergroup formation. The soils within this formation are residual and consist of poorly-sorted non-marine sediments. Conglomerate and greenstone clasts are common, as well as red sandstone beds. Due to significant weathering, the soils are generally identified as silts or clays at upper elevations and gradually transition to more coarse-grained materials as elevations approach the parent bedrock. Our findings are characteristic of the highly weathered parent rock types mapped.

4.2 Subsurface Conditions

4.2.1 General

The subsurface conditions discussed in the following paragraphs and those shown on the attached boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between different soil strata are usually less distinct than those shown on the boring logs. Although individual soil test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other

locations or at other times. Data from the specific soil test borings are shown on the attached boring logs in Appendix II.

Below the existing ground surface, the borings generally encountered residual soils. These materials are generally discussed in the following paragraphs.

4.2.2 Surficial Soils

Surficial soil was encountered at the borings to depths ranging between 2 and 3 inches. Surficial soil is typically a dark-colored soil material containing roots, fibrous matter, and/or other organic components, and is generally unsuitable for engineering purposes. F&R has not performed laboratory testing to determine the organic content or other horticultural properties of the observed surficial soil materials. The term surficial soil is not intended to indicate suitability for landscaping and/or other purposes, but is intended as a general term for typically dark near surface soils that are often observed to contain some degree of organic matter. The surficial soil depths provided in this report are based on driller observations and should be considered approximate. We note that the transition from surficial soil to underlying materials may be gradual, and therefore the observation and measurement of surficial soil depths is subjective. Actual surficial soil depths should be expected to vary across the site.

4.2.3 Residual Soils

Residual soils were encountered beneath the surficial soils, extending to the borings' termination depths. These soils were generally described as SILT or Elastic SILT (ML or MH). The Standard penetration resistance (field N-value) in these fine-grained soils (SILTs) ranged from 5 to 19 blows per foot (bpf) and indicated these soils are firm to very stiff in consistency.

Two borings, B-2 and B-3, encountered a very stiff layer at the deepest part of the borings. The rest of the samples were all consistently in the firm-to-stiff range, with field N-values from 5 to 9 bpf.

4.3 Subsurface Water

The test borings were monitored during and after drilling operations to obtain short-term subsurface water information. Subsurface water was not observed during or immediately after completion of drilling. Cave-in depths were measured to range from as shallow as 9.7 feet at boring B-1 to as deep as 11.0 feet in boring B-4. Cave-in can be indicative of seepage, particularly in sandy soils. Please see the boring logs included in Appendix II for cave-in depths at each boring location. The borings drilled for infiltration testing were observed 24 hours after drilling, prior to infiltration testing, and subsurface water was not observed in the borings at that time.

It should be noted that the location of the subsurface water table could vary by several feet because of seasonal fluctuations in precipitation, evaporation, surface water runoff, local topography, and other factors not immediately apparent at the time of this exploration. Normally, the highest subsurface water levels occur in the late winter and spring and the lowest levels occur in the late summer and fall.

4.4 Laboratory Test Results

As discussed in Section 3.2, laboratory testing was performed on representative soil samples collected during our subsurface exploration. The results from the laboratory testing are summarized in the tables below.

Boring	Sample Depth (Feet)	LL/PI[(a)] %	Passing #200 Sieve[(b)] %	Natural Water Content %	USCS[(c)] Class.
B-1	5.0-6.5	--	--	51.5	MH*
B-1	8.5-10.0	57/13	--	--	MH
B-2	5.0-6.5	61/15	--	--	MH
B-2	8.5-10.0	--	69.0	--	MH*
B-2	13.5-15.0	--	--	29.2	MH*
B-3	0.0-1.5	--	--	22.7	MH*
B-3	2.5-4.0	--	--	43.7	ML*
B-3	5.0-6.5	--	--	45.2	ML*
B-3	8.5-10.0	--	--	56.7	ML*
B-3	13.5-15.0	--	--	25.0	ML*
B-4	5.0-6.5	--	--	48.1	ML*
B-4	8.5-10.0	--	79.8	--	ML*

(a) Liquid Limit and Plasticity Index from Atterberg Limits test (ASTM D 4318)
(b) Percentage of fines (silt and/or clay) from #200 Sieve Wash (ASTM D 1140)
(c) Unified Soil Classification System *visually evaluated

Froehling & Robertson, Inc. (F&R) has completed pH testing which does not indicate that corrosive soils are present on site; however the balance of the corrosion series testing is pending and will be provided in an addendum once complete.

