

Department of Veterans Affairs
National Cemetery Administration

Design-Build Request for Proposal
INSTALL PRE-PLACED CRYPTS AND IN-GROUND CREMAINS
Project No. 832CM3031

Biloxi National Cemetery
Biloxi, Mississippi

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Standard Drawings Disclaimer

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•These terms and conditions constitute the complete and final agreement of the parties hereto.

•Receiver accepts the aforementioned terms and conditions.

**SECTION 00851
LIST OF DRAWINGS**

The drawings listed below accompanying this specification form a part of the RFP.

<u>Drawing No.</u>	<u>Title</u>
RFP1	Cover Sheet
RFP2	Overall Site Plan
RFP3	Site Plan Enlargement
RFP4	Representative Drawings 1
RFP5	Representative Drawings 2

END OF SECTION

**SECTION 01 00 00
GENERAL REQUIREMENTS**

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**SECTION 01 00 00
GENERAL REQUIREMENTS**

1.1 GENERAL INTENTION

- A. Contractor shall furnish all labor, materials, and equipment to perform and complete all work for Design-Build for installation of concrete lawn crypts at Biloxi National Cemetery, as shown on the drawing location and in the specifications.
- B. Visits to the site may be made only by appointment with the Cemetery Director.

**Mr. Shawn Hamner
Telephone: (228) 388-6668**

**Biloxi National Cemetery
400 Veterans Avenue
Bldg. 1001
Biloxi, MS 39531-2410**

1.2 STATEMENT OF BID ITEM (S)

Bid Item 1 – The contractor shall provide design-build services 3,791 pre-placed concrete lawn crypts and 517 In-ground Cremains Sites to create final build-out of burial capacity. The sections identified for burial are represented on the RFP Drawings. Work shall include surveying, design and construction documents per NCA design criteria, excavation, installation of crypts, irrigation system, drainage and other site improvements necessary for the functioning of a crypt field and burial areas.

Bid Item 2 – Manufacture or purchase, delivery and off-loading at the site minimum of 3,791 precast concrete burial crypts that are to be installed under Bid Item 1. Double depths or quads are acceptable. Purchase and deliver 30 additional crypt lids, 3 crypt lid-lifting devices and 3 shelf-lifting devices.

1.3 SPECIFICATIONS AND DRAWINGS BY THE CONTRACTOR

- A. The contractor shall submit one concept drawings and construction documents at 50%, 100% and Final for government approval. There will be construction documents reviews at 50% and 100%. The contractor shall respond to all review comments and incorporate comments on the following submission. Also see section 00 11 21, RFP for Design Build for additional submission requirements.

1.4 FIRE SAFETY

- A. Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.
 - 1. American Society for Testing and Materials (ASTM)
 - E84-1998..... Surface Burning Characteristics of Building Materials
 - 2. National Fire Protection Association (NFPA):
 - 10-1998 Standard for Portable Fire Extinguishers
 - FCLCH-30-1996 Flammable and Combustible Liquids Code
 - 51B-1999..... Standard for Fire Prevention during Welding, Cutting and Other Hot Work
 - 70-1999 National Electrical Code
 - 241-1996 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 the Contracting Officer for review for compliance with contract requirements in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.
- C Site Access: Maintain free and unobstructed access to site 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.
- E Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- G Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- H Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer.
- I. Fire Hazard Prevention Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions to the Contracting Officer.
- J Smoking: Smoking is prohibited inside buildings under construction and completed. Dispose of waste and debris in accordance with NFPA 241.

1.5 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 Contracting Officer and coordination with the cemetery director. 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 sheds, shops, offices) and utilities may not be erected by the Contractor.
- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when

and as authorized by the Contracting Officer. 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 damages caused by the contractor's activities including curbs, sidewalks, or roads.

- D. The Contracting Officer shall determine working space and space available for storing materials.
- E. Workmen are subject to rules of Cemetery applicable to their conduct and working attire. See Director for current rules.
- F. Execute work in such a manner as to not interfere with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.
- G. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Contracting Officer. All such actions shall be coordinated with the Utility Company involved. The Contractor shall notify the cemetery director in writing at least 2 weeks prior to actual field actions to prevent any impact on cemetery operations and activities.
- H. 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, or gas, payment of such fee shall be the responsibility of the Government and not the Contractor. Contractor will administer, coordinate and install all connections.
- I. Phasing: To insure such executions, Contractor shall furnish the Contracting Officer with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof.
- J. Coordination of construction activities with the cemetery director and cemetery operations is required. Burial activities take precedence over construction activities. The contractor shall cooperate to the fullest extent in the coordination of construction activities with cemetery operations and burial activities. It is not expected but may happen that construction activity will be halted for burial activities. Good coordination between cemetery and construction usually precludes this.
- K. The contractor is required to discontinue work at least one day before all Federal Holidays. A general clean up of the site is required at that time in the existing portion of the cemetery. No debris shall be left adjacent to or on any gravesite or on cemetery ground.

1.6 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES & 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 sites, 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 as directed by the Contracting Officer. Any grading within the drip line trees must be done with hand shovels and hand tools.
- 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 Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

- C. Refer to Section 01 57 19, ENVIRONMENTAL PROTECTION, 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. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. If applicable, a National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is responsible for compliance.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Contracting Officer or COR of areas in which construction occurs and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by area:
1. Existing condition of landscaping, drainage, paving, walks, and other features.
 2. Shall note any discrepancies between drawings and existing conditions at site.
 3. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and the Contracting Officer.
- 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 Contracting Officer, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with approved specifications, which will be furnished by design-build team. 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" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 01001, GENERAL CONDITIONS.
- C. Re-Survey: Thirty days before expected partial or final inspection date the Contractor and Contracting Officer together shall make a thorough re-survey of the areas involved. They shall furnish a report on conditions then existing, of landscaping, drainage, paving, walks, and other features as compared with conditions of same as noted in first condition survey report.
1. Re-survey report shall also list any damage caused by Contractor despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. 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.
 2. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by Contracting Officer.

- E. Disposal and Retention: Materials and equipment accruing from work removed shall be disposed of as follows:
 - 1. Reserved items, which are to remain property of the Government, are identified by noted on drawings or in specifications as items to be stored. Items, which remain property of the Government, shall be removed or dislodged from present locations in such a manner as to prevent damage, which would be detrimental to re-installation and reuse. Store such items where directed by Contracting Officer.
 - 2. Items not reserved shall become property of the Contractor and be removed by Contractor from National Cemetery.
 - 3. Items of portable equipment and furnishings located in areas in which work is to be done under this contract shall remain the property of the Government.

1.8 RESTORATION

- A. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services, fire protection systems or communications systems which are not scheduled for discontinuance or abandonment.
- B. 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 clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2) of Section 01001, GENERAL CONDITIONS.

1.9 PHYSICAL DATA

- A. Data and information furnished or referred to 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. (FAR 52.236-4)

1.10 PROFESSIONAL SURVEYING SERVICES

A registered professional land surveyor or registered civil engineer with the State of Illinois 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.

1.11 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established general base lines and existing benchmarks, investigated and designed by the team and indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at 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 Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by

the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor. (FAR 52.236-17)

- B. Establish and plainly mark center lines for each gravesite control monument including all grid markers, section markers, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure, roads, parking lots, and gravesite control monuments, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of gross excavation and rough grading 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. Survey shall include, but not be limited to, location of lines and grades of utilities and elevations of floor slabs. A survey of proposed spoils area shall be done. all proposed areas of clearing shall be staked out and reviewed with the COR.
- D. Approval of all applicable permits and plans required by this project shall be approved and paid for by the Design/build contractor. The Design/build contractor shall investigate all applicable permitting requirements and provide a check list of all permits, name of the appropriate authorities having jurisdiction (AHJ) and disposition of all applicable permits. This shall be done in advance of any construction or earthwork activities.
- E. During progress of work, and particularly as work progresses through the site, the contractor shall have lines and grades and plumbs of all major formwork checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnishing such certifications to the Contracting Officer before any concrete or backfill covering work.

1.12 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, to 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 Contracting Officer's review, as often as requested.
- C. Contractor shall deliver one approved completed set of as-built drawings to the Contracting Officer within 14 calendar days after the acceptance of the project by the Contracting Officer.
- D. Contractor's AE shall update the AutoCAD files and mark all changes and supply a complete set of as-built AutoCAD copy on CD-ROM to COTR prior to final pay request.

1.13 USE OF ROADWAYS

- A. For hauling, use only roads authorized by the Contracting Officer. The Contractor at Contractor's expense shall construct temporary roads if needed. When necessary to cross curbing, sidewalks, or similar construction, they must be protected. All disturbed areas must be restored.

1.14 CONTRACTING OFFICER'S FIELD OFFICE – NOT USED.

1.15 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT - NOT USED.

1.16 TEMPORARY TOILETS

- A. Provide for use of by all Contractors' workers ample portable temporary sanitary toilet accommodations.

1.17 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the irrigation system or completion of portions thereof, the contractor through the permanent connection of the new irrigation system to the existing irrigation shall be provided water through the irrigation system for flushing and testing of said system. 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, 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.

1.18 TELEPHONE EQUIPMENT - NOT USED

1.19 TESTS

- A. Conduct final tests required in various sections of specifications in presence of the Contracting Officer or designee. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- B. All related components as defined above shall be functioning when any system component is tested.
- C. 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 OPERATING MANUALS AND INSTRUCTIONS

- A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (three copies each) for each separate piece of equipment shall be delivered to the Contracting Officer 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 must reference the exact model, style and size of the piece of equipment and system installed. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned VA/NCA 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. 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 interrelated systems. All instruction periods shall be at such times as scheduled by the Contracting Officer. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor whom, in the opinion of the Contracting Officer, does not demonstrate sufficient qualifications in accordance with requirements for instructors.

1.21 CONSTRUCTION SIGN

- A. Furnish a construction sign and coordinate with the cemetery director to select a noticeable location to post the sign with information of the name of the project, the name of the contractor as Notice of Construction to the general public and visitors.

1.22 SAFETY SIGN – NOT USED

1.23 CONSTRUCTION PROGRESS DIGITAL IMAGES

- A. During the construction period through completion, furnish Department of Veterans Affairs with daily construction progress views of digital images, containing those views taken on that visit as per these specifications:
 - 1. Daily construction progress digital photographs will be taken to show construction progress and submitted to COTR daily through daily log reports. Report and log shall be submitted daily. The accumulation of photographs shall be submitted on CD or USB drive at the conclusion of construction as part of the final deliverable prior to final inspection. Provide a minimum of 150 digital photographs.
- B. Images on CD-ROM or USB drive shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. Compressed size of the file shall be no less than 80% of the original with no loss of information. File names shall contain the date the image was taken, the Project number and a unique sequential identifier. The CD-ROM or USB drive shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- C. In case any set of prints are not submitted within five days of date established by COTR for taking thereof, the COTR may have such images/photographs taken and cost of same will be deducted from any money due to the Contractor.

1.24 INTERIOR COLOR SLIDES – NOT USED.

1.25 HISTORIC PRESERVATION

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 Contracting Officer. The Design/Build contractor shall contact the appropriate SHPO and obtain concurrence from the same for all aspects of this project but initial consultation shall be done by others.

END

**SECTION 01 32 16.13
NETWORK ANALYSIS SCHEDULES (NCA)**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Coordinate this section with the paragraphs of FAR 52.232, VAAR 852.236 and Section 01 00 00, GENERAL REQUIREMENTS. Specifically Article, FAR 52.232 - 5 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), Article, VAAR 852.236 - 83(PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), and Article, OPERATIONS AND STORAGE AREAS, Paragraph "Phasing" in the Section 01 00 00, GENERAL REQUIREMENTS.
3. Delete between //-----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

PART 1- GENERAL

1.1 DESCRIPTION:

- A. The Contractor shall develop a Network Analysis System (NAS) plan and schedule demonstrating fulfillment of the contract requirements, shall keep the network up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) Precedence Diagramming Method (PDM) technique will be utilized to satisfy both time and cost applications. All schedule data and reports required under this specification section shall be based upon regular total float, not relative total float schedules.

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 network diagram, review and report progress of the project with and to the Contracting Officer's representative.
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section and such authority shall not be interrupted throughout the duration of the project.

SPEC WRITER NOTE: In paragraphs 1.3, A;
1.3,B, and 1.3,C; (i) applies to

competitively bid projects, (ii) applies to 8(a) projects and (iii) applies to RFP solicitations. Edit as required.

1.3 CONTRACTOR'S CONSULTANT:

- A. To prepare the network diagram, and compact disk(s), which reflects the Contractor's project plan, the Contractor shall engage an independent CPM consultant who is skilled in the time and cost application of scheduling using (PDM) network techniques for construction projects, the cost of which is included in the Contractor's bid. This consultant shall not have any financial or business ties to the Contractor, and shall not be an affiliate or subsidiary company of the Contractor, and shall not be employed by an affiliate or subsidiary company of the Contractor.
- B. // (i) Prior to engaging a consultant, and within 10 calendar days after award of the contract, // (ii) With the initial cost proposal, // (iii) With the initial response to the RFP // the Contractor shall submit to the Contracting Officer:
1. The name and address of the proposed consultant.
 2. Sufficient information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
 3. A list of prior construction projects, along with selected PDM network diagram samples on current projects which the proposed consultant has performed complete project scheduling services. These network diagram samples must show complete project planning for a project of similar size and scope as covered under this contract.
- C. The Contracting Officer has the right to approve or disapprove employment of the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of information. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor must have their CPM Consultant approved prior to // (i) submitting any diagram, (ii) completion of contract negotiations, (iii) submission of their best and final offer.//

1.4 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide to the VA, Senior Resident Engineer and CPM Schedule Analyst, monthly computer processing of all computer-produced time/cost schedules and reports generated from monthly project

updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of Primavera (P6) to the contracting officer's representative; a hard copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data in Primavera (P6) batch format; and the resulting monthly updated schedule in a compressed electronic file in Primavera (P6), (PDM) format. These must be submitted with and substantively support the contractor's monthly payment request and the signed lookahead report. The resident engineer shall identify the five different report formats that the contractor shall provide based upon the monthly schedule updates.

- B. The contractor is responsible for the correctness and timeliness of the computer-produced reports. The Contractor is also responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA shall report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor will reprocess the computer-produced reports and associated compact disk(s), when requested by the Contracting Officer's representative, to correct errors which affect the payment and schedule for the project.

1.5 THE COMPLETE PROJECT NETWORK DIAGRAM SUBMITTAL

- A. Within 45 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three blue line copies of the complete network diagram on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in a compressed Primavera (P6), (PDM) format. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, duration, predecessor and successor relationships, trade code, area code, description, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start and start-to-start without lead or lag constraints. Activity/event date constraints, not

required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the network diagram shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have a zero duration. The complete working network diagram shall reflect the Contractor's approach to scheduling the complete project. **The final network diagram in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents.** These changes/delays shall be entered at the first update after the final network diagram has been approved. The Contractor should provide their 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.

- B. Within 30 calendar days after receipt of the complete project network diagram, the Contracting Officer or his representative, will do one or both of the following:
1. Notify the Contractor concerning his actions, opinions, and objections.
 2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised network diagram, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.
- C. The approved baseline network diagram schedule and the corresponding computer-produced schedule(s) shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.

D. The Complete Project Network Diagram will contain approximately _____work activities/events.

1.6 WORK ACTIVITY/EVENT COST DATA

- A. The Contractor shall cost load all work activities/events except procurement activities. The cost loading shall reflect the appropriate level of effort of the work activities/events. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. In the event of disapproval, the Contractor shall revise and resubmit in accordance with Article, THE COMPLETE PROJECT NETWORK DIAGRAM SUBMITTAL. 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 FAR 52.232 - 5 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), Article, and VAAR 852.236 - 83(PAYMENTS UNDER FIXED-PRICE CONSTRUCTION).
- C. In accordance with Article PERFORMANCE OF WORK BY THE CONTRACTOR in FAR 52.236 - 1 and VAAR 852.236 - 72, the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.
- //D. The Contractor shall cost load work activities/events for ASBESTOS ABATEMENT. The sum of asbestos abatement work activity/event costs shall equal the value of the asbestos bid item in the Contractors' bid.//
- //E. The Contractor shall cost load work activities/events for all BID ITEMS. The sum of the cost loading for each bid item work activities/events shall equal the value of the item in the Contractors' bid.//

F. Work activities/events for Contractor bond shall have a trade code and area code of BOND.

1.7 NETWORK DIAGRAM REQUIREMENTS

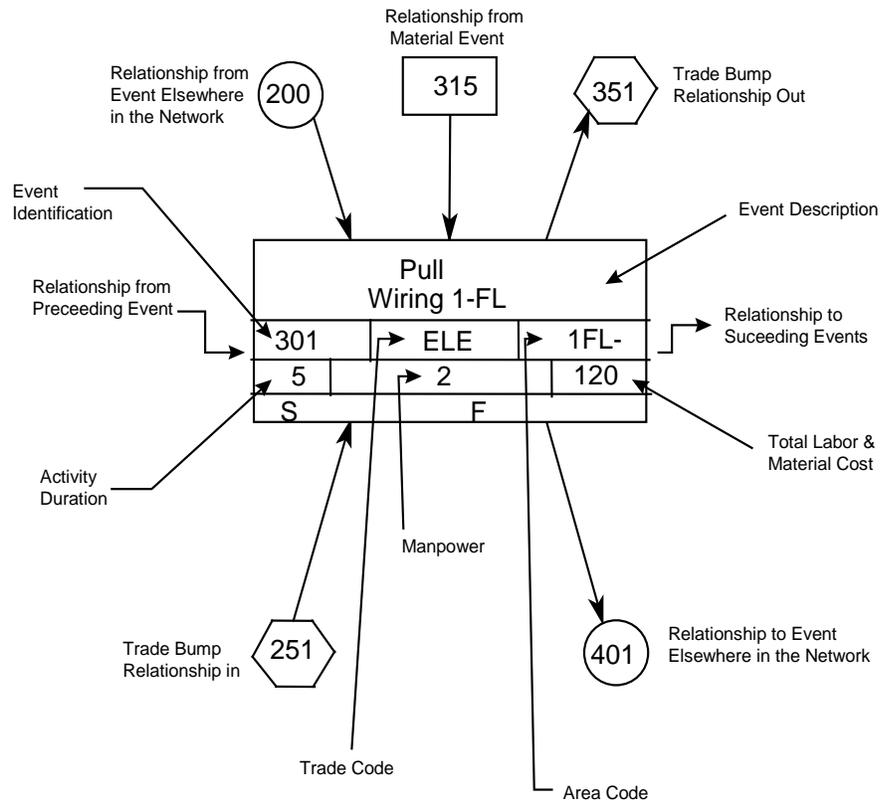
A. Show on the network diagram the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the network diagram, the Contractor shall:

1. **Exercise sufficient care to produce a clear, legible and accurate network diagram, refer to the drawing, CPM-1 (Sample CPM Network). Computer plotted network diagrams shall legibly display and plot all information required by the VA CPM activity/event legend or the computer plotted network diagram will not be acceptable. If the computer plotted network diagram is not found acceptable by the contracting officer's representative, then the network diagram will need to be hand drafted and meet legibility requirements. Group activities related to specific physical areas of the project, on the network diagram for ease of understanding and simplification. Provide a key plan on each network diagram sheet showing the project area associated with the work activities/events shown on that sheet.**
2. Show the following on each work activity/event:
 - a. Activity/Event ID number.
 - b. Concise description of the work represented by the activity/event. (35 characters or less including spaces preferred).
 - c. Performance responsibility or trade code (five alpha characters or less): GEN, MECH, ELEC, CARP, PLAST, or other acceptable abbreviations.
 - d. Duration (in work days.)
 - e. Cost (in accordance with Article, ACTIVITY/EVENT COST DATA of this section and less than \$9,999,999 per activity).
 - f. Work location or area code (five characters or less), descriptive of the area involved.
 - g. Manpower required (average number of men per day).
 - h. The SYMBOL LEGEND format shown below and on the drawing, CPM-1 (Sample CPM Network) is mandatory and shall be followed in

preparing final network diagrams.

SYMBOL LEGEND

Show Network Diagram page number location(s) for all incoming/outgoing node connector(s).



3. Show activities/events as:

- a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
- b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
- c. Interruption of VA Facility utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
- d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.

SPEC WRITER NOTE: Use the following on multiple phased project only.

- e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase. Schedule these activities/events so that only one phase is scheduled for completion within the same 30 consecutive calendar day period (except for those phases immediately preceding the final acceptance). Maintain this scheduling condition throughout the length of the contract unless waived by the Contracting Officer's representative in writing.

SPEC WRITER NOTE: Use the following on projects that require a separate bid item for asbestos abatement.

- f. Work activities/events for the asbestos abatement bid item shall have a trade code of ASB.

SPEC WRITER NOTE: Use the following on projects that have bid items.

- g. Bid items other than the Base Bid (ITEM 1) and Asbestos Abatement item shall have trade codes corresponding to the appropriate bid item number (e.g., ITM 3, ITM 4 and other items).
4. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.
 5. Break up the work into activities/events of a duration no longer than 20 work days each, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the Contracting Officer may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be less than 20 work days. Refer to drawing CPM-1 for VA approval activities/events which will require minimum duration longer than 20 workdays. The construction time as determined by the CPM schedule from early start to late finish for any sub-phase, phase or the

- entire project shall not exceed the contract time(s) specified or shown.
6. 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. Lead and lag time activities will not be acceptable.
 7. Uniquely number each activity/event with numbers ranging from 1 to 99998 only. The network diagram should be generally numbered in such a way to reflect either discipline, phase or location of the work.
- B. Submit the following supporting data in addition to the network diagram, activity/event ID schedule and electronic file (s). Failure of the Contractor to include this data will delay the review of the submittal until the Contracting Officer is in receipt of the missing data:
1. The proposed number of working days per week.
 2. The holidays to be observed during the life of the contract (by day, month, and year).
 3. The planned number of shifts per day.
 4. The number of hours per shift.
 5. List the major construction equipment to be used on the site, describing how each piece relates to and will be used in support of the submitted network diagram work activities/events.
 6. Provide a typed, doubled spaced, description, at least one page in length, of the plan and your approach to constructing the project.
- C. To the extent that the network diagram or any revised network diagram shows anything not jointly agreed upon, it shall not be deemed to have been approved by the Contracting Officer. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the Contracting Officer's approval of the network diagram.
- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA (Senior resident Engineer and CPM Schedule Analyst) an electronic file(s) containing one file of the data required to produce a Primavera (P6), (PDM) produced schedule, reflecting all the activities/events of the complete project network diagram being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall 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 pursuant to Article FAR 52.232 - 5 (PAYMENTS UNDER FIXED-PRICE CONSTRUCTION), and VAAR 852.236 - 83(PAYMENTS UNDER FIXED-PRICE CONSTRUCTION). The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated computer-produced calendar-dated schedule unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of Primavera (P6), (PDM) to the contracting officer's representative; a listing of all project schedule changes, and associated data, made at the update; and an electronic file (s) of the resulting monthly updated schedule in a compressed Primavera (P6), (PDM) format. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.
- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Primavera (P6), (PDM) schedule in electronic format, which, in the sole judgment of the Contracting Officer, is necessary for processing the monthly progress payment, the Contractor shall not be deemed to have provided an estimate and supporting schedule data upon which progress payment may be made.

1.9 PAYMENT AND PROGRESS REPORTING

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's representative) and the Contractor. Contractor and the CPM consultant will be required to attend all monthly progress meetings. Presence of Subcontractors during progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's representative). The Contractor shall update the project schedule and all other data required by this section shall be accurately filled in and completed prior to the monthly progress meeting. The Contractor shall provide this information to the Contracting Officer or the VA representative in

completed form three work days in advance of the progress meeting. 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. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the network diagram and computer-produced schedules. Changes in activity/event sequence and duration which have been made pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
 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.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contractor and the Contracting Officer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.
- C. After completion of the joint review and the Contracting Officer's approval of all entries, the contractor will generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.
- D. After completing the monthly schedule update, the contractor's scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and resident engineer for the contract change(s). When there is a disagreement on logic and/or durations, the consultant shall use the schedule logic and/or durations provided and approved by the resident engineer. After each rerun update, the resulting

electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the resident engineer within fourteen (14) calendar days of completing the regular schedule update. **Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**

- E. After VA acceptance and approval of the final network diagram, and after each monthly update, the contractor shall submit to the Contracting Officer three blue line copies of a revised complete network diagram showing all completed and partially completed activities/events, contract changes and logic changes made on the intervening updates or at the first update on the final diagram. The Contracting Officer may elect to have the contractor do this on a less frequent basis, but it shall be done on a quarterly basis as a minimum.
- F. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, RE office representatives, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. Whenever it becomes apparent from the current monthly progress review meeting or the monthly computer-produced calendar-dated schedule 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 CPM revisions shall be incorporated by the Contractor into the network diagram before the next update, at no additional cost to the Government.

1.11 CHANGES TO NETWORK DIAGRAM AND SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor will submit a revised network diagram, the associated compact disk(s), 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 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 CPM 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 network diagram regardless of the cause for these revisions.
- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, 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 network diagram 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 VA representative.
- D. The cost of revisions to the network diagram resulting from contract changes will be included in the proposal for changes in work as specified in Article, FAR 52.243 -4 (CHANGES), VAAR 852.236 - 88 (CHANGES - SUPPLEMENTS), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the network diagram not resulting from contract changes is the responsibility of the Contractor.

1.12 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, CPM 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. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer-produced calendar-dated schedule, do not affect the extended

and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.

- 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, FAR 52.243 -4 (CHANGES), VAAR 852.236 - 88 (CHANGES - SUPPLEMENTS). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.
 - 1. Delay attributed to unusually severe weather must be supported by climatological data covering the period in question, as well as the same period for the ten preceding years. When the weather condition in question exceeds the ten-year average in intensity or frequency, the excess experienced is considered to be "unusually severe." Comparison is normally on a monthly basis and because contract time is based upon calendar days, the days of the week are immaterial. Whether or not unusually severe weather delays the work would depend upon its effect on the work under way at the time and whether or not the effected work activities are on a critical path.
 - 2. For RFI's, strikes and similar non-work activities/events, the contractor shall submit to the SRE a report for the time the contract as a whole was delayed. This report shall give the dates the delay began and ended, the cause of the delay, the particular part or parts of work affected, and the number of calendar days the delay affected the completion date of the contract as a whole.

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

SPEC WRITER NOTES:

1. Use this section only for NCA projects
2. Delete between //-- // if not applicable to project. Also delete any other item or paragraph not applicable in the sections and renumber the paragraphs.

- 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 Resident Engineer 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 required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. // Submit // other // 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 shall be sent via first class mail //FAX // 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.

SPEC WRITER NOTE: Omit following subparagraph "C" if laboratory tests are not required.

- 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 Resident Engineer and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.

- //4. Contractor shall forward a copy of transmittal letter to Resident Engineer simultaneously with submission to a commercial testing laboratory //.
5. Laboratory test reports shall be sent directly to Resident Engineer 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 Resident Engineer 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 // (except laboratory samples), // shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

(Architect-Engineer)

(A/E P.O. Address)

(City, State and Zip Code)

- 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 Resident Engineer.

SPEC WRITER NOTE: Include following paragraph only if samples are to be sent to project site. If so, delete reference to samples in Paragraph 1-10.

- 1-12. Samples // (except laboratory samples) // for approval shall be sent to Architect-Engineer, in care of Resident Engineer, VA Medical Center,

(P.O. Address)

(City, State and Zip Code)

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**SECTION 01 45 29
TESTING LABORATORY SERVICES**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // -- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.

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 00, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 00, 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.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

- 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/C330M-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
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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 // Contracting Officer // RE/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 // Contracting Officer // RE/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 RE/COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of RE/COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to RE/COR, Contractor//, and Local Building Authority// within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

- D. Verbal Reports: Give verbal notification to RE/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 RE/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 RE/COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

SPEC WRITER NOTES:

1. Adjust the following requirements to include applicable conditions for specific project. Weigh the requirement for full time observation and costs.
 2. Provide // full time // part time // observation of fill placement and compaction and field density testing in building areas and provide // full time // part time // observation of fill placement and compaction and field density testing in pavement areas 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 // AASHTO // T99/T180 // Method A // // ASTM // D698 // D1557 // Method A // ASTM D698 and/or ASTM D1557.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 // AASHTO T238 // 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 RE/COR before the tests are conducted.

SPEC WRITER NOTES:

1. Include only applicable types of construction. Rates are for typical project; adjust for individual project.
- a. Building Slab Subgrade: At least one test of subgrade for every 185 m² (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m² (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
 - b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - c. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - e. 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.
 - f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to RE/COR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by RE/COR.

