

SECTION 00 11 21

DESIGN-BUILD INSTRUCTIONS

A. PART I – PROJECT OBJECTIVES

A1. Statement of Work

Provide all labor, materials, tools, equipment, and supervisions to perform and complete all design-build construction work at Danville National Cemetery, Danville, Illinois, described here in other specific tasks as further defined by these instructions.

Bid Item 1 – Work shall include survey, geotechnical investigation, design layout, submittal to the Government for approval and installation approximately 1,000 pre-placed lawn crypts at existing Section 21, preparation and excavation of the existing proposed site, installation of a new in-ground irrigation system and quick couplers matching existing, and installation of associated gravesite control monuments and section markers. Design and install needed infrastructures including storm water drainage system along with other applicable site improvements.

Bid Item 2 – Manufacture, delivery and off-loading at the site approximately 1,000 double depth precast concrete burial crypts that are to be installed under Bid Item 1.

The pre-placed lawn crypts shall be of standard dimensions as described in the drawings and specifications. An engineered drainage field will be installed under the pre-placed crypts. The cemetery has an existing irrigation system, the entire crypt area shall be irrigated and tie into the existing system. The contractor shall clear the proposed area, install crypts, irrigation system and quick couplers. The irrigation system shall be the expansion of and connection to the existing system and shall have pop-up heads and shall provide head-to-head coverage in the project areas.

Finished work shall include the placement of 18-in of screened fill and 6-in of top soil for the sod placement and establishment. The contractor will sod the entire project area and all disturbed areas with same sod used in the existing cemetery. Gravesite Control Monuments shall be installed after the crypts have been installed and will be of standard dimensions matching existing. The contractor shall be responsible for the disposal of all

construction wastes and debris in accordance with Section 31 20 00. Investigation of both on-site and off-site disposal of spoils should be done.

All earthwork grading and other requirements of this project shall be done in accordance with all applicable Federal, State, and Local codes and standards. As a member of the Design/Build joint venture, the Designer of Record is responsible for researching, preparing and paying for and complying with all applicable permits and assuring compliance to the same during the pre-construction and construction phases of this project.

Other site improvements may include but is not limited to watering station, site furnishing, sod installation and minimum landscapes

A2. Schedule

Schedule Objectives - The anticipated completion of this project duration is 365 calendar days after receipt of Notice-to-Proceed.

Request for Proposal Issued	Planning Day-1	
Pre-proposal Conference	Planning Day-21	
Proposal Submitted		
Contract Award		
Notice to Proceed (NTP)	Day 1	
Construction Completion /Final Inspection/Custody Receipt	Day 365	

A3. Definitions

- A. Design-Build (DB) as defined by the Department of Veterans Affairs (VA) is the procurement by the Government, under one contract, with one firm or joint venture (JV) for both design and construction services for a specific project.
1. Contracting Officer: The services to be performed under this contract are subject to the general supervision, direction, control and approval of the Contracting Officer.
 2. Project Manager: The Contracting Officer's representative responsible for administering contracts under the immediate direction of the Contracting Officer.

3. **CONTRACTING OFFICER'S REPRESENTATIVE (COR):** The COR is the Contracting Officer's authorized representative. The COR is responsible for protecting the Government's interest in the execution of the construction contract work. COR's duties include surveillance of all construction work to assure compliance with the contract documents, interpretation of the contract documents, recommending approval of changed work to the contracting officer, approval of all submittals, samples, shop drawings, etc. The COR on behalf of the government may act within the limitations set forth in COR's delegation of authority from the Contracting Officer.
4. **Design Build Contract:** This term, as used herein, refers to the Contract(s) to perform the design and construction of the project.
5. **Contractor:** This term, as used herein, refers to the contractor under this contract or the DB team.

B. PART II – RESPONSIBILITIES OF THE DESIGN-BUILD TEAM

1. The DB team includes all J/V partners, consultants and sub contractors to the one firm. The DB team shall provide Architectural and Engineering disciplines for the preparation of construction documents, and construction contractor capabilities for construction of the project.
2. If the DB Team A/E and contractor are a J/V (not one and the same firm) engineering and other technical consultants shall be subcontractors of the J/V Architect - not the Design-Build construction contractor or sub contractors. If the DB Team A/E and contractor is one and the same firm (not a J/V) those consultants shall be subcontractors of DB firm not the construction subcontractors.
3. The RFP documents are intended to describe existing conditions, certain required items, and design parameters to be included in the project. It is the DB Team's responsibility to complete the documents and construction in a manner consistent with the intent of the RFP documents within the required time period (contract length).

C. PART IV - POST AWARD REQUIREMENTS

C1. Construction Document Preparation:

1. Design Review Submissions:

- a. The Design-Build Team A/E (DB A/E) shall prepare and submit 50%, 90% and 100% complete construction documents for review and approval by VA in accordance with standard professional practice, the Department of Veterans Affairs RFP (VA RFP), and prevailing codes. The specifications must be edited to represent the specific design and construction proposed by the Contractor. A commercial level of design, materials and construction quality is required.
- b. All submission packages will be reviewed at 50% and 90% completion stages and obtains VA review comments and approval prior to the submission of 100% complete construction documents. If any package is not complete for the required stage, a post review may be required; the cost of which will be borne by the DB team.
- c. For each review submission package shall include an index of drawings (by sheet number and title) and specifications (by section number and title) submitted. The packages will be distributed to the VA Project Manager, Memorial Network Services (MSN) IV Engineer, and other as determined to be appropriate by the VA Contracting Officer.

2. Submittal Requirements:

a. Drawing Sheets and Labeling Requirements:

- 1) All plans are to use the standard NCA base sheet. Sheet size is 30" x 42".
- 2) All drawings shall be bound, along the left margin, into sets in the order of the drawing symbol list contained in this scope. The binding must not obscure any information on the drawings.
- 3) Each set of drawings will have a cover sheet, which indicates: project name, project number, and index of drawings in the set, names and addresses of all associated A/E firms, vicinity map, site location map, project location map and other pertinent project information.
- 4) Each sheet as well as all materials submitted will be clearly labeled above the title block, what submission it is, corresponding to the required submissions in this RFP i.e., "100 % Construction Documents Submittal". This label will be appropriately revised after the review.

5) Drawing Symbol Identification:

Symbol	Information
X-	Cover Sheet
B-	Sub-Surface Investigation and Survey Drawings

D-	Demolition Drawings
L-	Landscape Architecture
S-	Structural Drawings
I-	Irrigation

b. Graphic Standards:

- 1) Plans must clearly demonstrate what new work is, what is existing and what is to be demolished. New work must be graphically bolder (darker) than existing conditions. Dashed lines shall show demolition work. ALL lettering must be a minimum of 1/8-inch high.
- 2) All sheets will have the same north arrow orientation. North shall be oriented to the top of each plan sheet. Each sheet having a drawing that requires it, will have a north arrow on the sheet. Drawing scales must be indicated on each sheet in both written and graphic form. Each sheet will have a key map for locating and orienting individual drawing sheets to the whole site.
- 3) All plans will show drafting symbols and abbreviations.
- 4) Drawings using match lines must not overlap information. All information must stop at the match line and resume at the corresponding match line.
- 5) Detail sheets will be organized logically and present the material intended in an orderly manner. Items with plan, front and side views will be arranged in that context to one another. Each detail must be clearly labeled and the scale indicated.

c. Specifications:

Submit 8½" x 11" copies of all required calculations and specifications. All letter reports will be labeled with the project name, project number, name(s) of the A/E firm(s), date and title of the report or estimate. Final submittal of specifications shall be in Microsoft Word and formats on CDROM.

- d. Submission package will be reviewed by VA at the 100% completion stage. If the submission package is not complete, a post review may be required the cost of which will be borne by the DB Team.

- e. The Design Review Submission package shall include 4 full size hard copy sets with the following distribution:

VA STAFF	DRAWINGS	CALCS.	SPECS
Project Manager	2 Sets	1 Set	1 Set
MSN 4 Engineer	1 Set	1 Set	1 Set
Cemetery Director	1 Set		1 Set

Submittal addresses and contact information:

VA STAFF	MAILING ADDRESS	PHONE /FAX/ E-MAIL
Project Manager:	Department of Veterans Affairs National Cemetery Administration (43B) 425 I Street, NW, 5E425E Washington, DC 20001 Attn: Lu Richards	Phone: (202) 632-4769 FAX: (202) 565-4944 Lu.richards@va.gov
MSN IV Engineer:	Department of Veterans Affairs Indianapolis Memorial Service Network (MSN #4) Tom Koerting Minton-Capehart Federal Building 575 N. Pennsylvania Street Indianapolis, IA 46204 Attn: Engineer	Phone: (317) 916-3795 FAX: (317) 226-0206 Thomas.koerting2@va.gov
Cemetery Director:	Danville National Cemetery 1900 East Main Street Danville, IL 61832 Supervised by Abraham Lincoln NC Attn: Cemetery Director	Phone: (217) 554-4550 FAX: (217) 554-4803

- f. The Final Construction Documents will include 2 full size hard copy sets, 2 half size sets and 1 electronic set on CD-ROM (dwg and pdf files). The package will include an index of drawings (by sheet number and title) and specifications (by section number and title). All VA comments made on the Design Review Submission will be incorporated in this final submission. The final packages will be distributed the same as the Design Review Submission above.

3. Design Review Meetings:

- a. Review meetings will be held as determined if necessary by the project manager to resolve design issues.
 - b. The DB team shall allow a minimum of fourteen (14) calendar days for each review cycle. A cycle includes:
 - 1) VA's receipt of the design review submission package.
 - 2) DB teams receipt of comments from VA, either electronically, by fax, or by hard copy delivery.
 - 3) Scheduling of the review meeting (optional by project manager).
 - c. Coordination of the review meeting schedules will be the responsibility of the DB Team Project Manager (for the DB Team). See section I. Quality Assurance/Quality Control.
4. Electronic Media:
- a. Design review submission drawings will be half size hard copy. Final Construction Document submission drawings will be hard copy (on mylar) and executed in electronic format both signed and dated. All drawings will be in AutoCAD 2004 format or newer in accordance with the latest version of the A/E/C CADD Standard of the CADD/GIS Technology Center for Facilities, Infrastructure and Environment. These standards can be downloaded from the Internet website at:
<http://tsc.wes.army.mil/products/standards/aec/aecstdweb.asp>.
 - b. At the DB Team's request, the drawings included in the VA RFP will be available to the DB team in hard copy only for use in preparing the construction drawings. Drawings are provided without warranty or obligation on the part of VA as to accuracy or information contained therein. The user shall independently verify all information in the files. Any user shall agree to indemnify and hold VA harmless from any and all claims, damages, losses, and expenses including, but not limited to, attorney's fee arising out of the use of the drawings.
 - c. Specifications and other 8 1/2 by 11 formatted materials will be executed in electronic format Microsoft Word.
 - d. The specifications included in the VA RFP shall be available to the DB team in hardcopy for use in preparing the construction specifications.

5. Professional Licensing:
 - a. The DB A/E who prepares the construction documents shall be a professional architect, landscape architect or engineer licensed in the State of Illinois.
 - b. The professional seal indicating such license by the state shall appear on the final construction documents. The architect whose seal is shown will be known as the Architect of Record. The DB A/E shall certify compliance with the VA RFP and all applicable codes.
6. Approved Construction Documents:
 - a. The final construction document submission package will be submitted by the DB team for approval by the VA after completion of the 100% review cycle for the final package to be submitted by the DB team. The VA will have 14 calendar days to take approval action.
 - b. The final construction documents submission package will include a full set of construction documents including all disciplines.
 - c. The final construction documents submission package will comply with the VA RFP.
 - d. If the final construction documents submission package is not complete, a post submittal may be required, the cost of which will be borne by the DB Team.
 - e. The approved final construction documents include such details that the project can be constructed and will be used for construction of the project.
 - f. See PART IV, D1 for Construction Document distribution.
7. Construction Drawing Preparation - Mandatory material and details may be indicated either on the drawings or in the specifications, at the option of the DB team. The construction drawings shall include a coordinated set of the following:
 - a. Civil engineering drawings including demolition plans, schedules calculations and details.
 - b. Structural drawings including foundation plans, framing plans, schedules, and details, including general notes and all calculations.
8. Construction Specifications - Project specifications shall include specifications for all products, materials, equipment, methods, and systems shown on the construction drawings in accordance with standard professional practice and the VA RFP. The specification submitted for review shall include:

- a. The name of the manufacturer, the product name, model number, or other identification as appropriate to clearly identify the product that will be used in the construction of the project;
 - b. Other data as appropriate to clearly identify the product that will be used in the construction of the project i.e. shop drawings, product data, and samples as required by the VA RFP documents; and
 - c. The required stamp of the licensed architect or engineer of record will be considered as certification of compliance with the RFP requirements.
9. Design Requirements - Compliance with codes and standards.
- a. Project design shall be in compliance with local building codes and with applicable standards and codes described in VA Program Guide and design materials included or referenced in the solicitation materials.
 - b. See Section 6. Approved Construction documents, above, for required inclusion of design review comments.
 - c. In the design of new work under this contract, the DB team shall consider all requirements (other than procedural requirements) pertaining to environmental and erosion and sediment control regulations; and
 - d. The DB team shall provide prompt, written notification to the Contracting Officer concerning conflicts with, or recommended deviations from codes, laws, regulations, standards, and opinions of review officials as described above. No work altering the scope of this contract shall be undertaken prior to receipt of written approval from the Contracting Officer.
 - f. No action may be brought against the DB Team or VA and no fine or penalty may be imposed for failure to carry out any of the previously described recommendations of Federal, state, or local officials. VA is not be required to pay any amount for any action taken by a state or political division of a state in carrying out functions described in this article, including reviewing plans, carrying out on-site inspections, issuing permits, and making recommendations.
 - g. The DB team shall advise the Contracting Officer of any variances with the applicable Department of Labor, Occupational Safety and Health Standards, for occupancy requirements.
10. Quality Assurance/Quality Control:

To reduce design errors and omissions, the DB team shall develop and execute a QA/QC plan that demonstrates the project plans and specifications have gone through a rigorous, thorough review and coordination effort.

C2. Construction Period Submittals

- A. The DB contractor shall distribute a total approved construction documents prepared by the DB Team to VA, as directed by the VA Project Manager.
- B. Other submittals - The DB team shall submit test results, certificates, manufacturer's instructions, manufacturer's field reports, etc. as required by the VA RFP specifications, to the VA COR.
- C. Project record drawings - The DB team will maintain a set of construction documents (field as-built drawings) to record actual construction changes during the construction process as required by the RFP specifications. The project record drawings will be available for review by the VA COR at all times.
- D. Shop drawings and submittals - The DB A/E shall check the DB construction contractor's shop drawings, detail drawings, schedules, descriptive literature and samples, and review the color, texture and suitability of materials for conformity with the RFP Documents and construction documents. The DB A/E shall recommend approval, disapproval, or other suitable disposition to the VA COR. The VA COR will have final approval authority. The DB AE shall evaluate the submittals with reference to any companion submittals that constitute a system. When necessary, the DB A/E will request the DB Construction Contractor to submit related components of a system before acting on a single component. Should this procedure be inappropriate, the DB A/E shall review all prior submittals for related components of the system before acting on a single component. The DB A/E may be required to hold joint reviews with VA staff. The DB A/E shall notify the VA COR in writing of any and all deviations from the requirements of the construction documents that he has found in the submittals.

C3. Project Close-Out and As-Built Submittals

The DB team shall comply with the requirements in the "General Conditions", outlined in the solicitation package, and "General Requirements", Section 01 00 00, for submission of final constructed as-built drawings, equipments, apparatus, and other operational and maintenance manuals and documents as noted or required. Required as-built drawings and specifications will be submitted in the same format required for the construction documents.

C4. Site Visits and Inspections

During the construction period the DB A/E shall make weekly visits to the project site to ensure proper construction as part of the QA/QC process. The COR may also request DB AE's visits for special purposes. Only registered architects and engineers thoroughly familiar with the project may make these site visits. The COR has the prerogative to determine the professional discipline(s) required for any visit. The DB A/E shall observe the construction, advise the COR of any deviations or deficiencies or solutions to issues discussed. A site inspection report with construction process pictures and includes the date, time and purpose of the inspection, items reviewed, deficiencies observed, recommendations and additional actions required, etc shall be furnished to the COR within three work days following the site visit date.