Boring	Depth (feet)	Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-1	2.5 – 4.0	pending	pending	pending	pending
B-2	2.5 – 4.0		6.2		
B-4	2.5 – 4.0		5.2		

4.5 Infiltration Test Results

The Particle-Size Analysis was performed in accordance with ASTM D422 (Standard Test Method for Particle-Size Analysis of Soils). Infiltration tests were performed and the results are listed in the table below.

Sample	Infiltration Rate (in/hour)	Sand %	Silt %	Clay %	USDA Texture
B-1	0.688	--	--	--	--
B-2	0.125	31.2	51.6	17.2	Silt Loam
B-3	0.063	--	--	--	--
B-4	0.188	20.5	47.9	31.6	Clay Loam

5.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1 General

The following evaluations and recommendations are based on our observations at the site, interpretation of the field data obtained during this exploration, as well as the field and laboratory data obtained during the previous exploration, and our experience with similar subsurface conditions and projects. Soil penetration data has been used to estimate an allowable bearing pressure and associated settlement using established correlations. Subsurface conditions in unexplored locations may vary from those encountered. If the structure's location, loads, or elevations are changed or differ from those assumed, we should be notified and requested to confirm and, if necessary, re-evaluate our recommendations.

Design of a given structure is dependent on the proposed structural loads, soil conditions, and construction constraints such as proximity to other structures, etc. The subsurface exploration aids the geotechnical engineer in identifying the soil stratum appropriate for structural support. This identification includes considerations with regard to both allowable bearing capacity and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction.

5.2 Bearing Recommendations

Lawn crypt structures may be designed for an allowable bearing pressure of up to 1,500 pounds per square foot (psf). The completed structures should bear at least three feet below finished grades for shrink-swell considerations.

During construction of the proposed structures, an experienced geotechnical engineer or his/her representative should be on site to confirm that the in-situ bearing conditions at the bottom of each excavation are adequate for the design bearing pressure recommended in this report.

5.3 Modulus of Subgrade Reaction

Structural analyses and design of floor slabs may require the use of a vertical modulus of subgrade reaction (k). We note that typical practice for slab-on-grade design is to provide a "k" value based on published correlation with soil types and California Bearing Ratio (CBR) test values. Such correlations are based on empirical data from plate load tests. The plate load test sufficiently models typical floor and wheel loads that exert stresses on the order of 3 to 5 feet. Based on published correlations, we estimate that a design modulus of subgrade reaction (k) = 90 pci is appropriate for slab-on-grade design calculations.

5.4 Lateral Earth Pressures

The following information is provided to aid in analysis of soil loads on any below-grade walls. Earth pressures on walls below grade are influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction, and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as freestanding walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement, pit, pool and tunnel walls, should be designed for the structure requiring the use of at-rest earth pressures.

A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Because significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one-half to two-thirds for design purposes.

Since a specific application for the lateral earth pressure has not been provided, we have included our recommendations for active, at-rest, and passive parameters. The crushed stone parameters may be used provided that the backfill extends out from the bottom of the wall and within a 45-degree slope from the base of the wall.

Design Parameters	Typical ML/MH	VDOT No. 57 Stone
Moist unit weight of backfill	120 pcf	105 pcf
Angle of Internal Friction (ø)	19^o	40^o
Equivalent Fluid Unit Weight (pcf), Active	61	23
Equivalent Fluid Unit Weight (pcf), At Rest	80	38
Coefficient of Earth Pressure at Rest (K_o)	0.67	0.36
Coefficient of Passive Earth Pressure (K_p)	1.97	4.60
Coefficient of Active Earth Pressure (K_a)	0.51	0.22
Coefficient of Friction [Concrete on Soil](μ)	0.32	0.32

We anticipate that the onsite soils will be used to backfill around the crypt structures. Subsequently, we have provided the typical onsite soil parameters for use on this project. If an open-graded stone is used (such as VDOT No. 57 Stone) a drainage system should be installed. The drainage system can consist of a six-inch drain tile, surrounded by stone and wrapped in filter fabric. It should drain to daylight; however if the topography does not allow for this, it can be property contained using a sump pit and pumping it to daylight or a storm sewer if available. If there is the opportunity for water to exist under the crypts, such that buoyant forces will cause uplift, the crypts should be designed to resist these forces or a full drainage system should be installed with a backup power source for sump operated drainage.