3.2 FOUNDATION PILES

SPEC WRITER NOTES:

1. Verify that test piles are required and location is shown.

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to RE/COR.
- //C. Auger-Placed Piles: Take and test samples of grout in accordance with ASTM C109 for conformance with specified strength requirements. Make no less than six cubes for each day of casting. Test three cubes at 7 days and three at 28 days. //
- //D. Cast-in-Place Concrete Piles: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced. //
- //E. Prestressed Concrete Piles:
 1. Inspection at Plant: Inspect forms, placement of reinforcing steel and strands, placement and finishing of concrete, and tensioning of strands.
 2. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
 3. Test strand for conformance with ASTM A416/A416M and furnish report to RE/COR.
 4. Inspect piles to insure specification requirements for curing and finishes have been met. //

SPEC WRITER NOTES:

1. Verify need for topsoil testing with Landscape Architect. Additional soil testing for pesticides, fertilizers, and other chemicals should be incorporated based upon discussion with the Landscape Architect.
2. Soils from borrow pits will generally require testing for toxic materials; verify criteria with governing jurisdiction.

3.3 LANDSCAPING

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
1. Test for organic material by using ASTM D2974.
 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
 - //3. Test for moisture absorption capacity.//
- B. Submit laboratory test report of topsoil to RE/COR.
- //C. Submit recommendations for soil amendments, from a regional soil conservation service or cooperative extension, to bring soil into compliance with minimum parameters in these specifications.//

SPEC WRITER NOTES:

1. Edit this section to refer to local state highway standards for materials and specifications, whenever possible. Insure these specifications agree with applicable state highway specifications and allow the construction to occur utilizing locally available materials accepted for the intended use that are approved in the state highway standards and specifications.
2. When editing following section, specific project location may have differing standards to reference.

3.4 ASPHALT CONCRETE PAVING

- A. Aggregate Base Course:
1. Determine maximum density and optimum moisture content for aggregate base material in accordance with // AASHTO T180, Method D // 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 // AASHTO T191 // 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.

SPEC WRITER NOTES:

1. Substitute applicable lab method or delete lab method if theoretical density is specified. Modify AASHTO standards indicated herein below to reflect the local equivalent test utilized by the State Highway

Department (SHD) standards and specifications. Contact local asphalt plant laboratories, or refer to SHD standards, for approved SHD products and associated tests that are the equivalent to the indicated AASHTO standards. Utilize SHD standard materials and testing procedures wherever possible and edit the following paragraphs accordingly.

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 RE/COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COR.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/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.

SPEC WRITER NOTES:

1. Include only tests applicable to the project. For a project with a large volume of concrete consider changing the rate of making concrete cylinders during the progress of the job.

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 m³ (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 RE/COR make three cylinders for each 80 m³ (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. RE/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 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (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 RE/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 RE/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 RE/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/m³ (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.

SPEC WRITER NOTES:

1. Testing of reinforcement bars is required for all major projects in the State of California. Check with structural engineer for testing in other locations.

3.7 REINFORCEMENT

- //A. Review mill test reports furnished by Contractor.//
- //A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18). //
- B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- C. Written report must include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.8 PRESTRESSED CONCRETE

- A. Inspection at Plant: Forms, placement and concrete cover of reinforcing steel and tendons, placement and finishing of concrete, and tensioning of tendons.
- B. Concrete Testing: Test concrete including materials for concrete required in Article, CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.
- C. Test tendons for conformance with ASTM A416 and furnish report to RE/COR.
- D. Inspect members to insure that specification requirements for curing and finishes have been met.

3.9 ARCHITECTURAL CAST STONE

- A. Perform testing according to ASTM C1364 or verify compliance by reviewing previous test results of same product.
- B. Inspect the plant to verify that specification requirements for curing and finishes have been met.

3.10 MASONRY

- A. Mortar Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
 - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.
- C. Masonry Unit Tests:
 - 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
- E. Field Inspection and Materials Testing:
 - 1. Verify the following prior to grouting:
 - a. Grout space is clean.
 - b. Type, spacing, and placement of reinforcement, connectors, and anchors comply with the contract requirements.

SPEC WRITER NOTES:

- 1. Verify need for and extent of Structural Steel Inspection and testing services with Structural Engineer.

3.11 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Conform to AWS D1.1 Structural Welding Code for welding.
- B. Prefabrication Inspection:
 - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 - 2. Approve welding procedure qualifications by pre-qualification or by witnessing qualifications tests.
 - 3. Approve welder qualifications by certification or retesting.
 - 4. Approve procedure for control of distortion and shrinkage stresses.
 - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 - 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.

- g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.

SPEC WRITER NOTES:

- 1. Specify radiographic testing only for very large jobs or those with complicated full penetration welds.
- h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
 - i. Verify that rejected welds corrections are made in accordance with AWS D1.1.
 - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to RE/COR.

SPEC WRITER NOTES:

- 1. Verify need for and extent of Steel Decking Inspection and testing services with Structural Engineer.

3.12 STEEL DECKING

- A. Provide field inspection of welds of metal deck to the supporting steel, and testing services to insure steel decking has been installed in accordance with contract documents and manufacturer's requirements.
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS D1.1. Refer to the "Plug Weld Qualification Procedure" in Part 3 "Field Quality Control."
- C. Submit inspection reports, certification, and instances of noncompliance to RE/COR.

3.13 SHEAR CONNECTOR STUDS

- A. Provide field inspection and testing services required by AWS D.1 to insure shear connector studs have been installed in accordance with contract documents.
- B. Tests: Test 20 percent of headed studs for fastening strength in accordance with AWS D1.1.
- C. Submit inspection reports, certification, and instances of noncompliance to RE/COR.

SPEC WRITER NOTES:

- 1. Use rates specified and estimated quantities to determine approximate number of tests and man-days of inspection required.

3.15 TYPE OF TEST

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
/(AASHTO T180)/(AASHTO T99)/(ASTM D1557)/(ASTM D698)/	

Field Density, Soils (AASHTO T191, T205, or T238)	_____
Penetration Test, Soils	_____

- B. Landscaping:
 Topsoil Test _____
- C. Aggregate Base:
 Laboratory Compaction, // (AASHTO T180)// //(ASTM D1557)// _____
 Field Density, //(AASHTO T191)// //(ASTM D1556)// _____
 Aggregate, Base Course
 Gradation (AASHTO T27) _____
 Wear (AASHTO T96) _____
 Soundness (AASHTO T104) _____
- D. Asphalt Concrete:
 Field Density, (AASHTO T230)//ASTM D1188// _____
 Aggregate, Asphalt Concrete
 Gradation (AASHTO T27) _____
 Wear (AASHTO T96) _____
 Soundness (AASHTO T104) _____
- E. Concrete:
 Making and Curing Concrete Test Cylinders (ASTM C31) _____
 Compressive Strength, Test Cylinders (ASTM C39) _____
 Concrete Slump Test (ASTM C143) _____
 Concrete Air Content Test (ASTM C173) _____
 Unit Weight, Lightweight Concrete (ASTM C567) _____
 Aggregate, Normal Weight:
 Gradation (ASTM C33) _____
 Deleterious Substances (ASTM C33) _____
 Soundness (ASTM C33) _____
 Abrasion (ASTM C33) _____
 Aggregate, Lightweight
 Gradation (ASTM C330) _____
 Deleterious Substances (ASTM C330) _____
 Unit Weight (ASTM C330) _____
 Flatness and Levelness Readings (ASTM E1155) (number of days) _____
- F. Reinforcing Steel:
 Tensile Test (ASTM A370) _____
 Bend Test (ASTM A370) _____
 Mechanical Splice (ASTM A370) _____
 Welded Splice Test (ASTM A370) _____
- G. Prestressed Concrete:

- Testing Strands (ASTM A416) _____
- H. Masonry:
 - Making and Curing Test Cubes (ASTM C109) _____
 - Compressive Strength, Test Cubes (ASTM C109) _____
 - Sampling and Testing Mortar, Comp. Strength (ASTM C780) _____
 - Sampling and Testing Grout, Comp. Strength (ASTM C1019) _____
 - Masonry Unit, Compressive Strength (ASTM C140) _____
 - Prism Tests (ASTM C1314) _____
- I. Structural Steel:
 - Ultrasonic Testing of Welds (ASTM E164) _____
 - Magnetic Particle Testing of Welds (ASTM E709) _____
 - Radiographic Testing of Welds (ASTM E94) _____
- J. Sprayed-On Fireproofing:
 - Thickness and Density Tests (ASTM E605) _____

SPEC WRITER NOTES:

- 1. Use man-days on small projects where the inspection will be paid separate from field tests.

//K. Inspection:

Technical Personnel (Man-days) _____//

SPEC WRITER NOTES:

- 1. Use the following for large projects where field testing is part of technician's service.

//L. Technical Personnel: (Minimum _____ months)

- 1. Technicians to perform tests and inspection listed above. Laboratory will be equipped with concrete cylinder storage facilities, compression machine, cube molds, proctor molds, balances, scales, moisture ovens, slump cones, air meter, and all necessary equipment for compaction control. //

- - - E N D - - -

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Refer to and edit this Section per the environmental protection actions required and identified in the specific project mitigation memorandum on file with the Project Manager.
3. Delete or add information between //----// and any other items applicable to project. Renumber the paragraphs as applicable. Also delete any other items not applicable to the project and renumber the Paragraph's.

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 effect 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.

1.2 DEFINITIONS OF POLLUTANTS

- 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.

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, 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.

SPEC WRITER NOTES:

1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
 2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.
- 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
- C. 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/>

1.5 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // _____// requirements.
- 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>.

1.6 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 Resident Engineer/Contracting Officer's Representative (RE/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 RE/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.

SPEC WRITER NOTES:

1. Edit below as required.

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, // stream crossings, // 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 RE/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.

SPEC WRITER NOTES:

- 1. Coordinate these specifications and the drawings and ensure that details for straw waddles, fiber rolls, etc. are indicated to secure bare areas awaiting the 1 year maturity of any hydroseeding or soil stabilization.

1.7 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, based upon leaving the site that has yet to mature of hydroseeding. 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 RE/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. See Section 02 41 19.
 - 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 Sediment and Erosion 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.

SPEC WRITER NOTES:

1. The design year storm is determined by the downstream environment to be protected and defined in State or Local Regulations. Implement appropriate protection based on the estimate of damage to the downstream environment versus the design year

storm that will cause damage. If permanent sediment basins are necessary for the particular project, include these permanent facilities in the project design and the contract documents. If permanent basins are not required, delete reference thereto.

- a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local //_____// (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, that drain from the surface of the basin.
 - b. Reuse or conserve the collected topsoil sediment as directed by the RE/COR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING //short form//.
 - c. 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 Environmental Protection 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 wattles, fiber rolls, until permanent drainage and erosion control facilities are completed and operative.

SPEC WRITER NOTES:

1. Coordinate the following two paragraphs with the drawings, details and notes to clearly indicate how the Contractor shall accomplish these tasks.
6. Manage and control borrow and spoil areas on // and off // Government property 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 the RE/COR.
- 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.
 2. //Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.//
- SPEC WRITER NOTE:
1. Specify additional operations unique to this contract.
3. Monitor water areas, wetlands and wetland buffers affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list protected species that require specific attention along with measures for their protection.
- E. 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 // insert Name of State and title of State Air Pollution Statue, Rule, or Regulation // 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 //from asphaltic batch plants if onsite, or other onsite material processing operations// 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, //plant sites,// 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, light bituminous treatment, 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.
- F. 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 Resident Engineer/COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.

SPEC WRITER NOTE:

1. Revise hours and sound levels in accordance with local standards and regulations as necessary.
1. Perform construction activities involving repetitive, high-level impact noise only between //6:00 //___//a.m. and //6:00//___//p.m. unless otherwise permitted by local ordinance or the RE/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
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SPEC WRITER NOTE:

1. Insert additional information as needed when unique to a particular NCA site.
 2. See 2. below. Will BLASTING be allowed in contract?
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	//--//
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 Resident Engineer/COR noting any problems and the alternatives for mitigating actions.
- G. 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.
- H. 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 RE/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 01 74 19
CONSTRUCTION WASTE MANAGEMENT

SPEC WRITER NOTE: Use this section only
for NCA projects.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
 - 1. Waste Management Plan development and implementation.
 - 2. Techniques to minimize waste generation.
 - 3. Sorting and separating of waste materials.
 - 4. Salvage of existing materials and items for reuse or resale.
 - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
 - 1. Soil.
 - 2. Inerts (eg, concrete, masonry and asphalt).
 - 3. Clean dimensional wood and palette wood.
 - 4. Green waste (biodegradable landscaping materials).
 - 5. Engineered wood products (plywood, particle board and I-joists, etc).
 - 6. Metal products (eg, steel, wire, beverage containers, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (eg, ABS, PVC).
 - 10. Carpet and/or pad.
 - 11. Gypsum board.
 - 12. Insulation.
 - 13. Paint.

1.2 RELATED WORK

- A. Section 02 41 00, DEMOLITION.
- B. Section 01 00 00, GENERAL REQUIREMENTS.

C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

1.3 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
1. Excess or unusable construction materials.
 2. Packaging used for construction products.
 3. Poor planning and/or layout.
 4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.4 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.

- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
 - 1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 - 2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
- B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
 - 1. Procedures to be used for debris management.
 - 2. Techniques to be used to minimize waste generation.
 - 3. Analysis of the estimated job site waste to be generated:

- a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
4. Detailed description of the Means/Methods to be used for material handling.
- a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- B. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- C. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.6 APPLICABLE PUBLICATIONS

Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

- A. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.7 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION**3.1 COLLECTION**

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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**SECTION 02 41 10
DEMOLITION AND SITE CLEARING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // ---- // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. Use this Section for projects involving total or large scale demolition. Omit this Section on projects involving minor demolition.
4. Buildings, structures, utilities, etc., required to be removed must be clearly shown.
5. Debris or trash dumps should be shown to the fullest extent. If quantities of materials to be removed cannot be accurately estimated, do not include estimates of quantities. If site clearing is included in project, removal of debris from onsite trash dumps should be included in that specification section, then removal of materials from onsite trash dumps should be included in this specification section.
6. Modify the following paragraphs to reflect specific conditions for the project.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies all site preparation work, demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2 RELATED WORK

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: // Section 31 20 00, EARTH MOVING // Section 31 20 11, EARTH MOVING (SHORT FORM) //.
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Asbestos Removal: Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- F. Lead Paint: Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.

G. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

H. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT

1.3 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

SPEC WRITER NOTES:

- 1. Unless the building is to be demolished story by story paragraph F2 should not be used.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.

3. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the Resident Engineer/Contracting Officer's Representative (RE/COR). Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have RE/COR's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 UTILITY SERVICES

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
- B. Erosion Control: Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. Install silt fence and inlet protection as shown and as per requirements of the SWPPP, prior to any soil disturbance activities. Provide temporary seeding as required by the SWPPP.
- C. Maintain site controls in accordance with Storm Water Pollution Prevention Plan and repair as directed by COTR to sustain compliance with SPDES permit. Maintain all records as required by the SWPPP. Perform inspections as required by the SWPPP.
- D. Topsoil - On-site: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 150 mm (6 inches). Satisfactory topsoil is reasonably free and/or screened of subsoil, clay lumps, stones, and other objects over 25 mm (1 inch) in diameter, and without weeds, roots, and other objectionable material.
 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Storm Water Pollution Prevention Plan. Refer to Division 2 Section 32 90 00, "Planting" for soil amendments required prior to spreading topsoil.
 - a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the Architect.
- E. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.

1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 150 mm (6 inches) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- F. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
- G. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 Sections. Removing abandoned underground piping or conduits interfering with construction is included under this Section, except as indicated to be abandoned in-place.
- H. Continue maintenance of erosion controls in compliance with the Storm Water Pollution Prevention Plan until the work is completed and the threat of erosion is gone by either around surface stabilizer or lawn "grow-in" is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:
1. As required for installation of new utility service lines.
 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the RE/COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor

shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

- C. In removing buildings and structures of more than two stories, demolish work story by story starting at highest level and progressing down to third floor level. Demolition of first and second stories may proceed simultaneously.
- D. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall // become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations // be hauled to VA specified disposal site //. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500 mm (5 feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications. Burning is not permitted on the property.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the RE/COR. When Utility lines are encountered that are not indicated on the drawings, the RE/COR shall be notified prior to further work in that area.

3.2 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to RE/COR. Clean-up shall include off the Cemetery Property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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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: Division 31 "EARTHWORK."
- B. Materials Testing and Inspection during Fabrication and Construction: Division 1 Section TESTING LABORATORY SERVICES.

1.4 SUSTAINABILITY REQUIREMENTS

- A. Materials in this section may contribute towards contract compliance with sustainability requirements. See Section 01 81 11, SUSTAINABLE DESIGN REQUIRMENTS, for project // local/regional materials, // low-emitting materials, // recycled content, // certified wood // ____// requirements.
- B. 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.
- C. 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/conserves/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.
- B. Fulfillment of regulatory requirements does not relieve the Contractor of satisfying sustainability requirements stipulated by Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS, as it relates to recycled content; additional product and material selections with recycled content may be required, as determined by Contractor's Sustainability Action Plan.

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 RE/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 Resident Engineer/Contracting Officer's Representative RE/COR for approval the following:
- a. Five 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.

SPEC WRITER NOTES:

1. Edit the following paragraph regarding the use of the plastic anchor cover. The plastic anchor cover may be eliminated, if approved by the Project Manager following discussion with operations personnel that are familiar with the problems regarding using these plastic caps where frost occurs. Substitution of a small well washed gravel has by experience made it easier for the staff to remove the gravel and ice that accumulates in the lifting bowls.

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 //removable anchor covers to prevent dirt from entering the anchor bowl and installed in such a manner as to stay in-place when excavating equipment is scraping backfill off the top of the lid//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 RE/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 RE/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 RE/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 RE/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 RE/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.

SPEC WRITER NOTES:

- 1. Remove reference citations that do not remain in Part 2 or Part 3 of edited specification.
- 2. Verify and make dates indicated for remaining citations the most current at date of submittal; determine changes from date indicated on the TIL download of the section and modify requirements impacted by the changes.

- 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.

SPEC WRITER NOTES:

1. Use plastic caps on each of the lifting bowls, unless specifically directed otherwise by the Project Manager with approval of the NCA Crypt Specialist.
 2. Modify the following paragraph to reflect the decision whether or not to use the plastic cap over the lifting bowl.
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. //A removable plastic cap secured to the anchor which prevents fill material from entering the anchor bowl. Cap to be flush mounted to ensure the entire assembly is not an obstruction for crypt excavating equipment. //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 RE/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 RE/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 RE/COR.
 - a. The RE/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 RE/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 RE/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 RE/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 RE/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 RE/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 RE/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 RE/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 RE/COR's discretion, a non-rounded stone may be considered as a substitute for the rounded stone. The RE/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 than 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

SPEC WRITER NOTES:

1. Modify the following as needed following discussion with the current operations staff regarding the sand layer (adjust the thickness, or eliminate.)
 2. Coordinate the thickness of topsoil based upon recommendations from the current Cemetery operations, if applicable, and based upon the soil conditions below the topsoil, to ensure adequacy for roots, and efficient use of water.
- 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 100 mm (4 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. Install drainage board for pea gravel flow containment located in perimeter crypt gaps in areas shown on Drawings.
1. Drainage board shall be installed at the perimeter of crypt field in locations where standard or oversize traditional gravesite burial spaces are identified on the drawings and other areas so designated.
 2. Drainage board shall be as appropriate to fill gap and stop pea gravel flow, and provide for drainage rates of 1000 L/hr/m (100 gal/hr/lf) in any direction.

3. The drainage board shall be made of "non-deteriorating" recycled materials and be able to be compressed and return to its original thickness.
 4. Drainage board shall contain pea gravel between Crypts. Attach board to Crypt wall exterior with fastening method approved during functional load testing. Ensure board material re-expands to original thickness if compressed. Drainage board shall be installed from bottom of Crypt to bottom of lid. Exterior edge of board shall be inset at least 50 mm (2 inches) from edge of crypt and extend 600 mm (2 feet) in between Crypts.
- I. 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 along side crypts unless impact loads are shown not to exceed crypt design loads.
 - J. 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 axle load maximum. Keep 9 m away"** ("**12,000-lb axle load maximum. Keep 10 yards away**") and placed minimum 15 m (50-ft) apart.
 - K. Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.
 - L. Finish grading and prepare topsoil as indicated on plans.
 - M. 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 RE/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.
 - N. 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 RE/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.

SPEC WRITER NOTES:

1. Delete or modify Paragraph A.2 as directed by the Project Manager.

3.8 INSPECTION AND ACCEPTANCE

A. Final inspection and acceptance will be by RE/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 31 20 11
EARTH MOVING (SHORT FORM)**

SPEC WRITER NOTES:

1. Use this section only for NCA projects. Delete text between // _____ // not applicable to project. Edit remaining text to suit project.
2. Use this section for small projects where earthwork is not extensive and site work restoration only is required.
3. Where materials are specified, substitute readily available materials meeting local State DOT standards, when possible. Contact local quarries regarding availability of local materials meeting State DOT standards.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Earthwork including excavation, fill, backfill, and lawn restoration.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain references only when specified elsewhere in this section.

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. // Foundation System Requirements: FLOWABLE FILL, Section 31 23 23.33 //.

1.3 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

- A. Measurement: Cross section and measure the uncovered and separated materials, and compute quantities by the Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:

1. 300 mm (12 inches) outside of the perimeter of formed footings.
2. 600 mm (24 inches) outside the face of concrete work when forms are required, except for footings.
3. 150 mm (6 inches) below the bottom of pipe and maximum the pipe diameter plus 600 mm (24 inches) in width for pipe trenches.

4. Outside dimensions of concrete work when no forms are required (trenches, conduits, and similar items not requiring forms).
- B. // Payment: No separate payment shall be made for rock excavation quantities shown. The contract price and time will be adjusted for overruns or underruns according to Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable //.
- C. // Payment for Differing Site Conditions: When rock excavation, as classified, is encountered, the contract price and time will be adjusted according to Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable //.

1.4 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, 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 // reference borings and // design requirements, excavate to acceptable strata subject to Contracting Officer's Representative's (COR) approval.
- B. Earthwork: Earthwork operations required within the new construction area. 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 // AASHTO // T99 // T180 // Method A. // ASTM // D698 // D1557 // Method A //.
- D. The term fill means fill or backfill.
- E. Topsoil: Fertile, friable, natural topsoil of loamy character and characteristic of locality, capable of growing healthy horticultural crops of grasses.

1.5 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.

SPEC WRITER NOTES: Retain Unclassified excavation above or classified excavation below.

- B. Classified Excavation: Removal and disposal of all material not defined as rock.
- C. Rock Excavation:
1. Solid ledge rock (igneous, metamorphic, and sedimentary rock).
 2. Bedded or conglomerate deposits, cemented to present characteristics of solid rock which cannot be excavated without blasting; or the use of modern power excavator (shovel, backhoe, or similar power excavators) minimum 0.75 m³ (1 cubic yard) capacity, properly used, having adequate power and in good running condition.
 3. Boulders or other detached stones each having a volume of 0.4 cubic meter (1/2 cubic yard) or more.

1.6 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Nursery and Landscape Association (ANLA):
1. 2004 - American Standard for Nursery Stock.
- C. American Association of State Highway and Transportation Officials (AASHTO):
1. T99-01 (R2004) - Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop.
 2. T180-01 (2004) - Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (18 inch) Drop.
- D. ASTM International (ASTM):
1. D698-07 - Laboratory Compaction Characteristics of Soil Using Standard Effort.
 2. D1557-07 - Laboratory Compaction Characteristics of Soil Using Modified Effort.
- E. Standard Specifications of (Insert name of local state) State Department of Transportation, latest revision.

1.7 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
 - 2. Plot plan showing elevations.
- C. Test Reports: Certify // each product complies // products comply // with specifications.
 - 1. Rock Excavation Report:
 - 2. Certification of rock quantities excavated.
 - a. Excavation method.
 - b. Labor.
 - c. Equipment.
 - 3. Land Surveyor's or Civil Engineer's name and official registration stamp.

SPEC WRITER NOTES: Use only when there is
a VA Retained Testing Laboratory.

- D. Samples:
- E. Soil Samples: Provide proposed off site or on site fill material to COR, suitable for laboratory tests.

1.8 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, // color, // production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

PART 2 - PRODUCTS

2.1 MATERIALS

SPEC WRITER NOTES: Make material
requirements agree with applicable
requirements specified in the referenced
Applicable Publications. Update and
specify only which applies to the
project.

- A. Fills: Materials approved from on site and off site sources.
 - 1. Dry Density: 1760 kg/m3 (110 pcf) minimum.

2. Plasticity Index: 6 maximum.

3. Liquid Limit: 30 maximum.

B. Granular Fill:

1. Under Concrete Slab: Crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4).

2. Bedding for Sanitary and Storm Sewer Pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

SPEC WRITER NOTES: Make the following sections match the areas shown on Drawings. Clearly show which areas are to be restored utilizing fertilizer and seed, or sod. Provide detail on Drawings with thickness and condition of materials to be applied and whether straw is to be applied over the seed.

C. Fertilizer: 5 percent nitrogen, 10 percent phosphorus, and 5 percent potash.

D. Seed: Grass mixture comparable to existing turf.

E. Sod: Comparable species with existing turf, without broken pads and torn or uneven ends. Use State Certified or State Approved sod when available.

1. Thickness of Cut: 19 mm to 32 mm (3/4 inch to 1 1/4 inches) excluding top growth.

PART 3 - EXECUTION

3.1 SITE PREPARATION

SPEC WRITER NOTES:

1. Make the following sections match the areas shown on Drawings. Note any visible areas of trash, debris, previously dumped or stored materials to be removed according to these sections on Drawings.
2. Do not estimate quantity or volume of materials to be removed when being handled as part of the lump sum price for the Work.

A. Clearing:

1. Clear within the limits of earthwork operations as described or designated by the COR.

2. Remove trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions.

3. Remove materials from the Cemetery Property.

B. Grubbing:

1. Remove stumps and roots 75 mm (3 inches) and larger diameter.
2. Leave undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects minimum 900 mm (3 feet) below subgrade or finished embankment.
3. Do not leave material within the burial profile up to 2400 mm (8 feet) below finished grade.

C. Trees and Shrubs:

1. Remove trees and shrubs, not shown for removal, within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines when approved in advance by the COR.
2. Remove materials from the Cemetery Property.
3. Transplant trees and shrubs with a ball of earth and burlap according to the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc.
4. Transplant trees and shrubs to a permanent or temporary position within two hours after digging.
5. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding liquid fertilizer semi-annually with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash.
6. Maintain plants moved to permanent positions as specified for plants in temporary locations until substantial completion.
7. Protect from damage, existing trees and shrubs. Trim, clean, and paint existing trees and shrubs including the roots, according to standard industry horticultural practice for the geographic area and plant species.
8. Do not store building materials closer to trees and shrubs to remain than the farthest extension of limbs.

D. Stripping Topsoil: Unless otherwise indicated on the drawings, extend limits of earthwork operations 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, within the limits of earthwork operations as specified above, unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Stockpile topsoil and protect as directed by the COR. Eliminate foreign

material larger than 0.014 cubic meter (1/2 cubic foot) in volume, from soil when stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Do not excavate wet topsoil.

SPEC WRITER NOTES:

1. Modify specifications for topsoil, whether on site or imported to the site, to contain the minimum organic content and constituents identified in geotechnical report. When there no recommendations, follow specifications adopted by the closest State Department of Transportation (DOT) for topsoil. When onsite topsoil does not meet minimum requirements of geotechnical report or DOT standards, whichever is greater, then soil shall either be amended to meet the requirements, or topsoil shall be imported that does meet the requirements.

2. Edit specifications or add notes on drawings requiring analysis of topsoil and plans for achieving the stated constituents and characteristics for the topsoil are submitted to the COR for review and approval.

1. Test soil for chemicals, pesticides and fertilizers when topsoil is removed from formerly utilized as farmland, to verify suitability for use in new lawn areas.

E. Concrete Slabs and Paving:

1. Score deeply or saw cut existing concrete slabs and paving to be removed in a neat, straight cut, sections where excavation or trenching occurs.
2. Extend pavement section, minimum of 300 mm (12 inches) on both sides of widest part of trench excavation. Provide parallel final score lines unless otherwise indicated on Drawings.
3. Remove material from the Cemetery Property.