- E N D -

Section 01 01 01
Topographic Survey and Geotechnical Investigation

1. General

The design A/E shall obtain professional surveying services from licensed surveyors if the State of Illinois to verify topographic surveys of the project site as well as areas within the existing development that are affected by this project.

1.1 Geotechnical Survey

- 1.1 The A/E shall obtain a geotechnical investigation of the site. Soil type, bearing capacity, depths to bedrock, ground water, aquifers, perched water tables or springs shall be identified. If ground water or rock strata are discovered, they shall be identified and a profile prepared illustrating its depth below surface. Indicate if sufficient topsoil is available on the site to provide four inches of cover on all lawn or turf areas. The geotechnical survey, including boring logs and test pit logs, shall be shown on the drawings. Test pits to a depth of eight feet below existing grade or to bedrock are required in burial areas. The location and quantity of the tests pits should be defined by the A/E to establish a recommendation for remediation of buried objects or soil conditions that may hinder or prohibit burial using standard excavation equipment.
- 1.2 Soil borings are acceptable for non-burial area investigation. Borings shall be made in as many areas as the A/E considers necessary and as VA approves in order to obtain a good understanding of the soil and rock conditions of the site for roads, building construction or other design features.

2 Site Plan Preparation – Following NCA Design Guidelines

- 2.1.1 The A/E shall prepare site plans for gravesite development into the project area. The A/E shall subdivide the site as appropriate for this project. Vegetated areas; roads, walks and topography shall visually separate burial sections. In general, gravesites sizes are set with nominal 3' by 8' for lawn crypts; edges of burial sections shall be ten (10) feet from roads and twenty feet from site boundaries or perimeter fence lines. The maximum distance from the edge of a road to the farthest gravesite within a burial section shall be 350 feet over relatively level land. In areas with steep slopes, the distance from road to farthest gravesite shall be shorter. Generally, for every increase of 5% of slope, there should be a decrease of 100 feet or more for walking distance. Topography is the primary factor in determining the direction graves face within a burial section. The preference is to stand downhill and view the inscription while facing uphill. Where the topography is not significant, road layout and accessibility will determine the direction graves face. All gravesites would get upright headstones. A single burial section should have one predominant slope. Permanent gravesite control markers shall be surveyed into the new burial sections. NCA standard detail for this marker would be used. All markers shall be laid out using the coordinate grid system. Each burial section in the cemetery is identified and the limits of the burial section clearly indicated, by section markers located along the roads and in line with the markers. One or more section markers bearing either the number or letter assigned to that

section should mark each burial section. Section markers shall be treated as a component of the cemetery signage system. Section markers that match the new signage shall be provided throughout the entire site, including the existing development.

- 2.1.2 Pre-placed lawn crypts shall be laid out to maximize land usage as well as take advantage of topography. Crypt area layout cannot exceed 3% slope for the finished grade or the gravel setting bed. Crypts can step in layout but should not exceed 18 inches of soil cover. The crypts are double depth; NCA would provide a drawing of a typical crypt for inclusion in the project. Design of crypt is for reference only and does not imply other types would not be accepted. Design should take the potential high ground water table into consideration.

3. Grading

On site balance of cut and fill is required. Assume that massive regrading of the site is required and acceptable. Interment areas shall range from 3%, the minimum to achieve positive drainage, to a maximum of 15%. Extensive grading to achieve these criteria grading is acceptable. It is reasonable to assume that the 45 acres would be graded to a uniform constant grade across the site. The radical topography that exists shall be removed to achieve consistent uniform grades not only for aesthetic viewing but also for facilitating drainage.

4 Utilities

The AE is responsible to locate, inventory, analyze capacities and demands, contact local utility companies and bring up to current codes for the new development. Documented proof by letter or reports of contact with names and addresses of all utility companies to be submitted with the schematic design. Any improvements must be analyzed from a cost-sharing standpoint with the affected utility.

5 Irrigation

The AE should design an automatic irrigation system for the expansion area integral with the renovated system at the developed area if applicable. NCA does not anticipate the need for storage capacity but AE should analyze capacity and demand. AE shall investigate and study in terms to provide renovation and upgrade to design and integrate with the expansion to have a synchronized control as one whole system. A narrative report as to how the current system renovation including hydraulic analysis, flow monitoring and shut down capabilities should be submitted for the design workshop or review.

6. Site Analysis- if applicable

6.1 A guideline Master plan will be provided by VA. A/E shall prepare and present a site analysis plan illustrating site characteristics from data gathered from personal site visits and the topographic survey. The analysis will contain a graphic and narrative description of the cemetery site. The site analysis plan will illustrate at a minimum:

- a. site organization – interment areas and maintenance area, cemetery features, views, prevailing winds, etc.

- b. entrances -- public and maintenance;
- c. circulation and routes of travel – on and off site, public, maintenance and staff. Public traffic includes funerals and visitors; maintenance traffic includes headstone and supplies delivery, interment equipment, soil spoils, grounds maintenance supplies and equipment and casketed remains after the committal service; staff traffic includes employee arrivals and departures;
- d. significant constraints for construction and burials (steep grades, flood plains, saturated ground with high water table, wetlands, rock, etc.);
- e. site drainage, storm water collection and disposal.
- f. all existing utilities, location and distribution.

7 Geotechnical Survey

Obtain and present a subsurface geotechnical investigation of the site. with minimum numbers of boring and testing of 2 for size under half acres, 3 for less than an acre

8 TOPOGRAPHIC, UTILITY, & LANDSCAPE SURVEY

A informational topography of the expansion site maybe present in the drawing. The Design A/E shall provide and present a topographic survey of the project site and other affected areas in accordance with the Survey section.

8.1 PROJECT LIMITS: The area to be surveyed shall include the undeveloped area and other areas in the existing development that are affected by the work. The survey shall locate and identify all natural and man-made site features as described in the specifications below. The boundary information shall be incorporated into and submitted with the topographic survey.

8.2 Survey:

8.2.1 General:

8.2.1.1 Seals: The Surveyor shall affix his registration seal and signature to all final drawings.

8.2.1.2 Certification: All final site survey drawings shall bear the following certification adjacent to the Surveyor's seal and signature:

"I hereby certify that all information indicated on this drawing was obtained or verified by actual measurements in the field, and that every effort has been made to furnish complete and accurate information."

8.2.1.3 Legends: The final survey shall include a legend consisting of suitable weighted lines and symbols designating standard boundary and topographic features, facilities, and utilities, etc. A legend of abbreviations and symbols shall be provided also.

8.2.1.4 Drawing Scale: The scale of the final mylar plans shall be 1"=30'0" (or larger scale where appropriate). All plans shall show a scale of drawing, bar scale, and direction of

true north. When more than one continuous plan is required, match lines shall identify adjoining plans. Each match line shall be referenced to the adjacent corresponding plan. A small key drawing shall be included on each plan illustrating the relationship of the sheet to the entire site.

8.2.1.5 Overall Survey Plan: If site is large and requires more than one sheet for survey an overall survey plan shall be submitted on a single sheet at the largest standard engineering scale that allows the entire site to fit on the standard drawing sheet. The overall plan shall show as much as practical the information contained on the multiple sheets, or shall show a reduced level of detail to clearly illustrate significant features.

8.2.1.6 Vertical Control: Vertical control shall be based on a USC&G, state, or local vertical datum, preferably NAD 27 or 83 datum, as practiced Federal, State and Local standards. The location and description of benchmarks shall be noted on the plans and tied together into a control plan. The control plan shall be illustrated on an overall plan of the survey.

8.2.1.7 Contour Interval: Contours shall be indicated by broken lines, drawn at two foot intervals, or otherwise approved or required interval.

8.2.2 DETAILED REQUIREMENTS:

8.2.2.1 Bench Marks: Bench marks shall be installed where none exist, and shall be of a usual and customary standard for the project locality, as approved by the Contracting Officer.

8.2.2.2 Boundary Lines: Boundary lines shall be illustrated by length, bearing, interior angles, radii, offsets, and points of tangency, as appropriate or available, on found boundary information.

8.2.2.3 Other Lines: Illustrate all known zoning setbacks, restriction lines, easements, and rights-of-way (ROW).

8.2.2.4 Roads & Walks: Illustrate the location, alignment and dimension of all roads, curbs, walks, parking and paved areas. Road centerlines shall be indicated with true bearings and by stationing on centerlines if found or available. Curves shall be described by designating the points of curvature and tangency by station. All curve data shall be included as well as the locations of radius and vertex points. Double lines shall be used to designate road curbs. Note the type of pavement for all highways, streets, roads, walks and other surfaces. Note the legal and common names of roads. Show the direction of travel on existing one-way or restricted roadways. Illustrate existing parking lot striping and handicapped designated parking spaces, aisles and ramps.

8.2.2.5 Contours Crossing Roadways: When crossing roads, contour lines shall clearly illustrate crown, grade, and height of curbs. Spot elevations shall be shown on approximate 50-foot centers along the centerline of roads, edges of roads and at the bottom and top of curbs.

- 8.2.2.6 Ownership and Jurisdiction: Identify the owner, or organization with jurisdictional responsibility, for all adjacent properties, roadways, easements, ROW, restrictions, covenants, etc.
- 8.2.2.7 Future Modifications & Improvements: Report all known proposed modifications to the property and adjacent properties to the Contracting Officer. Illustrate future modifications and improvements (i.e.: street widening, sewer or easement extensions, adjacent development, etc.) where appropriate, and as directed by the Contracting Officer. *(In-depth investigations of future modifications and improvements will be addressed by the Contracting Officer on a case-by-case basis, and if necessary, will be added to the project scope of work as a modification to the contract.)*
- 8.2.2.8 Prominent Site Features & Structures: Provide the location, dimensions and elevations of all prominent site features including buildings, fences, gates, walls, pavement areas, signs, ramps, drainage facilities, and monuments. Illustrate all other prominent landscape features such as gravesite spoil and borrow areas, excavations, rock outcroppings, overhangs, faults, springs, and steep slope areas. (Where slopes exceed 25%, contour intervals of greater than two feet will be considered.)
- 8.2.2.9 Burial Sections & Gravesite Control Monumentation: where adjacent to survey work, illustrate the outline of all burial sections (not individual graves).
- 8.2.2.10 Spot Elevations: Spot elevations shall be provided on an approximate 50 foot minimum grid pattern, and at all other appropriate locations where site features, structures, or utilities require greater detail to illustrate existing conditions. Provide spot elevations (to the nearest tenth of a foot on pavements) at the top and bottom of abrupt changes in grade.
- 8.2.2.11 Underground and Overhead Utilities: Locate all overhead and visible underground services, utilities, utility poles, light standards, irrigation systems (including sprinkler heads), sewer manholes and inlets, fire and water hydrants, valve boxes, etc. Locate and indicate the type and size of all visible pipes and other utility system elements. Identify the visible system source or origin, the direction of flow, out-fall, noted or obvious pressure level, etc. Locate the invert and inlet elevations of all manholes, catch basins, inlets, culverts, and headwalls, where it is safe and practical to do so. Show all irrigation heads adjacent to roads affected by survey. *(Note: The Surveyor, or the A/E, shall alert the Contracting Officer of the need for underground utility survey, by a professional utility surveyor where design conditions appear to warrant additional detail. This work shall be undertaken as a modification to this contract.)*
- 8.2.2.12 Trees & Shrubs: Locate and identify all freestanding trees of 4" caliper and larger by botanical and common names and by trunk caliper. Locate all trees of 15" caliper within wooded areas. Illustrate the perimeters of all shrubbed and wooded masses, ground cover, and plant beds. Describe the predominant vegetation located within these outlines, if known. Indicate the height and diameter of freestanding shrubs. Identify turf and lawn areas.
- 8.2.2.13 Water Bodies & Flood Plains: Illustrate all watercourses and bodies, including any flagged wetlands defined by the A/E. The A/E shall provide the Surveyor with

information and illustrate the limits of any 100-year flood plain areas, as delineated on FEMA maps, on the final survey drawings.

8.2.3 LOCATION OF BORINGS AND GRAVE TEST PITS: The Surveyor shall locate and stake in the field, and illustrate the location of all borings and test pits on the final survey drawings.

8.2.4 AERIAL PHOTOGRAPHS: Provide the VA with copies of all aerial photographs if used in the preparation of the survey. Provide the VA with one composite photograph of the cemetery mounted on foam core boards, suitable for framing.

9.0 SPECIFICATIONS FOR BOUNDARY SURVEY:

9.1 GENERAL: The survey shall identify all boundaries, easements, setbacks and Right of Way (ROW) lines adjacent or located on the site. Drawings shall meet the graphic standards outlined in the submittal requirements for the project scope of work and here.

9.1.1 Format: All work shall be accomplished in a manner that would fulfill the legal requirements for a transfer of real property. The boundary survey and written descriptions shall conform with the usual and customary land record formats for the municipality or jurisdictional authority where the surveyed property is located.

9.1.2 Scale of Final Drawings: The final plans shall be clear and legible when reproduced at a scale of 1"=30'-0".

9.1.3 Platting: All plan sheets shall be prepared in correct relative position.

9.1.4 Legends: Usual and customary weighted, broken, or dotted lines and symbols shall be used to designate property lines, structures, utilities, and other site features and shall be identified in a legend, or key, on the plans.

9.1.5 Certification: The survey plans shall include the Surveyor's signature across the Surveyor's official seal.

7.1.6. Field Notes & Records: The Surveyor shall keep all field notes and records in a neat and orderly manner. These records shall be maintained and readily available for inspection and verification during the work. Field notes, calculations, and supporting records shall be submitted to the Contracting Officer upon completion of the work.

9.2 DETAILED REQUIREMENTS:

9.2.1 Boundaries: The survey shall illustrate all bearings, distances, curves, and interior angles. Boundaries of an unusual nature (curvilinear, offset, or other change of direction between corners) shall be referenced with curve data (including measurement chords and other data) sufficient for re-establishment.

- 9.2.2 Site Surface Features: The survey shall illustrate the outline and location of all existing features including structures and buildings, streets, ROWs, (public or private), block boundaries, easements, railroads, streams, etc. If there are no site features affecting the property, the Surveyor shall so state on the plan.
- 9.2.3 Encroachments: Illustrate and identify all visible or known encroachments.
- 9.2.4 Local Coordinate System: The Surveyor shall comply with local regulations, if any, to reference the boundaries of the survey to a regional or local coordinate system.
- 9.2.5 Legal Descriptions: The Surveyor shall include on the survey plan the following:
- 9.2.5.1 A metes and bounds description of each separate parcel, or tract within the limit of the project area. For new properties, the Surveyor is responsible for “anything that he can see.” If the Surveyor uncovers anything that was missed by the title search, it should be immediately brought to the attention of the Contracting Officer.
- 9.2.5.2 A description of all easements (i.e.: sewer, water, gas, power, steam, telephone, data, fiber optic, wireless, visual, etc.) to which each parcel is subject including the location, owner, and the location where the information can be found. The Surveyor shall check any and all known Title Reports and report his findings to the Contracting Officer in a brief letter report.
- 9.2.5.3 The Surveyor shall advise the Contracting Officer on the need for a Title Report, and if required, shall submit a proposal (including scope, schedule and estimate) for the work.
- 9.2.6 Monuments: All boundary monuments shall be illustrated and described on the plan. If required, new monuments shall be installed at all corners and points of tangency, if no existing monuments are found. New monuments shall *not* be required where an existing monument, of similar or equal design to that specified above, is found to be in an accurate and correct position and sound condition. Additional monuments, above and beyond the total originally proposed by the Surveyor, and accepted by the Contracting Officer, shall be considered a change in scope to this contract.
- 9.2.6.1 The Surveyor shall propose monuments that are of a usual and customary standard for the project locality.
- 9.2.6.2 At locations where a true property corner is inaccessible, the monument shall be offset and referenced to the true corner. If it is impractical to install an offset monument, set a monument in an adjacent stable structure, curb, or sidewalk. Offset monuments shall be located within the site, if practical. Provide notation describing the offset monument alignments on the plans.