The recommended equivalent fluid pressures were provided assuming that a constantly functioning drainage system is installed between below-grade walls and backfill material to reduce the potential for buildup of hydrostatic pressures resulting in lateral stresses in excess of those stated. If a functioning drainage system is not installed, then lateral earth pressures should be determined using the buoyant weight of the soil. Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Surcharge loads should be evaluated using the appropriate active or at-rest pressure coefficients provided above. The effect of surcharge loads should be added to the recommended earth pressures to determine total lateral stresses.

5.5 Surface Water/Groundwater Control

Subsurface water for the purposes of this report is defined as water encountered below the existing ground surface. Based on the subsurface water data obtained during our exploration

program at this time, we do not anticipate that subsurface water will be encountered during anticipated earthwork and shallow excavations.

An important aspect to consider during development of this site is surface water control. During the construction, we recommend that steps be taken to enhance surface flow away from any excavations and promote rapid clearing of rainfall and runoff water following rain events. It should be incumbent on the contractor to maintain favorable site drainage during construction to reduce deterioration of otherwise stable subgrades.

5.6 Pavement Design Recommendations

During the installation of the crypts, it is expected that existing pavements may be damaged. Subsequently, the following recommendations are to aid in the repair and reconstruction of existing pavements.

The thickness of the recommended pavement section is directly related to the service life, the initial cost of placement, the preparation of the soil subgrade, and the method by which the granular base and the pavement are placed. We anticipate that the pavement sections for this project will service primarily personal vehicular traffic with an occasional truck and trailer hauling machinery. Our design analysis was performed using guidance from the Virginia Asphalt Associates, Inc. and verified as suitable based on methodology from the VDOT's "Pavement Design Guide for Subdivision and Secondary Road (July 2009)".

The design and analysis of the pavement structure is based on a performance period of 20 years and a Design CBR value of 4, taken from VDOT's published values in their design guide. For our design purposes, we have assumed the Annual Average Daily Traffic (AADT) of 100 vehicles per day. If the actual traffic loads or preferred design life (20 years) differ from our assumed values, F&R should be notified so that we can adjust our pavement design recommendations as necessary.

The following flexible pavement section is recommended for reconstructed areas of the pavement:

Flexible Pavement – Standard Duty		
Layer	**VDOT Specification**	**Recommended Minimum Thickness (Inches)**
Surface Course	Asphalt Concrete (SM-9.0A)	1.5
Base Course	Asphalt Concrete (IM-19.0A)	2.0
Aggregate Course	Untreated Dense-graded Aggregate Material No. 21B	6.0

The final subgrade within the pavement area should be carefully evaluated by the geotechnical engineer to verify its suitability for placement of pavement and/or new fill. Any unsuitable materials encountered within pavement areas should be undercut and either replaced with engineered fill or re-compacted in accordance with the recommendations of this report. Any removal of existing damaged pavements should be performed by saw-cutting at least one foot beyond the damaged area, and complete removal of the damaged asphalt section.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the possibility of the subgrade materials becoming saturated over a long time. Based upon the results of the soil test borings, the groundwater table should not affect the performance of pavements; however, surface runoff water that becomes trapped during construction on the exposed subgrade soils could create localized deterioration of the soil's support capacity. Standing water that may develop on the surface of the pavement may be minimized by:

- adequate design (surface graded to control runoff to desired locations - catch basins, drain inlets, gutters, etc.);
- adequate compaction of each lift of pavement section component material (to minimize localized settlements that result in ponding);
- accurate grading of each lift of pavement section component material (to achieve the desired design grades);
- installing temporary weep holes in drainage structures, construction of drainage swales and diversion ditches and proper backfill and grading behind curbs to minimize water intrusion from behind the curbs.