F. Disposal:

1. Remove materials from site and disposed of at legally approved site.
2. Comply with applicable Federal, State and local regulations. Do not burn materials on site.

3.2 EXCAVATION

- A. Shoring, Sheeting and Bracing: Shore, brace, or slope to an 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 bottom of the excavation. Shore excavations carried below the elevations of adjacent existing foundations.
 2. Provide concrete fill support when bearing of foundation is disturbed by excavation, improper shoring or removal of shoring, placing of backfill, and similar operations, // in compliance with Specification Section 31 23 23.33, FLOWABLE FILL, // under disturbed foundations, as directed by COR. Do not remove shoring until permanent work in excavation has been inspected and approved by COR.
- B. Excavation Drainage:
1. Operate pumping equipment // , and install other materials, means and equipment // to keep excavations free from water and subgrades dry, firm, and undisturbed until permanent work is received by COR.
 2. // Obtain approval from COR before placement of permanent work on subgrades //.
 3. // Remove disturbed material to firm undisturbed material after water is brought under control, when subgrade for foundations is disturbed by water. 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, coordinate with COR to consider use of flowable fill //.
- SPEC WRITER NOTES: Modify the following paragraph as required for the specific project.
- C. Blasting: // Blasting is permitted only when authorized by COR according to applicable provisions of 29 CFR 1926. // Blasting is not acceptable //.
- D. Building Earthwork:
1. Excavate foundation excavations to solid undisturbed subgrade.
 2. Remove loose or soft material to solid bottom.
 3. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
 4. Do not tamp earth for backfilling in footing bottoms.

E. Trench Earthwork:

1. Utility Trenches (Except Sanitary and Storm Sewer):
 - a. Excavate to width required for sheeting and bracing and proper performance of Work.
 - b. Grade bottom of trenches with bell-holes, scooped-out to provide uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is indicated on Drawings.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COR.
2. Sanitary and storm sewer trenches:
 - a. Trench Width:
 - 1) Below Point 150 mm (6 inches) Above Top of Pipe:
 - a) Pipe up to 300 mm (12 inches): 600 mm (24 inches) diameter.
 - b) Pipe Larger than 300 mm (12 inches): 4/3 diameter of pipe plus 200 mm (8 inches).
 - 2) Trench Width Above 150 mm (6 inches): Pipe size as required for sheeting and bracing and proper performance of the Work.
 - b. Bed Bottom Quadrant of Pipe:
 - 1) Undisturbed Soil: Bell holes no larger than necessary for jointing. Backfill with clean earth, placed and tamped by hand, maximum 300 mm (12 inches) above top of pipe.
 - 2) Granular Fill: Depth of fill minimum 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 excess backfill using acceptable excavated materials. Do not use unsuitable materials.
 - d. Use granular fill for bedding where rock or rocky materials are excavated.

SPEC WRITER NOTES: Modify the following section to clarify the determination of unsuitable material by the COR or the Geotechnical Engineer from the VA Testing Laboratory. Coordinate the determination with the work performed by Testing Laboratory as specified in Section 01 45 29, TESTING LABORATORY SERVICES.

F. Site Earthwork:

1. Perform excavation as indicated on Drawings and as follows:
 - a. Remove and replace unsuitable subgrade materials, as determined by the COR.
 - b. // Obtain material samples for soil classification, under COR's direction, for testing by an approved testing laboratory to determine suitability //.
 - c. // Testing of the soil shall be performed by the VA Testing Laboratory //.
 - d. When unsuitable material is encountered and removed, the contract price and time will be adjusted according to Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL REQUIREMENTS as applicable. Adjustments to be based on cubic meters (cubic yard) in cut section only.
2. Finished subgrade elevation as follows:

SPEC WRITER NOTES: Modify the following statements to correspond with the common practice for the project area and ensure information is consistent with Drawing details.

- a. Pavement Areas: Bottom of pavement or base course as applicable.
- b. Planting and Lawn Areas: 100 mm (4 inches) below finished grade, unless otherwise specified or indicated on the Drawings.

3.3 FILLING AND BACKFILLING

- A. General: Fill or backfill when all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from 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. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes in contact

with backfill have been installed, and work inspected and approved by COR.

- B. Proofrolling Existing Subgrade: Proof roll with 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) loose depth and then compacted. Do not place material muddy, frozen, or with frost surfaces.

SPEC WRITER NOTES:

1. Modify the following paragraph as required to specify the compaction test method to be followed and the required test method.
2. Recommend calling local testing laboratories to find out the common test method for the soils in the project area.
3. Adjustment of the required percentage of compaction shown below may be appropriate for areas not receiving engineered or structural fill.
4. Follow recommendations from the geotechnical report or have tests made for the existing in place soil densities as a comparison. Use the recommendations from the geotechnical report of the site conditions wherever possible.

- D. Compaction: Use approved equipment (hand or mechanical) to suit type of material compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of the COR. Moisten or aerate material necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact each layer // until there is no evidence of further compaction // minimum 95 percent of maximum density determined according to the following test method // AASHTO // T99 // T180 // Method A // ASTM // D698 // D1557 Method A //.

3.4 GRADING

- A. General: Uniformly grade areas within limits specified, including adjacent transition areas. Smooth finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between points and existing finished grades. Provide 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 building away from building walls with minimum distance of 1800 mm (6 feet).
- D. Finished grade 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled, 150 mm (6 inches) thick, unless otherwise indicated on Drawings.

SPEC WRITER NOTES: Delete scarify,
compact, and grade when proof-rolling
will suffice.

- F. Finish subgrade in condition acceptable to the COR at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade before further construction when approved compacted subgrade is disturbed by subsequent operations or adverse weather.
- G. Tolerances:
 1. Subgrade and Base Course Final Grades for Paved Areas: Plus or minus 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS

- A. General: Harrow and till new or existing lawn areas to remain, 100 mm (4 inches) deep. Establish existing or design grades by dragging or similar operations. Do not do earthwork on wet soil. Obtain plant bed approval from COR before seeding or sodding operation begins.

SPEC WRITER NOTES: Adjust minimum
thickness of topsoil per geotechnical
report recommendations, or the common
practice for the area, or the
recommendations of the State Department
of Transportation, whichever is greater.

- B. Finished Grading: Begin after rough grading has settled. Scarify subgrade surface areas 100 mm (4 inches) deep. Apply topsoil smooth, even surface, and true grades minimum 100 mm (4 inches). Shape top and bottom of banks to form reverse curves in section; make junctions with undisturbed areas to conform to existing topography.

- C. Fertilizing: Mix fertilizer into the soil 100 mm (4 inches) deep at a rate of 12 kg/100 m² (25 pounds per 1000 square feet).
- D. Seeding: Apply seed at a rate of 2 kg/100 sq.m (4 pounds per 1000 square feet). Rake seed lightly. Roll area not to exceed 225 kg/m (150 pounds per foot) of roller width.
- E. Sodding: Water topsoil lightly before laying sod. Tightly butt sod strips at the ends and stagger in a running bond fashion. Place sod strips running across slope from bottom to top. Secure sodded slopes by pegging or other approved methods. Roll sodded area not to exceed 225 kg/m (150 pounds per foot) of the roller width.
- F. Watering: Upon completion in any one section, water thoroughly new sod pad and soil to a sufficient depth. COR will be responsible for sod after installation and acceptance.

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 Cemetery property //.
- B. // Disposal: Transport surplus satisfactory soil to designated storage areas on Cemetery property. Stockpile or spread soil as directed by COR //.
- 1. // Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose off Cemetery property //.

3.7 CLEANING

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

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**SECTION 31 23 19
DEWATERING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete text between // _____ // not applicable to project. Edit remaining text to suit project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. Surface water included in this work shall include water that appears on the surface as rainfall or snowmelt runoff, or ground water conditions below grades that appear at the surface in the form of weeps or springs. Dewatering of surface water from flowing streams, brooks, lakes, ponds, or rivers identified on USGS topographic maps or shown on the plans as flowing shall not be included in this specification section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Implementation of Erosion and Sedimentation Control Plan.
 2. Dewater excavations, including seepage and precipitation.
- B. Provide all labor, materials, tools, equipment, power, and services necessary for care of water and erosion control. Begin excavation work before the approved Erosion and Sedimentation Control Plan is in place.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain references only when specified elsewhere in this section.

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Erosion Control: Section 01 57 23, TEMPORARY STORM WATER POLLUTION CONTROLS.

1.3 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show drawings and data with method employed in dewatering excavated areas, 30 days before commencement of excavation.
 - 2. Show location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey water from site to adequate disposal. Show details of the dewatering facilities, including equipment and erosion protection. Include facilities and procedures for insuring discharge water quality according to the applicable provisions of Erosion Control Plan or SWPPP or NPDES requirements, Section 01 57 23, TEMPORARY STORM WATER POLLUTION CONTROLS.
 - 3. Include written report outlining control procedures to be adopted when a dewatering problem arises.
 - 4. Submit materials in format acceptable to all regulatory agencies.
- C. Inspection Reports.
- D. All required permits.
- E. Delegated Design Drawings and Calculations: Signed and sealed by responsible design professional.
 - 1. Identify deviations from details shown on drawings.

1.4 QUALITY ASSURANCE

- A. Permitting Requirements: Comply and obtain required Federal, State, and County permits where Work is performed.
- B. Comply and provide information to Contracting Officer's Representative (COR), all conditions of regulating permits. Obtain written approval from COR before discontinuing operation of dewatering system.

PART 2 - PRODUCTS**2.1 SYSTEM DESCRIPTION**

SPEC WRITER NOTES:

1. Modify these specifications to insure that the Contractor coordinates the control of surface water described in this section, with the requirements in the National Pollution Discharge Elimination System (NPDES) requirements, where applicable.
2. Modify these specifications to require that the Contractor perform the dewatering work while maintaining water quality discharge requirements of the applicable State or Federal regulations.

- A. Dewatering: Lower and control ground water table levels and hydrostatic pressures and control surface water.

2.2 SYSTEM PERFORMANCE

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.
 1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by COR when deviations do not affect design concept and specified performance.
- B. Design dewatering system complying with specified performance:
 1. Size and Capacity: At least // 300 mm (1 foot) // below lowest foundation subgrade or bottom of pipe trench.
 2. Reduce hydrostatic head below excavation surface minimum 300 mm (1 foot) until backfill has been completed at least 300 mm (1-foot) above the initial observed groundwater level.
 3. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
 4. Maintain stability of sides and bottom of excavation.
 5. Construction operations are performed in the dry subgrade.
 6. Control of surface and subsurface water as part of dewatering requirements. Maintain adequate control.
 - a. Stabilize excavated and constructed slopes not adversely affected by saturated soil.
 - b. Control erosion.
 - c. Flooding of excavations or damage to structures does not occur.

- d. Surface water drains away from excavations.
- e. Protect excavations of becoming wet from surface water before additional work is undertaken.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install dewatering system to lower and control ground surface water to permit excavation, construction of structure, and placement of backfill materials in dry conditions. Make dewatering system adequate to pre-drain the water-bearing strata above and below bottom of structure foundations, utilities and other excavations.
- B. Reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, minimum // 300 mm (1 foot) // below prevailing excavation surface.
- C. Operation:
 - 1. Place dewatering system in operation before excavation below ground water table. Operate system continuously 24 hours a day, 7 days a week until construction work below existing ground water level is complete.
 - 2. Place adequate weight of backfill material to prevent buoyancy before discontinuing operation of the system.
- D. Water Disposal:
- E. Dispose water removed from excavations in such a manner as:
 - a. Avoid endanger portions of work under construction or completed.
 - b. Avoid inconvenience to Government or to others working near site.
 - c. Comply with permit regulations for disposal of water.
 - d. Control Runoff: Control runoff in work areas including but not limited to excavations, access roads, parking areas, laydown, and staging areas. Provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. Remove water from work areas and dispose according to applicable permits.
- 2. Excavation Dewatering:
 - a. Divert, collect, control, and remove water from construction work areas and excavations.

- b. Arrange drainage features and alter as required to avoid degradation of the final excavated surfaces.
- c. Utilize all necessary erosion and sediment control measures to avoid construction related degradation of natural water quality.
- 3. Remove and dispose surface and ground water entering excavations, trenches, and work areas during construction. Keep excavation dry during subgrade preparation and until construction is complete and pipe is installed to avoid damage from hydrostatic pressure, flotation, or other cause will result.

F. Standby Equipment:

- 1. Install complete standby equipment for immediate operation, as required to maintain de-watering on a continuous basis and in the event that all or any part of the system become inadequate or fail.

G. Corrective Action:

- 1. Perform work necessary to restore foundation soil and damaged structure resulting from failure of dewatering system.

H. Damages:

- 1. Immediately repair damages to adjacent facilities caused by dewatering operations.

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**SECTION 32 84 00
PLANTING IRRIGATION**

SPEC WRITER NOTES:

1. Use this section only for NCA projects. Delete text between // _____ // not applicable to project. Edit remaining text to suit project.
2. Modify paragraph 1.1 according to project requirements, indicate whether irrigation system is part of an existing system being modified, or whether system is new.
4. Remove references to automatic operation, when system being installed is manually operated.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. // Manually controlled // Stand-alone programmable // Programmable fully automatic // irrigation system with full and complete 100 percent coverage within areas indicated on drawings.

SPEC WRITER NOTE: Add or delete items required to cover work for specific project.

2. Sleeving irrigation pipes and wires as indicated, and beneath hardscape surfaces.

SPEC WRITER NOTE:

Modify following statement that proposed irrigation equipment is to match or be compatible with the existing irrigation equipment and control system.

3. // Manufacturer of primary irrigation equipment including but not limited to sprinklers, controllers, control valves, // weather station // // and decoders // shall be compatible with the existing components on the cemetery //.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain references only when specified elsewhere in this section.

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. As-Built Drawings: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Availability and Use of Utility Services: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Submittals: Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- E. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- F. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- G. Electrical supply and connection to irrigation controller // and irrigation pumps //: Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- H. Spigot: Section 323000, SITE FURNISHINGS.
- I. Water Distribution Systems: Section 33 10 00, WATER UTILITIES.
- J. Irrigation Pressure Booster System: Section 32 82 00, IRRIGATION PUMPS.
- K. Plants, Turf, and Grasses: Section 32 90 00, PLANTING.

SPEC WRITER NOTE: Modify following paragraph based upon project conditions. Retain applicable definitions after editing.

1.3 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, // and lateral line drain valves //. Piping is under pressure during flow.
- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 Volts or for remote-control, signaling power-limited circuits.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement of the irrigation system pipes, or wires will require disturbance of other than landscape materials.

- E. RE: Contracting Officer's Representative (COR).
- F. COR: Contracting Officer's Technical Representative.

1.4 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standard Institute (ANSI).
 - 1. B40.1-05 - Gauges-Pressure Indicating Dial Type-Elastic Element.
- C. American Society of Sanitary Engineers (ASSE).
 - 1. 1013-2005 - Reduced Pressure Principle Backflow Preventers.
- D. ASTM International (ASTM).
 - 1. A36/A36M-14 - Carbon Structural Steel.
 - 2. A53/A53M-12 - Pipe, Steel, Black and Hot-Dipped, Zin-Coated, Welded and Seamless.
 - 3. A242/A242M-04 (2009) - High Strength Low-Alloy Structural Steel.
 - 4. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - 5. A536-84 (2009) - Ductile Iron Castings.
 - 6. B33-10(2014) - Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
 - 7. B61-08 - Steam or Valve Bronze Castings.
 - 8. B62-09 - Composition Bronze or Ounce Metal Castings.
 - 9. B584-14 - Copper Alloy Sand Casting for General Applications.
 - 10. D1785-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
 - 11. D1238-04c - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
 - 12. D1784-11 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 13. D1785-06 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120.
 - 14. D2241-15 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 15. D2464-15 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 16. D2466-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 17. D2564-12 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

18. D3139-98 (2005) - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
19. D3261-15 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
20. D3350-10 - PE Pipe & Fittings Materials.
21. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
22. F656-15 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

E. American Water Works Association (AWWA).

1. C110/A21.10-08 - Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch for Water.
2. C111/A21.11-06 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. C115/A21.15-05 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. C151/A21.51-09 - Ductile-Iron Pipe, Centrifugally Cast.
C153/A21.53-00 - Ductile-Iron Compact Fittings for Water Service.
5. C504-15 - Rubber Seated Butterfly Valves.
6. C509-09 - Resilient-Seated Gate Valves for Water Supply Service.
7. C600-10 - Installation of Ductile Iron Water Mains and Their Appurtenances.
8. C900-07 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting, 100 mm and Through 300mm (4 In. Through 12 inches) for Water Transmission and Distribution.
9. C901-08 - Polyethylene (PE) Pressure Pipe and Tubing, 13 mm (1/2 inches) through 76 mm (3 inches), for Water Service.
10. C905-10 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 48 In. (350 Through 1,200 mm) for Water Transmission and Distribution.

F. Manufacturers Standardization Society (MSS).

1. SP70-2006 - Cast Iron gate Valves, Flanged and Thread Ends.

G. National Electrical Manufacturers Association (NEMA).

1. 250-2008 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.5 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting // at project site // minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

1. Required Participants:
 - a. COR (COR).
 - b. // Architect/Engineer. //
 - c. // Inspection and Testing Agency. //
 - d. Contractor.
 - e. Installer.
 - f. // Manufacturer's field representative. //
 - g. Other installers responsible for adjacent and intersecting work, including // _____ //.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.
 - g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

SPEC WRITER NOTES: Verify number of copies of irrigation information submittals with NCA/CFM Project Manager.

1.6 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 1. Shop Drawings: Show size, configuration, and fabrication and installation details.
 2. Controller Chart:

- a. Prepare map diagram showing valves, // decoders, // lateral lines, and control wires // and communication cables // route location. Identify valves size, station, number and type irrigation type. Submit approved "As-built" drawings before charts are prepared.
 - b. Provide one reduced drawing of actual "as-built" system controller chart, showing area covered by each automatic controller, supplied at maximum size controller door allows. When controller sequence is not legible when Drawing is reduced to door size, enlarge drawing to readable size and place folded in sealed plastic container, inside controller door.
 - c. Print chart with different color used to show area of coverage for each station. Charts must be completed and approved before final inspection of the irrigation system.
3. Irrigation point-of-connection showing pipe and valve sizes and lay lengths within specified vaults.
 4. Irrigation control panel showing all components of control system, location and layout within control cabinet.
 5. Show sizes of irrigation zones in GPM based on flow rates of actual irrigation outlets submitted and approved. Size valves for actual demand in GPM not exceeding manufacturer's recommendations for valves with pressure-regulating option.
 6. Flower Water Station Spigot Connection Assembly and Curb Stop Valve.
 7. Any other detailing through shop drawings indicated in the Drawings.
- C. Samples: // includes laboratory samples //.
1. // Product //: // size // // long // square //, each type and color //.
 - a. Submit quantity required to show full color // and texture // range.
 2. // Product //: Full sized, complete assembly.
 3. Approved samples may be incorporated into work.
- D. Manufacturer's Literature and Data:
1. Description of each product.
 2. Gear-driven rotor sprinkler heads indicating manufacturer recommendation for each application.
 - a. // Include Center for Irrigation Technology Space Pro Single Leg Profile showing Distribution Uniformity and Scheduling Coefficient for nozzles being used at specified spacing. //

- b. // Provide computer generated distribution uniformity and scheduling coefficient calculations for nozzles used at specified spacing. //
- 3. Controllers.
- 4. Valves.
- 5. Installation instructions.
- 6. Warranty.
- E. Materials List:
 - 1. Pipe and fittings.
 - 2. Valves.
 - 3. Mainline components.
 - 4. Water filtration components.
 - 5. Electrical components.
 - 6. Control system components.
- F. Test Reports: Certify // each product complies // products comply // with specifications.
- G. Operation and Maintenance Data:
 - 1. Care instructions for each exposed finish product.
 - 2. Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Regularly manufactures specified products.
 - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //
- B. Installer Qualifications: // Product manufacturer. // Manufacturer authorized installer //.
 - 1. Regularly installs specified products.
 - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //.

SPEC WRITER NOTES: Provide requirements for welding certificates and welders' qualifications if required according to system installed for specific project.

- C. Welders and Welding Procedures Qualifications: // AWS D1.1/D1.1M. // AWS D1.2/D1.2M // AWS D1.3/D1.3M. //
- D. Products Criteria:
 - 1. Multiple Units: When two or more units, same type or class of materials or equipment required, provide compatible products from one manufacturer.
 - 2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for final assembled product.
 - a. All components of assembled unit need not be products of same manufacturer but component parts which are alike are product of single manufacturer.
 - b. Components are compatible with each other and with total assembly for intended service.
- E. Codes and Regulations:
 - 1. Comply with latest edition of National Electrical Code, Uniform Plumbing Code, and applicable laws and regulations of governing authorities.

1.8 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

SPEC WRITER NOTE: Specify extended manufacturer's warranties for materials only.

- B. Manufacturer's Warranty: Warrant irrigation materials against material and manufacturing defects.

SPEC WRITER NOTE: Specify customarily available warranty period for specified products.

1. Warranty Period: One year.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. System Requirements:

1. Full (head to head plus 10-percent) and complete coverage of irrigated areas. Adjust head locations as required to achieve full coverage of irrigated areas.
2. Layout work as shown on the drawings. Drawings are diagrammatic to the extent that swing joints, offsets and fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of Drawings. Lines are to be common trenched wherever possible. Place irrigation heads shown along roadways between // _____cm (inches) // x cm (x inches) and x cm (x inches) from edge of pavement, unless otherwise specified.
3. Locations of remote control valves is schematic. Group remote control valves wherever possible and align at set dimension back of curb along roads // at the perimeter of burial sections //. Locate remote control valves individually or in groups of two. Where exact location for valves has not been set, or there are conflicts, coordinate location with COR before installation.
4. Run irrigation lines and control wire at boundaries of graves, thru designated utility lanes or beside roadways.
5. Run irrigation lines, control wires and power wires in trenches as indicated on Drawings or as typical for industry standards, when not indicated.
6. Connect new system to existing mains. // Disconnect and abandon existing irrigation system. // Connect to new mains //.
7. Unless noted otherwise, run irrigation lines, power wires and control wires in sleeves or conduit where installed beneath any site hardscape materials.

- #### **B. Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for

intended location and application. Run irrigation lines, cables, control wires, and high voltage conduits in separate sleeves.

SPEC WRITER NOTE:

1. Modify following paragraph to adjust coverage requirements when irrigation water quality causes staining hardscape materials due to water quality issues like high Iron.

2. Modify paragraph below as appropriate to indicate exactly what programming of central computer is required as well as programming for stand-alone programs and for any new satellite controllers.

3. Modify paragraph below when adding to existing irrigation system to address fully functional irrigation program, when all satellites and zone control valves are fully operational. Provide programming as required to perform temporary irrigation needed operate to establish new lawn and plants, before acceptance by the Government.

For central controls both existing and new controllers, provide or modify programming so system will operate existing and new controllers for fully operational irrigation system. In addition, require to provide any interim modifications to central controls to allow operation of existing system as well as all or portions of new, until the full system is operational.

- C. Completely program central controller // and satellite controllers // according to approved // master irrigation schedule //.
- D. Follow manufacturer's instructions for installation.
- E. Submit manufacturer's written certification that Control System is complete, including related components, and fully operational to COR.

SPEC WRITER NOTE:
Update and specify only that which
applies to the project.

2.2 SYSTEM PERFORMANCE

SPEC WRITER NOTE:
1. Use article below only if irrigation
system will be Designed/Build.
2. Specify actual pressure when known for
project.

- A. Design irrigation system complying with specified performance:
 - 1. Minimum Working Pressure // Program landscape irrigation pump station settings by the selected irrigation installer to maintain system pressure of minimum 90 psi dynamic while minimum two stations of similar water use volume are in simultaneous operation including stations at or near the furthest uphill interval from the irrigation system point of connection. Do not allow programming of control station to exceed 105 psig. // Station-specific pressure regulation shall occur at each control valve and shall be set by the selected irrigation installer to the optimum or manufacturer recommended operating pressure of the associated irrigation emission devices downstream of each control valve.
 - 2. Minimum Design Pressures:
 - a. Irrigation Mainline Piping: 1380 kPa (200 psig).
 - b. Lateral Piping: 1380 kPa (200 psig).
 - c. Valves: 1380 kPa (200psig) WOG.

2.3 MATERIALS

- A. Use new materials without flaws or defects.

2.4 PRODUCTS - GENERAL

- A. Provide each product from one manufacturer.

2.5 PIPE AND FITTINGS

- A. Irrigation Main Pipe:

SPEC WRITER NOTE:

1. Retain pipe required.
2. Modify to 1375 kPa (200 psi) if working pressure exceeds the pipe pressure rating, or if the main is installed beneath pavement.

1. Ductile Iron Pipe: AWWA C151, minimum working pressure 1025 kPa (150 psi), cement lined, exterior bituminous coated.
 2. Polyvinyl Chloride (PVC) Pressure Pipe: ASTM D1784, PVC 1120, SDR 21 minimum working pressure 1375 kPa (200 psi), gasketing conforming to ASTM F477. Pipe outside diameters, comply with AWWA C151 cast iron pressure pipe to accommodate cast iron fittings.
 3. Polyvinyl Chloride (PVC) Pressure Pipe: ASTM D1784, Class 200, SDR-21, rated at 1375 kPa (200 psi), gasketing conforming to ASTM F477.
 4. High Density Polyethylene (HDPE) pipes: AWWA C901. Pipe and fittings PE 3408 HDPE resin compound meeting cell classification 345434C, ASTM D3350; and Type 111, Class C, Category 5, Grade P34, ASTM D1238.
 5. Mainline Pipe Within Sleeves: Provide restrained casing spacers for gasketed joints.
- B. Irrigation Main Fittings:
1. Ductile Iron Pipe Fittings:
 - a. Mechanical Joint Fittings: ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
 - b. Flanged Fittings: ANSI/AWWA C110 and ANSI B16.1 850 kPa(125 lbs.).
 - c. Push-On Joints: ASTM D3139 for Laboratory Qualifying Tests. Use push-on rubber-gasketed ductile iron fittings.
 - d. Gaskets: ASTM F477, rubber.
 - e. Joint Restraints: Class 350 Ductile Iron per ASTM A536.
 2. PVC Pipes Fittings:
 - a. Mechanical Joint Fittings: ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
 - b. Flanged Fittings: ANSI/AWWA C110 and ANSI B16.1 850 kPa(125 lbs.).
 - c. Gaskets: ASTM F477, rubber.
 - d. Joint Restraints: Class 350 Ductile Iron per ASTM A536.
 3. High Density Polyethylene (HDPE)Fittings:

a. Butt, Heat-Fusion Fittings: ASTM D3261.

C. Lateral Pipe:

1. PVC Pipe: ASTM D1784 Rigid, Unplasticized (PVC) 1120, Class 12454-A or 12454-B, with integral bell end suitable for solvent welding.
2. Pressure Rated PVC Pipe: ASTM D2241, Class 200, SDR-21, 1375 kPa(200 psi) pressure rating.
3. PVC Pipe: ASTM D2466 and D1784.
4. Threaded Pipe: ASTM D1785, PVC 1120, Schedule 80 threaded connections, risers and swing joints. Pipe Above Grade and in Concrete Structures: // Ductile Iron meeting AWWA C600, AWWA C115, flanged joints and fittings, working pressure 1025 kPa (150 psi) //.

D. Lateral Fittings:

1. Irrigation Laterals: ASTM D2466 PVC, Schedule 40, solvent welded socket type.
2. Threaded Pipe: ASTM D2464, PVC, Schedule 80.
3. Swing Joints: Manufacturer's standard with elastomeric seal, allows 360 degree rotation, minimum 1375 kPa (200 psig) working pressure.

E. Joining Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.
2. Irrigation Laterals: ASTM D2466 and D1784 PVC Schedule 40, Type 1, solvent weld fittings.
 - a. Primer: ASTM F656.
 - b. Solvent Cement: ASTM D2564.
3. Threaded pipes: Teflon-type tape or Teflon based paste pipe joint sealant. Use non-hardening, non-toxic pipe joint sealant for water-carrying pipes on metal threaded connections.

SPEC WRITER NOTE:

1. Modify sleeves to reflect design conditions, following Facilities Design Guide for location of irrigation mains.
2. Select appropriate sleeves for locations, depth, soil conditions and loading.

2.6 SLEEVES

- A. Sleeves: ASTM D1784 Rigid, Unplasticized (PVC) 1120, Class 12454-A or 12454-B, with integral bell end.
 1. Pipes Larger than 300 mm (12 inch): AWWA C905, DR-18 rated at 1615 kPa (235 psi).