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SECTION 01 32 16.16
NETWORK ANALYSIS SYSTEM - (BAR CHART SCHEDULE)

1.1 DESCRIPTION:

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

1.2 CONTRACTOR'S REPRESENTATIVE:

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

1.3 COMPUTER PRODUCED SCHEDULES:

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

1.4 THE SCHEDULE SUBMITTAL:

- A. The contractor shall provide detailed WBS for the proposed project. The schedule will contain sufficient work activities/events based on the WBS to adequately present the accomplishment of the work based on real time production rates for said activities. VA will review and approved the sufficiency of the activities listed.
- B. Within 10 calendar days after receipt of the Contract Award, the Contractor shall submit for the Contracting Officer's review and approval the schedule. Each activity/event on the schedule shall contain as a minimum, but not limited to, activity/event description, duration, start dates, finish dates, budget amounts, and predecessor and successor relationships. Work activity/event relationships shall be restricted to finish-to-start, only, without lead or lag constraints. Logic events (non-

work) will be permitted where necessary to reflect proper sequence among work events, but must have a zero duration.

- C. The schedule shall reflect the Contractor's methodology to completing the project. The schedule in its original form shall contain no contract changes or delays that may have been incurred during the schedule development. It shall reflect the Contractors “**AS BID**” or “**DAY 1**” schedule. Changes and /or delays shall be entered at the first monthly update after the schedule has been approved. The Contractor should provide his requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.
- D. Within 10 calendar days after receipt of the complete project network diagram, the Contracting Officer will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. If required schedule a meeting with the Contractor for joint review, correction or adjustment of the proposed schedule. Within 10 calendar days after the joint review, the Contractor shall revise and shall submit a revised schedule to the Contracting Officer. The revised schedule will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved. This approved schedule shall constitute the approved schedule until subsequently revised in accordance with the requirements of this section.

1.5 WORK ACTIVITY/EVENT COST DATA:

- A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Overhead, profit and general conditions shall be pro-rated on all work activities/events for the entire project length. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.
- B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in the General Conditions.

1.6 NETWORK DIAGRAM REQUIREMENTS:

- A. Show on the schedule the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the schedule, the Contractor shall show activities/events as:
1. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 2. Contracting Officer Technical Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 3. Interruption of VA Cemetery utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
 4. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
 5. VA inspection and acceptance activity/event with a minimum duration of five (5) work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
- B. Break up the work into activities/events of duration no longer than sixty (60) work days each. The duration for VA approval of any required submittal, shop drawing, or other submittals will be 5 workdays. The construction time as determined by the schedule from start to finish for any sub-phase, phase or the entire project shall not exceed the contract duration.
- C. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed.

1.7 PAYMENT TO THE CONTRACTOR:

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

Contracting Officer permits an exception to this requirement. Monthly payment requests shall include:

- 1) the approved schedule,
- 2) a listing of all project schedule changes,

These must be submitted with and support the contractor's monthly application and certificate for payment request documents.

- C. An updated schedule submitted with the progress payment does not constitute a contract change without the written consent of the Contracting Officer.
- B. When the Contractor fails to furnish to the Contracting Officer the required information which, in the sole judgment of the Contracting Officer, is necessary for processing the monthly progress payment, the Contractor shall not be paid for that period.

1.8 PAYMENT AND PROGRESS REPORTING:

- A. Biweekly progress meetings will be held with the Contracting Officer or Contracting Officer's Representative, the Contractor and others as deemed necessary by the contracting officer. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer. Job progress will be reviewed to verify:
 1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Bar chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.
 6. Activity/event duration and percent complete shall be updated independently.

1.9 RESPONSIBILITY FOR COMPLETION:

- A. Whenever it becomes apparent from the progress meetings that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the revisions shall be incorporated by the Contractor into the schedule before the next update, at no additional cost to the Government.

1.10 CHANGES TO THE SCHEDULE:

- A. Within 10 calendar days after VA acceptance and approval of any updated schedule, the Contractor will submit a revised schedule and a list of any activity/event changes including predecessors and successors for any of the following reasons:
1. Delay in completion of any activity/event or group of activities / events, indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Bar chart as the direct cause for delaying the project beyond the acceptable limits.
 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 3. The schedule does not represent the actual prosecution and progress of the project.
 4. When there is, or has been, a substantial revision to the activity/event costs of the schedule regardless of the cause for these revisions.
- B. Revisions made under this paragraph that affect the previously approved schedule for Government furnished equipment, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, must be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the Contracting Officer's Representative.

- D. The cost of revisions to the Bar chart resulting from contract changes will be included in the cost of the change.
- E. The cost of revisions to the schedule not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION:

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Bar chart data and supporting evidence as the Contracting Officer may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.
- B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within 10 calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under Article, CHANGES, in the Section, GENERAL CONDITIONS. The Contractor shall include, as a part of each change order proposal, all revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved schedule.
- D. All delays due to non-work activities/events such as RFIs, WEATHER, LABOR STRIKES, and similar non-work activities/events shall be analyzed on a case by case basis.

END OF SECTION

SECTION 01 33 23
SHOP DRAWINGS PRODUCT DATA AND SAMPLES (SUBMITTALS)

- 1.1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in Section, 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 be collectively referred to 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. Do not combine items from different specification sections into the same submittal. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. Any item that does not exactly match the specifications shall be submitted as an approved equal or superior item and shall be so noted on the item transmittal. In addition, Contractor shall insure that the submittals that are not exactly matching the specifications, be submitted with the specified product information and the alternate materials, with all differences noted and explanations as to why the alternate materials are better or in the best interest of the Governments to accept. Lower cost to the Contractor is not sufficient basis for submitting any alternate as an "approved equal" material or product. 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. Timely submission is required to assure adequate lead-time for procurement of 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 and action thereon will be taken by COTR on behalf of the Contracting Officer.
- 1.6. Contractor shall assign a file number to the submittal. **FILE NUMBERS SHALL BE SEQUENTIAL STARTING AT 001 AND PROCEEDING. A RESUBMITTED SUBMITTAL SHALL BEAR THE SAME FILE NUMBER AS THE ORIGINAL AND WILL HAVE AN ALPHA ADDED TO IT, STARTING WITH A FOR THE FIRST RESUBMITTAL THEN B AND SO ON UNTIL IT IS APPROVED. EACH AND EVERY PAGE SUBMITTED MUST BEAR THE NAME OF THE PROJECT, THE PROJECT NUMBER AND THE SUBMITTAL NUMBER.** Any subsequent correspondence shall

refer to this file 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 therefore 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. The Contractor assumes responsibility for coordinating and verifying schedules. The Contracting Officer 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, not by subcontractors.
 - A. Submit samples in single units unless otherwise specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter contain the list of items, name of Cemetery, name of Contractor, Project name, project number, 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 and product information sheets shall be marked to clearly indicate the specific item submitted for approval.
 1. A copy of letter must be enclosed with items any items received without identification letter will be discarded by the government immediately.
 2. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
 - C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests 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. Contractor shall send a copy of transmittal letter to COTR with submission of material to a commercial testing laboratory.
 4. Laboratory test reports shall be sent directly to COTR.
 5. 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.
 6. 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 COTR until completion of contract, at which time such samples will be discarded. 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 copy.
 2. Copy shall be size (24" by 36 " minimum).
 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 4-3/4 by 5 inches shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. One copy of approved or disapproved shop drawings will be returned to Contractor.
- 1-10. Samples, shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to:

NAME AND ADDRESS TO FOLLOW or be provided at pre-construction conference.

- 1-11. During the pre-construction conference, the COTR may modify the submittal process to expedite the review process, while maintaining the centralized record of the submittals with All submittal materials will be sent by private overnight shipper.
- 1-12. Submittal distribution requirements: hard copies: TWO copies to COTR; TWO copies to NCA Project Manager.
- 1-13. SUBMITTALS will be reviewed and returned with comment (approved or rejected) to CONTRACTOR by COTR.

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by the Contractor.

1.2 APPLICABLE PUBLICATIONS:

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

B. State of Kentucky, Department of Transportation, Construction and Material Specifications, Office of Contracts, latest edition.

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

T27-97.....	Standard Specification for Sieve Analysis of Fine and Coarse Aggregates
T96-94.....	Standard Specification for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-97.....	Standard Specification for the Moisture-Density Relations of Soils Using a 5.5 lb Rammer and a 12 in Drop
T104-97.....	Standard Specification for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T191-93.....	Standard Specification for Density of Soil In-Place by the Sand-Cone Method

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

C31/C31M-98.....	Standard Practice for Making and Curing Concrete Test Specimens in the Field
C33-99	Standard Specification for Concrete Aggregates
C39/C39M-99.....	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C138-92	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C172-99	Standard Practice for Sampling Freshly Mixed Concrete
C173-94	Standard Test Method for Air Content of freshly Mixed Concrete by the Volumetric Method
C1064/C1064M-99	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
C1077-77	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

D2974-87	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-98	Standard Specification for Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-99	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
E329-00.....	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used on Construction

E. American Welding Society (AWS):

D1.1-00	Structural Welding Code-Steel
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1.3 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 COTR 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 COTR 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 shall meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall 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) shall meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COTR. When it appears materials furnished, or work performed by Contractor fails to meet contract requirements, Testing Laboratory shall direct attention of COTR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COTR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

- A. General: The Testing Laboratory shall 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 shall be as identified herein and shall include 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 COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 - 2. Provide full time observation of fill placement and compaction and field density testing in building and crypt areas and provide 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, or test section method in State of Kentucky, Department of Transportation, Construction and Material Specifications.
 - 2. Make field density tests in accordance with the primary testing method in the State of Kentucky, Department of Transportation, Construction and Material Specifications, and/or AASHTO T-310 or AASHTO T-191 wherever possible. Should the testing laboratory propose alternative methods, they should provide satisfactory explanation to the COTR before the tests are conducted.

- a. Foundation Wall Backfill: One test per 100 feet of each layer of compacted fill but in no case fewer than two tests.
 - b. Pavement Subgrade: One test for each 400 square yards, but in no case fewer than two tests.
 - c. Curb, Gutter, and Sidewalk: One test for each 300 feet, but in no case fewer than two tests.
 - d. Trenches: One test at maximum 100 foot intervals per 4 foot of vertical lift and at changes in required density, but in no case fewer than two tests.
 - e. 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 COTR. In each compacted fill layer below wall footings, perform one field density test for every 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 COTR.

3.2 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.
- B. Submit laboratory test report of topsoil to COTR.

3.3 SITE WORK CONCRETE:

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

3.4 CONCRETE:

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

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

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 50 cubic yards or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. COTR 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 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 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. 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.

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 COTR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Furnish certified compression test reports (duplicate) to COTR. 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 psi.
 - e. Weight of standard weight structural concrete in 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.

3.5 REINFORCEMENT:

- A. Review mill test reports furnished by Contractor.

3.7 TYPE OF TEST:

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soil(AASHTO T99)	<u>1</u>
Field Density, Soil (ASTM D2922)	<u>10</u>
Penetration Test, Soil	<u>2</u>
B. Landscaping:	
Topsoil Test	<u>3</u>
C. Aggregate Base:	
Laboratory Compaction,(ASTM D 1557)	<u>1</u>

Field Density, (ASTM D2922)	<u>5</u>
Gradation (AASHTO T27 or ASTM C 136)	<u>3</u>

D. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31)	<u>5</u>
Compressive Strength, Test Cylinders (ASTM C39)	<u>5</u>
Concrete Slump Test (ASTM C143)	<u>5</u>
Concrete Air Content Test (ASTM C173)	<u>5</u>
Unit Weight, Standard Weight Concrete (ASTM C138)	<u>2</u>

E. Inspection:

Technical Personnel (Man-days)	<u>15</u>
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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

EP-1. DESCRIPTION

- A. This section specifies the control of environmental pollution that the Contractor is responsible for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor shall bear the cost to perform specified control measures.
- 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. Effect other species of importance to man, or;
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
 - 1. Sediment: Soil and other debris that has been eroded and transported by runoff water.
 - 2. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 - 3. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
 - 4. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 - 5. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalies, herbicides, pesticides, organic chemicals, and inorganic wastes.
 - 6. Sanitary Wastes:
 - a. Sewage: Domestic sanitary sewage and human and animal waste.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

EP-2. QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

EP-3. SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS PRODUCT DATA AND SAMPLES, furnish the following:
 - 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer and Cemetery Director to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 10 days after the meeting, the Contractor shall submit to the COTR and the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. 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.
 - b. 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.
 - c. Procedures to provide the environmental protection that comply 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.
 - d. Permits, licenses, and the location of the solid waste disposal area.
 - e. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.
 - f. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - g. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

- B. 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.

EP-4. 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. Confine activities to areas defined by 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, topsoil, and land forms without permission from the COTR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.
 - 1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
 - 2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
 - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
 - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
 - 3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
 - 4. Temporary Protection of Disturbed Areas: Silt fences, construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
 - a. Reuse or conserve the collected topsoil sediment as directed by the COTR. Topsoil use and requirements are specified in Section, EARTHWORK.
 - 5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain temporary

erosion and sediment control measures such as silt fence grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.

6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby watercourses or lakes.
 7. Manage and control spoil areas on Government property to limit spoil to areas shown and prevent erosion of soil or sediment from entering nearby watercourses or lakes.
 8. Protect adjacent areas from despoilment by temporary excavations and embankments.
 9. 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.
 10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 11. Handle discarded materials other than those included in the solid waste category as directed by the COTR.
- 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. Listed construction activities shall include, but not be limited to, those provided for in the submitted and approved "Environmental Protection Plan".
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention 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.
 3. Monitor water areas 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 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 Kentucky Air Pollution Statute, 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 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, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 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. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COTR.
1. Contractor will be required to periodically shut down or move equipment during services at the active cemetery. Contractor shall coordinate his work and equipment operations with the COTR to mitigate noise concerns.
- 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, leave the construction area in a clean condition satisfactory to the COTR. Cleaning shall include off the station 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.

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SECTION 02 41 00 DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of portions of existing site elements and/or improvements.

1.2 RELATED WORK:

- A. Safety Requirements: Section 01 00 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

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 Section GENERAL CONDITIONS, Article, and 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.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove irrigation lines, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new pre-placed crypts and irrigation lines.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him, off the Cemetery Property.

- C. Remove and legally dispose of all materials, other than earth to remain as part of project work. Materials removed shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. Materials that are discovered to be hazardous shall be handled as unforeseen.

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 COTR. 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 covered by this Section includes fabrication, handling, delivery to the site, storage and installation of precast concrete burial crypts; hereafter referred to as units or crypts, subbase foundation and drainage, placement of the units, backfilling, grading, fine grading and turf establishment, and other, all as shown on the plans or specified herein. In addition contractor shall provide:
1. Three (3) crypt lid lifting apparatus.
 2. Four (4) extra concrete crypt lids.
 3. A device to retrieve and lower the inside shelf without entering the crypt.
- B. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the plans. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter. 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. The Contractor may propose alternative designs of the corresponding components if all the following requirements are met.
1. Any proposed alternative design shall comply with the design criteria and the functional tests of this specification.
 2. All provisions of this specification shall apply to any proposed alternative design.
 3. 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.

1.2 RELATED WORK

- A. Excavation and Backfill: Section 31 20 00 EARTHWORK.
- B. Materials Testing and Inspection during Fabrication and Construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: With submittal of bid documents, Contractor shall submit documentation regarding the manufacture of the units. Contractor shall provide evidence that manufacturer has a minimum of three years experience with pre-casting

units of similar type, and provide evidence that the manufacturer plant(s) used are certified by the National Precast Concrete Association (NPCA).