5.6 Excavation Conditions

Auger refusal materials were not encountered in the borings performed within the planned termination depth at the four borings drilled across the site. Based on the foregoing, difficult excavation conditions are not anticipated within the top eight feet of this site. F&R notes that the profile of the bedrock surface within the Piedmont region is typically irregular and variable, and that bedrock could be encountered at deeper or shallower depths between test boring locations and in unexplored areas of the site.

In mass excavations for general site work, hard or dense soils (soils with standard penetration resistances of 30 or more blows per foot) can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor, or by breaking it out with a tracked excavator or large front-end loader. In confined excavations such as is anticipated for the crypts, utility trenches, etc., removal of partially weathered rock typically requires use of large backhoes, pneumatic spades, hoe rams or pre-drilling and splitting.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

GENERAL EXCAVATION:

Rippable Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.

Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

TRENCH EXCAVATION:

Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (e.g. Caterpillar Model 315 or equivalent), and occupying an original volume of at least one-half (1/2) cubic yard.

6.0 GEOTECHNICAL CONSTRUCTION RECOMMENDATIONS

6.1 Site Preparation

Before proceeding with construction, any utilities, existing pavements, concrete sidewalks, surficial soils, and other deleterious non-soil materials (if any) should be stripped or removed from the proposed construction area. Attention should be given to these areas to ensure all unsuitable material is removed prior to continuing with construction. During the stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

Particular attention should be given to any utility trenches within the proposed additions' footprints. For obvious reasons, existing underground utility trenches were avoided in our drilling program. Our experience is that utility trenches are sometimes backfilled with very little compactive effort. Where utility lines are removed, the trench subgrade should be verified by an F&R representative prior to backfilling in accordance with the controlled structural fill recommendations provided in the following section of this report.

After stripping, areas intended to support lawn crypts and new fill should be carefully evaluated by a geotechnical engineer. Areas intended for slab-on-grade support should be proofrolled with a 20- to 30-ton loaded truck, or other pneumatic-tired vehicle of similar size and weight, under the observation of the geotechnical engineer. A 1.5 ton trench roller can be used to proofroll areas that cannot be accessed by a truck, such as the bottoms of excavations and utility trenches. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated.

The proofrolling observation is an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations in the existing subgrade, especially near existing utilities, where poor-quality fill may exist and where new fill placement and subgrade structures are proposed. Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with structural fill or stabilized in-place. Undercut areas should be backfilled with structural fill or lean concrete. Open-graded stone (such as VDOT 57 Stone) should not be used for backfilling where water can collect within the backfilled stone. See Section 6.3 of this report for further details. The actual need for, and extent of, undercutting and/or in-place stabilization required can best be determined in the field by the geotechnical engineer at the time of construction.

6.2 Structural Fill Placement and Compaction

The onsite material can be used for fill. However, based on the USCS classifications of onsite soil, difficulty with moisture control during construction is expected. Granular fill, such as VDOT 57 Stone, may be used for backfill if desired. If granular material is used as backfill, it is recommended to cap the fill with 12 inches of low permeability soil, such as MH or CH, to help reduce water infiltration behind the wall. Other materials may be suitable for use as general fill materials that are to be placed in landscaped areas, and should be individually evaluated by the geotechnical engineer. Controlled structural fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than three inches.

We recommend that structural fill be compacted to at least 95 percent of the Standard Proctor (ASTM D 698 or AASHTO T 99) maximum dry density and that the moisture content be maintained within three percentage points of the optimum moisture content, as determined from the Standard Proctor density test. Fill materials should be placed in horizontal lifts with maximum height of 8 inches loose measure. New fill should be adequately keyed into stripped and scarified subgrade soils. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. In confined areas such as may be used for this project, portable compaction equipment and thin lifts of three to four inches may be required to achieve the specified degree of compaction.

Generally, we do not anticipate significant problems controlling moistures within approved fill during periods of dry weather, but moisture control may be difficult during winter months or extended periods of rain. We recommend that the contractor have equipment on site during earthwork for both drying and wetting of fill soils. Attempts to work the soils when wet can be expected to result in deterioration of otherwise suitable soil conditions or of previously placed and properly compacted fill.

If construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils intended for structural support should be scarified and re-compacted. Each lift of fill should be tested to confirm that the recommended degree of compaction is attained. In confined areas, a greater frequency may be required.

6.3 Construction

All subgrades intended to support structures should be observed, evaluated, and verified for the design bearing pressure by the geotechnical engineer after excavation and prior to reinforcement steel placement. We anticipate that low consistency soils may be encountered during excavation, and localized undercutting and/or in-place stabilization of bearing subgrades may be required.

The actual need for, and extent of, undercutting should be based on field observations made by the geotechnical engineer or his/her representative at the time of construction. To aid in identifying unsuitable soils, we recommend that a dynamic cone penetrometer (DCP) be used at the bottom of any excavations.

Excavations in areas intended to support crypts should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. If plastic concrete is used, it should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below field-placed concrete, settlements will increase. Excavations should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

In a dry and undisturbed state, the subgrade soils at the site will provide suitable subgrade support for fill placement and construction operations. However, when wet, the soil can degrade quickly either with or without disturbance from contractor operations. Therefore, good site drainage should be maintained during earthwork operations to help maintain the stability of the soil. Attempting site work during adverse seasonal conditions will have significant effect on the site work budget, as substantially more undercutting will be required. Ideally, earthwork should be performed during the summer or early fall (typically drier and warmer months).

6.4 Surface Water/Groundwater Control

Subsurface water for the purposes of this report is defined as water encountered below the existing ground surface. Even though no subsurface water was encountered during drilling, there is a possibility that rainwater may collect in structural excavations. If this occurs, sump pits and pumps can be used to remove water from excavations, and the contractor should be equipped to do so.

Below-grade walls should be constructed using either a free-draining material as backfill or a drainage system. The drainage system can tie into a perimeter drain and run to daylight.

An important aspect to consider during development of this site is surface water control. During the construction, we recommend that steps be taken to enhance surface flow away from any excavations and promote rapid clearing of rainfall and runoff water following rain events. It should be incumbent on the contractor to maintain favorable site drainage during construction to reduce deterioration of otherwise stable subgrades.

6.5 Temporary Excavation Recommendations

Mass excavations and other excavations required for construction of this project must be performed in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines (29 CFR 1926, Subpart P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and/or shoring requirements. The OSHA guidelines require daily inspections of excavations, adjacent areas and protective systems by a competent person for evidence of situations that could result in cave-ins, indications of failure of a protective system, or other hazardous conditions. All excavated soils, equipment, building supplies, etc., should be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. F&R cautions that the actual excavation slopes will need to be evaluated frequently each day by the competent person and flatter slopes or the use of shoring may be required to maintain a safe excavation depending upon excavation-specific circumstances. The contractor is responsible for providing the competent person and all aspects of site excavation safety. F&R can evaluate specific excavation slope situations if we are informed and requested by the owner, designer or contractor's competent person.

7.0 CONTINUATION OF SERVICES

We recommend that we be given the opportunity to review project plans and specifications when construction documents approach completion. This review evaluates whether the recommendations and comments provided herein have been understood and properly implemented. We also recommend that Froehling & Robertson, Inc. be retained for professional and construction materials testing services during construction of the project. Our continued involvement on the project helps provide continuity for proper implementation of the recommendations discussed herein.

The Geotechnical Engineer of Record should be retained to monitor and test earthwork activities and excavations. It should be noted that the actual soil conditions at the various subgrade levels will vary across this site and thus the presence of the Geotechnical Engineer and/or the engineer's representative during construction will serve to validate the subsurface conditions and recommendations presented in this report. We recommend that F&R be employed to monitor the earthwork construction, and to report that the recommendations contained in this report are completed in a satisfactory manner. Our involvement on the project will aid in the proper implementation of the recommendations discussed herein. The following is a recommended scope of services:

- Review of project plans and construction specifications to verify that the recommendations presented in this report have been properly interpreted and implemented;
- Observe and perform testing during earthwork to document that subsurface conditions encountered during construction are consistent with those anticipated in this report;
- Observe subgrade preparation including any proofrolling operations, undercutting of soft/loose unsuitable soils, installation of drainage materials, geotextiles and fill placement;
- Observe all excavations and bearing grades for compliance with the geotechnical recommendations;
- and provide Construction Materials Testing.