2. Pipes Smaller than 300 mm (12 inch): // ASTM D2241, Class 200, SDR-21 or AWWA C905, DR-25 rated at 1375 kPa (200 psi). // or // AWWA C900, rated at 1375 kPa (200 psi). //.
- B. Size: As indicated on Drawings or twice nominal pipe diameter when not shown. Wiring bundle area not exceeding 40 percent of sleeve cross sectional area, according to NEC recommendations.
- C. Restrained Casing Spacers: ASTM A536, Grade 65-45-12 high strength ductile iron.
1. Restraining Rods: ASTM A242 and ANSI/AWWA C111/A21.11, high strength low alloy material.
 2. Runners: ASTM D-1894, ultra-high molecular weight polymer, 175-350 Joules/cm (600-1200 ft-lbs./in.) tensile impact and coefficient of friction 0.14-0.17.

SPEC WRITER NOTES:

1. Provide self-restrained fittings or restraint harnesses for three inch or larger mainline piping.
2. Provide gasketed ends on main line piping three inches or larger.
3. Modify the following depending on size of main into which thrust block is attached. Use thrust blocks only when pipe size exceeds six inches.
4. For bends beneath hardscape for mains 150 mm (6 inch) or larger require plastic and rebar as indicated on the thrust block details.
5. Coordinate specifications with drawing details.

2.7 RESTRAINTS

- A. Self-Restrained Fittings: Meeting // ASTM A536 // ANSI/AWWA C153/A21.53 "Ductile-Iron Compact Fittings For Water Service" or ANSI/AWWA C110/A21.10 "Ductile-Iron and Gray-Iron Fittings, 76 mm through 1219 mm (3 inches through 48 inches), For Water" //.
1. Provide on rubber gasketed pipe pipes 75 mm (3 inch) diameter or larger.
 2. Size: As indicated on Drawings.
- B. Thrust Blocks: Concrete, 20 MPa (3,000 psi), 50 micrometers (2-mil) plastic and 12.7 mm (No. 4) rebar wrapped or painted with asphalt tar based mastic coating.
1. Provide on pipe fittings greater than or equal to 75 mm (3 inch) diameter or rubber gasketed pipe.

2. Size: As indicated on Drawings.
- C. Joint Restraint Harness: Provide joint restraint harness where joints not positively restrained by flanged fittings, threaded fittings, or retainer glands and thrust blocks.
1. Provide in ductile iron fittings 76 mm (3 inch) and larger, transition fittings between metal and PVC pipe, where thrust block is not allowed, or where extra support is required to retain fitting or joint.
 2. Provide joint restraint harness or retainer glands with preset torque shearing set screws on mainline gate valve assemblies 76 mm (3 inch) and larger.
 3. Provide stainless steel bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials retainer, ASTM A536, and high strength, low alloy steel bolts and connecting hardware, ANSI/AWWA C111/A21.11.

2.8 MAINLINE COMPONENTS

SPEC WRITER NOTES:

1. Provide one or more of the following valve types based upon project specific conditions.
3. Coordinate specifications and drawing details.

- A. Valves (Except Remote Control Valves):
1. Underground Shut-Off Valves:
 - a. Gate Valves 50 mm (2 inches) and Larger: AWWA C509, iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, // 1025 kPa (150 psi) // 1375 kPa (200 psi) // minimum working pressure.
 - b. Butterfly Valves 80 mm (3 inches) and Larger: AWWA C504, cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, // 1025 kPa (150 psi) // 1375 kPa (200psi) // minimum pressure.
 2. Check Valves: Swing.
 - a. Smaller than 100 mm (4 inches): ASTM B61 or B62, bronze body and bonnet, 850 kPa (125 pound) WSP.
 - b. Larger than 100 mm (4 inches): Iron body, bronze trim, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG.

SPEC WRITER NOTE: Modify as required for project conditions and provide pressure setting for valve in specific location for installation.

3. Pressure Reducing Valve:
 - a. Cast steel body, renewable seats, stainless steel trim, high velocity components. // ASSE: Certified 1003-2027, Threaded Union inlet and outlet, Cast bronze valve body meeting ASTM B584, Stainless steel 300 Series Internal components and strainer screen //.
 - b. Adjustable to desired pressure, within range of operation specified.
 - c. Air-Vacuum Relief Valve: Epoxy-coated cast Iron body, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 14 kPa to 1580 kPa(2 psi to 230 psi). Continuous acting combination air and vacuum and air release valve. // Cast Bronze body meeting ASTM B584, 300 series Stainless Steel, internal components and springs, maximum working pressure 1200 kPa (175 psi). //
4. Bronze Ball Valve with Stainless Steel Handle:
 - a. Maximum Pressure: 4140 kPa (600 psi) CWP.
 - b. Federal Specification: WW-V-35C.
 - 1) Type II.
 - 2) Composition BZ.
 - 3) Style 3.
5. Master Control Valve:
 - a. Body and Cover: Polyester-coated.
 - b. Spring: Stainless steel.
 - c. Diaphragm: Nylon fabric reinforced with rugged insert.
 - d. Bolts, Studs, and Nuts: Zinc-cobalt coated steel.
 - e. Tubing and Fitting Control Accessories: Reinforced plastic and brass.
 - f. Solenoid: 24V AC.
 - g. Operation: // Normally opened // Normally closed // with automatic control globe valve with contamination-proof, self-flushing filter screen.
 - h. .Pressure Rating: 16 bar (232 psig).
 - i. Operating Pressure Range: 0.5 to 16 bar (7 to 232 psig).

6. Quick Coupling Valve Assembly:
- a. Description: Brass construction, 1 inch nominal size, operating pressure 35-860 kPa (5-125 psi), locking rubber or vinyl cover.
 - b. Swing Joints: Joint with offsets for flexible joints.
 - c. Quick Coupler Anchor: Bolt on anchor type.

SPEC WRITER NOTE: For new installations use high quality brass, bronze or stainless steel manufacturer's equipment for similar golf course or lite commercial applications.

- d. Valve Box: Acrylonitrile Butadiene Styrene (ABS) Plastic, 10 inch round valve box with // green // brown // black lid // color to match location //.
- e. Filter Fabric: Spunbonded polyester 3.5 oz per sq. yard (118.7 grams per sq. m.) landscape fabric.

SPEC WRITER NOTES:

1. Coordinate specifications with flower watering station facility type and spigot.
2. Revise specifications to provide water through service with isolation valve and pressure regulation valve connection to flower watering spigot.
3. Follow Facilities Design Guide for type of spigot for project location, of new facilities.
4. Revise specs to match existing facilities, unless otherwise noted, note required changes.

B. Flower Water Station Spigot Connection Assembly: As indicated on Drawings.

1. Flower Watering Station Spigot: As specified in Section 32 30 00, SITE FURNISHINGS.
2. Curb Stop Valve: ASTM B62, brass body, 2070 kPa (300 psi) minimum working pressure, female threaded connections, with stop and waste feature.
3. Inline pressure regulator: Low lead cast body conforming to ASTM B584, 2750 kPa (400 psi) maximum inlet pressure, with 105 to 515 kPa (15 to 75 psi) adjustable outlet pressure.
4. Copper Pipe: ASTM B88, type "M" soft tubing, wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint.

- a. Solder: 95-percent tin and 5-percent antimony.
- 5. Valve Box: Concrete curb valve box, cast iron lid, 200 mm ID x 300mm (8 inch ID by 12 inch), face anchored in concrete.

C. Valve Box:

1. Gate and Butterfly Valve:

a. Materials:

SPEC WRITER NOTES: Retain precast
concrete valves box below for pavement
areas; HDPE for turf and planter areas.

- 1) Precast Concrete: Precast concrete, 30 MPa (4000 psi) compressive strength.
- 2) HDPE: Structural foam Type A, Class III, // black // green // tan // in color, minimum 475 mm (19 inches) long by 350 mm (14 inches) wide, 305 mm (12 inches) deep, key-lockable hinged lid.

b. Cover: Mark box cover, differentiate between lawn irrigation system and domestic water supply system, set flush on finished grade.

c. Operations:

- 1) T-Handle Socket Wrench Operation: Underground valves 50 mm (2 inch) nut.
- 2) Handwheels: MSS SP70 Above ground and in pits.
- 3) Enclosed Gear Drive Operators: Butterfly valves 150 mm (6 inches) and above.

d. Accommodate end valves with type of pipe being installed. Provide mechanical joint ends with self-restrained joints on buried irrigation main valves.

2. Remote Control Valves:

a. Materials:

SPEC WRITER NOTES:
1. Retain precast concrete valves box
below for pavement areas; HDPE for turf
and planter areas.
2. Select polymer concrete boxes for
boxes located where vehicular traffic is
expected, or for boxes 432 mm (17 inches)
or larger.

- 1) Precast Concrete: Precast concrete, 30 MPa (4000 psi) compressive strength.

- 2) Polymer Concrete: Fiberglass reinforced plastic with Plastic resin binder. Lid to have minimum loading capacity of 3630 kg (8,000 lbs.) per 254 mm by 254 mm (10 inch by 10 inch) square.
- 3) HDPE: Structural foam, Type A, Class III.
 - a) Color: // Black. // Green. // Tan. //.
 - b) Size: Minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.

SPEC WRITER NOTE: Select Stencil Paint required to match existing conditions, or as directed by Architect/Engineer during project design review.

- b. // After installation, hot brand valve box lid 75 mm (3 inch) // two 80 mm (3 inch) // high, 1 mm (3/16 inch) deep with permanent white epoxy paint, designating controller and circuit numbers. Place numbers in center of valve cover facing nearest main or service road. //.
 - c. Provide // _____ // 750 mm (30 inch) long valve adjustment keys.
 3. // Drip zone Lateral Flush Cap Assembly: HDPE round reinforced plastic valve box and lid, minimum 14.5 cm (5-3/4 inches) diameter top opening with lift-hole. Access box height, 23cm (9-1/16 inches) minimum. //.
 4. // Emitter Access Boxes: HDPE round plastic boxes and lid, color // green, // tan, // 13 cm (5 inches) minimum top diameter, height 26 cm (10-1/4 inches) minimum. //.
- D. Backflow Preventer: ASSE 1013, reduced pressure principle, except pressure drop, in each new connection to existing potable water distribution system.
1. Design Flow Rate: Maximum 70 kPa (10 psi).

SPEC WRITER NOTES:

1. Retain applicable Water Meter paragraph.
2. Modify as applicable to install water meter or meters to record all irrigation water sources. Designer to confirm the requirements of meter installation with water provider.
3. Add specifications for water meters to be used by the Government for record

keeping of all irrigation water sources
for project.

E. Water Meter Assembly:

1. Water Meter:
 - a. // By Utility Company. //.
 - b. // Install Utility Company water meter. //.
 - c. // Provide meter approved by Utility Company. Submit approval before installation. //.
2. Water Meter Pit:
 - a. Reinforced poured in place concrete or approved precast concrete.
 - 1) Size: As indicated on Drawings.
 - 2) Rungs: Cast iron or aluminum, asphalt coated when in contact with concrete, free of sharp edges, burrs or projections with slip resistant finish.
 - a) Size: 25 mm (one inch) diameter, 300 mm (12 inches) wide, 175 mm (7 inches) clear space to wall, minimum 65 mm (2 1/2 inch) depth in wall.
 - 3) Reinforced Concrete: Same as above except, minimum 150 mm (6 inches) in wall.
 - 4) Vault Covers:
 - a) // Aluminum spring loaded access hatch. // Stainless Steel spring loaded access hatch. // Cast iron access cover. //

SPEC WRITER NOTES: Retain option for
roadway application.

3. Frames and Covers: Cast-iron, // traffic rated // with cast-in identification symbol "WATER".

SPEC WRITER NOTES: Retain rungs for
structure more than 1200 mm (4 feet) in
depth.

4. Strainers: Brass strainer, basket or "Y" type.
 - a. Size:
 - 1) Body smaller than 70 mm (2-1/2 inch), brass or bronze.
 - b. Body 70 mm (2-1/2 inch) and larger, cast iron or semi-steel.
 - c. Cover: Provide blow-off connection and shut-off valve for 20 mm (3/4 inch) diameter hose connection.

5. Pressure Gages: ANSI B40 1, 114 mm (4-1/2 inch) diameter, metal case, oil filled bottom connected with shut-off cocks.
 - a. Dial: Either black or white lacquered throughout. Provide shut-off cocks.
 - b. Maximum graduations: 10 kPa (2 psi).
6. Pipe Supports: Corrosion-resistant, galvanized finish.
 - a. Plumbing and mechanical equipment supports for basket strainer, pressure reducing valve and master valve.
 - 1) Flange Cradle: ASTM A36.
 - 2) Collar/Base Cup: ASTM A53 D.O.M tubing.
 - 3) Threaded Stud: ASTM A36; rolled thread; Grade ASTM A307.
 - 4) Base Plate: Sheet steel, 6.5 mm (0.25 inch) plate; ASTM A36.
 - 5) Welds: 100 percent MIG. Electrode E70XX.
 - a) Cradle: Radiused to CL 125 flange diameter, 120 degree coverage.
7. Backflow Enclosure:
 - a. Construction: Vandal-resistant steel tube and wire with a smooth surface.
 - b. Coating: performance polymer alloy powder.
 - c. Locking Mechanism: Stainless Steel full release.
 - d. Warranty: One year.
 - e. Powder Coat Color: standard dark green.

2.9 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. Remote Control Valve: Globe type, heavy construction, manual shut-off and flow control adjustment for manual operation, minimum 1025 kPa (150 psi) working pressure; higher working pressure for systems that operates with working pressures above 140 psi.
 - a. Install underground, operated by a // 24-volt AC electric solenoid // 24-volt AC/DC direct drive thermal hydraulic motor. // Provide unions on both sides of valve. Provide assembly over gravel sump as indicated on Drawings.

SPEC WRITER NOTE: Retain valves below for normal water or water containing sand.

- b. Valves: Brass or plastic construction, straight or angle pattern type, or cast-iron body with brass bonnet, trim and renewable

seat, and two inlet tappings (furnished with one plugged) to allow straight or angle pattern valve installation.

SPEC WRITER NOTE: Retain valves below for sewage effluent or extremely dirty water.

- c. Valves: Diaphragm type, designed to operate water containing sand and debris, self-cleaning type with contamination filter. Incorporate non-adjustable type opening and closing speed control surge pressures protection, or operate by means of slow acting direct drive without ports, screens or diaphragms.

SPEC WRITER NOTE: Retain valve with pressure regulators when required for the project.

- d. Provide valves with pressure regulators.
- e. Valves Serviceability: From top without removing valve body from system. Provide // _____ // 750 mm (30 inch) long adjustment keys. Operate valves maximum 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.
2. PVC Union: Schedule 80 threaded union with O-ring seal.
 3. Bronze Ball Valve with Stainless Steel Handle:
 - a. Maximum Pressure: 4140 kPa (600 psi) CWP.
 - b. Federal Specification: WW-V-35C.
 - 1) Type II.
 - 2) Composition BZ.
 - 3) Style 3.
 4. Filter Fabric: Spunbond polyester 3.5 oz. per square yard landscape fabric.
 5. Wire connectors: Direct burial 600 V maximum voltage. Wire combination size: (2 to 5) 18 AWG to (2) 12 AWG. UL approved. 3M DBY or DBR.
 6. Identification Tags: Christy I.D. tags. Standard Yellow, one sided. Tag Size: 57 mm by 69 mm (2.25 inch by 2.7 inch), hot stamped black letters on, yellow background. Hot stamp component number code as indicated.

SPEC WRITER NOTE: Modify specifications below to include all irrigation head and drip components being used in the project. Descriptions below are generic.

- B. Popup Gear Driven Rotary Sprinkler Assembly: Integral self-closing anti-drain valve, 3.0 m (10 feet) maximum head pressure with removable inlet debris screen.
1. Full Sprinklers:
 - a. Body: Corrosion resistant, impact resistant, heavy-duty ABS outer case.
 - b. Head Type: Dual or tri-nozzle combination positive gear assembly drive on stainless steel spindles in water lubricated sand proof case.
 2. Part Circle Sprinklers: Same as full sprinklers above, except variable arc type.
- C. Multi-Stream Rotary Nozzles:
1. Radius and arc as shown on Drawings.
- D. Spray Heads: High impact plastic or brass nozzle with adjusting screw to regulate radius and flow. Heavy-duty stainless steel retracting spring and ratcheting system for pattern alignment. Soft elastomer pressure-activated co-molded wiper seal.
1. Body: Heavy duty, ultraviolet resistant plastic sprinkler body, stem, nozzle, with non-clogging filter and pressure compensating screens (PCS).
 2. Head Type: Pop-up, matched precipitation rate nozzle as shown.
 3. Flow Rate: As indicated on Drawings.

SPEC WRITER NOTE: Modify above and below to include irrigation head and drip components required. Descriptions below are generic.

- E. Pressure Compensating Bubblers:
1. // 5 gph // 7 gph // 10 gph // as shown. 1.25 cm (1/2 inch) FPT threaded inlet.
- F. Drip Emitters:
1. Emitter Type: Pressure compensating, permanently assembled type, 1.25cm (1/2 inch) FPT inlet.
 2. Flow Rate: 1gpm at inlet pressures between 15 and 50 psi.
 3. Emitter Tubing: UV resistant vinyl, 6mm (0.22 inch) O.D. and 4 mm (0.16 inch) I.D., manufactured by same manufacturer as emitters.

G. Low Voltage Control Valve Wire:

1. Wire: Solid copper wire, UL LLC approved for direct burial.
 - a. Size: According to manufacturer's instructions, but minimum AWG 14.
2. Splicing Materials: Epoxy waterproof sealing packet.
3. Low Voltage Controller Cable: Multi-strand, UL LLC approved for direct burial.
 - a. Number, Size and Type: According to manufacturer's instructions.
4. // Decoder-to-Solenoid (DTS) Cables 14 AWG, solid copper; 2-conductor; Use jacketed wire pairs with colors matching jacketed wires on decoders for connecting decoders to control valves. //

SPEC WRITER NOTE: Use non-detectable type
at cemeteries only.

H. Warning Tape: Polyethylene film warning tape, 0.1 mm (4 mils) thick, 75 mm (3 inches) wide, // detectable // non-detectable //, imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW", colored as follows:

1. Blue with Black Letters: Potable water.
2. Purple with Black Letters: Reclaimed or untreated well water.

I. Tracer Wires: Plastic-coated copper tracer wire, 1.8 mm (14 gage), green, Type TW. Install with non-metallic irrigation main lines.

J. Decoders for Two-Wire Operation:

1. Decoder: Solid-state design, housed in a watertight molded plastic housing.
 - a. Decoder leads: 18-gauge, insulated, stranded copper.
 - b. Colors as indicated.
 - c. Wire Leads: Minimum of 305 mm (12 inches) long.
 - d. Wire Connections: Watertight electrical connections suitable for the wire type being connected.
2. Decoders: Mounted underground in separate 305 mm by 457 mm (12 inch by 18 inch) valve boxes, or with remote control valves. Fastened to inside of valve boxes with stainless steel self-tapping screws. Brand valve boxes containing decoders "SP" in 50 mm (2 inch) high letters, painted with permanent white epoxy paint. Place boxes on 457 mm (18 inch) deep bed of pea gravel.
 - a. 26VAC input service provided by the two-wire communication path.
3. Provide factory pre-coded decoders with 1, 2, or 4 addresses, each activating one remote valve solenoid.

4. Use 4 address decoders to extent. Include line surge protection.
 5. Provide manufacturer's optional barcode scanner-based decoder programming unit to input decoder addresses. Provide programming unit capable of backing up and restoring programs.
 - a. Field Decoders: TW-D-1 (One station decoder, includes dry splices); TW-D-2 (Two station decoder, includes dry splices); TW-D-4 (Four station decoder, includes dry splices).
 6. Decoder Cable Fuse Device: Paige Electric DCFD 2-way and DCFD3 3-way electrical isolation devices; or approved equal.
 7. Lightning Arrestor: Rain Master TW-LA-1, or approved equal.
 8. Grounding Rods: 16 mm by 2.5 meters (5/8 inch diameter by 8-foot long) copper ground rod, copper clamp and #6 bare copper wire; UL-approved; sized per manufacturer's instructions.
- K. Two-Wire Decoder Cable:
1. Two-conductor control cable design consisting of tin coated copper conductors, insulated with PVC and having a high density polyethylene direct burial jacket. Conductors are listed as Type UF by UL or ETL or CSA.
 2. Conductor: Minimum conductor size 14 AWG; soft annealed tin coated solid copper conforming to ASTM B33.
 3. Insulation: Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF rated 60°C.
 4. Cable Assembly: Insulated conductors are laid parallel.
 5. Outer Jacket: Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 1.2 mm (3/64 inch) minimum jacket material to completely fill interstices between the two insulated conductors.
 6. Color Coding: Black, Red.
 7. Jacket Color: Blue. (Use a different jacket color for each controller on the project).
- L. Hard Wire Communication Cable: Direct burial, polymer-coated aluminum shielded, insulated, 1-pair multi-conductor, with polyethylene outer jacket for connecting satellite controllers with each other.
1. Provide two 20 AWG, full braid shield, 100 Ohm impedance. One copper conductor and one silver tinned conductor, black jacket, rated for direct burial shielded communication cable used for hardwire satellite serial link. Cable shall not exceed 5000 feet in length.
 2. All cable must be certified by Rain Master Irrigation systems.

- M. Flow Sensor Cable: Direct-burial, polymer-coated aluminum shielded, insulated, 1-pair multi-conductor, with polyethylene outer jacket for connecting flow sensors with satellite controllers.
1. Two 20 AWG foil shield w/drain, black jacket, rated for direct-burial BLK, WHT. Two conductor direct burial shielded cable used with all field sensor connections to satellites such as flow sensors. Cables not to exceed 609 meters (2000 feet) in length.
 2. Cables must be certified by Rain Master Irrigation systems.
- N. Communication Cable Splice and Cap: A three-part, rigid body closure that self-encapsulates two-and five-pair buried service wire. It has a built-in bonding system that bonds the buried service wire shield as the splice is put together. The special formulated sealant is a one-part, no-mix, non-urethane product containing no grease.
- O. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.
- P. Pull Rope for Empty Conduits: 1/4 inch diameter, 12-strand, 544 kg (1,200 lb) tensile strength braided polypropylene rope.
- Q. Drainage Backfill: Clean gravel or crushed stone, graded from 6 mm (1/4 inches) minimum to 19 mm (3/4 inch) maximum.
- R. Pipe Bedding and Initial Backfill: Clean sand per Section 31 20 00 EARTH MOVING for trenching and backfilling of utilities.

2.10 CONTROL SYSTEM COMPONENTS

SPEC WRITER NOTE:

1. Retain below for projects having one or more field satellites.

- A. Automatic Central Control Equipment-Field Satellites:
1. Overall Control Concept: Central computer system; contains irrigation starting controls, capable of overriding field satellite units, and operating individual remote control valves according to timing schedules programmed into // central // field units //.
 - a. Number of Units and Locations: As indicated on Drawings.

SPEC WRITER NOTE:

1. Modify as required to indicate components included in system for this project. Add additional equipment where required to provide communication between

water supply source equipment and irrigation equipment.

2. Central Computer Control System: Manufacturer's standard components; Central Computer, // Master Flow Meter, // Leak Detection Flow Meters, // Moisture Sensor, // ET Measurement Device, // Rain Measurement Device, // Wind Measurement Device, // Central Control Software, // Field Controller // and necessary components and software in standard package supplied by irrigation control manufacturer.

SPEC WRITER NOTES:

Listing in spec note following is only guideline. Manufacturer and models vary.

1. Modify performance criteria for Central Computer Control System, without indicating manufacturer. Accurately define functioning and operational components.
2. Modify where Central Computer Control System match existing system, clarify whether full system replacement of Central and satellites is acceptable instead of matching existing.
3. Modify to include function and performance information. Describe how system operates and provide desired leak detection performance. Describe causes of alarm conditions, specify system shut down level which occurs as a result of alarm conditions.
4. Specify exactly how new irrigation system components are to be integrated with existing and what modification, replacement, upgrading, etc. is required for the existing system.
5. Prepare performance based narrative. describing how system operates in normal automatic conditions; manual conditions; partial shutdown conditions and emergency shut down conditions.
6. Prepare performance-based narrative describing water supply source operates in conjunction with irrigation Central Computer equipment.

3. Central Computer Control System:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, Manufacturer and models vary.

Accurately define material and operational components.

1. Controller should be capable of reading flow meter and recording flow for each station. Logging reading for xx water days, including run times, water use, and operational characteristics.
2. Receiving and storing on-site, daily ET weather data and accumulated rainfall to automatically determine station run times in minutes.
3. Operating multiple master schedules to allow daily, weekly programming.
4. Comparing water budget proportionate to historical ET.
5. Operating Cycle and Soak watering.
6. Containing full, built-in English and Spanish operating manual.
7. Detecting electrical faults and bypass, and logging all alerts.
8. Programming rain shut down.
9. Activating/deactivating master valve control.
10. Optional integrated Radio Remote compatible.
11. Starting pump.
12. Monitoring flow within operator-set parameters.
13. Built-in transient protection and lightning protection.

a. Performance Criteria:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Identify housing materials.
2. Define pulse output, Voltage and pulse rate proportional to flow.
3. Fully compatible with internal interface of controller.
4. Powered by the controller.
5. Flow meter data can be accurately read by the controller up to X,XXX feet.
6. By the same manufacturer as the irrigation controller.
7. Define/describe unit features/sensing features.

4. Flow Meter:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Solid-state tensiometer type.
2. Include data transmission circuitry, which sends moisture level readings back to irrigation controller using valve field wires.
3. Entire unit encased in epoxy.
4. Require no calibration for life of the sensor.
5. Unaffected by temperature, salinity or changes in pH.
6. Accurately transmit moisture levels up to x,xxx ft.

5. Moisture Sensors:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Powered by field controller.
2. Measures ET directly in 0.01" increments and sends pulses directly to field controller.
3. Fully compatible with internal interface at field controller.
4. Mounted inside stainless steel, vandal-resistant enclosure specifically designed for the device.

6. ET Measurement Device:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Accurately measures rainfall in 0.01" increments by means of a tipping and emptying device mounted below center of collection dish.
2. Fully compatible with internal interface at field controller.
3. Operate between 32 degrees F and 125 degrees F.
4. Be constructed of anodized aluminum.
5. Controller sets the following programming parameters for rain.
 - a. Stop Irrigation after x.xx inches.
 - b. Maximum Rain in One Hour is x.xx inches.
 - c. Maximum Rain in 24 Hours is x.xx inches.
 - d. Let Rain only build up to x.xx inches.

7. Rain Measurement Device:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Accurately define material and operational components.
2. Powered by field controller.
3. Accurately measures wind in 0.1 mph increments.
4. Fully compatible with internal interface at field controller.
5. Operate between -50 degrees C and + 50 degrees C.
6. Be constructed of anodized aluminum.
7. Record wind speeds up to 140 MPH.
8. Controller sets the following programming parameters for wind:
 - a. Pause Irrigation when wind is at xx MPH for xx minutes.
 - b. Resume Irrigation when wind drops to xx MPH for xx minutes.

8. Wind Measurement Device:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and

models vary. Accurately define material and operational components.

1. Operates on Windows compatible computer with minimum 16 MB memory.
2. Requires 300 megabytes hard disk space for program and files.
3. Functions on any combination of phone, or local radio, or hardware interface.
4. Allows uploading and downloading programs and log data by controller or groups of controllers.
5. Has real-time access to run stations and programs, check master valve operation, and operate controllers.
6. Capable of printing alerts based on operator-set data filters; automatically creating permanent files each time data is uploaded.
7. Allows program, log, summary and alert data for each controller to be printed selectively.
8. Capable of automatically uploading weather station, and Rain Bucket and redistributing to field units.
9. Capable to operate up to x,xxx controllers.
10. Capable of automatically retrieving water usage data and writing to text files monthly.
11. Capable of allowing user override changes.
12. Communication links or central control system failure cannot affect normal water management operation of field controllers.

9. Central Computer Software.

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. When using digital radio, radio shall be an internal packet-switched digital radio modem capable of two-way communication on Mobitex public network.
2. When using radio, radio modem and all interface boards shall be mounted inside the controller and powered by the same 24VAC internal transformer.
3. A vandal-resistant epoxy-filled dome antenna shall be used in any type of radio communication.

10. Field Controllers with Central Communication:

- a. Conduct an on-site radio test with manufacturer to verify satisfactory operation before submitting a bid for radio control.