- B. Precast concrete manufacturer shall provide a licensed Structural Engineer to certify that the units conform to specified requirements.
- C. Installation Qualifications: 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. 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, two perimeter crypts and a single interior crypt to demonstrate quality of construction of crypts and conduct on-site buried crypt load testing. Commence production of crypts only after submittal approval and on-site load testing has been scheduled for witnessing by the NCA Crypt Specialist.
- F. Design Criteria (Double Depth Crypt):
 - 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 a removable one-piece inside shelf.
 - c. Crypt interior size: Interior minimum dimensions are as follows: 30" minimum width at the inside bottom floor and for the full height of the crypt; 86" minimum length along the inside bottom floor and for the full height of the crypt; 25" minimum clear height from the highest part of the inside shelf to the underside of the lid and; 25" minimum clear height from the lowest part of the inside shelf to the top of the casket risers and; 3/4" minimum height casket risers from the crypt floor spaced 20" from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.
 - d. Crypt height and wall thickness: Exterior maximum height dimension: 60" including the lid. Crypt wall thickness: 2-inches plus or minus 1/2 inch. Perimeter crypts may exceed wall thickness dimension. Crypt wall sections at support slots for the inside shelf may be of lesser thickness.
 - e. Layout: Crypts shall fit in a 3-foot by 8-foot plot or a lesser plot size as noted on the plans. The lesser plot size shall govern. If the contractor's layout or crypt

size dimensions differ, the Contractor at no cost to the Owner shall submit a Layout/Size Plan for approval by the COTR.

2. Units shall be designed for a burial depth with soil cover as indicated on the plans, and be capable of structurally withstanding a center point load of 6,000 lbs prior to burial, passage of a wheel axle load of 12,000 lbs after burial, and a 3-foot tall pile of excavated material on top of or adjacent to buried crypts.
3. The Contractor shall submit to the NCA inspector for approval five sets of design documentation showing structural design of the units. **Contractor shall provide one set to NCA Crypt Specialist.** This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.
4. The concrete lid shall be designed to be removable and replaceable. Lid lifting shall be from top positioned galvanized anchors (4-required per lid) with a removable anchor covers to prevent dirt from entering the anchor bowl as specified in Sec 2.2 and installed in such a manner as not to be hit by excavating equipment when scraping backfill off the top of the lid. The Contractor shall furnish the cemetery with three (3) OSHA approved lifting devices for removing the lid.
5. Inside shelf will be one piece rigid construction, fully conceal the lower casket with a rigid barrier, weigh 40 lbs. or less, allow for easy casket lowering belt removal, and capable of holding 400 lbs indefinitely. The entire inside shelf should be rigid, non-brittle and non-deteriorating. Provide a tool that Owner can easily retrieve and install the shelf from ground level without entering the crypt.
6. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning ½ inch down from top.
7. The design of casket risers shall allow the casket to rest ¾ inch above the inside floor of the crypt and above the top of the inside shelf in order aid in casket lowering straps removal. In addition, rests location shall not exceed 21 inches from crypt centerline.
8. There shall be a minimum of two 1" diameter drain holes in the bottom at opposite ends of each crypt to allow for complete water drainage.
9. The crypt lifting wire/cable shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire/cable once crypt has been installed.

G. 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 wall thickness may be increased to allow for a gap between lids as deemed appropriate to meet layout requirements.

H. Functional Load Test: A functional on-site load test will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional test will consist of following loading conditions:

1. Confined Loading: An interior unit between two perimeter units shall be placed in a hole dug in the ground on site and covered with 24 inches of soil or covered to the maximum depth as shown on the plans, which ever is greater. The soil will be compacted to Standard Proctor (AASHTO T-99) a density along the sides of 95% and reduced density over the lid, both as shown on the plans. An axle load of 12,000 lbs. will then be passed over the covered crypts for a minimum of 10 times in repetition, in a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts. The crypts shall then be fully excavated, exposed and the lids removed to allow careful examination inside and outside. The crypts must not show any signs of stress or cracking.
2. Concurrent with Confined Loading, the inside shelf of the interior crypt shall be loaded with one worker with a minimum weight of 200 lbs. Worker shall walk on individual supports to confirm structural integrity and load bearing capability. Worker shall adhere to all safety regulations while performing test. Upon uncovering and load removal, without entering the crypt the inside shelf shall be retrieved for inspection and lowered back into place by the removal tool device to be provided the Cemetery. The inside shelf must not show any signs of stress, cracking or excessive deflection during load testing and retrieve/return procedures.

1.4 ALLOWABLE TOLERANCES

A. Tolerances of individual units shall be as follows:

1. Variation in overall crypt outside dimensions of unit (height, length and width): 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: 1/16" plus or minus.

3. Maximum height differential in final placement in the ground: 1/4" above or below design grade.
4. Cracks greater than 0.030 inch in width are cause for crypt rejection by the NCA inspector. With evidence of fiber or steel reinforcement, any cracking 0.030 or lesser width that does **not** extend thru wall is acceptable. Any cracking 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.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, Contractor shall furnish to the Owner 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 Consolidate Concrete (SCC) with a **15% minimum requirement** of a cement substitute of fly ash and/or other pozzalons.
- C. Submit Shop Drawings:
 1. Erection 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 COTR (NCA inspector) 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 NCA inspector 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 NCA inspector 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.

1.6 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. The Contractor shall provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Contractor is responsible for transportation, storage and handling of units such that any negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting cable to transport crypts. On the job site, forklift handling of crypts may be approved by the VA upon demonstration that no crypt damage will be incurred.
- B. Storage:
 - 1. Units may be stored at designated locations(s) on site.
- C. Markings and Identifications:

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

1.7 COORDINATION

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

1.8 GUARANTEE

- A. After erection, completed work will be, subject to terms of Article, GUARANTEE in Section 01 00 00, GENERAL CONDITIONS, except guarantee period is extended to five years.

1.9 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced.
Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
T99-01(2004)..... Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb)
Rammer and a 305 mm (12 inch) Drop
T180-01(2004)..... 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 and
Commentary.
- D. American Society for Testing and Materials (ASTM):
A 36/A 36M-08 Standard Specification for Carbon Structural Steel.
A 82/A 82M-07 Standard Specification for Steel Wire, Plain for Concrete
Reinforcement.
A 153/A 153M-09 Standard Specification for Zinc Coating (Hot Dip) on Iron
and Steel Hardware.
A 185/A 185M-07 Standard Specification for Steel Welded Wire
Reinforcement, Plain, for Concrete.
A 615/A 615M-09 Standard Specification for Deformed and Plain Carbon-
Steel Bars for Concrete Reinforcement

C 31/C 31M-10	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
C 33/C 33M-11	Standard Specification for Concrete Aggregates
C 39/C 39M-10	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen
C 78/C 78M-10	Standard Test Method for Flexural Strength for Concrete (Using Simple Beam with Third-Point Loading)
C 150/C 150M-09	Standard Specification for Portland Cement.
C 172/C 172M-10	Standard Practice for Sampling Freshly Mixed Concrete.
C 260/C 260M-10	Standard Specification for Air-Training Admixtures for Concrete.
C 494/C 494M-10	Standard Specification for Chemical Admixtures for Concrete
C 595/C 595-10	Standard Specification for Blended Hydraulic Cement.
C 1017/C 1017M-07	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
C 1116/C 1116M-10	Standard Specification for Fiber-Reinforced Concrete.
C 1157/C 1157M-10	Standard Performance Specification for Hydraulic Cement
C 1602/C 1602M-06	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
C 1399/C 1399M-10	Standard Test Methods for Obtaining Residual-Strength of Fiber-Reinforced Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Precast Concrete: All crypts shall be of concrete with a minimum 28 days compressive strength of 5,000 psi, be Self Consolidated Concrete (SCC) containing structural fiber with an inverted slump between 22" and 28"; and shall contain a minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids. All to be in conformance to the following requirements:

1. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
Normalweight Aggregates: ASTM C 33
2. Water: ASTM C1602
3. 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.
- 4. Prohibited Admixtures: Calcium Chloride thycyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Reinforcement:
 - 1. Welded Steel Wire Fabric: ASTM A185.
 - 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.

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 (1/4" and smaller) caused by air bubbles, normal color variations, normal form joint marks, small chips (1/4" and smaller) and spalling (no more than one square foot total per unit) are permitted.
 - 2. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.
 - 3. The lid lifting system shall be top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 2-1/2" diameter minimum recessed bowl of depth

sufficient to easily connect lifting device as designated compatible by anchor manufacturer. Anchors are to be installed at locations to ensure maximum lid lifting stability. A removable plastic cap secured to the anchor will prevent 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.

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. 90% 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 NCA inspector.
2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.

2.3 TESTING AND INSPECTION

- A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including the removal of lids, number painting inside crypts, and replacement of the lids for inspection by the COTR. The NCA

inspector 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: Three cylinders per day of crypt production to be taken in accordance to ASTM C172 as applicable to SCC. Strength shall exceed 5000 psi after 28 days curing in accordance to ASTM C31 & C39. Test inverted slump when cylinders are made.
 - 2. Beam testing to confirm design flexure strength: 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 NCA inspector.

3.2 GENERAL LAYOUT CONTROL

- A. A professional registered Land Surveyor shall establish and control horizontal and vertical alignment of units.

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, grading of subgrade and aggregate base for proper installation of units.
- 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, INSTALLTION AND PAINITNG

A. Handling:

1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. On the job site, use the designed lifting cable to transport crypts from the truck to storage to the final installation.
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:

1. Install units by competent erector crews trained and certified as competent by manufacturer.
2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids 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, the contractor shall remove lids with the specified lifting apparatus for crypt inspection by the NCA inspector and numbering. Numbers furnished by NCA shall be painted by the contractor 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 twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application **within 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 COTR has determined are damaged, cracked, 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 COTR.
- C. Repair work shall be sound, permanent, and flush with adjacent surfaces.
- D. Replacements and repairs shall be done at no additional cost to the Government.

3.7 BACKFILLING AND MATERIAL STORAGE

- A. Protect installed crypt units during backfill operations.
- B. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall contain no material that will cause a concentrated point load. The perimeter wall backfill shall be compacted to a Standard Proctor (AASHTO T-99) to 95% density to the level equal to the top of the crypts.
- C. Install an approved pea gravel (rounded) fill per gradation into gaps between crypts leaving no voids. Use rodding to assure no bridging occurs and void areas are eliminated. No sand allowed. At NCA's discretion, a cut aggregate substitute of same gradation may be approved with demonstration that filling gaps between crypts leaves no voids.

Aggregate Size No	Grading Requirements - Amounts finer than Each Sieve (Square Openings), Mass Percent					
	1/2"	3/8"	No. 4	No. 8	No. 16	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

- D. 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 2 inches of identification sand, soil to specified level, and 4 inches of topsoil as the final layer. The entire backfill atop the units shall be compacted to a Standard Proctor (AASHTO T-99) of 95% density.
- E. No equipment over the crypts should exceed crypt design loads as specified herein (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over the crypts unless impact loads are shown not to exceed crypt design loads.

- F. Immediately during crypts install, contractor to 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 ***“12,000-lb axle load maximum.”*** Lathes & signage shall be maintained in-place during backfilling thru final acceptance of the crypt field.
- G. Finish grading and prepare topsoil as indicated on plans.
- H. The contractor shall not store or stockpile any stone, sand, backfill or any other material within ten (10) yards of or on top of installed crypts. All costs to inspect affected crypts for possible damages will be at contractor's expense.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance will be by NCA inspector.

- - - E N D - - -

SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:

1. Site preparation.
2. Excavation.
3. Filling and backfilling.
4. Grading.
5. Soil Disposal.
6. Clean Up.

1.2 DEFINITIONS

A. Unsuitable Materials:

1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade: Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proof rolling, or similar methods.

B. Trench Earthwork: Trench work required for irrigation lines.

C. Site Earthwork: Earthwork operations required in area outside of a line located 5 feet outside of principal crypt perimeter and within new construction area with exceptions noted above.

D. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field tests.

E. Fill: Soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.

F. Backfill: Soil materials used to fill an excavation.

G. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or dimensions without written authorization by the COTR. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.

- H. Authorized additional excavation: Removal of additional material authorized by the COTR based on the determination by an accredited Independent soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- I. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- J. Structure: Foundations, slabs, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- L. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- M. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe.
- N. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- O. Utilities include on-site underground pipes, conduits, ducts, and cables.
- P. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements and blasting operations: GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, 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. Erosion Control: Section 31 20 01, SOIL STABILIZATION (EROSION CONTROL,) and Section 32 90 00, PLANTING.
- F. Site Preparation: Section 02 41 00, DEMOLITION.
- G. Paving sub-grade requirements:

1.4 CLASSIFICATION OF EXCAVATION

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. Rock Excavation:
 - 1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a track-mounted hydraulic excavator; equipped with a 42-inch wide, short-tip-radius rock bucket; rated at not less than 120 hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179. Trenches in excess of 10 feet wide and pits in excess of 30 feet in either length or width are classified as open excavation.
 - 2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at not less than 210 hp flywheel power and developing a minimum of 45,000 lbf breakout force; measured according to SAE J-732.
 - 3. Other types of materials classified as rock are boulders of rock material exceeding 1 cubic yard for open excavation, or 3/4 cubic yard for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.

1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

- A. Measurement: Cross section and measure uncovered and separated materials, and compute quantities by 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. 24 inches from outside face of concrete work for which forms are required, except for footings.
 - 2. 12 inches from outside of perimeter of formed footings.
 - 3. 6 inches below bottom of pipe and not more than pipe diameter plus 24 inches in width for pipe trenches.
 - 4. From outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS.
- B. Rock Excavation Report:
 - 1. Certification of rock quantities excavated.
 - 2. Excavation method.
 - 3. Labor.
 - 4. Equipment.
 - 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
 - 6. Plot plan showing elevation.
- C. Submit gradation reports for all materials listed in Part 2 – Products.
- D. Refer to Section 01 45 29, Testing Laboratory Services, for earthwork test reports required.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. State of Kentucky Department of Transportation (IADOT), Construction and Material Specifications, latest edition.
- C. American Association of State Highway and Transportation Officials (AASHTO):
 - T99-97..... Standard Specification for the Moisture-Density Relations of Soils Using a 5.5 lb Rammer and a 12-inch Drop
 - T191-93..... Standard Specification for Density of Soil In-Place by the Sand-Cone Method
- D. Society of Automotive Engineers (SAE):
 - J-732-92..... Specification Definitions Loaders

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fills: Material approved from on site or off site sources having a minimum dry density of 110 pcf, a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Utility Pipe Bedding: Naturally or artificially graded mixture of natural or crushed limestone, gravel, natural sand, and sand manufactured from stone, conforming to the IADOT Construction and Materials Specifications, approved by the COTR and conforming to the following gradation:

Type 1

<u>U.S. Sieve Designation</u>	<u>Percent by Weight Passing Square Openings</u>
2-inch	100
1-inch	70-100
3/4-inch	50-90
No. 4	30-60
No. 30	9-33
No. 200	0-20

Type 2 (meets the gradations of 703.05, 703.02 or one of the gradations below):

<u>U.S. Sieve Designation</u>	<u>Percent by Weight Passing Square Openings</u>
2½-inch	100
1-inch	70-100
3/4-inch	100
3/8-inch	80-100
No. 4	60-100
No. 8	45-95
No. 40	10-50
No. 50	7-55
No. 200	0-15

- D. Aggregate Base: Under structural foundation and pavement sub bases, aggregate shall consist of CCS, Crushed Gravel, Crushed Air-cooled Blast Furnace Slag (ACBFS), Granulated Slag (GS) or Open Hearth (OH) slag, conforming to the IADOT Construction and Materials Specifications, approved by COTR and conforming to the following gradation:

Item 304

<u>U.S. Sieve Designation</u>	<u>Percent by Weight Passing Square Openings</u>
2-inch	100
1-inch	70-100
3/4-inch	50-90
No. 4	30-60
No. 30	9-33
No. 200	0-15 (0-10 for OH slag)

- E. Drainage Stone: Drainage Stone shall be used for under drains and as the compacted sub base material under crypts. Drainage Stone shall consist of washed, narrowly graded mixture of crushed stone, or crushed gravel; coarse-aggregate grading Size 57; with 100 percent passing a 1 1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve. All drainage stone shall be void of foreign matter and meet the clean water requirements of the Iowa EPA.