These services are not included in our current scope of services and can be rendered for an additional cost.

8.0 LIMITATIONS

This report has been prepared for the exclusive use of KCI Engineering of New York, PC or their agent, for specific application to the Culpeper National Cemetery project, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our evaluations and recommendations are based on design information furnished to us, the data obtained from the previously described subsurface exploration program, and generally accepted geotechnical engineering practice. The evaluations and recommendations do not reflect variations in subsurface conditions which could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our recommendations based upon on-site observations of the conditions.

There are important limitations to this and all geotechnical studies. Some of these limitations are discussed in the information prepared by ASFE, which is included in Appendix III. We ask that you please review this ASFE information.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should evaluate earthwork, pavement, and foundation construction to verify that the conditions anticipated in design actually exist.

Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

In the event that changes are made in the design or location of the proposed structure, the recommendations presented in the report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this report modified and/or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid.

APPENDIX I

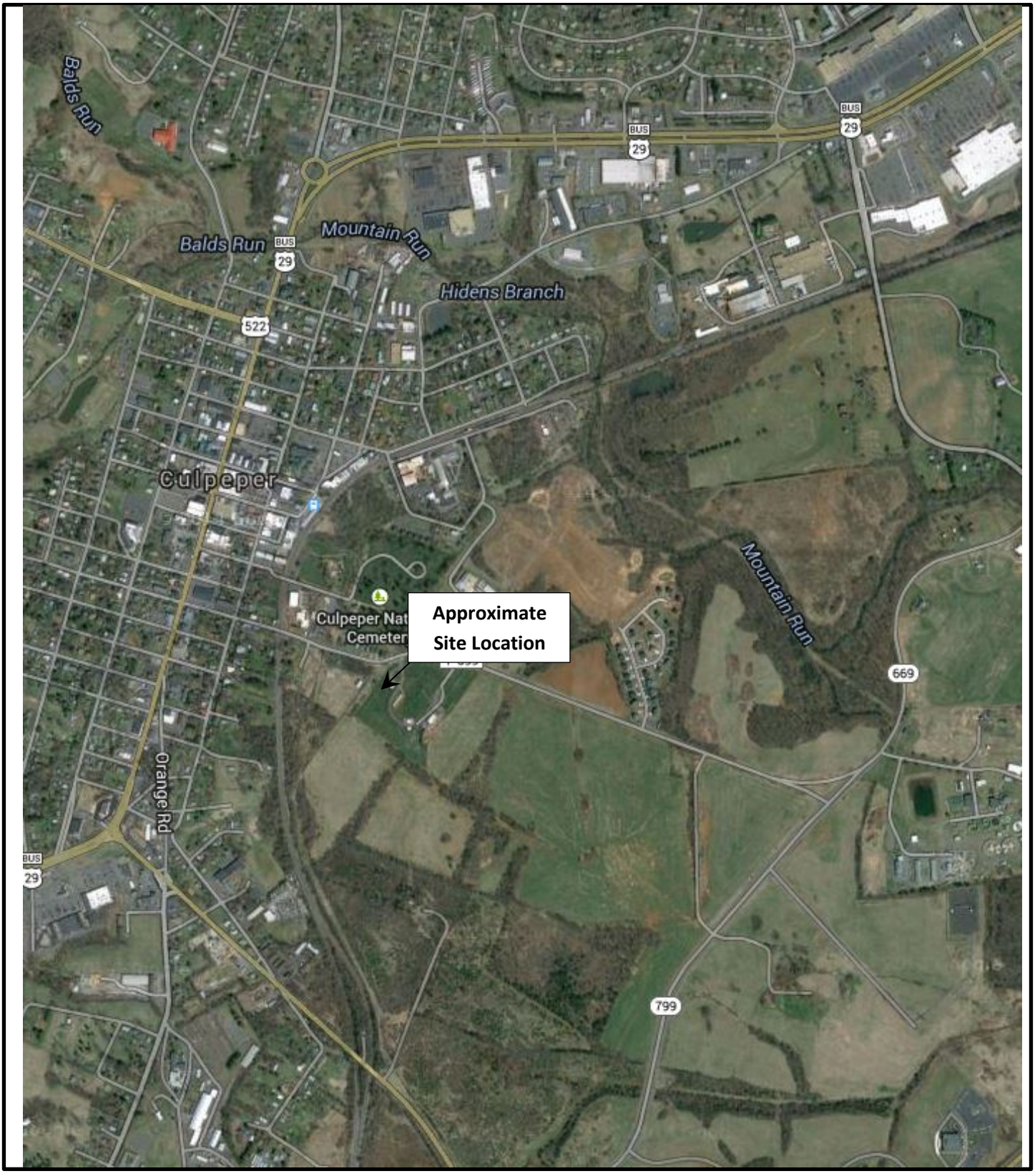
FROEHLING & ROBERTSON, INC.