SPEC WRITER NOTE:

1. Equipment type in paragraph below is for addition to existing system, but is not VA preference.
2. For smaller projects with independent controllers, retain Electric or Solar Powered Controller as conditions permit.

B. Automatic Control Equipment-Independent Satellite Controllers:

1. Overall Control Concept. Electric automatic control system consists of independent satellite controllers operating individual remote control valves according to timing schedules programmed in each independent units. Number of units and location as indicated on Drawings.

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Multiple independent programs with multiple start times.
2. Station watering time can be set from one (x) minute to (x) hours and in one (1) minute increments.
3. Allow rapid programming for a block of stations with same watering time.
4. Programs allows independent seven-day a week or a skip-a-day routine.
5. Provide controller with a real time clock to retain the actual time during power outages.
6. Provide controller with a non-volatile memory to retain programs during power outages or seasonal shutdowns.
7. Run a single station for a select time in manual mode.
8. Provide controller with built-in remote control capability.
9. Provide controller with automatic field wire fault detection, report the fault, and move to the next programmed station.
10. Provide UL approved controller.
11. Provide controller with a percentage key to increase or decrease all station runtimes on a percentage basis.
12. Provide controller with ability to select cycle and soak.

2. Control System: System consists of Independent controller, and accessories necessary to operate irrigation system. Provide standard package containing these components and software.

C. Automatic Control Equipment-Solar-powered:

SPEC WRITER NOTES:

Listing in spec note following is only guideline individual manufacturer and models will vary. Accurately define material and operational components.

1. Solar powered control systems are typically highly proprietary ie. LEIT Control Systems, Irritrol, Aquarius base specification upon performance and technical criteria, avoid mentioning manufacturer by name.
2. Define Control System components - Independent controller, Rain Sensor, Moisture Sensor, Freeze sensor, and

accessories necessary to operate the irrigation system.

3. Define temperature range between x °F and x °F (x °C to x °C).
4. Define circuit protection from electrostatic discharge to xx,xxx Volts.
5. Define power source- powered by an internal photovoltaic module.
6. Define output to actuators: digital control pulses at x.xx Volts DC.
7. Define photovoltaic module shall be protection- Lexan polycarbonate, or other lens.

1. Overall Control Concept. Solar-powered automatic control system consists of one or more independent controllers operating individual remote control valves according to timing schedules programmed into the independent units. Number of units and location as indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove existing // item name // to permit new installation.
 1. Retain existing // item name // for reuse.
 2. Dispose of // other // removed materials.

3.2 INSPECTIONS AND REVIEWS

- A. Site Inspections:
 1. Verify site conditions and note irregularities affecting work. Report irregularities to COR before beginning work.
- B. Utility Location ("Call Before You Dig"):
 1. Arrange and coordinate underground utility locations with local authorities and cemetery maintenance personnel.
 2. Repair underground utilities damaged during construction with no increase in contract price.
- C. Irrigation System Layout Review: Stake locations of irrigation system components as defined below for COR's review. Notify the COR one week in advance of review. COR will identify and approve modifications during this review.

3.3 INSTALLATION - GENERAL

- A. Install products according to manufacturer's instructions // and approved submittal drawings //.
 - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Perform excavation, trenching, and backfilling for sprinkler system as specified in Section 31 20 00, EARTHWORK and as indicated on Drawings.

3.4 LAYOUT OF WORK

- A. Stake alley and sprinklers locations in existing burial sections using a licensed surveyor. Use alleys as indicated on Drawings.
- B. Stake out irrigation system.
- C. When staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with COR. To comply with requirements of the following conditions specified herein this specification section to obtain compliance of regulatory regulations.

3.5 SLEEVING AND BORING

- A. Provide and install sleeves where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Extend sleeve minimum 300 mm (12 inches) beyond edge of paved surface, wall, etc. Cover pipe ends and mark edge of pavement.
- C. Verify sleeve sizing is adequate before installation. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.
- D. Bed sleeves, minimum 100 mm (4 inches) sand backfill above top of sleeve.

3.6 PIPE AND FITTING ASSEMBLY

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur.
 - 2. Cap assembled pipe ends. Remove caps only to continue assembly.
 - 3. Curve trenches to change direction or avoid obstructions within limits of pipe curvature. No deflection allowed at pipe joint. Minimum radius of curvatures as follows:

SIZE	RADIUS	OFFSET PER 6 m (20 feet) LENGTH

SIZE	RADIUS	OFFSET PER 6 m (20 feet) LENGTH
38 mm (1 1/2 inches)	7.5 m (25 feet)	2.3 m (7 ft-8 inches)
50 mm (2 inches)	7.5 m (25 feet)	2.3 m (7 ft-8")
63 mm (2 1/2 inches)	30 m (100 feet)	575 mm (1 ft-11 inches)
75 mm (3 inches)	30 m (100 feet)	575 mm (1 ft-11 inches)
100 mm (4 inches)	30 m (100 feet)	575 mm (1 ft-11 inches)
150 mm (6 inches)	45 m (150 feet)	400 mm (1 ft-4 inches)
200 mm (8 inches)	60 m (200 feet)	300 mm (1 ft-0 inch)
250 mm (10 inches)	75 m (250 feet)	225 mm (9 inches)
300 mm (12 inches)	90 m (300 feet)	200 mm (8 inches)

B. Mainline Pipe and Fittings:

1. Plastic Pipe:

- a. // Lay pipe "snake fashion" in trench 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections. //.
- b. Provide expansion joints every 1525 cm (50') o.c. Install per manufacturer's instructions.
 - 1) Acceptable manufacturer is Spears (S119-XX) or approved equal.
- c. Joints:
 - 1) Solvent Welded Socket Type, ASTM D2855.
 - 2) Threaded Type: Apply liquid Teflon, thread lubricant. Tighten joint with strap wrench up to two additional full turns after joint is hand tight (hard).
 - 3) Elastomeric Gasket: ASTM F477, compatible with bell annular groove.
 - a) Thoroughly clean inside of bell or coupling, outside of spigot, and elastomeric gasket immediately before joining two lengths of PVC pipe.
 - b) Lubricate joint and rubber gasket according to pipe manufacturer's instructions.
 - c) Insert elastomeric gasket in the annular groove of bell or coupling according to the manufacturer's instructions.

Mark pipe not furnished with depth mark before assembly and insert to full depth of joint.

- d) Align spigot and bell or coupling and push until spigot is fully inserted in bell or coupling. Push with smooth steady motion.

2. Ductile Iron Pipe: AWWA C600.

a. Joints:

- 1) Mechanical: AWWA C111. Provide bolts, nuts, glands and gaskets on pipe and fittings socket opening.
- 2) Push on: Apply thin film gasket lubricant and place in proper position in bell contour. Insert bevel end of joining pipe and make contact with gasket. Force pipe bevel end to bottom of bell without displacing gasket. Do not caulk. Use lubricant furnished by pipe manufacturer.
- 3) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set minimum 150 mm (6 inches) from walls or floor.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe according to manufacturer's instructions and accepted industry practices.
- b. Cure 30 minutes before handling and 24 hours before pressurizing or installing vibratory plow.
- c. Snake pipe from side to side within trench or install with expansion joints.
- d. In irrigation isles, coordinate location of monuments to avoid conflicts.

2. Fittings: Cross type fittings is not acceptable.

D. Emitter hose:

- 1. Use Type 1/11 solvent weld.
- 2. Use line size by 10 mm (3/8 inch) insert bushings to transition from PVC Schedule 40 fittings to flex-vinyl hose.

E. Specialized Pipe and Fittings:

- 1. Mechanical Joint Connections: Install fittings, fasteners and gaskets according to manufacturer's instructions and accepted industry practices.
- 2. PVC Threaded Connections:
 - a. Factory-formed threads. Field-cut threads are not acceptable.

- b. Apply thread sealant according to manufacturer's instructions and accepted industry practices.
- c. Use plastic components male threads and metal components female threads for plastic-to-metal connection.

F. Thrust Blocks:

- 1. Use cast-in-place concrete bearing against undisturbed soil.
- 2. Size, orientation and placement as indicated in installation details on Drawings.
- 3. Wrap fitting with plastic protecting bolts, joint, and fitting from concrete.
- 4. Install rebar with mastic coating as indicated on Drawings.

G. Joint Restraint Harness:

- 1. Install harness according to manufacturer's instructions and accepted industry practices.
- 2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install self-restraining casing spacers at gasketed pipe bell joints and every 10-feet along gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's instructions.

SPEC WRITER NOTES:

- 1. Modify following paragraph to correspond to indicated valve installations. Main irrigation line valves, 150 mm (6 inches) or larger can be located in roadways, refer to Facilities Design Guide for details.
- 2. Modify to indicate minimum depth irrigation main lines where located beneath roads, pavement or walks.

3.7 INSTALLATION OF MAINLINE COMPONENTS

- A. General: Install as indicated on Drawings.
- B. Valve for Existing Facilities: Match existing of the same type, unless specifically noted otherwise.
- C. All valves meet or exceed specified parameters identified herein, or parameters for existing valves being matched, whichever provide higher quality product.
- D. Valves Setting:
 - 1. Install as indicated on Drawings and according to manufacturer's instructions.
 - 2. Do not set valves under roads, pavement or walks.

3. Clean valve interior before installation.
4. Place valves in same valve box where pressure control valves are installed adjacent to remote control valve.
5. Set valve box cover flush with finished grade.
6. Brand or cast "GV" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.

E. Air/Vacuum Relief Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "AV" in 2 inch high by 3/16 inch deep letters on valve box lid.

F. Quick Coupling Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "QC" in 2 inch high by 3/16 inch deep letters on valve box lid.

G. Flower Watering Station Hydrant Connection Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Sequence of Construction:
 - a. Coordinate exact location with COR.
 - b. Install components before concrete pad. Coordinate installation with Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
3. Location:
 - a. Install stations at locations indicated on Drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. Do not install mainline or lateral pipe under Flower Watering Stations.
4. Paint "FW" in 2 inch high by 3/16 inch deep letters on valve box lid.

3.8 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly: Install as indicated on Drawings and according to manufacturer's instructions.

1. Mainline Flushing:
 - a. Flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tees for mainline flushing. Plug service tees not used for flushing.

- c. Connect 50 mm (2 inch) pipe to flushing service tees, to direct water away from trench and into drainage swale, curb section or storm sewer, away from work area and not disrupt cemetery operations.
 - d. Use water volume 0.9 m/s (3 FPS) velocity in largest pipe flushing.
 - e. Flush multiple points simultaneously.
 - f. Flush minimum 20 minutes. Continue flushing until water is clear of debris.
 - g. COR will review flushing operation and water clarity before stopping flushing operation.
 - h. Disconnect pipe from service tees and install remote control valves.
- 2. Adjust valve to regulate downstream operating pressure as follows:
 - a. Rotor Sprinklers: 480 kPa (70 psi).
 - b. Rotating Stream Nozzles: 310 kPa (45 psi).
 - c. Spray Sprinklers: 240 kPa (35 psi).
 - 3. Connect control wires to solenoid wires with wire connectors and waterproof sealant. Install connectors and sealant according to manufacturer's instructions.
 - 4. Install only one remote control valve to valve box. Locate valve box 1.5m (5-feet) from and align square from adjacent edges of paved areas.
 - 5. Attach ID tag to solenoid with controller station number to control wiring.
 - 6. Brand controller and station number in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
- B. PopUp Gear-Driven Rotary Sprinkler Assembly:
- 1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
 - 2. Install at locations indicated on drawings.

SPEC WRITER NOTE: Adjust below based on project conditions.

- 3. Locate rotary sprinklers // 75 mm (3 inches) // 150 mm (6 inches) // from adjacent edges of paved areas, walls or fences.
- 4. Install sprinklers perpendicular to finish grade.
- 5. Install swing joint as indicated on Drawings.

6. Supply appropriate nozzle or adjust arc coverage of each sprinkler.
7. Adjust each sprinkler throw radius.
8. Install sod 600 mm (2-foot) square around rotary sprinklers in seeded areas.

C. Spray Sprinkler Assembly:

1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
2. Install at locations indicated on drawings.

SPEC WRITER NOTE: Adjust below based on project conditions.

3. Locate rotary sprinklers // 75 mm (3 inches) // 150 mm (6 inches) // from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to and flush with finish grade.
5. Install swing joint as indicated on Drawings.
6. Supply appropriate nozzle or adjust each sprinkler arc coverage.
7. Adjust each sprinkler throw radius.

D. Sprinkler Heads and Quick Couplers:

1. Place on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples and install sprinkler heads and quick couplers at flush with ground surface ensuring no dirt or foreign matter enters outlet.
2. Place part-circle rotary sprinkler heads maximum 150 mm (6 inches) from edge, of and flush with top adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
3. Install shrub sprays, sprinklers, and quick couplers on swing joints as detailed on Drawings.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from curb or pavement edges. Place adjacent to walls. Stake heads parallel to riser before backfilling trenches.

3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at locations indicated on Drawings.
2. Install electrical connections according to manufacturer's instructions and as indicated on Drawings.

SPEC WRITER NOTE:
1. Modify following paragraph to coordinate with grounding requirements

other than lightning protection where specific resistance values are required for grounding system.

2. Follow manufacturer's instructions regarding lightning protection.

3. Lightning Protection: Drive full length grounding rods into soil. Provide and install grounding plates as indicated on Drawings or as required to create grounding connection with field-tested resistance value equal to or lower than specified values identified in this specification. Connect 4mm diameter (#6 AWG) copper grounding wire to rod and plate using CADWELD style connections. Brand "GR" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
4. Attach wire markers to control wire ends inside controller unit housing. Label remote control valve wires with identification number indicated on Drawings, where control wire is connected.
5. Connect control wire to corresponding control unit terminal.
6. Install permanent receiver for hand held radio when not factory installed.
7. Install rain sensor and complete electrical connections control unit according to manufacturer's instructions.

B. Power Wire:

1. Route power wire as indicated on Drawings. Install minimum number field splices. When power wire is spliced, make splice with recommended connector. Place splices in separate 300 mm (12 inch) standard valve box. Coil 600 mm (2 feet) wire in valve box. Brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
2. Lay power wire in trenches. Do not use vibratory plow.
3. Wire: NEC code compliant, green wire as common ground wire from power source to satellites and white for common (neutral) wire.
4. Carefully backfill around power wire, avoid wire insulation or wire connector damage.
5. Unless noted on Drawings, install wire parallel with and below mainline pipe. Install wire minimum 50 mm (2 inches) below bottom of PVC mainline pipe.
6. Encase wire in electrical conduit not installed with PVC mainline pipe, with continuous run of warning tape placed in backfill, 200 to 250mm (8 to 10 inches) below ground surface, directly over wiring.

7. Surface mount wire installed above grade in a professional manner, routing approved by COR.
8. Connect wire to power source.

C. Control Wire:

1. Bundle two or more control wires in the same trench. Bundle with pipe wrapping tape spaced 3 m (10-foot) intervals.
2. Chisel control wiring into soil utilizing vibratory plow device manufactured for pipe pulling and wire installation. Use appropriate chisel with wire, fed into chute on chisel, and not subject to pulling tension. Minimum burial depth equal minimum cover previously listed.
3. Provide 600 mm (24 inch) excess wire length in 200mm (8 inch) diameter loop at each 90 degree change in direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous wire runs. Do not tie wiring loop. Coil 600mm (24 inch) wire length within each remote control valve box.
4. Install common ground wire and one control wire for each remote control valve. Multiple valves on single control wire are not acceptable.
5. Install spare control and common wires as indicated on Drawings.
6. Use wire connectors and waterproof sealant to splice wire according to manufacturer's instructions. Locate splices in valve box containing irrigation valve assembly, or in separate valve box. Use same procedure for valve connection and in-line splices. When separate valve box is used for wire splices, brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
7. Install wire parallel with and below mainline pipe, unless indicated on Drawings.
8. Protect wire not installed with PVC mainline pipe with continuous run of warning tape place in backfill 150 mm (6 inches) above wiring.
9. Cap exposed wire ends with waterproof wire splices.
10. Locate wiring in trench from master controllers to satellites and stub-cuts for future extension, with new mains or in separate trench at back of curb, unless cross-country route is indicated on Drawings. Locate in trench with mains when possible on cross-country routes.

11. Set wiring bundles located with piping, below bottom of pipe. No two wires of same colors in any bundle. Bundle and tie or taped wires at 3 m (10 foot) intervals. Provide same numbered tag at each wire end, i.e., at valve, at field located controllers and at master controller.
12. Minimize splicing. Provide pull box at each splice. No splice will be allowed between field located controllers and remote control valves.
13. Provide 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.
14. Do not place irrigation system power wiring in same conduit as control wiring.

D. Instrumentation:

1. Install according to manufacturer's instructions at location indicated on drawings.
2. Provide electrical connections between central control system hardware and weather station under direction and observation of central control system manufacturer's personnel.

3.10 TRACER WIRE INSTALLATION

- A. Install tracer wire on trench bottom, adjacent to vertical pipe projections, continuous throughout pipe length, with spliced connections soldered and wrap with insulation tape.
- B. Install tracer wire following main line pipe and branch lines and terminate in yard box with gate valve controlling main irrigation lines. Provide sufficient wire length to reach finish grade, bend back wire end making loop and attach Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record tracer wire locations and terminations on project record documents.

3.11 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 1. Before punch list review, provide operating keys, servicing tools, spare parts, and other items indicated on Drawings.
- B. Other Materials: Install other materials or equipment indicated on Drawings or installation details that are part of irrigation system.

3.12 FIELD QUALITY CONTROL

A. Special Inspections and Tests:

1. On-Site Radio Test: Conduct on-site radio test before submitting bid for type of radio control.

B. Field Inspections:

SPEC WRITER NOTE: Section 01 45 29,
TESTING LABORATORY SERVICES includes
VA provided testing for large projects
and contractor provided testing for small
projects. Coordinate testing
responsibility.

C. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

1. Test irrigation system per procedures listed in section 1.10.
2. Notify the COR three days in advance of testing.
3. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
4. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
5. Provide clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
6. Volumetric Leakage Test - Gasketed Mainline Pipe:
 - a. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - b. Purge all air from the pipeline before test.

SPEC WRITER NOTES:

1. Modify the following paragraphs where 700 kPa (100 psi) is indicated as the test pressure, if the irrigation lines are to be operated at a normal pressure higher than 450-500 kPa (65-70 psi). The test pressure should be performed at a minimum of 150% of the normal operation pressure for the line, without exceeding the pressure rating for the pipe.
2. Adjust the allowable leakage as proportional to the actual test pressure as compared to the 700 kPa (100 psi) indicated.

- c. Provide all necessary pumps, bypass piping, storage tanks, meters, 75 mm (3 inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous 700 kPa (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
- d. Allowable deviation in test pressure, 35 kPa (5 psi) during test period; average pressure during test, 700 kPa (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the pressure is 5 psi below the test pressure. Restore test pressure to 700 kPa (100 psi) at end of test. Measure water added to mainline pipe volumetrically to nearest 10 ml (0.025 gallons).
- e. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. Amount of additional water pumped in during test not exceeding the value in table, or the calculated value using the formula below, based on differing number of joints, duration or pressure of the test:
 - 1) Leakage Allowable (Gallons per (100 Joints)/Hour).

PIPE SIZE mm (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140

63mm (2 1/2")	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.40
75mm (3")	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
100 mm (4")	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64
150 mm (6")	0.63	0.68	0.73	0.77	0.81	0.85	0.89	0.92	0.96
200 mm (8")	0.84	0.90	0.97	1.03	1.08	1.13	1.18	1.23	1.28
250 mm (10")	1.05	1.13	1.21	1.28	1.35	1.42	1.48	1.54	1.60
300 mm (12")	1.26	1.36	1.45	1.54	1.62	1.70	1.78	1.85	1.92

Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$.

Where: L = Allowable Leakage (gph).

N = Number of Joints.

D = Nominal Diameter of Pipe (inches).

P = Average Test Pressure (psi).

2) The following are the values for a 2 hour duration test at 100 psi for pipe length containing 100 joints.

a) 3.10 L (0.82 gallons) per 100 joints of 75 mm (3 inch) diameter pipe.

b) 4.09 L (1.08 gallons) per 100 joints of 100 mm (4 inch) diameter pipe.

c) 6.13 L (1.62 gallons) per 100 joints of 150 mm (6 inch) diameter pipe.

d) 8.18 L (2.16 gallons) per 100 joints of 200 mm (8 inch) diameter pipe.

e) 10.22 L (2.70 gallons) per 100 joints of 250 mm (10 inch) diameter pipe.

f) 12.26 L (3.24 gallons) per 100 joints of 300 mm (12 inch) diameter pipe.

g) Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

f. Cement or caulking to seal leaks is prohibited.

g. Contractor may sub-contract testing to pipeline testing company approved by RE/COTR.

7. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

- a. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kPa (80 psi) for 30 minutes.
 - b. Cap all sprinkler risers.
 - c. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - d. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 - e. Cement or caulking to seal leaks is prohibited.
 - f. After lateral passes test and before operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
8. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:
- a. Activate each remote control valve in sequence from each new satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units // through central controller // through standalone communication system //. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. COR will visually observe operation, water application patterns, and leakage.
 - b. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
 - c. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
 - d. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
 - e. Repeat tests until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
 - f. // Test backflow prevention device with certified tester before project acceptance. //
9. Distribution Uniformity (DU):
- a. Perform DU Test on one zone of burial section rotors and one zone of tree lawn rotors per satellite controller.

- b. Select the zones of sprinklers representative of area being irrigated by satellite controller in the presence of the COR.
- c. Perform catch can test using procedures recommended by Irrigation Association.
- d. Where DU test fails, adjust zone pressures // and // or // nozzle sizes to meet required Distribution Uniformity.
- e. Calculate and provide written documentation of DU for each zone tested.
- f. Irrigation Association Certified Landscape Irrigation Auditor must perform the test. Provide written evidence of certification before conducting test.

SPEC WRITER NOTES:

1. Grounding for satellites is very site specific and is dependent on the site soil conditions and methods being utilized to construct earth grounding. To achieve desired resistance value for grounding of less than 15 ohms, recommended maximum allowable value, and recommended value of 5 ohms or below, adjustment to number and type of grounding facilities installed is required.
2. When testing of field installed grounding installations produce resistance values that are higher than those recommended above, the only way to lower resistance level is to add more grounding equipment. Refer to Facilities Design Guide for information on what to include for grounding to protect the irrigation equipment, and procedures to follow to achieve desired grounding without incurring cost increases due to change orders.
3. Modify the following to include sufficient information that will result in providing fully functional grounding system for irrigation system equipment that will result in test results grounding at or below readings specified herein.
4. Modify values for grounding test readings when required to be at levels recommended by manufacturer for protection of equipment, or as indicated herein, whichever is lower.

10. Control System Grounding:

- a. Test all new satellite controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, when acceptable by equipment manufacturer without equipment warranty invalidation. Test results meet or exceed control system manufacturer's instructions for acceptance, while maintaining equipment warranty.
- b. Replace defective wire, grounding rod or appurtenances. Repeat test until manufacturer's instructions are met. Add grounding rods as needed, bond all rods together.
- c. When test is acceptable, document results of grounding test on inside of each satellite controller pedestal door and via written report submitted to the COR. Documentation includes satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. Mark test results on the inside of each satellite controller pedestal door using a permanent marker.
- d. Submit to the COR, written report of test data listing satellite 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 the local ground for each satellite.

SPEC WRITER NOTES:

1. Modify following paragraph to reflect testing of the entire irrigation system, when there are portions already exist, or just operating new portion installed as part of this project. Having existing irrigation components as well as new complicates the testing process and faults, as there can be situations where the existing system problems may cause the failure during automatic operations. Clarify exactly what has to be done to adjust the programming, so known problem zones in the existing system can be removed from the scheduling program to prevent faults.

2. The irrigation system as well as the water supply source providing water to the irrigation system, when other than a connection to a municipal water supply connection, both need to be demonstrated as well as any equipment and or facilities that have been installed to insure that the two systems operate

together as designed, with any safe guards that were designed to be fully functional. Modify as required to clearly require full acceptance testing for the applicable systems.

11. Irrigation System Acceptance Test (Burn inches) before Final Inspection:

- a. Upon completion of construction and before Final Inspection, an Acceptance Test (Burn inches) must be passed.
- b. Coordinate start of Test with COR.
- c. During Test, irrigation system must be fully operational from // central control system // standalone programs at the individual satellites // for the system //. Operate irrigation system, with no faults for 14 consecutive days. When at any time during the 14 day test period, system fault occurs, determine source of the fault and correct, and restart 14 day evaluation period. When system fault occurs, make repairs within 24 hours of notification from COR. Document any faults of test report listing date, fault, cause of fault and corrective action taken.
- d. When system has operated for 14 days without fault, contact the COR to schedule Final Inspection.
- e. When system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; when does not shut down, test starts over.

SPEC WRITER NOTES:

1. The following may be applicable when there is water supply source control system that operates with interconnection to irrigation computer control software. Modify as appropriate for the project conditions.
2. Delete SCADA Paragraph below, when water supply source system operates totally off pressure in irrigation system, performing pressure maintenance, and no separate computer operated system safeguards and there is no SCADA system.
3. Modify Paragraph describe the intercommunication being tested between SCADA system and Irrigation Central Computer systems.
4. Delete below when no SCADA system is present.

12. Flushing: After testing, flush system beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
13. Operation Test: Upon completion of the final adjustment of sprinkler heads to permanent level at ground surface, test each sprinkler section by pan test and visual test to indicate uniform distribution within any one sprinkler head area and over the entire area. Operate entire installation to demonstrate the complete and successful operation of all equipment.

D. Maintenance Services:

SPEC WRITER NOTES:

1. Adjust verbal instructional hours in following paragraph to suit installation. Cemetery equals 16 hours, minimum.
2. Modify following paragraph to fully describe requirements specific to this project. Add, modify, or delete items provided according to site specific project. Results should be a clear requirement for fully annotated, tabbed and indexed manual describing normal operations, troubleshooting, and emergency procedures, as well as start-up and shut-down procedures.

1. Maintenance and Operating Instructions: Before final acceptance, provide verbal instructions, minimum _____ hours, to operating personnel. Provide two additional years of software support for one

hour each month. Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manuals as follows:

- a. 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:
- b. 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.
- c. Manufacturer's Operation and Maintenance manuals.
- d. Manufacturer's Technical Service Bulletins.
- e. Manufacturer's Warranty Documentation.
- f. Software License Information.
- g. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
- h. Predictive schedule for component replacement.
- i. Listing of technical support contacts.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize new irrigation system according to local practices in first fall after completion of construction of irrigation system and start up in spring after completion of construction. Repair any damage caused in improper winterization. Coordinate winterization and start-up with cemetery landscape maintenance personnel.

3.14 CLEANING

- A. Clean exposed // product // surfaces. Remove contaminants and stains.

3.15 DEMONSTRATION AND TRAINING

- A. Instruct VA personnel in proper irrigation system operation and maintenance.
 1. Trainer: Manufacturer approved instructor.
 2. Training Time: 30 days minimum.
- B. Submit training plan and trainer qualifications. See Section XX XX XX - // RELEVANT COMMISSIONING SECTION //.
- C. Acceptance Condition: After completing work, operate irrigation system 15 consecutive calendar days without breakdown.

SPEC WRITER NOTES:

Adjust the following depending upon the control system provided and the computer equipment available at this facility. Coordinate the following with the Project Manager before including in the specifications. If included modify to make clear exactly what is to be provided.

- D. Provide training video on DVD or CD, whichever is compatible with the computer system provided for the central computer, to familiarize maintenance personnel with equipment provided. Coordinate final training presentation with Architect/Engineer and COR in outline form before creation, verify format and organization of content is applicable for facility staff utilization.

3.16 PROTECTION

- A. Protect // product // from // traffic and // construction operations.
- B. Cover // product // with reinforced kraft paper, and plywood or hardboard.
- C. Remove protective materials immediately before acceptance.
- D. Repair damage.

- - - E N D - - -

**SECTION 32 90 00
PLANTING**

SPEC WRITER NOTE: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants, soils, turf, and landscape materials and accessories.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTES: Update and retain
references only when specified elsewhere
in this section.