- F. Pea Stone: Pea Stone shall be used for fill between crypts, and shall consist of washed, narrowly graded mixture of free draining material, aggregate size 8, with 100 percent passing a 1/2-inch sieve and 0 to 5 percent passing a No. 16 sieve. All pea stone shall be void of foreign matter and meet the clean water requirements of the Iowa EPA.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, paving, debris, trash, and other obstructions. Remove materials from Cemetery Property.
- B. Grubbing: Remove stumps and roots 3 inch and larger diameter. Undisturbed sound stumps, roots up to 3 inch diameter, and nonperishable solid objects a minimum of 3 feet below subgrade or finished embankment may be left. Within proposed or future burial sections, stumps and roots 3 inches and larger are to be removed to a depth 8 feet below finished grade.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 15 feet of new construction and 7.5 feet of utility lines when removal is approved in advance by COTR. Remove materials from Cemetery Property. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs that are to remain, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by COTR. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 1/2 cubic foot in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 2 inches in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that tilth of soil will be destroyed.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 12 inches on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Cemetery Property.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
 2. Locations of existing contours indicated on plans, except spot elevations, are from a site survey that measured spot elevations and subsequently generated existing contours. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify COTR of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify COTR of any differences between existing or constructed grades, as compared to those shown on the plans.
 3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
 4. Finish grading is specified in Section 32 90 00, Planting.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, to its angle of repose, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Extend shoring and bracing to bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
 2. If bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COTR.
- B. Blasting: NOT ALLOWED.
- C. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proof roll exposed sub-grade with a fully loaded dump truck to check for pockets of soft material.

2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

D. Wall Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 3000 psi concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.

E. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
 - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
 - b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
 - c. Support piping on undisturbed earth unless a mechanical support is shown.
 - d. Length of open trench in advance of piping laying shall not be greater than is authorized by COTR.
2. Storm sewer trenches:
 - a. Excavation of trenches for pipe culverts, sewers and drains, shall be in conformance with the IADOT Construction and Materials Specifications Section 603.03, and as approved by the COTR. Method "A" shall be used for a cut situation, and Method "B" shall be used for a fill situation.
 - b. Bedding of pipe shall be in conformance with the IADOT Construction and Materials Specifications, and as specified in Section 33 40 00, STORM DRAINAGE SYSTEM, and as approved by the COTR.
 - c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

- F. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be

removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by COTR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the COTR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:

- a. Provide a smooth transition between adjacent existing grades and new grades.
- b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
 - 1) Lawn or Unpaved Areas: Plus or minus 1-inch. (Finished elevations include 6 inches topsoil.)
 - 2) Walks: Plus or minus 1 inch.
 - 3) Pavements: Plus or minus 1 inch.

3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or damp proofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by COTR.
- B. Backfill of trenches for pipe drains shall be in conformance with the IADOT Construction and Materials Specifications Section 603.08, and as specified in Section 33 40 00, STORM DRAINAGE UTILITIES, and as approved by the COTR.

- C. Placing: Place materials in horizontal layers not exceeding 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- D. Compaction (General): Compact with approved tamping rollers, sheeps foot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing retaining walls without prior approval of COTR. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil according to the State of Kentucky, Construction and Materials Specification, AASHTO T-310 or AASHTO T-191.
 - 1. Compaction of backfill within trenches for storm drains shall be in conformance with the IADOT Construction and Materials Specifications Section 603.09, and as specified in Section 33 40 00, STORM DRAINAGE UTILITIES, and as approved by the COTR.

3.4 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 6 inches unless otherwise shown.
- D. Finish subgrade in a condition acceptable to COTR 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 prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- E. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 0.25 inches of indicated grades.

3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.

- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- E. Segregate all excavated contaminated soil designated by the COTR from all other excavated soils, and stockpile on site on two 6 mil polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.
- F.

3.6 CLEAN UP

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

---- E N D ----

SECTION 31 20 01
SOIL STABILIZATION (EROSION CONTROL)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies erosion control measures to be provided for the purposes of erosion control and soil stabilization.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Environmental Regulations: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROL.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Demolition: Section 02 41 00, Earthwork: Section 31 20 00, EARTHWORK.

1.3 SUBMITTALS:

- A. Manufacturers' Product Literature and Data: Submit the following as one package:
 - 1. Silt fence materials.
 - 2. Construction/protection fence materials.

PART 2 – PRODUCTS

2.1 MATERIALS:

- A. FILTER MATERIAL: Filter material for silt fence inlet protection shall be a fabric designed for silt retention. Filter material shall be woven, polypropylene, polyester or polyamide material that is resistant to ultraviolet degradation, mildew and rot. Height shall be as shown on the Drawings. Filter material shall meet the following specifications:
- B. WIRE FABRIC: Wire fabric for erosion control fence shall be 14 gauge galvanized wire.
- C. SUPPORT POSTS: Support posts for erosion protection barriers shall be 2" sq. (min.), No. 2 or better wood posts or medium weight steel fence posts; height and post spacing as shown on the Contract Drawings.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. SITE CONDITIONS: Site grading and soil preparation shall be done only during periods which are normal for such work as determined by weather conditions, accepted practice, and as approved by the COTR. When conditions are such, because of freeze, excessive moisture, or other factors, that satisfactory results are not likely to be obtained or when work may result in erosion, work shall be stopped. It shall not be resumed until desired results can be obtained or until approved alternative or corrective measures and procedures are adopted.

3.2 CONSTRUCTION METHODS:

- A. SILT FENCE: Install silt fence as directed by the COTR. Construct it adequately to handle the stress from hydraulic and sediment loading. Bury fabric to a depth as shown on the Contract Drawings and/or AS REQUIRED TO COMPLY WITH SATE OR LOCAL SOIL CONSERVATION SERVICE OR ASSOCIATED AUTHORITY HAVING JURISDICTION, AHJ. Splice fabric ends together with hog rings, locking plastic ties, or other approved methods. Maintain the integrity of silt fences as long as they are necessary to contain sediment runoff. Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Correct deficiencies immediately. When accumulated silt reaches a depth of 6 inches, remove the sediment and deposit it at approved sites in a manner that will not contribute to additional siltation.

----- E N D -----

SECTION 32 84 00 PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor is responsible for providing a manually controlled a standalone programmable fully automatic system with full and complete coverage within the project areas indicated on the drawings. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all design and build for the operations in connection with and reasonably incidental to the complete installation of the fully functional irrigation system, and provide warranty, the installation details, and others as specified. Other items of work specifically included are:
 - 1. Procurement of all applicable licenses, permits, and payment of required fees.
 - 2. Coordination of Utility Locates ("Call Before You Dig").
 - 3. Maintenance period services.
 - 4. Sleeving for irrigation pipes and wires as required, and/or beneath all hardscape surfaces.

1.2 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, and 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 V 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.

1.3 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals: SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- D. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- E. Division 26, Electrical
- F. Section 32 90 00, PLANTING

1.4 QUALITY ASSURANCE

A. Irrigation Contractor:

1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the construction of at least five (5) irrigation systems having large diameter gasketed pipe (6-inch and larger), centralized control systems with hardwired or radio communication, electrically operated remote control valves, large radius rotary sprinklers (minimum 1-inch inlet with swing joint) and pre-fabricated pump stations.
2. Irrigation Contractor must be licensed in the State of Illinois.

B. Equipment Manufacturer:

1. Manufacturer regularly and presently manufactures the item submitted as one of their principal products.
2. There is a permanent service organization, maintained or trained by the manufacturer, which will render satisfactory service within 24 hours of receipt of notification that service is requested.
3. Installer, or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform the specified work.

C. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.
2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 - a. All components of an assembled unit need not be products of the same manufacturer but component parts which are alike are the product of a single manufacturer.
 - b. Components are compatible with each other and with the total assembly for the intended service.
3. Nameplates: Nameplate bearing manufacturer's name or identification trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

SPEC WRITER NOTE:

1. Modify the following paragraph to adjust the coverage requirements when the irrigation water quality causes staining of hardscape

materials due to water quality issues like high Iron.

D. System Requirements:

1. Full (head to head plus 10%) and complete coverage of the irrigated areas is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to head locations as required to achieve full coverage of irrigated areas.
2. Layout work as closely as possible to approved designed drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of the drawings. Lines are to be common trenched wherever possible. Irrigation heads along roadways shall be placed between //fill in range in numbers of cm (inches)// x cm (x in.) and x cm (x in.), unless otherwise specified.
3. Locations of remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads. Remote control valves shall be located individually or in groups of two, to minimize tripping hazards. Where the exact location for the valves has not been set, or there are any conflicts, the location shall be coordinated with the designer and COTR before installation.
4. Irrigation lines and control wire shall run at boundaries of graves, thru designated utility lanes or beside roadways so that any gravesite may be opened in the future without disruption of the irrigation system.
5. Irrigation lines, control wires and power wires shall be run in trenches as designed and indicated on the drawings and meet all industrial standards.
6. Connect new system to existing mains or if needed to design for connection to new mains.
7. Unless noted otherwise, all irrigation lines, power wires and control wires shall be run in sleeves or conduit where installed beneath any site hardscape materials with minimum 18" of coverage.

E. 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.

SPEC WRITER NOTES:

1. Modify this paragraph as appropriate to indicate exactly what programming is needed for standalone programs and hand-held control unit.
2. Modify this paragraph when adding to an existing irrigation system to address the fully

functional irrigation program, when all satellites and zone control valves are fully operational. Provide programming as required to perform temporary irrigation that will be needed to establish new lawn and plants before acceptance by the owner.

3. The new system shall be fully integrated into and with the existing system if there is an existing system.
- F. Completely program the system according to approved master irrigation schedule.
- G. Follow manufacturer's instructions for installation.
- H. Manufacturer of Control Systems to certify Control System is complete, including all related components, and totally operational. Submit certificate to COTR.

SPEC WRITER NOTES:

1. Submit "Do not drink" signage as part of signage submittal package also.

1.5 SUBMITTALS

- A. Make submittals and provide number of copies per Specifications Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, "DO NOT DRINK" sign and all other irrigation device, equipment shown or described on the approved drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the COTR. Incomplete submittals will be returned without review. Sequentially number each page of the submittal for ease in referencing during submittal review. Pages within a letter or number identified Tab section may be numbered sequentially as long as the process is consistent and provide unique page identification for each page of the submittal.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water filtration components, electrical components and control system components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts and specifications for equipment to be included in the project work. For rotary sprinklers include Center for Irrigation Technology Space Pro Single Leg Profile showing the Distribution Uniformity and Scheduling Coefficient for the nozzles being used at the specified spacing.

- D. Shop Drawings: Complete detailed layout shop drawings covering design of system showing pipe sizes and lengths; fittings, locations, types and sizes of sprinkler heads; controls; backflow preventers; valves; drainage pits; location and mounting details of electrical control equipment; complete wiring diagram showing routes and wire sizes; wiring details and source of current and connections to existing services. Do not start work prior to final shop drawing approval.
- E. Testing: Submit a proof of testing report with appropriate signature following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. Record Drawings: Submit information listed in Parts 1 and 3 of these specifications.
- H. Name and address of a permanent service organization maintained or trained by the manufacturers that will as a result of determined warranty work, or after warranty period following execution of a service contract for this facility, render satisfactory service within 24 hours of receipt of notification that service is requested.

SPEC WRITER NOTES:

1. Clarify the paragraph below regarding the “as-built” drawings to specifically describe what format and level of detail is required for the drawings.
2. Integrate, as applicable, the requirements for the Contractor to provide GPS coordinates of the underground and surface facilities as well as the depth of the underground facilities. Coordinate with the Spec. Section on the GPS equipment and base station to be provided at the facility, as applicable.
3. Add requirements for documentation of the positions of all valves, bends, fittings, sleeves, etc. to fully document the installed location of the irrigation system components. All of the installed components shall be located by GPS coordinates referenced to a ground based coordinate system. Below ground components shall also have the elevations indicated. If the coordinates of actual facility locations and elevations are collected, the “As-built” drawing produced utilizing the coordinates shall be provided in an electronic drawing ACAD DWG

file format or as a GIS drawing. In either case, the electronic drawing that is produced should be made up of polylines, points and closed polygons, which are readily used in GIS software, when and if it becomes available. Adjust these requirements according to the project specific requirements established for GPS and GIS systems. The points being located shall be annotated and the coordinates shall be provided in a spreadsheet table as well as imbedded in the coordinate system of the drawing.

4. Modify the following for this modification to an existing cemetery.
5. The irrigation system drawing for the Cemetery should include all of the irrigation system that is constructed and operational at the completion of this project. Coordinate the preparation of the irrigation system drawing, as applicable, with the existing irrigation system drawings and if possible create specifications that will result in the production of a new complete irrigation system drawing, electronically and as paper drawings, suited for use by the Cemetery operations staff, or matching the existing drawing(s) format if applicable.
6. if applicable, adjust the "As-built" drawing requirements, if the central computer controlling the irrigation system operation has the capability to incorporate a graphical interface representation of the cemetery and irrigation system, that will allow irrigation control zones to be turned on and off by clicking with a mouse on a sprinkler head, lateral line or control valve within a graphically represented irrigation zone, like that in the "Site Control" software by Rainbird. Coordinate with the Manufacturer's representative regarding the software and "As-Built" drawing requirements to make this software option functional, if applicable for the project.

- I. Reproducible "as-built" drawings. Submit information indicating the "as-built" conditions for the irrigation system to the COTR as marked-up copies of the full sized bid documents posted with all addendum, clarification and approved modifications. Upon approval by the COTR the Contractor produced marked-up "as-built" irrigation drawings shall be submitted to the design A/E for preparation of the electronic "as-built" drawing(s) for the irrigation system.

After electronic "as-built" drawing(s) have been approved, the Contractor shall utilize them to prepare an overall irrigation system drawing to replace the existing one with this expansion area include /of a size suitable for display at the location determined appropriate by the Cemetery and COTR.

J. Controller Chart:

1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be submitted and approved before charts are prepared.
2. Provide one controller chart showing the area covered by controller for each automatic controller with tables showing information of items supplied and installed at the maximum size controller door will allow. Chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door.
3. Chart shall be a print with a different color used to show area of coverage for each station. Charts must be completed and approved prior to final inspection of the irrigation system.

1.6 SUBSTITUTIONS

- A. Unless otherwise noted, use specified equipment to match existing equipment. COTR must approve equipment prior to construction. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility. "As-Built" information shall show the items installed with detailed info such as size, depth, type, etc.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option without extra costs to the government.

1.7 PERFORMANCE REQUIREMENTS

SPEC WRITER NOTE:

1. Modify the following paragraph based on this individual project.
- A. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and appurtenances unless otherwise indicated.
 1. Irrigation Mainline Piping: 1380 kPa (200 psig).
 2. Lateral Piping: 1035 kPa (150 psig).

SPEC WRITER NOTE:

1. Modify the following to add codes as required, and local jurisdictional requirements.

1.8 CODES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

SPEC WRITER NOTE:

- 1. Modify the following, as applicable, based upon the conditions regarding the availability for the source of irrigation water supply for the irrigation system for this project.

1.9 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 new irrigation system for this project or completion of portions thereof, the contractor through the permanent connection of the new irrigation system to the existing system and irrigation water source of supply constructed as part of this project, shall be provided water at available flow and pressure, for use by the Contractor, with Contractor provided additional facilities and/or equipment as required to perform the required flushing and testing of the new irrigation system. Contractor shall be responsible to coordinate the construction of the new irrigation water source of supply with the irrigation system construction to insure that water is available for irrigation purposes, or shall provide for irrigation water by other means at no extra cost to the Government.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COTR, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities for providing temporary irrigation water. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.10 TESTING

- A. Notify the COTR five working days in advance of testing.
- B. 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.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the COTR.
- D. Furnish clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test – Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.

SPEC WRITER NOTES:

- 1. Modify paragraphs to fit your design and project needs as appropriate per industrial standards.
 - 2. Modify as needed. 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 and specify the allowable leakage as proportional to the actual test pressure as compared to the 700 kPa (100 psi) indicated, or per industrial standards.
- 3. 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.
 - 4. Allowable deviation in test pressure is 35 kPa (5 psi) during test period. Average pressure during the test shall be 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. Water added to mainline pipe must be measured volumetrically to nearest 10 ml (0.025 gallons).

5. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. The amount of additional water pumped in during the test will not exceed the value in the table, or the calculated value using the formula below, based upon differing number of joints, duration or pressure of the test:

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 ½")	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)

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

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.

6. Cement or caulking to seal leaks is prohibited.
7. Contractor may sub-contract testing to pipeline testing company approved by COTR.

F. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:

1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kpa (80 psi) for 30 minutes.
2. Cap all sprinkler risers.
3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
5. Cement or caulking to seal leaks is prohibited.
6. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

G. Operational Test – Remote Control Valves, Lateral Piping and Sprinklers:

1. Activate each remote control valve in sequence from each new satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units //through the central controller//through their stand alone communication system//. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The COTR will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
6. The backflow prevention device shall be tested by a certified tester prior to requesting final inspection for project acceptance.

H. Distribution Uniformity (DU):

1. Perform a DU Test on one zone of burial section rotors and one zone of tree lawn rotors per satellite controller. Verify that DU meets submittal 1.5C.
2. In conjunction with the COTR, select the zones of sprinklers that are representative of the area being irrigated by the satellite controller.
3. Perform a catch can test using procedures recommended by the Irrigation Association.
4. Where DU test fails adjust zone pressures and/or nozzle sizes to meet required Distribution Uniformity.
5. Calculate and provide a written documentation of the DU for each zone tested.
6. An Irrigation Association Certified Landscape Irrigation Auditor must perform the test. Provide written evidence of certification prior to conducting test.

SPEC WRITER NOTES:

1. Grounding for the satellites is very site specific and is dependent on the site soil conditions and the method(s) being utilized to construct the earth grounding. To achieve the desired resistance value for the grounding of less than 15 ohms, recommended maximum allowable value, and the recommended value of 5 ohms or below, adjustment to the 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 the resistance level is to add more grounding equipment. Refer to the Facilities Design Guide for information on what to include for grounding to protect the irrigation equipment, and procedures to follow to achieve the desired grounding without incurring cost increases due to change orders.
3. Modify the following to include sufficient information that will result in the Contractor providing a fully functional grounding system for the irrigation system equipment that will result in test results for the grounding that is at or below the readings specified herein.
4. Modify the values for the grounding test readings if required to be at levels recommended by the manufacturer for protection of the equipment, or as indicated herein, whichever is lower.

I. Control System Grounding:

1. 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, if acceptable by equipment manufacturer without equipment warranty invalidation. Test results must meet or exceed control system manufacturer's requirements for acceptance, while maintaining equipment warranty.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's requirements are met. Add grounding rods as needed, bond all rods together.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each satellite controller pedestal door and via a written report submitted to the COTR. Documentation should include satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. The test results should be marked on the inside of each satellite controller pedestal door using a permanent marker.
4. A written report of the 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 must be submitted to the COTR.

SPEC WRITER NOTES:

1. Modify the following paragraph to reflect testing of the entire irrigation system, if there are portions that already exist, or just operating the 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, if 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 system(s).

J. Irrigation System Acceptance Test (Burn in) Prior to requesting the Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test (Burn in) must be passed.
2. Coordinate start of Test with COTR.
3. During the Test, the irrigation system must be fully operational for the system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14-day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14-day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from COTR.
Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. When the system has operated for 14 days without fault, contact the COTR to schedule Final Inspection.
5. If the system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; if it does not shut down, find and fix the causes, the test starts over.

SPEC WRITER NOTES:

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

K. Central Control to Supervisory Control and Data Acquisition (SCADA) System Communication Test:

1. Replace defective wire, wire connections or appurtenances. Repeat the test until the manufacturer's guidelines are met.
2. Test communication between the irrigation central control computer and the SCADA equipment.
3. The Irrigation Delivery Software (IDS) shall function in coordination with the SCADA System for the Irrigation Water Supply Source (IWSS) and IDS systems to operate on fully automatic mode for 14 consecutive days// as described herein and in particular in the Section describing the installation and operation of the SCADA system//.

1.11 WARRANTY AND REPLACEMENT

- A. The purpose of the warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
 1. Warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Acceptance by COTR. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from COTR.
 2. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
 3. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

SPEC WRITER NOTE:

1. Modify the following to coordinate with the project specific conditions. Where there is an existing irrigation system and the project is an expansion, clearly indicate the specific construction requirements for the project.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Notify COTR. Coordinate construction of irrigation system with Cemetery Staff. Coordinate temporary shut-down of existing system with Cemetery Staff prior to construction. Disturbance to cemetery operations must be minimized. See irrigation plans and installation details and Specifications Sections for required coordination efforts related to the installation of specific irrigation components.

- B. Connections to the existing mainline must be approved by the COTR while minimizing the impact on the operation of the existing irrigation system.
- C. Install irrigation mainline and control and power wiring in sleeves under new roads prior to installation of road base, and under all other concrete or asphalt, either existing or new for this project.
- D. Install irrigation components in landscaped areas unless specifically indicated otherwise. Irrigation components in other than landscaped areas shall be in sleeves placed utilizing HDPE pipe, with no joints beneath the non-landscaped areas.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the COTR.

1.13 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
 - B40.1-05..... Gauges-Pressure Indicating Dial Type-Elastic Element
- C. American Society of Sanitary Engineers (ASSE):
 - 1013-2005 Reduced Pressure Principle Backflow Preventers
- D. American Society for Testing and Materials (ASTM):
 - A242/A242M-04 (2009) High Strength Low-Alloy Structural Steel
 - A536-84 (2009) Ductile Iron Castings
 - B61-08..... Steam or Valve Bronze Castings
 - B62-09..... Composition Bronze or Ounce Metal Castings
 - D1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D1238-04c..... Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
 - D1784-08 Rigid Poly(Vinyl Chloride)(PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - D1785-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120
 - D1894-08 Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
 - D2241-05 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

- D2464-06 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2466-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2564-04e1 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- D2657-07 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- D3139-98 (2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- D3350-10 Standard Specification for PE Pipe & Fittings Materials
- F477-08..... Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- E. American Water Works Association (AWWA):
- C110/A21.10-08 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water
- C111/A21.11-06 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- C115/A21.15-05 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- C151/A21.51-09 Ductile-Iron Pipe, Centrifugally Cast, for Water
- C153/A21.53-00 Ductile-Iron Compact Fittings for Water Service
- C504-06 Rubber Seated Butterfly Valves
- C509-09 Resilient-Seated Gate Valves for Water Supply Service
- C901-08 AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, 13 mm (½ In.) through 76 mm (3 In.), for Water Service
- F. Manufacturers Standardization Society (MSS):
- SP70-2006 Cast Iron gate Valves, Flanged and Thread Ends
- G. National Electrical Manufacturers Association (NEMA):
- 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum);

PART 2 - PRODUCTS

SPEC WRITER NOTE:

1. Update and specify only that which applies to the project.

2.1 QUALITY

- A. Use new materials without flaws or defects.

SPEC WRITER NOTE:

1. Modify sleeving to reflect the project design conditions, following the Facilities Design Guide regarding location of irrigation mains.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Equipment used will match the equipment installed in the previous phase as noted. COTR must approve equipment prior to construction. The Contactor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

SPEC WRITER NOTE:

1. Modify the following paragraph to select the appropriate sleeving for the locations, depth, soil conditions and loading to which the sleeving will be subjected.

2.3 SLEEVING

- A. Provide sleeves beneath all hardscape for irrigation pipe and all wiring. Provide separate sleeves beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use C905, DR-18 rated at 1615 kPa (235 psi) confirming to dimensional and tolerances established by ASTM Standard D2241 for mainline pipe sleeves larger than 300 mm (12-inch).
- D. Use Class 200, SDR-21, rated at 1375 kPa (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241 or AWWA C905, DR-25 rated at 1135 kPa (165 psi) conforming to AWWA Standard C905, or use C-900 PVC pipe, rated at 1375 kPa (200 psi).

- E. Sleeve sizes are to be as shown on the drawings or twice the nominal diameter of pipe if not shown. The wiring bundle area may not exceed more than 40% of the sleeve cross sectional area, per NEC recommendations.
- F. Restrained Casing Spacers:
 - 1. Use restrained casing spacers on gasketed mainline pipe contained in a sleeve. Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.

SPEC WRITER NOTE:

- 1. Insure that there is a detail in the drawings showing the casing spacer installation and the applicable size for specific pipe sizes, otherwise Paragraph E is applicable.
- 2. Sleeve Size: As shown in the Casing Spacer Installation Detail.
- 3. Use casing spacers manufactured from high strength ductile iron, per ASTM A536, Grade 65-45-12. Use restraining rods manufactured from high strength low alloy material meeting the requirements of ASTM A242 and ANSI/AWWA C111/A21.11. Use runners manufactured from ultra high molecular weight polymer with a tensile impact of 175-350 Joules/cm (600-1200 ft-lbs./in.) and a coefficient of friction of 0.14-0.17 per ASTM D-1894.

SPEC WRITER NOTE:

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

2.4 PIPE AND FITTINGS

- A. Irrigation Mains:
 - 1. Provide one of the following materials:
 - a. Ductile Iron, AWWA C151, minimum working pressure 1025 kPa (150 psi), cement lined, exterior bituminous coated.
 - b. Polyvinyl Chloride (PVC) Pressure Pipe, AWWA C900, PVC 1120, minimum working pressure 1025 kPa (150 psi). Pipe shall conform to outside diameters of AWWA C151 cast iron pressure pipe to accommodate cast iron fittings.
 - c. Polyvinyl Chloride (PVC) Pressure Pipe, Class 200, SDR-21, rated at 1375 kPa (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241.
 - d. High Density Polyethylene (HDPE) pipes shall comply with AWWA Specifications C901. Materials used for the manufacture of polyethylene pipe and fittings shall

be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238.

2. Except for HDPE pipe, use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings according to 2.4.E.
3. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 1105 kPa(160 psi), conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters not manufactured in Class 160.
3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Threaded Pipe:

1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.

D. Pipe Above Grade and in Concrete Structures:

1. AWWA C115, flanged joints and fittings working pressure 1025 kPa (150 psi).

E. Fittings:

1. Irrigation Mains:

a. Ductile Iron and PVC Pipe:

Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 850 kPa(125#). All fittings shall be installed with retainer glands designed for the pipe material, and shall be manufactured with twist off screws

that sheer off at the proper force to anchor the retainer gland to the pipe at the pressure rating for the pipe, or at the test pressure for the pipe, whichever is higher, without causing damage to the pipe.

b. High Density Polyethylene:

The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR-33/2005, published by the Plastic Pipe Institute (PPI). All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints. Lengths of pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier

2. Irrigation Laterals:

PVC, schedule 40, solvent welded socket type, ASTM D2466.

3. Threaded Pipe:

PVC, schedule 80, ASTM D2464.

4. Swing Joints:

Shall be a standard complete assembly by a manufacture, with elastomeric seals that allow 360 degree rotation, and are designed for minimum 1375 kPa (200 psig) working pressure.

F. Jointing Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.

2. Irrigation Laterals: Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

3. Threaded pipes: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use non-hardening, non-toxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

SPEC WRITER NOTES:

1. Modify the following depending upon the size of the main into which the thrust block is to be attached.

2. For bends beneath hardscape for mains 150 mm (6-inch) or larger require plastic and rebar as indicated on the thrust block details.
3. Coordinate the specifications with the drawing details.

2.5 RESTRAINTS

A. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to 75 mm (3-inch) diameter or any diameter rubber gasketed pipe. Use of mechanical restraints does not eliminate the need for installation of thrust blocks as specified.
2. Use 20 MPa(3,000-psi) concrete.
3. Use 50 micrometers (2-mil) plastic.
4. Use 12.7 mm (No. 4) Rebar wrapped or painted with asphalt tar based mastic coating.

B. Joint Restraint Harness:

1. Use a joint restraint harness as presented in the installation details and wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or retainer glands and thrust blocks.
2. Use a joint restraint harness with all ductile iron fittings 150 mm (6-inch) and larger, transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
3. Use a joint restraint harness or retainer glands with preset torque shearing set screws, on all mainline gate valve assemblies 100 mm (4-inch) and larger.
4. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Use retainer conforming to ASTM A536. Use high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.

2.6 MAINLINE COMPONENTS

A. Valves (Except remote control valves):

1. General valve installation shall be as presented in the installation details. Unless specifically noted otherwise, valves for existing facilities shall match the existing, of the same type. All valves shall meet or exceed any specified parameters identified herein, or the parameters for the existing valves being matched, whichever provided the higher quality product.

- a. Underground Shut-Off Valves: Provide one or more of the following based upon project specific conditions. Use type in paragraph 1) unless there are special circumstances that require the other types:
 - 1) Gate valves 50 mm (2 inches) and larger: 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. AWWA C509.
 - 2) Butterfly valves 80 mm (3 inches) and larger: cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, //1025 kPa (150 psi)//1375 kPa (200psi) minimum pressure. AWWA C504.
- b. Check Valves: Swing.
 - 1) Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 850 kPa (125 pound) WSP.
 - 2) One hundred mm (4 inches) and larger: Iron body, bronze trim, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG.

SPEC WRITER NOTE:

 - 1. Modify as appropriate for the project conditions and provide the pressure setting for the valve in the specific location for the installation.
- c. Pressure Reducing Valve:

Cast steel body with renewable seats, with stainless steel trim. Flow passages and all parts designed to withstand high velocity applications, flange connected. Unless otherwise noted, pressure reducing valves shall be adjustable to the desired pressure, within the selected range of operation specified.
- d. Air-Vacuum Relief Valve:
 - 1) Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 14 kPa to 1580 kPa(2 psi to 230 psi). Use a continuous acting combination air and vacuum and air release valve.
- e. PVC Ball Valve:

Use a true union ball rated to 1620 kPa (235 psi). Use valve with safe-t-blocked seal carrier (full rated pressured) safe-t-shear stem, and self adjusting floating seat.
- f. Quick Coupling Valve Assembly:
 - 1) As presented in the installation details.

- 2) Brass construction, 1-inch nominal size, operating pressure 35-860 kPa(5-125 psi) with locking rubber or vinyl cover. Acceptable manufacturer and model is //(fill in based upon the existing acceptable products)// to match existing equipment or approved equal. //For new installations use high quality brass, bronze or stainless steel manufacturer's equipment for similar golf course or lite commercial applications.
- 3) Swing Joint: Use pre-manufactured triple swing joint. Quality of manufactured product shall meet or exceed that of products manufactured by Spears, Lasko, or approved equal.
- 4) Quick Coupler Anchor: Use pre-manufactured bolt on anchor.
- 5) Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Product quality shall meet or exceed that of Brooks Products or approved equal.
- 6) Filter Fabric: Use a spunbond polyester 3.5 oz per square yard landscape fabric.

SPEC WRITER NOTES:

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

B. Flower Water Station Spigot Connection Assembly:

1. As presented in the installation details.
2. Flower Watering Station Spigot: As specified in Section 323000, Site Furnishings
3. Curb Stop Valve: Brass body, 2070 kPa (300 psi) minimum working pressure. ASTM B-62, female threaded connections, with stop and waste feature.
4. Inline pressure regulator, 275 kPa (40 psi) maximum, 1-inch maximum inlet and outlet.
5. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.

6. Valve Box: Use a concrete curb valve box with cast iron lid sized 200 mm ID x 300mm (8" ID x 12"). Valve box must be capable of being face anchored in concrete.
7. The final approved configuration, including the mounting method shall be as approved during the submittal process.

C. Valve Box:

1. Gate and Butterfly Valve:
 - a. Valve boxes in pavement shall be precast concrete with compressive strength of the concrete in excess of 30 Mpa (4000 psi). In turf and planter areas valve boxes shall be HDPE structural foam Type A, Class III, //black//green//tan// in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.
 - b. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to differentiate between lawn irrigation system and domestic water supply system and set flush with finished grade. Provide two (2) "T" handle socket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.
 - c. Operations:
 - 1) Underground: furnish valves with 50 mm (2 inch) nut for T-Handle socket wrench operation.
 - 2) Above ground and in pits: MSS SP70, with handwheels.
 - 3) All butterfly valves 150 mm (6 inches) and above shall have enclosed gear drive operators.
 - 4) Ends of valves shall accommodate the type of pipe installed. Valves on buried irrigation mains shall have Mechanical Joint ends with retainer glands.
2. Remote Control Valves:
 - a. When in pavement, valve boxes shall be precast concrete with compressive strength of the concrete in excess of 30 MPa (4000 psi). In planter areas, valve boxes shall be HDPE structural foam Type A, Class III, black in color (or match existing). Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.