SITE VICINITY MAP

Drawing No. 1

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Source: Google Maps
Scale: As Shown
Date: November 2014



FROEHLING & ROBERTSON, INC.

BORING LOCATION PLAN
Drawing No. 2

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Source: Google Earth
Scale: As Shown
Date: November 2014

- Approximate Boring Locations

APPENDIX II

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

Sands and Gravels		Silts and Clays	
No. of Blows, N	Relative Density	No. of Blows, N	Relative Density
0 - 4	Very loose	0 - 2	Very soft
5 - 10	Loose	3 - 4	Soft
11 - 30	Medium dense	5 - 8	Firm
31 - 50	Dense	9 - 15	Stiff
Over 50	Very dense	16 - 30	Very stiff
		31 - 50	Hard
		Over 50	Very hard

Particle Size Identification

(Unified Classification System)

Boulders:	Diameter exceeds 12-in. (300-mm)
Cobbles:	3-in. (75-mm) to 12-in. (300-mm) diameter
Gravel:	**Coarse** - ¾-in. (19-mm) to 3 in. (75-mm) diameter **Fine** - No. 4 (4.75-mm) sieve to ¾-in. (19-mm) diameter
Sand:	**Coarse** – No. 10 (2.0-mm) to No. 4 (4.76 mm) sieve **Medium** – No. 40 (0.425-mm) to No. 10 (2.0-mm) sieve **Fine** - No. 200 (0.075-mm) to No. 40 (0.425-mm) sieve
Silt and Clay:	Less than No. 200 (0.075-mm) sieve

Modifiers

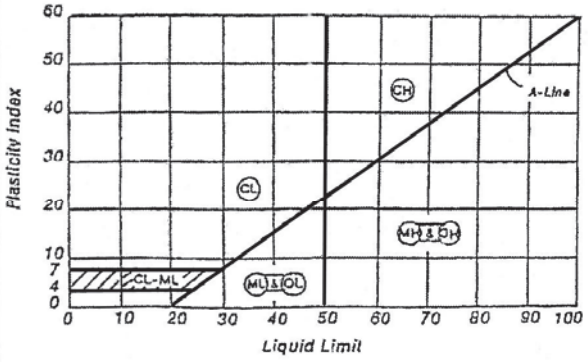
The modifiers provide our estimate of the amount of silt, clay or sand size particles in the soil sample.

Approximate Content	Modifiers
≤ 5%:	Trace
5 to 10%:	Few
15 to 25%:	Little
30 to 45%:	Some
50 to 100%	Mostly

Field Moisture Description	
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

SOIL CLASSIFICATION CHART - Adapted from ASTM D 2487

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of lines GW, GP, SW, SP GM, GC, SM, SC Less than 5% pass No. 200 sieve More than 12% pass No. 200 sieve 5% to 12% pass No. 200 sieve Borderline Classification requiring use of dual symbols $C_u = D_{60}/D_{10}$ Greater than 4 $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line and plasticity index greater than 4
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7 Atterberg limits ploting in hatched area are borderline classifications requiring use of dual symbols
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6 $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line and plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7 Atterberg limits ploting in hatched area are borderline classifications requiring use of dual symbols
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	PLASTICITY CHART For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols. Equation of A-line: PI = 0.73 (LL - 20)
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS Liquid limit GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity	
Highly Organic Soils			PT	Peat, muck and other highly organic soils	



*Based on the material passing the 3-in. (75-mm) sieve.

FROEHLING & ROBERTSON, INC.