- A. Topsoil Materials, Stripping and Stockpiling: Section 31 20 00, EARTH MOVING.
- B. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Erosion control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- D. Protection of Tress and Plantings: Section 02 41 10, DEMOLITION AND SITE CLEARING.
- E. Topsoil Placement and Compaction Test: Section 31 20 00, EARTH MOVING.
- F. Landscape Irrigation: Section 32 84 00, PLANTING IRRIGATION.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standards Institute (ANSI) Publications:
 1. ANSI Z60.1-2014 - Nursery Stock.
 2. ANSI Z133.1-2012 - Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements.
- C. ASTM International (ASTM):
 1. C33/C33M-16-Concrete Aggregates.
 2. C136/C136M-14 - Sieve Analysis of Fine and Coarse Aggregates.
 3. D698-12 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m<sup>3
 - 4. D977-13e1 - Emulsified Asphalt.
 - 5. D2028/D2028M-15 - Cutback Asphalt (Rapid-Curing Type).
 - 6. D2103-15 - Polyethylene Film and Sheeting.</sup>

- D. Hortus Third, most current edition: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- E. National Cemetery Administration (NCA):

SPEC WRITER NOTE: Agronomic and Horticultural practices specified in this handbook serve as Contractor's official reference guide for establishment and preliminary maintenance practices during construction project.

- 1. Handbook 3410 - Integrate Pest Management.
- 2. Handbook 3420-11 - Turfgrass Maintenance.
- F. Turfgrass Producers International (TPI):
 - 1. 2006 Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA):
 - 1. Federal Seed Act-2011 - Rules and Regulations of the Secretary of Agriculture.
- H. United States Environmental Protection Agency (EPA):
 - 1. 40 CFR Part 503-1993 - Biosolids Rule.

1.4 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

- 1. Required Participants:
 - a. Contracting Officer's Representative (COR).
 - b. COR (RE).
 - c. // Architect/Engineer (A/E). //
 - d. Contractor.
 - e. Installer.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

- 2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Inspection of planting materials.
 - b. Installation schedule.
 - c. Installation sequence.

- d. Preparatory work.
 - e. Protection before, during, and after installation.
 - f. Installation.
 - g. Inspecting.
 - h. Environmental procedures.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.5 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - a. Seeds.
 - b. Sod.
 - c. Soil amendments.
 - d. Antidesiccant.
 - e. Erosion control materials.
 - f. Hydro mulch.
 - g. Non-Asphaltic Trackifier.
 - h. Herbicide.
 - i. Weed Control.
 - j. Mulches.
 - k. Edging.
 - l. // insert other required products //.
 - 2. Plant list: List of local/regional suppliers for each species to be installed. Include quantities, plant dimension (height x spread) and container/root ball size. Certify in writing, confirmed orders for plants by submitting a Bill of Sale for each plant to be installed. Each plant of the same species shall be supplied by one grower only unless otherwise approved by COR.
 - a. Requests for substitutions of plants not available in size, quantity or type specified must be made within 30 days after Contract award. Submit written evidence that a specified plant cannot be obtained and has been unobtainable since Contract award.
 - b. Substitutions will only be authorized when a plant (or its alternates as specified) is not obtainable and COR, in consultation with District Agronomist, authorizes a change order

for use of nearest equivalent obtainable size or variety of plant having same essential characteristics with an equitable adjustment of contract price.

3. Warranty.

C. Samples: Submit before beginning Work of this section:

Inert Mulch	2.3 kg (5 lb.) of each type to be used.
Organic Mulch	2.3 kg (5 lb.) of each type to be used.
Imported Topsoils	2.3 kg (5 lb.) of each type to be used.
Organic Amendments	2.3 kg (5 lb.) of each type to be used.
All pesticides required such as preemergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.
Edging Materials	Manufacturer's standard size

D. Test reports: Certify products comply with specifications.

1. Imported Topsoil: Provide 2.3 kg (5 lbs.) representative sample from each proposed source for testing, analysis, and approval. Deliver samples to acceptable testing laboratory and have testing report sent directly to COR. Testing reports to include following tests and recommendations according to Association of Official Agricultural Chemists standards:

- a. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) performed by public extension service agency, State Land Grant College, or certified private testing laboratory. Percentages of clay and silt to be determined by hydrometer.
- b. Percent of organics to be determined by loss on ignition of oven-dried samples. Test samples to be oven-dried to constant

weight at 110 degrees C (230 degrees F), plus or minus 5 degrees C (41 degrees F).

- c. Macro and micro nutrient fertility tests as determined by Chemical analysis to include Macro and micro nutrient fertility tests as determined by pH, Salinity (EC), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Soluble Copper, Zinc, Manganese, Iron, Saturation Extract Boron, Aluminum, Soluble Salts, Exchangeable Sodium Percentage (ESP), // Sodium Adsorption Ratio (SAR) //, and Cation Exchange Capacity (CEC).
 - d. Tests, as specified, for gradation, organics, soil chemistry and pH to be performed by testing laboratory retained by National Cemetery Administration as described in Section 01 45 29, TESTING LABORATORY SERVICES.
 - e. Include recommendations for soil additives to correct soils deficiencies, as necessary, and for fertilizing and to adjust soil pH to optimum range for // cool // warm // season turfgrass liming applications to support successful turfgrass growth.
2. Organic Soil Amendment:
- a. Testing: Provide testing by an independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
 - b. Soil Amendment Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative samples of compost and provide compost analysis report for the following parameters:
 - 1) Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
 - 2) Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur s.
 - 3) Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
 - 4) Maturity Indicator. Provide bioassay results. Provide Carbon-Nitrogen ratio.
 - 5) Stability Indicator: Provide respiration test results.

3. Amended Soil (in place): Following incorporation of amendments and additives, provide minimum six (6) samples per 3,700 sq. m (40,000 sq. ft.), 150 mm (6 inch) depth by 75 mm (3 inch) diameter core samples of amended soil taken from project site for testing, analysis, and approval. Locate each samples as directed by COR from areas designated to be planted in turfgrass. Deliver samples to testing laboratories and have testing report sent directly to COR. Obtain amended soil sample acceptance before seeding or hydroseeding.

E. Certificates: Certify products comply with specifications.

F. Before delivery, submit notarized certificates for approval to COR attesting that following materials meet specified requirements:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
2. Fertilizers: Four certificates of analysis for each type of fertilizer.
3. // Lime //
4. // Gypsum //
5. // Soil Sulfur //
6. // Humates //
7. // Mycorrhizae //
8. // Peat //
9. Seed: Include guaranteed percentages of purity, weed content and germination of seed, and net weight and date of shipment.
10. Sod.
11. Membranes.
12. // M-Binder //
13. Hydro Mulching: Number of kilograms (pounds) of materials to be used per liter (gallon) of water.

G. Maintenance Data:

1. Care instructions for each plant material.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Regularly installs specified materials and products.
2. Installed specified products with satisfactory service on five similar installations for minimum five years.

- a. // Project Experience List: Provide contact names and addresses for completed projects. //
- b. A member with good standing of either the Professional Landcare Network (PLANET) the AmericanHort.
- c. Maintain an experienced full-time supervisor on Project site when work is in progress.
- d. Installer's // field supervisor // personnel assigned to the Work // shall have certification in // one of // all of // the following categories from the Professional Landcare Network and submit one copy of certificate to the COR:
- e. Certified Landscape Technician (CLT) - Exterior, with // installation // maintenance // irrigation // specialty areas, designated CLT-Exterior.
- f. Certified Ornamental Landscape Professional designated COLP.

SPEC WRITER NOTE: Delete if not applicable.

- B. Licenses: Submit licenses to COR:
 - 1. Arborist: One copy.
 - 2. Pesticide Applicator: License in state of project, commercial.

1.7 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- D. Bulk Products:
 - 1. Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants. Protect products from weather.
 - 2. Install erosion control materials to prevent erosion or displacement of bulk products.
- E. Notify COR of delivery schedule five days in advance, minimum. COR will inspect materials upon arrival. Remove unacceptable plant materials from project site immediately.
- F. Protect plants during delivery to prevent damage to root balls or desiccation of leaves.

- G. Protect trees during transport by covering root balls and tying branches.
- H. Machine dug plants are permitted provided root balls are sized according to ANSI Z60.1 and tops are protected from damage.
- I. Protect sod from drying out.

1.8 STORAGE AND HANDLING

- A. Store seeds, soil amendments, fertilizers, and packaged materials in dry locations away from contaminants.
- B. Keep sod moist and protect from exposure to wind and direct sunlight.
- C. Store plants not installed on day of arrival at project site as follows:
 - 1. Shade and protect plants from wind when stored outside.
 - 2. Heel in bare root plants.
 - 3. Protect plants by covering roots with moist wood chips, shredded bark, peat moss, or similar mulching material.
 - 4. Keep plants moist including those in containers, by watering with fine mist spray until planted.

1.9 FIELD CONDITIONS

- A. Seasons and Conditions:

SPEC WRITER NOTE: All planting dates for
 this project to be approved through
 consultation with appropriate
 NCA District Agronomist.

- 1. Perform landscape planting operations within following dates: From
 // _____ // to // _____ // for spring and from
 // _____ // to // _____ // for fall, but not before
 irrigation system installed, tested, and approved.
- B. Perform turfgrass installation operations within following dates, but
 not before irrigation system installed, tested, and approved.
 - 1. Spring Planting: // _____ // to // _____ //.
 - 2. Fall Planting: // _____ // to // _____ //.
- C. Restrictions: Do not plant when ground is // frozen, // snow covered,
 // saturated // or in otherwise unsuitable condition for planting.
 Special conditions may exist that warrant variance in specified
 planting dates or conditions. Submit written request for approval to
 COR stating special conditions and proposal variance.

1.10 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."
- B. Comply with "Warranty" requirements in Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
 - 1. One Year Plant and Turfgrass Warranty: Warranty begins when Government accepts plants and turfgrass but not before end of Landscape Plant and Turfgrass Establishment Period.
 - 2. Replace any dead plant material and any areas void of turfgrass immediately during warranty period and during an active growing season. One year warranty for replaced plants and turfgrass begins on day replacement work is completed and accepted.
 - 3. Replacement of relocated plants, not furnished, is not required unless they die from improper handling and care. Loss due to improper handling, care, or negligence requires replacement in kind and size.
 - 4. Government will inspect replacement plants and turfgrass at end of Warranty period. Replace any dead, missing, or defective plant material and turfgrass immediately and during growing season. Warranty ends on date of this inspection provided work specified in this section is complied.
 - 5. Remove stakes, guys wires/straps at end of one year warranty.

PART 2 - PRODUCTS**2.1 PRODUCTS - GENERAL**

- A. Provide each product from one source or manufacturer.
- B. Plant and Turf Grasses: Comply with the varieties specified or shown in plant list.
- C. Warrant plants are true to botanical name as listed in Hortus Third.
- D. Maintain equipment, tools and machinery on project site in sufficient quantities and capacity for proper execution of Work.

2.2 ORGANIC SOIL AMENDMENT

- A. Organic Soil Amendment: Dark brown or black and capable of enhancing plant growth. Ninety-eight percent of material passes 25 mm (1 inch) screen. No admixture of refuse (i.e. noticeable inert contamination) or materials toxic to plant growth are permitted, free of all woody fibers, seeds, leaf structures, plastic, petroleum products, and toxic and non-organic matter.
1. Acceptable Organic Soil Amendments: Peat moss, humus or peat, and commercially available combinations thereof.
 2. Acceptable Compost: Natural organic sources such as food or animal residuals, or yard trimmings.
 3. Unacceptable Sole Sources of Organic Matter: Untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
- B. Minimum Material Requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27 to 80 percent
pH	5.5 to 8.5
Ash	20 to 65 percent
Nitrogen	0.4 to 3.5 percent
Phosphorus	0.2 to 1.5 percent
Potassium	0.4 to 1.5 percent
C: N Ratio	25 to 30: 1
CEC	50 to 150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 40 CFR Part 503
Inert Contents	Less than 1 percent by weight
Water-Holding Capacity	150 to 200 percent
Pathogen/Weed Seed Destruction	Proof of EPA minimum heating requirements

- C. Topsoil stripped and stockpiled on project site is acceptable provided, after testing and addition of necessary additives, meets above specification. Provide additional Organic Soil Amendment as required to complete work.

- D. Provide organic soil amendment in areas with organic matter content below 4 percent that will be seeded, sodded or sprigged after grading activities are completed to create satisfactory topsoil horizon.
- E. Spread and incorporate organic soil amendment into finished subgrade at depths indicated on drawings to raise soil organic content to minimum four percent and maximum six percent. Allow for additional depth of organic soil amendment to bring all grades to required finished grades as shown on grading plans.

2.3 PLANTS

- A. Plants: ANSI Z60.1, except as otherwise stated in this section or shown on drawings. Where drawings or specifications are in conflict with ANSI Z60.1, drawings and specification will prevail.
 - 1. Provide well-branched and formed planting stock, sound, vigorous, and free of disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems.
 - 2. Provide single stemmed trees, with a single leader, unless otherwise indicated.
 - 3. Provide trees and shrubs of uniform, symmetrical growth, with straight boles or stems, free from objectionable disfigurements, and with branch spread of branches typical of variety.
 - 4. Provide ground cover and vine plants with number and length of runners for size, and proper age for grade of plants specified. Provide well established plants in removable containers, integral containers, or formed homogeneous soil sections.
 - 5. Provide plants grown under climatic conditions similar to those in project locality.
- B. Minimum acceptable sizes of all plants, measured with branches in normal position, to conform to plant list and ANSI Z60.1. Larger plants with COR's approval, at no additional cost to the Government. Increase ball of earth or spread of roots according to ANSI Z60.1 when larger plants are provided.
- C. Do not handle plants by trunk or stem. Trees must be moved by lifting root ball, box or container.
- D. Bare-root (BR) plants to have root system substantially intact, but with earth carefully removed. Cover roots with thick coating of mud by "puddling" after the plants are dug.
- E. Container grown plants to have sufficient root growth to hold earth intact when removed from containers, but not be root bound.

- F. When existing plants are to be relocated, ball sizes to conform to ANSI Z60.1 requirements for collected plants, with plants dug, handled, and replanted according to applicable requirements of this section.

2.4 LABELS

- A. Legibly tag each plant, or group and bundles or containers of the species, variety, and size of plant with durable, waterproof and weather-resistant label indicating correct plant name and size specified in plant list. Labels to be securely attached and not removed until acceptance by the Government.

SPEC WRITER NOTE: In areas where topsoil is unavailable, develop a specification to construct "topsoil" on site by amending existing soils. Utilize subparagraph B when topsoil is needed in addition to that stockpiled from Earthwork operation.

2.5 TOPSOIL

- A. Topsoil: Provide well-graded soil of good uniform quality, natural, friable soil representative of productive soils in project vicinity. Topsoil to be free of subsoil, foreign matter, objects larger than 25 mm (1 inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and have pH value of minimum 6.0 and maximum // 7.0 // ____ //, and be best suited to region, climate and plant material specific to project.
- B. Obtain material from stockpiles established under Section 31 20 00, EARTH MOVING, subparagraph, Stripping Topsoil that meet general requirements stated above. Amend topsoil not meeting pH range specified by the addition of pH adjusters.
- C. When sufficient topsoil is not available on project site to specified depth, provide additional topsoil. Minimum 10 days before topsoil delivery, notify COR of sources from which topsoil will be furnished. Obtain topsoil meeting general requirements stated above and comply with requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting pH range specified by adding pH adjusters.

SPEC WRITER NOTE:
1. Retain inorganic and organic soil amendments below reported to be needed to

amend existing site soils by recommendations of the soils report.
 2. Retain Mycorrhizae and Humates for sterile soils/high clay content soils with low organic matter content.

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: Agricultural limestone, minimum 90 percent calcium and magnesium carbonates. Grind lime fineness, minimum 90 percent passes No. 8 mesh and minimum 25 percent passes No. 100 mesh. Maximum moisture, 10 percent.
1. Dolomitic Lime: Natural, agricultural limestone (calcium and magnesium carbonate), minimum of 20 percent calcium and 11 percent magnesium and as follows:
 - a. Screen Analysis: 100 percent passing through No.30 sieve; 70 percent passing through No. 100 sieve; minimum 30 percent passing through No.325 sieve. Provide lime in form of granulated, prilled, dolomitic limestone.
 2. Calcitic Lime: Natural, agricultural limestone (calcium carbonate), minimum of 36 percent calcium and as follows:
 - a. Screen Analysis: minimum of 100 percent passing through No. 10 sieve; minimum of 80 percent passing through No. 100 sieve. Provide lime in form of granulated, prilled, limestone.
 3. Agricultural Gypsum: Finely ground, minimum of 90 percent calcium sulfate, or 85 percent calcium sulfate dihydrate.
 4. Sulfur: Granular, biodegradable, 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.
 5. Iron Sulfate: Granulated ferrous sulfate minimum of 20 percent iron and 10 percent sulfur.
 6. Aluminum Sulfate: Commercial grade, unadulterated.
 7. Sand: Clean washed river sand, free of calcium, chlorides and other deleterious substances.
 8. // Humates: Derived from mined Gypsum and with guaranteed minimum analysis; Calcium Sulfate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) 35.00%; Calcium (Ca) 7.00%; Sulfur s 5.00%, plus Humic Acids 1.5% derived from Leonardite. Pelletized product used for ease of application. //.
 9. // Mycorrhizae: Endomycorrhizal powder inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: *Glomus intraradices*, *Glomus mosseae*, *Glomus aggregatum*, and

Glomus etunicatum. Minimum 100,000 spores/propagules per pound. The powder particle size shall be less than 300 microns (100 percent passing the #50 screen). //.

2.7 ORGANIC SOIL AMENDMENTS

- A. Peat: Natural product of // sphagnum moss peat // peat moss // hypnum moss // peat reed-sedge peat // peat humus // derived from fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Shred and granulate peat to pass 13 mm (1/2 inch) mesh screen and condition in storage piles for minimum six months after excavation.
- B. Perlite: Horticulture grade.
- C. Vermiculite: Horticultural grade, free of any toxic materials.
- D. Organic Matter: Commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

SPEC WRITER NOTE: First paragraph below is for non-native ornamental planting; second paragraph is for native plantings. Retain one or both as appropriate.

2.8 PLANTING SOIL MIXTURE

- A. // Ornamental Plantings: Planting soil mixture composed of 3 parts topsoil and 1 part // peat moss // // compost // //.
- B. // Native Plantings: 100 percent native on-site soil free of clds and subsoil // Do not amend soils intended for native planting.

SPEC WRITER NOTE: Select applicable portions.

2.9 PLANT FERTILIZERS

- A. Provide commercial grade plant fertilizer of uniform composition and complying with applicable state and federal regulations.
- B. For new plant material, provide uniform free-flowing granular complete analysis fertilizer based on recommendations of soils reports, containing minimum 10 percent nitrogen, phosphoric acid and potash by weight with minimum 50 percent of nitrogen from controlled release source such as sulfur coated urea (SCU), polymer coated urea (PCU), and sulfur-coated/polymer coated urea (PCSCU).
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing manufacturer's warranted statement of analysis. Granular fertilizer to contain minimum 10 percent nitrogen by weight (50 percent

from controlled release source such as sulfur coated urea), 10 percent available phosphoric acid, and 10 percent potash.

2.10 TURFGRASS FERTILIZER

- A. Provide commercial grade granular fertilizer, free flowing, uniform in composition, and complying with applicable state and federal regulations. Submit fertilizer manufacturer's warranted statement of analysis. Fertilizer contain minimum 20 percent nitrogen by weight (50 percent from controlled release source such as sulfur coated urea), 5 percent available phosphoric acid, and 15 percent potash. Liquid starter fertilizer for hydro mulch slurry, commercial type with 50 percent of nitrogen from controlled release source.

2.11 MEMBRANES

- A. Polyethylene: Comply with ASTM D2103, 0.1 mm (4 mils) thick, and clear in color.
- B. Fiberglass Mat: Lime borosilicate glass fibers with 0.3 mm (0.01 inch) average fiber diameter and 50 to 100 mm (2 to 4 inch) strands of fiber bonded with phenol formaldehyde resin. Provide 100 percent textile glass fiber mat. Mat to be roll type, water permeable, and minimum 6 mm (1/4 inch) and maximum 13 mm (1/2 inch) thick with 12 kg/cu. m (3/4 lb. per cu. ft.) minimum density.
- C. Landscape Fabric: // Spun bonded polyester fabric weighing 18 g/sq. m (3/4 oz./sq. yd.) with 9,000 liter per minute flow rate per sq. m (225 gal. per minute flow rate per sq. ft.) // Woven needle-punched polypropylene weighing 113 g/sq. m (4.8 oz./sq. yd.) with 950 liter per minute flow rate per sq. m (90 gal. per minute flow rate per sq. ft.) //.

2.12 MULCH

- A. Mulch: Free of deleterious materials and stored to prevent inclusion of foreign material.
- B. Mineral Mulch: Riverbank stone, granite chips, marble chips, volcanic rock or similar and ranging from 25 mm (1 inch) to 65 mm (2-1/2 inches) according to ASTM C 136.
- C. Organic Mulch: Wood based products such as chips, nuggets or shredded hardwood:
1. Straw for turfgrass seedbed mulch: Stalks from oats, wheat, rye, barley, or rice free of noxious weeds, mold or other objectionable

material. Straw to be air-dried and suitable for placing with blower equipment.

2. Wood cellulose fiber mulch for hydraulic application (Hydro mulch) with fertilizer: Specially prepared wood cellulose fiber, processed with no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of application of materials. Do not apply any turfgrass seed in this type mixture. Maximum 12 percent moisture dry weight, plus or minus three percent at time of manufacture. pH range from 3.5 to 5.0. Manufacture wood cellulose fiber for application as follows:
 - a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, fibers will become uniformly suspended to form a homogenous slurry.
 - b. When hydraulically sprayed, material will form blotter-like cover.
 - c. Cover allows absorption of moisture and allow rainfall or applied water to percolate to underlying soil.

D. Non-Asphaltic Tackifier:

1. M-Binder: 100 percent organic, non-toxic, biodegradable, free of plant-growth or germination inhibitors; a botanical glue used in hydroseeding, to stabilize soils and for dust control. Derived from the seed of the plantago plant (*Plantago insularis*). Protein content: 1.62; Ash content: 2.70; Fiber: 4.00; ph: 6.8; Settleable solids: 5.00.

SPEC WRITER NOTE: Select Paragraph A or B below. Coordinate with requirements of conservation district for erosion control materials.

2.13 EROSION CONTROL

- A. Erosion Control Net: // Heavy, twisted jute mesh weighing _____kg/sq. m (_____ lbs./sq. yd.) with openings between strands approximately _____ mm square (_____ inches square) // Plastic net with 13 mm square (1/2 inch square) mesh // Knitted synthetic netting, interwoven with paper strips in rolls approximately 1500 mm (56 to 60 inches) wide with openings between strands approximately 13 mm square (1/2 inch square) //. Secure material with 150 mm (6 inch) wire staples by same manufacturer as netting. // Standard weave burlap weighing 100 to 142 g/m (3.5 to 5.0 oz./yd.). // Chicken wire with a

mesh of _____ // Install erosion control net according to manufacturer's instructions.

- B. Erosion Control Blanket: Cellulose fiber blanket bonded to 6 mm (1/4 inch) square plastic net weighing 10 kg/100 sq. m (20 lbs./1000 sq. ft.) in 1250 mm (50 inch) wide rolls.

2.14 STAKES AND GUYING STRAPS

- A. Tree Support Stakes: Rough sawn wood, free of knots, rot, cross grain, or other defects that impair strength. Minimum // 50 mm (2 inches) square // 65 mm (2-1/2 inches) diameter // by 2400 mm (8 feet) long and pointed at one end or galvanized steel pipe 32 mm (1-1/4 inches) by 3000 mm (10 feet) with cap, primed with 2 coats flat black exterior enamel.
- B. Hose Chafing Guards: New or used 2-ply reinforced rubber or plastic hose, all same color.
- C. Flags: White surveyor's plastic tape, 150 mm (6 inches) long, fastened to guying wires or cables.
- D. Guying Straps: Fabric designed specifically to guy newly planted trees. Wire will not be permitted.
- E. Turnbuckles: Galvanized or cadmium-plated steel with minimum 75 mm (3 inch) long openings fitted with screw eyes.
- F. Eye Bolts: Galvanized or cadmium plated steel with 50 mm (1 inch) diameter eye and minimum 40 mm (1-1/2 inches) screw length.
- G. Deadmen: 100 mm by 200 mm (4 inch by 8 inch) rectangular, or 200 mm (8 inch) diameter by 900 mm (36 inch) long sound wood.
- H. Anchors: Arrow shaped or auger iron anchors, noncorrosive, sized according to manufacturer's instructions.

SPEC WRITER NOTE: Edging material such as metal edgers, headerboards, and concrete mowbands are not encouraged on National Cemeteries. There are circumstances where such materials are appropriate and must be approved during the design process by the District Agronomist.

2.15 EDGING

- A. Machine Cut Divot Edge: 'V'-shaped trench used as separation between lawn and mulched planting beds. Fill machine cut divot edge with planting bed mulch as detailed in the drawings.

2.16 WATER

- A. Water: Contains no elements toxic to plant life, obtained from // _____ // as specified in Section 01 00 01, GENERAL REQUIREMENTS, Paragraph, Temporary Services.

2.17 ANTIDESICCANT

- A. Antidesiccant: Emulsion manufactured for agricultural use to provide protective film over plant surfaces permeable enough to permit transpiration.

2.18 SEED

- A. Seed: State-certified seed of latest season's crop delivered in original sealed packages, bearing producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label complying with USDA Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Onsite seed mixing will only be acceptable in presence of COR. Apply turfgrass seed separate from and before mulch material application.
- B. Minimum Acceptable Seed Quality Standards: Purity 95 percent, Germination 85 percent, Weed Seed Content less than 0.5 percent, Noxious Weeds 0.0 percent, Inert Material less than 3 percent, Germination Test Date no older than 6 months.
- C. All turfgrass seed mixtures, or sod composition to conform to species and cultivar requirements // shown on plans // detailed here //. Seed mixtures listed below are representative of an almost endless list of acceptable seed mixtures that roughly approximate these guidelines.

SPEC WRITER NOTE:

1. Choose appropriate species type for project's climate and location, cool or warm season turfgrass.
2. Zoysiagrass is not generally an acceptable species for NCA cemetery use due to its extremely slow rate of growth and high maintenance costs. When unique environmental and growing conditions exist at a NCA construction site, suggest that Zoysiagrass should be considered as the turfgrass species, a special waiver endorsed by NCA Chief Agronomist and appropriate District Agronomist must be obtained in writing before approval of the planting plan.
3. Modify seed mixture below to match cemetery's existing turf where applicable.

Cool Season Turfgrass Seed Mixtures	Percent by Weight
Primary Mixture	50 percent perennial rye grass, 30 percent Ky bluegrass, 20 percent fine fescue
Seeding Rate	2.7 kg/90 sq. m (6 lbs./1000 sq. ft.)
Secondary Mixture	50 percent tall fescue and 50 percent perennial rye grass
Seeding Rate	4.5 kg/90 sq. m (10 lbs./1000 sq. ft.)

1. Blend each species component with minimum two regionally adapted cultivars.

Warm Season Turfgrass Seed Mixtures	Percent by Weight
Preferred Mixture, Sunny Locations	Hybrid bermudagrass cultivars available as seed. Use blend that contains minimum two of the following cultivars in approximately equal proportions - Sunsport, Princess, Riviera, Southern Star, Blackjack, Savannah, Primo Blend.

Warm Season Turfgrass Seed Mixtures	Percent by Weight
Seeding Rate	0.9 kg/90 sq. m (2 lbs./1000 sq. ft.)
Preferred Species, Shady Locations	St. Augustinegrass - sod only
Secondary Species, Low Visibility Areas	centipedegrass or bahiagrass
Seeding Rate	3.6 kg/90 sq. m (8 lbs./1000 sq. ft.)

- D. Obtain approval of COR and NCA // Chief // District // Agronomist for deviations from these turfgrass species requirements.

2.19 SOD

- A. Sod: Nursery grown, certified sod as classified in TPI "Guideline Specifications to Turfgrass Sodding." Sod must also conform to turfgrass species limitations as outlined in seeding mixtures above.

2.20 HERBICIDES AND OTHER PESTICIDES

- A. Properly label and register pesticides with U.S. Environmental Protection Agency. Keep all pesticides in original labeled containers indicating analysis and method of use.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation.
 B. Protect existing construction and completed work from damage.
 C. Examine areas to receive planting for compliance with requirements and other conditions affecting performance.
 D. Proceed with installation only after unsatisfactory conditions have been corrected.

SPEC WRITER NOTE: Review requirement to stake and guy trees. In most cases, this is not needed.

- E. // Stake plant material locations and bed outlines for COR's approval before any plant pits or beds are dug. COR may make adjustments to plant material locations to meet field conditions //.