SPEC WRITER NOTE:

1. Modify subparagraph 1 and 2 as required to match the existing conditions, or as directed by the project area MSN Engineer during project design review.

- 1) After installation hot brand into lid of valve boxes 75 mm (3-inch) high, 1 mm (3/16") deep labels designating the size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.
- //1) After installation, label boxes with two 80 mm (3 inch) size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.//

b. Furnish two (2) 750 mm (30 inch) long valve adjustment keys.

//3. Drip zone Lateral Flush Cap Assembly:

- a. Round reinforced plastic valve box and lid constructed from HDPE. Opening at top of access box to be 14.5 cm (5-3/4") diameter, minimum. Height of access box to be 23cm (9-1/16"), minimum. Lid to have lift-hole for opening.//

//4. Emitter Access Boxes:

- a. Round plastic boxes with lid constructed of UV resistant thermoplastic material, tan in color. Top diameter to be 13 cm (5") minimum. Height of box to be 26 cm (10-1/4"), minimum.//

D. Backflow Preventer:

Provide reduced pressure principle backflow preventer in each new connection to existing potable water distribution system, ASSE 1013, except pressure drop at design flow shall not exceed 70 kPa (10 psi).

SPEC WRITER NOTES:

1. Retain applicable in following 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 owner for record keeping of all irrigation water sources for project.

E. Water Meter Assembly:

1. Water Meter:

- //a. Furnished and set by Public Service Company. //
- //a. Furnished by Public Service Company and installed by contractor.//
- //a. Contractor furnished and installed meter approved by Public Service Company. Forward approval before installation. //

2. Water Meter Pit:

- a. Reinforced poured in place concrete or approved precast concrete.
 - 1) Precast Concrete: Constructed of cast iron or aluminum with asphalt coating where in contact with the concrete. Rungs shall be 25 mm (one inch) diameter, 300 mm (12 inches) wide with 175 mm (7 inches) of clear space between the rung and the wall and a minimum of 65 mm (2 1/2 inch) depth in the wall.
 - 2) Reinforced Concrete: Same as above except a minimum of 150 mm (6 inches) in the wall.
- 3. Frames and Covers:
 - a. When not in roadway:
 - 1) Fed. Spec. RR-F-621. Cast Iron. Provide covers with cast-in identification symbol "WATER".
 - 2) Frame: Figure 1, Type I, Style A, Size 30A.
 - 3) Cover: Figure 8, Type A, Size 30A
 - b. When in roadway use traffic rated frame and cover
- 4. Steps:
 - a. Rungs shall be free of sharp edges, burrs or projections and be designed so a foot cannot slide off the end. Provide in all structures exceeding 1200 mm (4 feet) in depth.
- 5. Strainers:
 - a. Basket or "Y" type with brass strainer basket. Body smaller than 70 mm (2-1/2 inch) shall be brass or bronze; 70 mm (2-1/2 inch) and larger shall be cast iron or semi-steel. Strainer cover to be furnished with blow-off connection and shut-off valve to accommodate 20 mm (3/4 inch) diameter hose connection.
- 6. Pressure Gauges:
 - a. ANSI B40 1, 114 mm (4-1/2 inch) diameter, all metal case, oil filled bottom connected. Dial shall be either black or white lacquered throughout. Provide shut-off cocks. Maximum graduations of 10 kPa (2 psi).

2.7 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

- 1. Remote control valve:
 - a. As presented in the installation details. Installation shall result in the control valve being installed underground and operated by a // 24-volt AC electric solenoid // 24-volt AC/DC direct drive thermal hydraulic motor. // Valves shall be globe type

of heavy duty construction and shall have manual shut-off and flow control adjustment and provide for manual operation. Install valves with unions on each side to allow for easy removal. Valves shall have a minimum of 1025 kPa (150 psi) working pressure. Higher working pressure valves shall be provided for systems that operate with working pressures above 140 psi. Install assembly over gravel sump as presented in the installation details.

- b. Valves shall be of all brass or plastic construction furnished as straight or angle pattern type, or valve body shall be cast-iron with brass bonnet, trim and renewable seat and have two inlet tapings (furnished with one plugged) to allow installation as either a straight or angle pattern valve.

SPEC WRITER NOTE:

- 1. For normal water or water containing sand, retain sub-paragraph b. and delete sub-paragraph c. For sewage effluent or extremely dirty water, retain sub-paragraph c. and delete sub-paragraph b.

- //c. Valves shall be diaphragm type designed to operate in water containing sand and debris and shall have a self cleaning type contamination filter to filter all water leading to the solenoid actuator and the diaphragm chamber. Valve shall incorporate a non-adjustable type opening and closing speed control for protection against surge pressures, or valves shall operate by means of a slow acting direct drive without ports, screens or diaphragms.//

SPEC WRITER NOTE:

- 1. Coordinate with the project manager during the scoping of the project to determine if this feature should not be included.

- d. Valves shall contain pressure regulators.
 - e. Valves shall be completely serviceable from the top without removing valve body from the system. Furnish ____ 750 mm (30 inch) long adjustment keys. Valves to operate at no more than 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.
- 2. PVC Ball Valve: Use a true union ball rated to 235 PSI. Use valve with safe-t-blocked seal carrier (full rated pressured) safe-t-shear stem, and self adjusting floating seat. Acceptable manufacturer is Spears or approved equal.
 - 3. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.

4. Filter Fabric: Use a spun-bond polyester 3.5 oz. per square yard landscape fabric.
5. Wire connectors: Use 3M DBY or DBR.
6. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

SPEC WRITER NOTE:

1. Modify specifications below to include all irrigation head and drip components being used in the project. The descriptions below are generic.

B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:

1. Full Circle Sprinklers: To be a dual or tri-nozzle combination type with positive drive by means of a gear assembly. Sprinkler head to rotate uniformly and to be driven by means of a train of gears. Sprinklers to be equipped with an integral anti-drain valve to be self-closing at pressures of 3.0 m (10 feet) of head or less. Gears and pinions shall be assembled on stainless steel spindles in a water-lubricated sandproof gear case. An inlet screen shall prevent debris from entering the sprinkler and shall be removable with the internal assembly. Sprinklers outer case shall be constructed of corrosion resistant, impact resistant, heavy-duty ABS.
2. Part circle sprinklers to be variable arc type as required with same type drive used for full circle heads.

C. Spray Heads:

Nozzle shall be pop-up or fixed spray type of standard, undersize or oversize configuration as noted on plans. The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty, ultraviolet resistant plastic. It shall have a heavy duty stainless steel retract spring and a ratcheting system for alignment of the pattern. The sprinkler shall have a soft elastomer pressure-activated comolded wiper seal for cleaning debris from the pop-up stem. The sprinkler shall have a plastic or brass nozzle with an adjusting screw capable of regulating the radius and flow. The sprinkler shall be capable of housing protective, nonclogging filter screens or pressure compensating screens (PCS) under the nozzle.

SPEC WRITER NOTE:

1. Modify specifications above and below to include all irrigation head and drip components being used in the project. The descriptions below are generic.

//D. Drip Emitters:

1. Drip emitters shall be of the pressure compensating, permanently assembled type with 1.25cm (½") FPT inlet. Emitters shall be capable of providing 1gpm at inlet pressures between 15 and 50 psi.
2. Emitter distribution tubing shall be constructed of UV resistant vinyl material with a .22" O.D. and a .16" I.D. Tubing shall be as manufactured by the same manufacturer as the drip emitters.//

E. Low Voltage Control Valve Wire:

1. Wire: Solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground. Size of wire shall be in accordance with manufacturer's recommendations, but in no case less than No. 14.
2. Splicing Materials: Epoxy waterproof sealing packet.
3. Low voltage controller cable: Multi-strand cable, Underwriters Laboratories Inc. approved for direct burial in ground. Size and type of wire shall be in accordance with manufacturer's recommendations.

SPEC WRITER NOTE:

1. Use non-detectable type at cemeteries only.

F. Warning Tape:

1. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, // detectable//non-detectable // type blue with black letters (if potable water), or purple with black letters (if reclaimed or untreated well water), and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".

G. Tracer Wires:

1. No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

SPEC WRITER NOTE:

1. For projects having one or more field satellites, retain 2.8 and delete 2.9 and 2.10. For smaller projects with independent controllers, select Electric or Solar powered Controller options as conditions permit. Delete sections not selected and renumber from 2.8.

2.8 CONTROL SYSTEM COMPONENTS

A. Automatic central control equipment—with field satellites:

1. Overall Control Concept: The automatic control system shall consist of central computer system which provides irrigation starting controls and overriding capabilities of field satellite units in turn operating individual remote control valves in accordance with timing schedules programmed into the //central//field units//. The number of units and location of the installations are shown on the drawings.

SPEC WRITER NOTE:

1. Modify as required to indicate components that are included in the system for this project. Add additional equipment where required to provide communication between the water supply source equipment and the irrigation equipment.
2. The Central Computer Control System consists of a 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 all accessories necessary to operate the irrigation system. All of these components and software shall be a standard package as supplied by the irrigation control manufacturer.

SPEC WRITER NOTES:

1. Modify to provide performance criteria for the Central Computer Control System, without indicating any manufacturer information. The spec writer should accurately define functioning and operational components.
2. Modify where the Central Computer Control System is to match the existing system, and clarify whether a full system replacement of the Central and satellites is acceptable instead of matching the existing.
3. Modify to include functional performance information describing how the system is to operate and provide the desired leak detection performance. Describe what conditions are to cause alarm conditions and specify the level of system shut down that is to occur as a result of the 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 facilities and equipment.
5. Prepare a performance based narrative that clearly describes how the system is to operate during: normal automatic operations; manual operations; partial shut down conditions and emergency shut down conditions.

6. Prepare a performance based narrative describing how the water supply source is to operate in conjunction with the irrigation Central Computer equipment.

3. Central Computer Control System:

- a. The Central Controller shall have the following characteristics:

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Capable of reading a flow meter and recording flow for each station. Logging for each station for the last xx water days, run times, water usage, and operational characteristics.
3. Capable of receiving and storing on-site, daily ET weather data and accumulated rainfall to automatically determine station run times in minutes.
4. Multiple master schedules to allow daily, weekly programming.
5. Water budgeting proportionate to historical ET.
6. Cycle and Soak watering.
7. Complete English and Spanish operators manual built-in.
8. Electrical fault detection and bypass - logs all alerts.
9. Programmable rain shut down.
10. Activate / deactivate master valve control.
11. Optional integrated Radio Remote compatible.
12. Pump starts.
13. Flow monitoring within operator-set parameters.
 - n. Built-in transient protection and lightning protection.

4. Flow Meter

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Identify housing materials.
3. Pulse output, voltage and pulse rate proportional to the flow.
4. Fully compatible with the internal interface of controller.
5. Powered by the controller.

6. Flow meter data can be accurately read by the controller up to X,XXX feet.
7. By the same manufacturer as the irrigation controller.
8. Define/describe unit features/sensing features.

5. Moisture Sensors:

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Solid-state tensiometer type.
3. Include data transmission circuitry which sends moisture level readings back to the irrigation controller using valve field wires.
4. Entire unit encased in epoxy.
5. Require no calibration for the life of the sensor.
6. Unaffected by temperature, salinity or changes in pH.
7. Accurately transmit moisture levels up to x,xxx ft.

6. ET Measurement Device:

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Powered by the field controller.
3. Measures ET directly in 0.01" increments and sends pulses directly to field controller.
4. Fully compatible with the internal interface at the field controller.
5. Mounted inside a stainless steel, vandal-resistant enclosure specifically designed for the device.

7. Rain Measurement Device:

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Accurately measures rainfall in 0.01" increments by means of a tipping and emptying device mounted below the center of the collection dish.
3. Fully compatible with the internal interface at the field controller.
4. Operate between 32° F and 125° F.
5. Be constructed of anodized aluminum.

6. The controller shall provide 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.

8. Wind Measurement Device:

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Powered by the field controller.
3. Accurately measures wind in 0.1 mph increments.
4. Fully compatible with the internal interface at the field controller.
5. Operate between -50° C and + 50° C.
6. Be constructed of anodized aluminum.
7. Provide wind speeds up to 140 MPH.
8. The controller shall provide 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.

9. Central Computer Software

SPEC WRITER NOTES:

The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.

1. Shall run on a IBM compatible computer with minimum of 16 MEG of memory.
2. Shall require 300 megabytes of hard disk space for program and files.
3. Shall function with any combination of hardwired, phone, or local radio interface.
4. Shall allow uploading and downloading of programs and log data by controller or groups of controllers.
5. Shall allow direct real-time access to run stations, programs, check flows and check master valve operation, and turn controllers on or off.
6. Shall be capable of printing alerts based on operator-set data filters; and have capability of automatically creating permanent files each time data is uploaded.

7. Allow all program, log, summary and alert data for each controller to be selectively printed.
8. Shall have capability of automatically uploading weather data from the weather station, and Rain Bucket and re-distributing it to all field units.
9. Shall have the capacity to operate up to x,xxx controllers.
10. Shall have capability of automatically retrieving water usage data monthly and writing it to text files.
11. Have the capability of allowing the user override any changes made.
12. Failure of the central control system or communication links to the field controllers shall not affect normal, water management operation of field controllers.

10. Field Controllers with Central Communication:

- a. Manufacturer shall conduct an on-site radio test before submitting a bid to customer for any type of radio control.

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should 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 the 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 when using any type of radio communication.

SPEC WRITER NOTE:

1. The equipment type in the following paragraph is not desired by VA, however, is attached in case of additions to existing system.

//B. Automatic Control Equipment—Independent Satellite Controllers:

1. Overall Control Concept. The electric automatic control system shall consist of one or more independent satellite controllers which operate individual remote control

valves in accordance with timing schedules programmed into the independent units.

The number of units and location of the installations are shown on the drawings.

2. The Control System consists of an Independent controller, and all accessories necessary to operate the irrigation system. All of these components and software shall be a standard package
3. Independent controller shall have the following characteristics://

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. Multiple independent programs with multiple start times.
3. The station watering time can be set from one (x) minute to (x) hours and in one (1) minute increments.
4. The program shall allow for a rapid programming of a block of stations with the same watering time.
5. The watering days for each program may be based on a seven-day week or a skip-a-day routine.
6. The controller shall be furnished with a real time clock that retains the actual time during power outages.
7. The controller shall be furnished with a non-volatile memory that retains the program(s) during power outages or seasonal shutdowns.
8. The manually activated station cycle shall run a single station for a select time.
9. The controller shall be furnished with a built-in remote control capability.
10. The controller shall be furnished with automatic field wire fault detection, report the fault, and move to the next programmed station.
11. The controller shall be UL approved.
12. The controller shall be furnished with a percentage key to increase or decrease all station runtimes on a percentage basis.
13. The controller shall the ability to select cycle and soak

C. Automatic Control Equipment--Solar-powered:

1. Overall Control Concept. The solar-powered automatic control system shall consist of one or more independent controllers which operate individual remote control

valves in accordance with timing schedules programmed into the independent units. The number of units and location of the installations are shown on the drawings.

SPEC WRITER NOTES:

1. The listing in the spec note following is only a guideline individual manufacturer and models will vary. The spec writer should accurately define material and operational components.
2. 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.
3. Define what the Control System consists of - Independent controller, Rain Sensor, Moisture Sensor, Freeze sensor, and all accessories necessary to operate the irrigation system.
4. Shall operate between x °F and x °F (x °C to x °C)
5. Define circuit protection from electrostatic discharge to xx,xxx volts.
6. Define power source- powered by an internal photovoltaic module.
7. Define output to actuators shall be digital control pulses at x.xx volts DC.
8. Define photovoltaic module shall be protection- by a Lexan polycarbonate, or other lens.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. The Contractor Shall verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the COTR prior to beginning work.