BORING LOG

Boring: B-1 (1 of 1)

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Elevation:
Total Depth: 15.0'
Location: See Boring Location Plan

Drilling Method: HSA 3-1/4" ID
Hammer Type: Automatic
Date Drilled: 11/19/14
Driller: Martin

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
	0.2	2 inches of surficial soil	3-4-5	0.0	9	
		RESIDUAL: stiff, red-brown elastic SILT with little coarse sand - moist (MH)		1.5		No groundwater was encountered during drilling.
			2-3-5	2.5	8	
				4.0		
			3-3-4	5.0	7	
				6.5		
			3-3-4	8.5	7	
				10.0		Cave-in depth 9.7'
	12.0	stiff, red-brown, SILT with coarse sand - moist (ML)	4-3-4	13.5	7	
	15.0			15.0		
		Boring terminated at 15 feet. Boring backfilled upon completion.				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON, INC.

BORING LOG

Boring: B-2 (1 of 1)

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Elevation:
Total Depth: 15.0'
Location: See Boring Location Plan

Drilling Method: HSA 3-1/4" ID
Hammer Type: Automatic
Date Drilled: 11/19/14
Driller: Martin

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
	0.3	3 inches of surficial soil	3-4-5	0.0	9	
		RESIDUAL: stiff, red-brown, elastic SILT with some coarse sand - moist (MH)		1.5		
	2.0	firm to stiff, red-brown, elastic SILT - moist (MH)	2-3-5	2.5	8	No groundwater was encountered during drilling.
				4.0		
			2-2-3	5.0	5	
	7.0	stiff to very stiff, yellow-brown with black foliation, sandy elastic SILT - moist (MH)	2-3-5	6.5		
				8.5	8	
				10.0		Cave-in depth 10.2'
			3-5-7	13.5	12	
	15.0			15.0		

Boring terminated at 15 feet.
Boring backfilled upon completion.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON, INC.

BORING LOG

Boring: B-3 (1 of 1)

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Elevation:
Total Depth: 15.0'
Location: See Boring Location Plan

Drilling Method: HSA 3-1/4" ID
Hammer Type: Automatic
Date Drilled: 11/19/14
Driller: Martin

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
	0.3	3 inches of surficial soil	3-4-5	0.0		
		RESIDUAL: stiff, red-brown, elastic SILT with trace coarse sand - moist		1.5	9	
	2.0	(MH)	3-3-5	2.5		No groundwater was encountered during drilling.
		firm to stiff, red-brown and yellow-brown, SILT - moist		4.0	8	
		(ML)	2-2-3	5.0		
				6.5	5	
	7.0	stiff, yellow-brown and dark brown, SILT - moist (ML)				
			2-2-5	8.5		
				10.0	7	Cave-in depth 10.0'
	12.0	very stiff, red-brown and yellow with black foliation, SILT with some medium sand - moist (ML)				
			4-5-14	13.5		
	15.0			15.0	19	

Boring terminated at 15 feet.
Boring backfilled upon completion.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON, INC.

BORING LOG

Boring: B-4 (1 of 1)

Project No: 74S-0126
Client: KCI Engineering of New York, PC
Project: Culpeper National Cemetery
City/State: Culpeper, Virginia

Elevation:
Total Depth: 15.0'
Location: See Boring Location Plan

Drilling Method: HSA 3-1/4" ID
Hammer Type: Automatic
Date Drilled: 11/19/14
Driller: Martin

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
	0.3	3 inches of surficial soil	2-5-3	0.0		
		RESIDUAL: stiff, red-brown, elastic SILT with some gravel and coarse sand - moist		1.5	8	
	2.0	(MH)	3-3-5	2.5		No groundwater was encountered during drilling.
		stiff, red-brown, SILT - moist (ML)		4.0	8	
			3-3-5	5.0		
				6.5	8	
			2-3-4	8.5		
				10.0	7	
						Cave-in depth 11.0'
	12.0	stiff, brown and yellow-brown with black foliation, elastic SILT with trace coarse sand - moist (MH)	4-4-4	13.5		
	15.0			15.0	8	

Boring terminated at 20 feet.
Boring backfilled upon completion.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

APPENDIX III

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes— even minor ones— and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ— sometimes significantly— from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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