- F. Identify and review all underground utility locations before commencing work and exercise caution when working close to utilities. Notify COR of apparent conflicts with construction and utilities to plan adjustment before installation.

3.2 FINE GRADING AND ORGANIC AND INORGANIC SOIL AMENDMENT INCORPORATION

- A. Obtain COR's written approval of previously completed rough grading work before incorporating organic soil amendments.
- B. Immediately before dumping and spreading approved organic soil amendment, clean subgrade of stones larger than 50 mm (2 inches) and debris or rubbish and remove from project site. Before spreading organic soil amendment, rip subgrades too compact to drain water or based upon compaction tests with claw 305 mm (12 inches) deep, pulled by bulldozer 610 mm (24 inches') on center, both directions, then regrade surface.
- C. Place and uniformly spread soil amendment materials // humates // and mycorrhizae // over approved sub-grades. Apply inorganic soil amendments as recommended by soils report. Apply organic amendments to depth sufficiently greater than specified depth so after natural settlement and light rolling, specified minimum settled depth conform to lines, grades and elevations indicated on drawings. Incorporate soil amendment by disc harrowing, rototilling or other means in uniform manner. Incorporate upon organic matter deep enough to produce finished soil with organic matter content of between 4 and 6 percent. Provide additional organic soil amendment material, after in-place testing and approval, as required for organic matter content and finished grades at no additional cost to Government.
- D. Spread organic soil amendment material minimum 100 mm (4 inches) deep to finished grade at disturbed areas outside project limits.
- E. Do not handle subsoil or organic soil amendment material when wet or frozen.
- F. Set sufficient number of grade stakes to check finished grades. Set stakes in bottom of swales and at top of slopes. Connect contours and spot elevations with even slope.
- G. After incorporating soil amendments material into subsoil, prepare by scarifying or harrowing and hand raking. Remove large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove stones over 38 mm (1-1/2 inch) diameter from amended soil bed. Amended

soil also to be free of smaller stones in excessive quantities as determined by COR.

3.3 EXCAVATION FOR PLANTING

- A. Compact whole surface with roller or by other suitable means to achieve 88 to 85 percent maximum dry density according to ASTM D698. During compaction process, fill all depressions caused by settling or rolling with additional organic soil amendment. Regrade and roll surface until presenting smooth and even finish corresponding to required grades. Acceptable finished soil grade condition for all new turfgrass areas is "fine textured and firm." Satisfactory firmness test requires surface soil not be fluffy or powdery and able to support weight of average adult person without creating visible depression.
- B. Verify location of underground utilities before plant pit or bed excavation. Repair damaged utility lines. Where lawns have been established before planting, cover and protect before beginning excavations. Protect existing trees, shrubbery, and beds with barricades during project construction.
- C. Remove rocks and other underground obstructions to depth necessary to permit proper planting according to Drawings. Where underground utilities, construction, or solid rock ledges are encountered, COR may select other locations for plant material.
- D. Dig plant pits by approved method to provide vertical sides and flat bottoms. When sides of pit become glazed, scarify glazed surface.
- E. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to depth that will ensure removal of entire root system. Prepare bed as follows:
 1. Where existing soil is to be used in place, till beds // 150mm (6 inches) // 200mm (8 inches) // 300mm (12 inches) // _____ // deep. Spread soil amendment uniformly over bed // 50 mm (2 inches) // _____ // deep and thoroughly incorporate into existing soil // 150mm (6 inches) // 200mm (8 inches) // 300mm (12 inches) // _____ // deep using a roto-tiller or similar equipment to obtain uniform and well pulverized soil mix. Where existing soil is compacted (former roadways, parking lots, etc.) till soil to necessary depth to support growth of new planting. Remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to smooth and even surface to comply with established grades.

- F. In newly grading areas where existing soil will be removed and replaced to prepare new planting beds, remove // 150mm (6 inches) // 200mm (8 inches) // 300mm (12 inches) // _____ // of existing soil and replace with topsoil. Bring plant beds to smooth and even surface to comply with established grades. Till // 50 mm (2 inches) // _____ // of soil amendment into topsoil as specified.
- G. Form earth saucers around plants with topsoil. Provide 50 mm (2 inch) high basins for shrubs and 100 mm (4 inch) high basins for trees.
- H. Treat plant saucers, shrub, and ground cover bed areas, before mulching, with approved preemergence granular ornamental herbicide. Apply herbicide at 90 kg/hectare (200 lbs./acre) before both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through that material after material is in place.

SPEC WRITER NOTES: Adjust ball heights to suit local soil conditions.

3.4 SETTING PLANTS

- A. Move balled and burlapped and container-grown plants only by supporting ball or container. Remove container, taking care to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around roots or ball. Set plants with root crown 25 mm (1 inch) above surrounding grade. Plant ground cover plants after mulch is in place. Avoid contaminating mulch with planting soil.
- B. Backfill balled and burlapped and container-grown plants with native soil removed from planting hole to approximately half ball depth, then tamp and water. Use native soil to backfill hole. Carefully fold back top half of burlap and remove tying materials. Completely remove all wire caging or similar material. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill, then form earth saucers or water basins around isolated plants with topsoil.
- C. Plant bare-rootstock arranging roots in natural position. Form hill or mound in center of planting hole to allow plant to sit at proper depth. Spread roots out, over, and down mound in natural position. Mound to be firm to avoid settlement of entire plant. Remove damaged roots with clean cut. Carefully work native soil in among roots. Tamp and water

remainder of native soil, then form earth saucers or water basins around isolated plants with topsoil.

SPEC WRITER NOTE: Review requirement to stake and guy trees. In most cases, this is not needed.

3.5 // STAKING AND GUYING //

- A. Stake and guy plants as indicated on drawings and as specified.
- B. Drive stakes vertically to depth of 800 to 900 mm (2-1/2 to 3 feet) into ground outside plant pit, unless otherwise shown on drawings Do not injure root ball.
- C. Place deadmen minimum 450 mm (18 inches) below ground surface, unless otherwise indicated on drawings.
- D. Install iron anchors according to manufacturer's instructions.
- E. Fasten flags securely to each guy strap approximately 2/3 of the distance above ground level.
- F. // Remove stakes and guy straps after one year //.

3.6 EDGING PLANT BEDS

- A. Uniformly edge beds using machine to provide clear cut "V"-shaped trench between planted area and adjacent turfgrass. Fill trench with mulch.

SPEC WRITER NOTES: Use caution when considering polyethylene sheets, etc. These materials can cause soil and/or insect problems.

3.7 MULCHING PLANTS

- A. Apply approved preemergence granular ornamental herbicide and mulch within 48 hours after planting. Apply before both early spring and early fall weed seed germination.
- B. // Placing Inert Material: Place // polyethylene sheet // fiberglass mat // landscape fabric // with edges lapped 150 to 300 mm (6 to 12 inches) to receive inert mulch material. Punch 6 mm (1/4 inch) grid drainage holes in // polyethylene sheet // fiberglass mat // 300 mm (one foot) on centers over entire area. Spread inert mulch to uniform thickness over membrane as indicated on drawings //.
- C. Placing Organic Material: Spread wood-base mulch to uniform 50 to 75 mm (2 to 3 inch) thickness. Rake smooth. Flush mulch with adjacent lawn,

curbs and paving. Taper mulch thickness 50mm (2 inches) where planting beds meet adjacent areas.

- D. Keep mulch out of shrub crowns, away from tree trunks, and off buildings, sidewalks, light standards, and other structures.

3.8 PRUNING

- A. Do not prune new plants unless otherwise directed by arborist and approved by the COR. Prune indicated existing plant material as follows:
 1. Remove dead, broken and crossing branches.
 2. Make cuts with sharp instruments as close as possible to branch collar. Do not make flush cuts.
 3. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove leader.
 4. Remove trimmings from project site.
 5. Do not apply tree wound dressing to cuts.
- B. Prune existing trees as indicated on Drawings. Perform tree pruning and cavity work by licensed arborist according to ANSI Z133.1. Remove 13 mm (1/2 inch) diameter or larger dead wood, branches interfering with or hindering healthy growth of trees, and diseased branches with clean cut made flush with branch collar. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Use of climbing spurs is not acceptable. Remove stubs or limbs improper cuts or breaks.

3.9 FERTILIZATION OF EXISTING TREES

- A. Apply fertilizer to existing trees shown on drawings at rate recommended by soil test. Apply in 300 mm to 450 mm (4 inch to 8 inch) deep holes 40 to 50 mm (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at maximum 600 mm (2 feet) on center throughout outer half of branch spread zone of each tree. Fertilize to within 100 mm (4 inches) of surrounding grade. Use topsoil to bring surface up to surrounding grade. When using fertilizer in packet, tablet, or wedge form, apply according to manufacturer's instructions.

3.10 TILLAGE FOR LAWN AREAS

- A. Thoroughly rip subgrades minimum 150 mm (6 inches) // _____ // deep by scarifying, disking, harrowing, or other approved methods. Remove debris and stones on surface larger than 25 mm (1 inch) on surface after tillage. Do not till areas of 3: 1 slope ratio or greater.

Scarify these areas to 50 mm (1 inch) // _____ // depth and remove debris and stones.

3.11 FINISH GRADING

- A. After ripping subgrade for topsoil/subsoil bonding, spread topsoil evenly to minimum 150 mm (6 inches) deep. Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into subsoil to avoid soil layering. Spread additional topsoil as required to meet finish grades. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished lawn areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.12 APPLICATION OF FERTILIZER AND SOIL AMENDMENTS FOR TURFGRASS AREAS

- A. Apply turfgrass fertilizer and adjust soil acidity as recommended by soil test results. Add soil conditioners as specified for suitable topsoil in PART 2.

SPEC WRITER NOTE: If there are large areas of turf with slope ratio of 3: 1 or greater where, in the designer's judgment, likelihood of topsoil slippage may occur, revise this section and drawings to indicate those areas where new topsoil will not be installed.

- B. Spread soil amendments as recommended by soil test results.
- C. Incorporate soil amendments into soil to minimum 100 mm (4 inches) deep // depth as recommended by soil test results // in finish grading operation. Lightly mix starter fertilizer with top 13 mm (1/2 inch) of soil. Immediately restore soil an even condition before seeding or sod placement.

3.13 MECHANICAL SEEDING

- A. // Broadcast seed // Drill-seed // with approved equipment rate as outlined in "Seed" article above. Plant turfgrass seed before application of mulch material. Uniformly distribute seed in 2 directions at right angles to each other. Drag seeded area using approved device.
- B. Immediately after dragging, firm entire area with roller maximum 225 kg/m (150 lbs./ft.) of roller width.

- C. Immediately after preparing seeded area, evenly spread straw mulch at 0.5 kg/sq. m (2 tons/acre). Anchor mulch by mulch tiller, non-asphaltic tackifier, twine, or netting.

3.14 HYDRO-MULCHING

- A. Hydro-Mulching: Mix slow release starter fertilizer and approved wood cellulose mulch material, and tackifier in required amount of water to produce homogenous slurry. Uniformly apply slurry under pressure to deliver recommended quantity of fertilizer per 100 sq. m (1000 sq. ft.).

3.15 SODDING

- A. Place sod according to TPI Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at bottom of slope.
- B. Finishing: After sodding, blend edges of sod smoothly into surrounding area. Roll with lightweight roller to eliminate air spaces between sod and firmed soil.

3.16 WATERING

- A. Watering: Start watering turfgrass areas immediately after installation at sufficient rate to ensure thorough wetting of soil to minimum 50 mm (2 inches) deep. Supervise watering operation to prevent run-off. Supply necessary 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. Deep water all trees twice each week during Plant Establishment Period, providing water penetration throughout root zone to full depth of planting pits, as verified by COR. Discontinue watering at first hard frost in fall and resume at ground thaw in spring.

SPEC WRITER NOTE: Specify erosion control material and installation as recommended by manufacturer. The following is an example.

3.17 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material on designated areas as shown on drawings. Prepare, fertilize and vegetate areas to be covered, before erosion material is placed. Immediately following planting operations, lay erosion control material evenly and smoothly and in

contact with soil throughout. Omit straw mulch from all seeded areas receiving erosion control material.

- B. For waterways, unroll erosion control material in direction of water flow. When two or more strips are required to cover ditch area, overlap strips minimum 100 mm (4 inches). For strips to be spliced lengthwise, overlap ends minimum 150 mm (6 inches) with upgrade section on top.
- C. On slopes, place erosion control material either horizontally or vertically to slope with edges and ends of adjacent strips butted tightly against each other.
- D. Staple each erosion control strip in three rows (each edge and center with center row alternately spaced) with staples spaced maximum 1200 mm (4 feet) longitudinally. For two or more strips side by side on slopes, install common row of staples on adjoining strips. Staple all end strips at 300 mm (12 inch) intervals at end. Firmly embed staples in underlying soil.
- E. Provide erosion control maintenance to repair damage by erosion, wind, or any other cause. Maintain, protect, repair, or replace erosion control material until Termination of the Plant and Warranty Period.

3.18 LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD

- A. Landscape Plant and Turfgrass Establishment Period: Begins immediately after installation, with COR's approval, and continues through growing season sufficiently long for turfgrass and landscape plant materials to become establish and provide satisfactory to District Agronomist and NCA. Conditions and appearance are as follows:
 1. Turfgrass has obtained minimum of 98 percent generally weed-free surface cover.
 2. Landscape Plant Materials are fully rooted, actively growing and healthy and planting beds generally weed-free.
 3. Maintain plant and turfgrass during establishment period.
 4. Plants and turfgrass will not be accepted until completion of acceptable establishment period.
 5. During Landscape Plant and Turfgrass Establishment Period complete the following:
 - a. Water plants and turfgrass to maintain moist soil surface until plants and turfgrass are well established. Quantity of applied water required to achieve and maintain these conditions determined on site by District Agronomist in consultation with COR.

- b. Prune plants and replace mulch as required.
- c. Replace and restore // stakes, guy straps, // and // eroded plant saucers as required.
- d. Remove grass, weeds, and other undesired vegetation, including root growth, before they reach 75 mm (3 inches) high in plant bed and saucers. After all unwanted vegetation has been removed, apply approved preemergence herbicides and remulch.
- e. Spray with approved insecticides and fungicides to control pests and ensure plant survival in healthy growing condition, as directed by COR in coordination with District Agronomist.
- f. Provide the following during turfgrass establishment:
 - 1) Eradicate weeds. Water, fertilize, overseed, and perform other operation necessary to promote growth of turfgrass.
 - 2) Mow turfgrasses as often as necessary to maintain NCA specified mowing height for each type of turfgrass before final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses, mow at appropriate heights for species and cultivar as directed by COR in consultation with District Agronomist.
- g. Replace dead, missing or defective plant material during establishment period and an active growing season. Immediately replace each plant with one of same size and species.
- h. Replant areas void of turfgrass during an active growing season only.
- i. Sod will be evaluated for species and health thirty (30) days after laying last piece and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from sod operation will be living sod, uniform in color and leaf texture. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces to be tight and free of weeds and other undesirable growth.
- j. Seeding will be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from seeding operation will be 98 percent coverage uniform in color and leaf texture. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Reseed unsatisfactory areas within seven days during an active growing season.

- k. Complete remedial measures as directed by COR in consultation with District Agronomist to ensure plant and turfgrass survival.
- l. Repair damage caused while making plant or turfgrass replacements.

3.19 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE

- A. Landscape plant and turfgrass acceptance will occur after completion of LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. Contractor to have completed, located, and installed all plants and turfgrass according to drawings and specifications. All plants and turfgrass are expected to be living and in healthy condition at time of inspection and acceptance. Make written request two weeks before final inspection of landscape plants and turfgrass. Upon inspection, when work is found to not meet specifications, PLANT AND TURFGRASS ESTABLISHMENT PERIOD will be extended at no additional cost to 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 replacements have been installed.
 - 4. Remedial measures directed by COR have been completed.
- C. Criteria for Acceptance of Turfgrass:
 - 1. Sod: Living sod grass plants uniform in color and leaf texture and well rooted into soil below so that gentle pulling of turfgrass leaves by hand does not dislodge sod. Bare spots to be maximum 1250 sq. mm (2 sq. inches). Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 - 2. Seed: Living turfgrass plants with 98 percent coverage, uniform in color and leaf texture. Bare spots to be maximum 0.05 sq. m (0.5 sq. ft.).

3.20 CLEANING

- A. Remove and legally dispose of all debris, rubbish, and excess material from project site.
- B. Where existing or new turfgrass areas have been damaged or scarred, restore disturbed areas to original condition.

- C. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers.
- D. Maintain minimum one paved pedestrian access route and one paved vehicular access route to each building clean at all times.
- E. Clear other paved areas when work in adjacent areas are completed.

3.21 PROTECTION

- A. Protect plants and turfgrass areas from traffic and construction operations. Erect barricades, as required, and place approved signs at appropriate intervals until final acceptance.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.

SPEC WRITER NOTE: Delete following paragraph if not applicable.

3.22 ENVIRONMENTAL PROTECTION

- A. All work and operations to comply with requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

- - - E N D - - -

**SECTION 33 40 00
STORM SEWER UTILITIES**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures, and all other incidentals.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Materials and Testing Report Submittals.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS: Erosion and Sediment Control.
- F. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- G. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- H. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.
- I. Section 05 50 00, METAL FABRICATIONS: Fabrication of Steel Ladders.
- J. Section 22 14 00, FACILITY STORM DRAINAGE.
- K. Section 31 20 00, EARTH MOVING: Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the

publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- 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):
- HB-17-2002.....Standard Specifications for Highway Bridges,
17th Edition
- M190-2004.....Standard Specification for Bituminous-Coated
Corrugated Metal Culvert Pipe and Pipe Arches
- M252-2009.....Standard Specification for Corrugated
Polyethylene Drainage Pipe
- M294-2015.....Standard Specification for Corrugated
Polyethylene Pipe, 300 to 1500 mm (12 to 60
In.) Diameter
- C. American Concrete Institute (ACI):
- 318-2014.....Building Code Requirements for Structural
Concrete and Commentary
- 350-2006.....Code Requirements for Environmental Engineering
Concrete Structures and Commentary
- D. American Society of Mechanical Engineers (ASME):
- A112.6.3-2016.....Floor and Trench Drains
- A112.14.1-2003.....Backwater Valves
- A112.36.2M-1991.....Cleanouts
- E. American Society for Testing and Materials (ASTM):
- A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings
- A242/A242M-2013.....Standard Specification for High-Strength Low-
Alloy Structural Steel
- A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings
- A615/A615M-2016.....Standard Specification for Deformed and Plain
Carbon-Steel Bars for Concrete Reinforcement
- A760/A760M-2015.....Standard Specification for Corrugated Steel
Pipe, Metallic-Coated for Sewers and Drains

A762/A762M-2015.....Standard Specification for Corrugated Steel
Pipe, Polymer Precoated for Sewers and Drains

A798/A798M-2013.....Standard Specification for Installing Factory-
Made Corrugated Steel Pipe for Sewers and Other
Applications

A849-2015.....Standard Specification for Post-Applied
Coatings, Pavings, and Linings for Corrugated
Steel Sewer and Drainage Pipe

A929/A929M-2001(2013)...Standard Specification for Steel Sheet,
Metallic-Coated by the Hot-Dip Process for
Corrugated Steel Pipe

A1064/A1064M-2016.....Standard Specification for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete

B745/B745M-2015.....Standard Specification for Corrugated Aluminum
Pipe for Sewers and Drains

B788/B788M-2009 (R2014).Standard Specification for Installing Factory-
Made Corrugated Aluminum Culverts and Storm
Sewer Pipe

C14-2015a.....Standard Specification for Nonreinforced
Concrete Sewer, Storm Drain, and Culvert Pipe

C33/C33M-2016.....Standard Specification for Concrete Aggregates

C76-2015a.....Standard Specification for Reinforced Concrete
Culvert, Storm Drain, and Sewer Pipe

C150/C150M-2016.....Standard Specification for Portland Cement

C443-2012.....Standard Specification for Joints for Concrete
Pipe and Manholes, Using Rubber Gaskets

C478-2015.....Standard Specification for Circular Precast
Reinforced Concrete Manhole Sections

C506-2016a.....Standard Specification for Reinforced Concrete
Arch Culvert, Storm Drain, and Sewer Pipe

C507-2015.....Standard Specification for Reinforced Concrete
Elliptical Culvert, Storm Drain, and Sewer Pipe

C828-2011.....Standard Test Method for Low-Pressure Air Test
of Vitrified Clay Pipe Lines

C890-2013.....Standard Practice for Minimum Structural Design
Loading for Monolithic or Sectional Precast
Concrete Water and Wastewater Structures

C891-2011.....	Standard Practice for Installation of Underground Precast Concrete Utility Structures
C913-2008.....	Standard Specification for Precast Concrete Water and Wastewater Structures
C923-2008 (R2013)e1.....	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C990-2009 (R2014).....	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-2014.....	Standard Specification for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-2010 (R2014).....	Standard Specification for Flexible Transition Couplings for Underground Piping Systems
C1433-2016a.....	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-2013.....	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448-2012.....	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
D698-2012e2.....	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
D1056-2014.....	Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
D2321-2014e1.....	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2661-2014.....	Standard Specification for Acrylonitrile- Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
D3034-2015.....	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3350-2014.....	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

- D3753-2012e1.....Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- D5926-2015.....Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-2013.....Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- F794-2003 (R2014).....Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F891-2010.....Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
- F894-2013.....Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- F1417-2011a (R2015).....Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- F1668-2008.....Standard Guide for Construction Procedures for Buried Plastic Pipe
- F. American Water Works Association (AWWA):
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C219-2011.....Bolted, Sleeve-Type Couplings for Plain-End Pipe

C600-2010.....Installation of Ductile iron Mains and Their Appurtenances

C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

M23-2002.....PVC Pipe: Design And Installation, Second Edition

G. National Stone, Sand and Gravel Association (NSSGA):
.....Quarried Stone for Erosion and Sediment Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 40 00, STORM SEWER UTILITIES", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
- D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- E. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- F. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

1.5 QUALITY ASSURANCE

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes //catch basins// //stormwater inlets// according to manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.8 WARRANTY

- A. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- B. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of //one year// //two years// from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

1.9 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder.

All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. Guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

SPEC WRITER NOTE: Retain one or more of the following paragraphs. If retaining more than one type of pipe, indicate location of each type on Drawings.

2.2 STEEL PIPE AND FITTINGS

- A. Steel pipe and fittings shall be as per //ASTM A760/A760M// //ASTM A762/A762M//.
- B. Type of pipe: //I// //II// //IR// //IIR//.

SPEC WRITER NOTE: If Type I or II is selected, use the following paragraph.

C. //Corrugations: //Annular// //Helical// 68 by 15 mm (2-2/3 by 1/2 inch) corrugations.//

SPEC WRITER NOTE: If Type IR or IIR is selected, use the following paragraph.

D. //Corrugations: Helical 20 by 20 by 191 mm (3/4 by 3/4 by 7-1/2 inch) corrugations.//

E. Internal Coating: Internal coating shall be //fully bituminous coated (AASHTO M190 Type A)// //half bituminous coated, part paved (AASHTO M190 Type B)// //fully bituminous coated, part paved (AASHTO M190 Type C)// //fully bituminous coated, fully paved (AASHTO M190 Type D)// //concrete lined as per ASTM A849// //polymer precoated, part paved (AASHTO M190, Type B modified)// //polymer precoated, fully paved (AASHTO M190, Type D modified)//.

F. Exterior Coating: //Aluminum// //Zinc// //Polymer// //Bituminous// Coated.

G. Gaskets: ASTM D1056, Type 2, //A1// //B3//.

H. Connecting Bands: To be same type and size as the ends of the pipe being connected.

2.3 ALUMINUM PIPE AND FITTINGS

A. Corrugated aluminum pipe and fittings shall be ASTM B745/B745M, Type I with fittings of similar form and construction as pipe.

1. Special joint bands shall be corrugated steel with O-ring seals.
2. Standard joint bands shall be corrugated steel.

2.4 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: Pipe and fittings, DN 80 to DN 150 (NPS 3 to NPS 6) shall conform to ASTM D2661, with ends suitable for solvent cement joints.

2.5 PE PIPE AND FITTINGS

A. Smoothwall PE drainage pipe and fittings, DN 80 to DN 250 (NPS 3 to NPS 10); ASTM F714, DR 21 with smooth waterway for coupling joints.

SPEC WRITER NOTE: Select Paragraph 1 or 2 below. If both types of couplings are required indicate on Drawings location for different couplings.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

- B. Corrugated PE pipe and fittings, DN 300 to DN 1500 (NPS 12 to NPS 60); AASHTO M294, Type S with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

SPEC WRITER NOTE: Select Paragraph 1, 2 or 3 below. If both types of couplings are required indicate on Drawings location for different couplings.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
 2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
 3. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
- C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, RSC 160 with bell and spigot ends.
1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, //gasketed// //extrusion weld// type with integral bell.

2.6 PVC PIPE AND FITTINGS

- A. PVC Cellular-Core Pipe And Fittings:
1. Pipe: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 2. Fittings: ASTM D3034, //SDR 35// //Insert SDR//, PVC socket-type fittings.
- B. PVC Corrugated Sewer Piping:
1. Pipe: ASTM F949, PS46, corrugated pipe with bell-and-spigot ends for gasketed joints.
 2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
 3. Gaskets: ASTM F477, elastomeric seals.
- C. PVC Profile Sewer Piping:
1. Pipe: ASTM F794, Series 46, gravity sewer pipe with bell-and-spigot ends.
 2. Fittings: ASTM D3034, PVC with bell ends.
 3. Gaskets: ASTM F477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D3034, //SDR 35// //Insert SDR//, PVC Type PSM sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and fittings shall be ASTM F679, //PS46// //PS75// //PS115//, PVC gravity sewer pipe with bell-and-spigot ends.
2. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900, //Class 100// //Class 150// //Class 200// PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, //Class 100// //Class 150// //Class 200// PVC pipe with bell ends
3. Gaskets: ASTM F477, elastomeric seals.

2.7 CONCRETE PIPE AND FITTINGS

A. Non-reinforced concrete sewer pipe and fittings shall be ASTM C14, //Class 1// //Class 2// //Class 3//, with //bell-and-spigot// //tongue and groove// ends and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

B. Reinforced concrete sewer pipe and fittings shall be ASTM C76.

1. //Bell-and-spigot// //tongue and groove// ends and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

SPEC WRITER NOTE: Retain one of subparagraphs below for DN 300 to DN 3600 (NPS 12 to NPS 144).

2. Class I: //Wall A// //Wall B//
3. Class II: //Wall A// //Wall B// //Wall C //
4. Class III: //Wall A// //Wall B// //Wall C //
5. Class IV: //Wall A// //Wall B// //Wall C //
6. Class V: //Wall B// //Wall C //

C. Reinforced arch culvert and storm drain pipe and fittings shall be ASTM C506, Class //A-III// //A-IV// and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

- D. Reinforced concrete elliptical culvert and storm drain pipe and fittings shall be ASTM C507, Class //HE III// //HE IV// //VE III// //VE IV// //VE V// //VE VI// and //gasketed joints with ASTM C443, rubber gaskets // //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

2.8 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure 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 concrete pipes: ASTM C443, rubber.
 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with //stainless steel shear ring and// corrosion resistant metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full length, corrosion resistant outer shield and corrosion resistant metal tension band and tightening mechanism on each end.
- E. Ring-type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.9 PRESSURE PIPE COUPLINGS

- A. Couplings: AWWA C219, tubular sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.
- B. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include //1034 kPa (150 psi)// //1380 kPa (200 psi)// //Insert value// minimum pressure rating and ends sized to match adjoining pipes.
- C. Center Sleeve Material: //Carbon steel// //Stainless steel// //Ductile iron// //Malleable iron//.
- D. Gasket Material: Natural or synthetic rubber.
- E. Metal Component Finish: Corrosion resistant coating or material.

2.10 EXPANSION JOINTS AND DEFLECTION FITTINGS

SPEC WRITER NOTES:

1. Expansion joints and deflection fittings in the following paragraphs

are for buried, ductile iron pressure pipe, and other pipe with same diameters.

2. Expansion joints in the following paragraph provides both offset and expansion. Indicate minimum required offset and expansion data on Drawings.

- A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical joint ends complying with AWWA C110. Include two gasketed ball joint sections and one or more gasketed sleeve sections, rated for 1724 kPa (250 psi) minimum working pressure and for offset and expansion indicated.

SPEC WRITER NOTE: Expansion joints in the following paragraph provides linear expansion only.

- B. Ductile iron expansion joints: Three piece assemblies of telescoping sleeve with gaskets and restrained-type, //ductile iron// //steel with protective coating//, bell-and-spigot end sections complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working pressure and for expansion indicated.

SPEC WRITER NOTE: Fittings in the following paragraph provides deflection only.

- C. Ductile iron deflection fittings: Compound coupling fitting, with ball joint, flexing section, gaskets, and restrained joint ends, complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working pressure and for up to 15 degrees of deflection.

2.11 BACKWATER VALVES

- A. Cast Iron Backwater Valves: ASME A112.14.1, gray iron body and bolted cover, with bronze seat.

SPEC WRITER NOTE: Retain one or more of the following subparagraphs. If more than one type is required, show location of each on Drawings.

1. //Horizontal type; with swing check valve and hub-and-spigot ends.//
2. //Combination horizontal and manual gate valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.//
3. //Terminal type; with bronze seat, swing check valve, and hub inlet.//

- B. Plastic backwater valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.12 CLEANOUTS

- A. Cast Iron Cleanouts: ASME A112.36.2M, round, gray iron housing with clamping device and round, secured, scoriated, gray iron cover. Include gray iron ferrule with inside calk or spigot connection and countersunk, tapered thread, brass closure plug.

SPEC WRITER NOTE: Retain one or more options in the following subparagraph. If more than one top-loading classification is required, show location of each on Drawings.

1. Top-Loading Classification(s): //Light Duty// //Medium Duty//
//Heavy Duty// and //Extra-Heavy Duty//.
2. Pipe fitting and riser to cleanout shall be same material as main pipe line.

- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.13 DRAINS

- A. Cast Iron Area Drains: ASME A112.6.3, gray iron round body with anchor flange and round //secured// grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Top-Loading Classification(s): //Medium Duty// //Medium and Heavy Duty// //Heavy Duty//.

- B. Cast Iron Trench Drains: ASME A112.6.3, 150 mm (6 inch) wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular //secured// grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Top-Loading Classification(s): //Medium Duty// //Heavy Duty//
//Extra-Heavy Duty// //Medium and Heavy Duty// //Medium and Extra-Heavy Duty// //Heavy and Extra-Heavy Duty// //Medium, Heavy, and Extra-Heavy Duty//.

- C. Steel Trench Drains: ASTM A242/A242M, welded steel plate, to form rectangular body with uniform bottom downward slope of 2 percent toward outlet, anchor flange, and grate.

1. Plate Thicknesses: //3.2 mm (1/8 inch)// //6 mm (1/4 inch)//.
2. Overall Widths: //191 mm (7-1/2 inches)// //313 mm (12-1/3 inches)//.

- D. Grate openings shall be //6 mm (1/4 inch) circular// //10 mm (3/8 inch) circular// //10 by 75 mm (3/8 by 3 inch) slots//.

2.14 ENCASUREMENT FOR PIPING

- A. Material: AWWA C105 //linear low-density polyethylene film of 0.20 mm (0.008 inch)// //high-density, cross-laminated polyethylene film of 0.10 mm (0.004 inch)// minimum thickness.
- B. Form: //Sheet// //Tube//.
- C. Color: //Black// //Natural// //Insert color//.

2.15 MANHOLES AND CATCH BASINS

SPEC WRITER NOTE: Retain one or more of the following paragraphs. If more than one paragraph is selected, show location of each on Drawings.

- A. Standard Precast Concrete Manholes:
1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Diameter: 1200 mm (48 inches) minimum unless otherwise indicated.
 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
 4. Base Section: 150 mm (6 inch) minimum thickness for floor slab and 100 mm (4 inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 5. Riser Sections: 100 mm (4 inch) minimum thickness, and lengths to provide depth indicated.
 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
 7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
 8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
 9. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
 10. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) total thickness, to match diameter of manhole frame and cover,

and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Structures:

1. Description: ASTM C913; designed for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: If total depth from floor of structure to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D 4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
6. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inches) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Fiberglass Manholes:

1. Description: ASTM D3753.
2. Diameter: 1200 mm (48 inches) minimum unless otherwise indicated.
3. Ballast: Increase thickness of concrete base as required to prevent flotation.
4. Base Section: Concrete, 200 mm (8 inch) minimum thickness.
5. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
6. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.

7. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

D. Manhole Frames and Covers:

1. Description: Ferrous; 600 mm (24 inch) ID by 175 to 225 mm (7 to 9 inch) riser with 100 mm (4 inch) minimum width flange and 660 mm (26 inch) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: //ASTM A536, Grade 60-40-18 ductile// //ASTM A48/A48M, Class 35 gray// iron unless otherwise indicated.

2.16 CONCRETE FOR MANHOLES AND CATCH BASINS

- A. General: Cast-in-place concrete according to ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

- B. Concrete Design Mix: 27.6 MPa (4000 psi) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 420 MPa (60,000 psi) deformed steel.

- C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to 3/4 of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

2.17 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

- A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

- B. Sloped-Invert, Polymer-Concrete Systems:
1. Channel Sections:
 - a. Interlocking joint, precast, modular units with end caps.
 - b. 100 mm (4 inch) inside width and deep, rounded bottom, with built-in invert slope of 0.6 percent and with outlets in quantities, sizes, and locations indicated.
 - c. Extension sections necessary for required depth.
 - d. Frame: Include gray iron or steel frame for grate.
 2. Grates:
 - a. Manufacturer's designation "//Heavy// //Medium// Duty," with slots or perforations that fit recesses in channels.
 - b. Material: //Fiberglass// //Galvanized steel// //Gray iron// //Stainless steel//.
 3. Covers: Solid gray iron if indicated.
 4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
- C. Narrow-Width, Level-Invert, Polymer-Concrete Systems:
1. Channel Sections:
 - a. Interlocking joint, precast, modular units with end caps.
 - b. 125 mm (5 inch) inside width and 248 mm (9-3/4 inch) deep, rounded bottom, with level invert and with DN 100 (NPS 4) outlets in quantities, sizes, and locations indicated.
 2. Grates:
 - a. Slots or perforations that fit recesses in channels.
 - b. Material: //Fiberglass// //Galvanized steel// //Gray iron// //Stainless steel//.
 3. Covers: Solid gray iron if indicated.
 4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
- D. Wide-Width, Level-Invert, Polymer-Concrete Systems:
1. Channel Sections:
 - a. Interlocking joint, precast, modular units with end caps.
 - b. 200 mm (8 inch) inside width and 350 mm (13-3/4 inch) deep, rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.
 2. Grates:
 - a. Slots or other openings that fit recesses in channels.
 - b. Material: //Fiberglass// //Gray iron//.

3. Covers: Solid gray iron if indicated.
 4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
- E. Drainage Specialties: Precast, polymer-concrete units.
1. Large Catch Basins:
 - a. 600 by 300 mm (24 by 12 inch) polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. Gray iron slotted grate.
 - c. Frame: Include gray iron or steel frame for grate.
 2. Small Catch Basins:
 - a. 483 to 600 mm by approximately 150 mm (19 to 24 inch by approximately 6 inch) polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. Gray iron slotted grate.
 - c. Frame: Include gray iron or steel frame for grate.
 3. Oil Interceptors:
 - a. Polymer-concrete body with interior baffle and four steel support channels and two 6 mm (1/4 inch) thick, steel plate covers.
 - b. Steel plate covers.
 - c. Capacity: //530 L (140 gal.)// //757 L (200 gal.)// //984 L (260 gal.)//.
 - d. Inlet and Outlet: //DN 100 (NPS 4)// //DN 150 (NPS 6)//.
 4. Sediment Interceptors:
 - a. 686 mm (27 inch) square, polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. 600 mm (24 inch) square, gray iron frame and slotted grate.
- F. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
- G. Channel Section Joining and Fastening Materials: As recommended by system manufacturer.

2.18 PLASTIC, CHANNEL DRAINAGE SYSTEMS

- A. General Requirements for Plastic, Channel Drainage Systems:
1. Modular system of plastic channel sections, grates, and appurtenances.
 2. Designed so grates fit into frames without rocking or rattling.
 3. Number of units required to form total lengths indicated.

B. Fiberglass Systems:

1. Channel Sections:

- a. Interlocking joint, fiberglass modular units, with built-in invert slope of approximately 1 percent and with end caps.
- b. Rounded or inclined inside bottom surface, with outlets in quantities, sizes, and locations indicated.
- c. Width: //150 mm (6 inches)// //200 mm (8 inches)//.

2. Factory- or field-attached frames that fit channel sections and grates.

- a. Material: //Galvanized steel// //Stainless steel//
//Manufacturer's standard metal//.

3. Grates with slots or perforations that fit frames.

- a. Material: //Fiberglass// //Galvanized steel// //Gray iron//
//Stainless steel//.

4. Covers: Solid gray iron if indicated.

5. Drainage Specialties:

- a. Large Catch Basins: 600 mm (24 inch) square plastic body, with outlets in quantities and sizes indicated. Include gray iron frame and slotted grate.
- b. Small Catch Basins: 300 by 600 mm (12 by 24 inch) plastic body, with outlets in quantities and sizes indicated. Include gray iron frame and slotted grate.

C. PE Systems:

1. Channel Sections: Interlocking joint, PE modular units, 100 mm (4 inches) wide, with end caps. Include rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.

2. Grates: PE, ladder shaped; with stainless steel screws.

3. Color: Gray unless otherwise indicated.

4. Drainage Specialties: Include the following PE components:

- a. Drains: 100 mm (4 inch) diameter, round, slotted top; with DN 100 (NPS 4) bottom outlet.
- b. Drains: 200 mm (8 inch) diameter, round, slotted top; with DN 150 (NPS 6) bottom outlet.
- c. Drains: 100 mm (4 inch) square, slotted top; with DN 80 (NPS 3) bottom outlet.
- d. Drains: 200 mm (8 inch) square, slotted top; with DN 150 (NPS 6) bottom outlet.

- e. Catch Basins: 300 mm (12 inch) square plastic body, with outlets in quantities and sizes indicated. Include PE slotted grate 298 mm (11-3/4 inches) square by 28.6 mm (1-1/8 inches) thick.
- D. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
- E. Channel Section Joining and Fastening Materials: As recommended by system manufacturer.

2.19 PIPE OUTLETS

SPEC WRITER NOTE: Detail outlets on Drawings. Delete the following paragraph if piping includes flared outlet fittings and concrete head walls are not required.

- A. Head walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

SPEC WRITER NOTE: Retain one of three following subparagraphs or insert another grade.

- 1. Average Size: NSSGA No. R-3, screen opening 50 mm (2 inches).
- 2. Average Size: NSSGA No. R-4, screen opening 75 mm (3 inches).
- 3. Average Size: NSSGA No. R-5, screen opening 125 mm (5 inches).
- 4. Average Size: //Insert size//.

SPEC WRITER NOTE: Retain both following paragraphs to require specific stone sizes.

- C. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, 6 mm (No. 4) screen opening, average size graded stone.
- D. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 2721 kg (3 ton) average weight armor stone, unless otherwise indicated.

2.20 DRY WELLS

SPEC WRITER NOTE: Retain one of three following paragraphs.

- A. Concrete Well: ASTM C913, precast, reinforced, perforated concrete rings. Include the following:
 - 1. Concrete Floor: 27.6 MPa (4000 psi) minimum 28 day compressive strength.

2. Cover: Liftoff-type concrete cover with cast in lift rings
 3. Wall Thickness: 100 mm (4 inches) minimum with 25 mm (1 inch) diameter or 25 by 75 mm (1 by 3 inch) maximum slotted perforations arranged in rows parallel to axis of ring
 4. Total free area of perforations: Approximately 15 percent of ring interior surface
 5. Ring construction: Designed to be self-aligning.
 6. Filtering material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel.
- B. Manufacture PE side panels and top cover to assemble into 190 L (50 gal.) storage capacity units.
- C. Constructed-in-place aggregate type well: Include the following:
- SPEC WRITER NOTE: Retain subparagraph 1 or 2 below.
1. //Line with clay or concrete bricks.//
 2. //Line with concrete blocks or precast concrete rings with notches or weep holes.//
 3. Filtering Material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel.
 4. Cover: Precast, reinforced concrete slab, designed for structural loading according to ASTM C890 and made according to ASTM C913. Include slab dimensions that extend 300 mm (12 inches) minimum beyond edge of excavation. Cast cover with opening for manhole in center.
 5. Manhole: 600 mm (24 inch) diameter, reinforced concrete access lid with steel lift rings. Include bituminous coating over entire surface.

2.21 STORMWATER DISPOSAL SYSTEMS

SPEC WRITER NOTE: Retain one of two following paragraphs.

- A. Chamber Systems:
1. Storage and leaching chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
 2. Filtering material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel. Include Geotextile

- woven or spun filter fabric, in one or more layers, for minimum total unit weight of 135 g/sq. m (4 oz./sq. yd).
- B. Pipe Systems: Perforated manifold, header, and lateral piping complying with AASHTO M252 for DN 250 (NPS 10) and smaller, AASHTO M294 for DN 300 to DN 1500 (12 NPS to NPS 60). Include fittings, couplings, seals, and filter fabric.

2.22 HEADWALLS

- A. Headwalls: Cast-in-place concrete with a minimum compressive strength of 20 MPa (3000 psi) at 28 days.

2.23 FLARED END SECTIONS

- A. Flared End Sections: Sections shall be of standard design //fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929/A929M// //of reinforced concrete in accordance with DOT standards//.

2.24 PRECAST REINFORCED CONCRETE BOX CULVERT

- A. Precast Reinforced Concrete Box Culvert: Designed for highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conforming to ASTM C1433. For less than 600 mm (2 feet) of cover, subjected to highway loading, conform to ASTM C1433.

2.25 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

- A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.26 WARNING TAPE

SPEC WRITER NOTE: Use non-detectable type for cemeteries only.

- A. Standard, 4-Mil polyethylene 75 mm (3 inch) wide tape //detectable// //non-detectable// type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete

pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest 1/4 of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798/A798M.

3.3 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with //900 mm (36 inch)// //1200 mm (48 inch)// //1500 mm (60 inch)// //1800 mm (72 inch)// //Insert dimension// minimum cover as shown on the Drawings.
- C. 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.
 - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
 - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
 - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

6. Do not walk on pipe in trenches until covered by a depth of 300 mm (12 inches) over the crown of the pipe.
 7. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
 - E. 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.
 - F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
 - G. Install gravity-flow, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow.
 2. Install corrugated steel piping according to ASTM A798/A798M.
 3. Install corrugated aluminum piping according to ASTM B788/B788M.
 4. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.
 5. Install PE corrugated sewer piping according to ASTM D2321 with //gasketed joints// //extrusion welded joints//.
 6. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
 7. Install //non-reinforced concrete// //reinforced concrete// sewer piping according to ASTM C1479.

3.4 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

SPEC WRITER NOTE: If the project includes connections to existing VA owned manholes, retain the first optional

Article 3. If the project includes connections to existing public utility manholes, retain the second optional.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

- A. Comply with all rules and regulations of the public utility.
- B. Backwater Valve Installation: Install //horizontal-type backwater valves// //combination horizontal and manual gate valve// //terminal-type backwater valves// in piping where indicated.
- C. Cleanout Installation:
 1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast iron soil pipe fittings in sewer pipes at branches for cleanouts and cast iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - a. Use Light-Duty, top-loading classification cleanouts in //earth or unpaved foot-traffic// //Insert other// areas.
 - b. Use Medium-Duty, top-loading classification cleanouts in //paved foot-traffic// //Insert other// areas.
 - c. Use Heavy-Duty, top-loading classification cleanouts in //vehicle-traffic service// //Insert other// areas.
 - d. Use Extra-Heavy-Duty, top-loading classification cleanouts in //roads// //Insert area//.
 2. Set cleanout frames and covers in earth in cast-in-place concrete block, //450 by 450 by 300 mm (18 by 18 by 12 inches)// //Insert dimensions// deep. Set with tops //25 mm (1 inch)// //Insert dimension// above surrounding earth grade.
- D. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 1. Use Light-Duty, top-loading classification cleanouts in //earth or unpaved foot-traffic// //Insert other// areas.

2. Use Medium-Duty, top-loading classification cleanouts in //paved foot-traffic// //Insert other// areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in //vehicle-traffic service// //Insert other// areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in //roads// //Insert area//.
- B. Embed drains in 100 mm (4 inch) minimum concrete around bottom and sides.
- C. Set drain frames and covers with tops flush with pavement surface.
- D. Assemble trench sections with flanged joints and embed trench sections in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.

3.8 MANHOLE INSTALLATION

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops //75 mm (3 inches)// //Insert dimension// above finished surface elsewhere unless otherwise indicated.
- C. Circular Structures:
1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
 2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
 3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
- D. Rectangular Structures:
1. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base

- section. Structures provided with a base section shall be set on a 200 mm (8 inch) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
 5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
 6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
 7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inch) thick, by 300 mm (12 inch) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.9 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.10 STORMWATER INLET //AND OUTLET// INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete.
- B. Construct riprap of broken stone.
- C. Install outlets that spill onto grade, anchored with concrete.

- D. Install outlets that spill onto grade, with flared end sections that match pipe.
- E. Construct energy dissipaters at outlets.

3.11 DRY WELL INSTALLATION

- A. Excavate hole to diameter of at least 150 mm (6 inches) greater than outside of dry well. Do not extend excavation into groundwater table.
- B. Install precast, concrete ring dry wells according to the following:
 - 1. Assemble rings to depth indicated, and extend rings to height where top of cover will be approximately 200 mm (8 inches) below finished grade.
 - 2. Backfill bottom-inside of rings with filtering material to level at least 300 mm (12 inches) above bottom.
 - 3. Extend effluent inlet pipe 300 mm (12 inches) into rings and terminate into side of tee fitting.
 - 4. Backfill around outside of rings with filtering material to top level of rings and install cover over top of rings.
- C. Install manufactured, PE dry wells according to manufacturer's written instructions and the following:
 - 1. Assemble and install panels and cover.
 - 2. Backfill bottom-inside of rings with filtering material to level at least 300 mm (12 inches) above bottom.
 - 3. Extend effluent inlet pipe 300 mm (12 inches) into unit and terminate into side of tee fitting.
 - 4. Install filter fabric around outside of unit.
 - 5. Install filtering material around outside of unit.
- D. Install constructed-in-place dry wells according to the following:
 - 1. Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.
 - 2. Install block lining material dry, with staggered joints and 20 percent minimum of blocks on side for seepage. Install precast concrete rings with notches or weep holes for seepage. Build to diameter and depth indicated.
 - 3. Extend lining material to height where top of manhole will be approximately //200 mm (8 inches)// //Insert dimension// below finished grade.
 - 4. Backfill bottom of inside of lining with filtering material to level at least 300 mm (12 inches) above bottom.

5. Extend effluent inlet pipe 300 mm (12 inches) into lining and terminate into side of tee fitting.
6. Backfill around outside of lining with filtering material to top level of lining.
7. Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

3.12 CHANNEL DRAINAGE SYSTEM INSTALLATION

- A. Install with top surfaces of components, except piping, flush with finished surface.
- B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- C. Embed channel sections and drainage specialties in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.
- D. Assemble channel sections with flanged or interlocking joints.
- E. Embed channel sections in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.

3.13 STORMWATER DISPOSAL SYSTEM INSTALLATION

SPEC WRITER NOTE: Retain one of two paragraphs below to match systems specified.

- A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.
- B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.14 CONNECTIONS

- A. Connect //nonpressure, gravity-flow// //force main// drainage piping in building's storm building drains specified in Section 22 14 00, FACILITY STORM DRAINAGE.
- B. Encase entire connection fitting, plus 150 mm (6 inch) overlap, with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 20 MPa (3000 psi).

- C. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
 2. Make branch connections from side into existing piping, DN 100 to DN 500 (NPS 4 to NPS 20). Remove section of existing pipe, install wye fitting into existing piping.
 3. Make branch connections from side into existing piping, DN 525 (NPS 21) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 75 mm (3 inches) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. //Unshielded// //Shielded// flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 2. Use pressure-type pipe couplings for force main joints.

3.15 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least //200 mm (8 inch)// //Insert dimension// thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least //900 mm (36 inches)// //Insert dimension// below final grade. Fill to within //300 mm (12 inches)// //Insert dimension// of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 20 00, EARTH MOVING.

3.16 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.17 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
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. Reinspect and repeat procedure until results are satisfactory.

3.18 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various

items of equipment shall be performed simultaneously with the system of which each item is an integral part.

- B. Submit separate report for each test.
- C. 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. Air test gravity sewers. Concrete pipes conform to ASTM C924, plastic pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or ASTM C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 - 6. Test force main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than //1034 kPa (150 psi)// //Insert value//.
 - a. Ductile Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- E. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.19 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. //Flush with potable water.// //Flush with water.//

3.20 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.21 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

--- E N D ---

**SECTION 33 41 13
FOUNDATION DRAINAGE**

SPEC WRITER NOTES: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foundation drainage system, including installation, backfill, and cleanout extensions.

1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain
references only when specified elsewhere
in this section.

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Existing utility protection, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Trenching and Excavation: Section 31 20 00, EARTH MOVING.

1.3 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 1. M006-13-UL - Fine Aggregate for Hydraulic Cement Concrete.
 2. M252-09-UL - Corrugated Polyethylene Drainage Pipe.
 3. M288-15-UL - Geotextile Specification for Highway Applications.
- C. ASTM International (ASTM):
 1. A74-16 - Cast Iron Soil Pipe and Fittings.
 2. A746-09 (2014) - Ductile Iron Gravity Sewer Pipe.
 3. D448-12 - Sizes of Aggregate for Road and Bridge Construction.

4. D2321-14 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
5. D2729-03 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
6. D2737-12 - Polyethylene (PE) Plastic Tubing.
7. D3034-14 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
8. D4216-13 - Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds.
9. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
10. F758-141 - Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

1.4 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 1. Description of each product.
 2. Filter fabric indicating manufacturer recommendation for each application.
 3. Installation instructions.
 4. Warranty.
- C. Samples:
 1. Product: // long // square //, each type and color //.
 - a. Submit quantity required to show full color // and texture // range.
- D. Certificates: Certify // each product complies // products comply // with specifications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. Regularly manufactures specified products.
 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //

1.6 DELIVERY

- A. Deliver products in manufacturer's original sealed packaging.

- B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, // color, // production run number, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

- A. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify field conditions affecting drainage installation. Show field measurements on Submittal Drawings.
 - 1. Coordinate field measurement and fabrication schedule to avoid delay.

1.9 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

SPEC WRITER NOTES: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only which applies to the project.

2.1 MATERIALS

- A. Pipes: Type and size indicated. Make transitions, adapters, or joint details for dissimilar materials.
- B. Underslab Header:

SPEC WRITER NOTES: Choose material type based on design requirements and location and when possible follow geotechnical recommendations.

- 1. DN 100 to DN 375 (NPS 4 to NPS 15):
 - a. Pipe and Fittings: Cast-iron, ASTM A74 or ASTM A746.
 - b. Joints: Hub-and-spigot, gasket type.

2. // DN 100 to DN 250 (NPS 4 to NPS 10) // DN 300 to DN 900 (NPS 12 to NPS 36) //:
 - a. Pipe and Fittings: PE, ASTM D2737.
 - b. Joints: Coupling type.
3. DN 100 to DN 375 (NPS 4 to NPS 15):
 - a. Pipe and Fittings: PVC, ASTM D3034.
 - b. Joints: Bell-and-spigot.
 - c. Seal Gaskets: ASTM F477, elastomeric.

C. Perforated Drainage Pipe:

SPEC WRITER NOTES: Choose material type based on design requirements.

1. // DN 100 to DN 150 (NPS 4 to NPS 6) // DN 200 to DN 600 (NPS 8 to NPS 24) //:
 - a. Pipe and Fittings: PE, ASTM D2737.
 - b. Joints: Coupling type.
2. DN 100 (NPS 4):
 - a. Pipe and Fittings: PVC, ASTM D2729.
 - b. Joints: Bell-and-spigot, loose type.

D. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron.

1. Gravity Sewer Pipes: Provide neoprene gasket joints and long sweep elbow fittings.

E. Drainage Conduit:

1. Pipe: ASTM D4216 and ASTM D2729, PVC, perforated.
 - a. Size: 200 mm (8 inches), high minimum flow rate equal DN 100 (NPS 4) pipe.
2. Fittings and Couplings: PVC.

SPEC WRITER NOTES: Modify the following paragraph based on site characteristics and Geotechnical Engineer's recommendation, when possible.

F. Filter Fabric: Woven pervious filament sheet // polyester // nylon // polypropylene.

1. Equivalent Opening Size (AOS): No finer than US Standard Sieve No. // _____ // and no coarser than US Standard Sieve No. // _____ //.
2. // Percent Open Area: Minimum // _____ // percent and maximum // _____ // percent. //.
3. Physical Characteristics:

- a. Physical Strength: Minimum // _____ // pounds per inch when tested according to ASTM D 5034 using grab test method with 1 square inch jaws and 12 inches per minute constant travel rate.
- b. Elongation at Failure: Between // 30 // _____ // and // 70 // _____ // percent.
- 4. // Filaments: Long-chain synthetic polymer; 85 percent by weight of propylene, ethylene, or vinylidene-chloride, with stabilizers or inhibitors added to base plastic //.
- 5. // Fabric Edges, selvage or finish. // Fabric woven without longitudinal seams, installed as indicated on Drawings //.
- G. Drainage Material:
 - 1. Bedding: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4), ASTM D448.
 - 2. Pipe Fill 300 mm (1 Foot) Above: Crushed stone, 20 mm (3/4 inch) to 25 mm (No. 4) per ASTM D448.
- H. Concrete Sand: AASHTO M006.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine and verify substrate suitability for product installation in the presence of Contracting Officer's Representative (COR).
- B. Correct substrate deficiencies.
 - 1. Fill.
 - 2. Level.
- C. Keep trenches dry during drainage system installation.
- D. Clean interior of pipe before installation.

3.2 INSTALLATION - FOUNDATION DRAINAGE

- A. Install products according to manufacturer's instructions // and approved submittal drawings //.
- 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Trenching, Excavation and Backfilling:
 - 1. Perform trenching, excavation and backfilling according to Section 31 20 00 EARTH MOVING. Make 1/8 bends changes in direction of drain lines. Use wye fittings at intersections.
- C. Bedding:
 - 1. Place and compact graded bedding at bottom trench, minimum 6 inches deep. Rest section firmly through entire length, with recesses

formed for bell joints. Fully support pipe lower quadrant with bedding, except bell joint recesses.

SPEC WRITER NOTES: Include filter fabric
when required by Geotechnical Engineer.

D. // Filter Fabric: Place drainage pipe on filter fabric //.

E. Pipe Laying:

1. Install PE and PVC Pipe according to ASTM D2321 and ASTM F758.
2. Lay drain lines to grades and alignment, with continuous fall in flow direction and as indicated on Drawings.
3. Place bells ends, face upgrade.
4. Lay drain lines and firmly bed in granular material minimum 75 mm (3 inches) below invert to top of pipe true to grades and alignment, and slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed, 300 mm (1 foot) above top of pipe, unless otherwise noted.
5. Lay perforated pipe, perforations down. Lay plain end pipe, closed joints, held in place with two No. 9 spring steel wire clips at joint or standard clay collars.
6. Foundation Subdrainage: Install pipe pitched down in flow direction, minimum slope 0.5 percent, minimum cover 900 mm (3 feet), unless otherwise indicated.
7. Underslab subdrainage: Install piping pitched down in flow direction, minimum slope of 0.5 percent.
8. Install gaskets, seals, sleeves, and couplings according to manufacturer's instructions and as follows:
 - a. PE Joint: ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, "Joint Properties".
 - b. PVC Joint: ASTM D3034 with elastomeric seals gaskets, ASTM D2321.
 - c. Perforated PVC Joint: ASTM D2729, with loose bell and spigot joints.
9. Install cleanout extensions as indicated on Drawings and as follows:
 - a. Pre-placed Crypt Field Underdrain Cleanouts: Install as indicated on Drawings and set not to interfere with mowing operations. Provide concrete anchorage for plastic tops. Check

drain lines before backfilling. Remove obstructions and recheck lines.

3.3 FIELD QUALITY CONTROL

A. Field Inspections:

SPEC WRITER NOTE: Section 01 45 29, TESTING LABORATORY SERVICES includes VA provided testing for large projects and contractor provided testing for small projects. Coordinate testing responsibility.

B. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

3.4 PROTECTION

A. Protect pipe from and aggregate cover from damage and displacement until backfilling operation begins.

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