B. Utility Locates ("Call Before You Dig"):

1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the COTR one week in advance of review. The COTR will identify and approve modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of alley and sprinklers in existing burial sections using a licensed surveyor. Use alleys as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer's Technical Representative.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Do not lay pipe on unstable material, in wet trench or when, in the opinion of the COTR, trench or weather conditions are unsuitable for the work.
- C. Concrete thrust block shall be installed where the irrigation main changes direction as at elbows and tees and where the irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks.
Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.
- D. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- E. Hold pipe securely in place while joint is being made.
- F. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.
- G. Full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- H. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas mains, all of which have right of way.
- I. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
- J. Minimum cover:
 - 1. 900 mm (36-inches) over irrigation mainline pipe in landscaped areas and to bottom of road base. (distance from top of pipe to finish grade)

2. 450 mm (18-inches) over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
 3. 450 mm (18-inches) over control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 4. 450 mm (18-inches) vertical separation between lateral and mainline pipe installed in a common trench.
 5. 75 mm (3-inches) minimum horizontal separation between pipes and wiring in a common trench.
 6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
 7. Tops of remote control valves shall never be less than 75 mm (3 inches) below lid of valve box.
- K. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COTR.
- L. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- M. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the COTR.
- N. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.
- O. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
1. Backfill trench using excavated material in 150 mm to 200 mm (6-inch to 8-inch) layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- P. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 150 mm (6-inch) layers and compacting to the density of surrounding soil.
- Q. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COTR.

- R. Where utilities conflict with irrigation trenching and pipe work, contact the COTR for trench depth adjustments.
- S. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any concrete that cracks, due to settling, during the warranty period.
- T. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- U. Warning tape shall be continuously placed above sprinkler system water mains at a depth of 200-250 mm (8-10 inches).
- V. Survey monuments:
 - a. Protect markers during construction.
 - b. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it in the proper location.

3.4 SLEEVING AND BORING

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- C. Extend sleeve ends a minimum of 300 mm (12-inches) beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- D. Verify that sleeve sizing is adequate prior to installation. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 300 mm (12-inches) beyond edges of paving or construction. Cover pipe ends and mark edge of pavement with a chisel or saw. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.
- E. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 6 meters (20-foot) length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 6 m (20') LENGTH
38 mm (1 ½")	7.5 m (25')	2.3 m (7'-8")
50 mm (2")	7.5 m (25')	2.3 m (7'-8")
63 mm (2 ½")	30 m (100')	575 mm (1'-11")
75 mm (3")	30 m (100')	575 mm (1'-11")
100 mm (4")	30 m (100')	575 mm (1'-11")
150 mm (6")	45 m (150')	400 mm (1'-4")
200 mm (8")	60 m (200')	300 mm (1'-0")
250 mm (10")	75 m (250')	225 mm (9")
300 mm (12")	90 m (300')	200 mm (8")

B. Mainline Pipe and Fittings:

1. Plastic pipe:

- a. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.
- b. Joints
 - 1) Solvent Welded Socket Type: ASTM D2855.
 - 2) Threaded Type: Apply liquid teflon thread lubricant of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.

3) Elastomeric Gasket: ASTM F477.

- a) Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
- b) Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.
- c) Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling shall be in accordance with the manufacturer's recommendations. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.
- d) The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.

2. Ductile iron pipe:

- a. Installation: AWWA C600.
- b. Joints:
 - 1) Mechanical: AWWA C111. Provide sufficient quantities of bolts, nuts, glands and gaskets for each socket opening on pipe and fittings.
 - 2) Push-on: Apply thin film of lubricant to gasket and place in proper position in contour of bell. Insert beveled end of joining pipe and make contact with gasket. Force beveled end of pipe to bottom of bell without displacing gasket. Do not caulk. Use only lubricant furnished by manufacturer of pipe.
 - 3) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set not less than 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 in manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
 - c. Snake pipe from side to side within trench.

- d. In irrigation isles, coordinate with the location of the monuments to avoid conflicts.
- 2. Fittings: The use of cross type fittings is not permitted.
- D. Emitter hose:
 - 1. Use Type 1/11 solvent weld.
 - 2. Bushing for adaptation from PVC Schedule 40 fittings to flex-vinyl hose shall be line size by 10 mm (3/8 inch) insert bushings.
- E. Specialized Pipe and Fittings:
 - 1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
 - 2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.
- F. Thrust Blocks:
 - 1. Use cast-in-place concrete bearing against undisturbed soil.
 - 2. Size, orientation and placement will be as shown on the installation details.
 - 3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
 - 4. Install rebar with mastic coating as shown on the installation details.
- G. Joint Restraint Harness:
 - 1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
 - 2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.

SPEC WRITER NOTES:

- 1. Modify the following paragraph to correspond to the indicated valve installations. Main irrigation line valves, 150 mm (6-inches) or larger could be located in the roadways, refer to the Facilities Design Guide for details.

2. Modify to indicate the minimum depth for irrigation main lines where located beneath the roads, pavement or walks.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Setting of valves:

1. No valves shall be set under roads, pavement or walks.
2. Clean interior of valves of foreign matter before installation.
3. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.
4. Set valve box cover flush with finished grade.
5. Install as indicated in the installation details, per manufacturer's instructions.
6. Install where indicated on the irrigation plans.
7. Brand or cast "GV" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

B. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Sequence of construction:
 - a. Coordinate exact location with COTR.
 - b. Components are to be installed before concrete pad. Coordinate installation with concrete contractor.
3. Location:
 - a. Stations will be installed at locations indicated on drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. No mainline or lateral pipe is to be installed under Flower Watering Stations.
4. Paint "FW" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect 50 mm (2-inch) pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 0.9 m/s (3 FPS).
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. The COTR will review the flushing operation and clarity of water before stopping the flushing operation.
 - h. Disconnect pipe from service tee(s) and install remote control valve(s).
2. Install per manufacturer's recommendations where indicated on the drawings.
3. Adjust valve to regulate the downstream operating pressure to 480 kPa (70 psi) for rotor sprinklers, 310 kPa (45 psi) for rotating stream nozzles and 240 kPa (35 psi) for spray sprinklers.
4. Wire connectors and waterproof sealant will be used to connect control wires to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
5. Install only one remote control valve to a valve box. Locate valve box 1.5m (5-feet) from and align square with nearby edges of paved areas.
6. Attach ID tag with controller station number to control wiring at solenoid.
7. Brand controller and station number in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.

2. Install per the installation details at locations shown on the drawings.

SPEC WRITER NOTE:

1. Adjust the following based upon the conditions for the project.
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 the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 600 mm (2-foot) square piece of sod around all rotary sprinklers in areas to be seeded.

C. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.

SPEC WRITER NOTE:

1. Adjust the following based upon the conditions for the project.
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 the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

D. Sprinkler Heads and Quick Couplers:

1. Shall be placed on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.

2. Place part-circle rotary sprinkler heads no more than 150 mm (6 inches) from edge, of and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
3. Install all shrub sprays, sprinklers and quick couplers on swing joints as detailed on plans.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Stakes to be parallel to riser.
5. Install sprinklers and quick coupling valves on a swing joint assembly.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at location(s) shown in the drawings.
2. Install electrical connections per control system manufacturer's recommendations and is shown in the drawings.

SPEC WRITER NOTE:

1. Modify the following paragraph to coordinate with the grounding requirements for other than lightning protection where specific resistance values are required for the grounding system. Follow manufacturer's recommendations regarding lightning protection.
3. Lightning protection: Drive grounding rod(s) into soil its full length. Furnish and install grounding plate(s) as indicated or as required to create the grounding connection with the field tested resistance value equal to or lower than the 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 the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
5. Connect control wire to the corresponding control unit terminal.
6. Install permanent receiver for hand held radio if not factory installed.
7. Install rain sensor and complete electrical connections to per control unit manufacturer's recommendations.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 300 mm (12-inch) standard valve box. Coil 600 mm (2 feet) of 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. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
 3. Green wire shall be used as the common ground wire from power source to all satellites. White shall be the common (neutral) wire. All wiring is to be NEC Code compliant.
 4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
 5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 50 mm (2-inches) below top of PVC mainline pipe.
 6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 200 – 250mm (8-10 inches) below the ground surface, directly over the wiring.
 7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer.
 8. Connect wire to power source.
- C. Control Wire:
1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 3 m (10-foot) intervals.
 2. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.
 3. Provide a 600 mm (24-inch) excess length of wire in an 200mm (8-inch) diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous runs of wiring. Do not tie wiring loop. Coil 600mm (24-inch) length of wire within each remote control valve box.
 4. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
 5. Install spare control and common wires as directed on plans.

6. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
 7. Unless noted on plans, install wire parallel with and below mainline pipe.
 8. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 150 mm (6-inches) above the wiring.
 9. Cap all exposed wire ends with wire nuts.
 10. Wiring from master controllers to satellites and stub-cuts for future extension shall be located in trench with new mains or in separate trench at back of curb, unless cross-country route is shown. Locate in trench with mains when possible on cross-country routes.
 11. Wiring bundles located with piping shall be set with top of the bundle below top of the pipe. No two wires in any bundle shall be of the same color. Wires shall be bundled, and tied or taped at 4.5 m (15 foot) intervals. A numbered tag shall be provided at each end of a wire, i.e., at valve, at field located controllers and at master controller. The number at each end of wire to be the same.
 12. Splicing shall be held to a minimum. A pullbox shall be provided at each splice. No splices 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. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.
- D. Instrumentation:
1. Install per manufacturer's recommendations 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.

3.9 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling, and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.

- B. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record locations of tracer wires and their terminations on project record documents.

3.10 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 - 1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 TEST AND FLUSHING

- A. Test irrigation system per procedures listed in section 1.10.
- B. Flushing: After testing, flush system per procedures listed in section 3.7. beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
- C. Operation Test: Upon completion of the final adjustment of the sprinkler heads to permanent level at ground surface, test each sprinkler section by the pan test and visual test to indicate a uniform distribution within any one sprinkler head area and over the entire area. Operate the entire installation to demonstrate the complete and successful operation of all equipment.

3.12 MAINTENANCE AND OPERATION INSTRUCTIONS

SPEC WRITER NOTES:

- 1. Adjust verbal instructional hours in following paragraph to suit the installation. Cemetery equals 16 hours, minimum.
 - 2. Modify the following paragraph to fully describe the requirements specific to this project. Add, modify, or delete items to be provided according to the site specific project. The results should be a clear requirement for a fully annotated, tabbed and indexed manual describing normal operations, troubleshooting, and emergency procedures, as well as start-up and shut-down procedures.
- A. Maintenance and Operating Instructions: Prior to final acceptance, provide verbal instructions, for a period of not less than ____ hours, to the 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 manual(s) as follows:

1. 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:
2. 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.
3. Manufacturer's Operation and Maintenance manuals.
4. Manufacturer's Technical Service Bulletins.
5. Manufacturer's Warranty Documentation.
6. Software License Information.
7. 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.
8. Predictive schedule for component replacement.
9. Listing of technical support contacts.
10. Operation and maintenance submittal package must be complete prior to being reviewed by the COTR. Incomplete submittals will be returned without review.

SPEC WRITER NOTES:

1. Adjust the following depending upon the control system provided and the computer equipment available at this facility.
2. Coordinate the following with the Project Manager before including in the specifications. If included modify to make clear exactly what is to be provided.
11. Provide video taping of the training for the equipment provided for the project.
Training shall be produced on DVD or CD, whichever is compatible with the computer system provided for the central computer, where applicable. Training shall be suitable for refresher by the previously trained employees, or for use by new employees to learn the system equipment. Coordinate the final training presentation with the A/E and R.E. in outline form prior to creation, to insure that the format and organization of the content is applicable for the facility staff utilization.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize the new irrigation system in accordance with local practices in the first fall after completion of construction of the irrigation system and start up in the spring after completion of construction. Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the cemetery landscape maintenance personnel.

3.14 TESTING, OPERATIONAL PERFORMANCE AND ACCEPTANCE

- A. Provide the testing as indicated in previous sections of the specifications.
- B. Demonstrate the operations of the systems as indicated in the project specifications.
- C. Acceptance shall be predicated upon a successful demonstration of the operation of the systems, as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

3.15 MAINTENANCE

- A. Operate and maintain the irrigation system for duration of 30 calendar days after Final Inspection. Make periodic examinations and adjustments to irrigation system components.

SPEC WRITER NOTES:

1. Modify the following according to the system installed at the specific project and adjust the designation for the equipment to match that submitted and approved for installation.
2. Adjust the list to include spare of all of the modular electronic equipment for the field satellites, if applicable, and provide at least two spare radio card assemblies for that type of system, if applicable.
3. Add any other equipment that should reasonably be included in the spare parts inventory for the irrigation equipment and systems installed for the project.

3.16 SPARE PARTS

- A. Upon completion of the work furnish the Owner the following for his maintenance stock.
 1. 10 - 570C - 6p sprinklers
 2. 5 - 570C - 12p sprinklers
 3. 5 - FB - 100 - pc Flood Bubbler Nozzles
 4. 2 - 300 - 03 Shrub Sprinkler Bodies
 5. 2 - wp300 - Shrub Sprinkler Bodies
 6. 15 m (50') - funny pipe
 7. 1 - 252 - 06 - 06 38mm (1 ½") valve

8. 5 – Super 700 Rotary Heads

3.16 CLEANUP

- A. Upon completion of work, remove from site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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SECTION 32 90 00 PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

This work consists of furnishing and installing all planting materials required for landscaping to restore area to be integrated into the cemetery landscape and to pre-project conditions for disturbed areas.

1.2 EQUIPMENT

Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

- A. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.
- B. Section 31 20 00, EARTHWORK.

1.4 SUBMITTALS

- A. Samples: Submit the following samples for approval before work is started:
 - Organic Mulch One five-gallon bucket with lid filled of each type to be used.
- B. A proposed Watering Schedule shall be submitted for approval thirty (30) days prior to installation of the plants. Schedule shall include the means and methods to achieve the requirements of the specifications.
- C. Certificates of Conformance or Compliance with the Specifications: Before delivery, certificates attesting that the following materials meet the requirements specified shall be submitted to the COTR for approval:

1.5 DELIVERY AND STORAGE

- A. Delivery:
 - 1. Notify the COTR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
 - 2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches.
 - 3. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.

1.6 PLANTING INSTALLATION SEASONS AND CONDITIONS

A. Perform planting operations within the following dates:

Containerized:	None specified
Balled & Burlapped:	November 15 to March 15
Bag Grown:	September 15 to April 15

1.7 PLANT ESTABLISHMENT PERIOD

A. The Establishment Period for plants shall begin immediately after installation, with the approval of the COTR, and continue until the date that the Government performs a final inspection. During the Plant Establishment Period the Contractor shall:

1. Water all plants as required according to the approved Watering Schedule to maintain an adequate supply of moisture within the root zone.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy wires, and eroded plant saucers as required.
7. Remove plants that die during this period and replace each plant with one of the same size and species.
8. The Contractor is responsible for theft or damage to plants until the final inspection.

1.8 PLANT GUARANTEE

A. All work shall be in accordance with the terms of the Paragraph, "Guaranty" of Section GENERAL CONDITIONS, including the following supplements:

B. A One Year Plant Guarantee will begin on the date that the Government performs the final inspection and issues a custody receipt. All plants must be living and in a healthy condition at the time of final inspection, exhibiting vigorous uniform growth, free of disease, insect infestation and physical damage.

C. The Government will re-inspect all plants at the end of the One Year Guarantee. The Contractor will replace any dead, missing, or defective plant material prior to this re-inspection. The Guarantee will end on the date of this re-inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:

1. Replace dead, missing or defective plant material prior to the re-inspection.
2. Mulch and weed plant beds and saucers.
3. From plants having been installed for one year, remove stakes, guy wires and any required tree wrappings.
4. Repair damage caused while making plant replacements.

PART 2 - PRODUCTS

2.1 GENERAL

All plant material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well-developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti-desiccant at the nursery before digging.
- C. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the COTR, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
- D. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
- E. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
- F. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- G. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the COTR authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

- H. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.3 LABELS

Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.7 PLANTING SOIL MIXTURE

The planting soil mixture shall be composed of one (1) part Organic Manure to seven (7) parts approved topsoil. Add bonemeal at 5 lbs. per cubic yard, and fertilizer as described.

2.8 PLANT FERTILIZER

- A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.
- B. For new plant material, provide packet, table, or pellet forms of slow release fertilizers bearing the manufacturer's guaranteed statement of analysis. Slow release fertilizers shall contain a minimum percentage by weight of sixteen percent (16%) total nitrogen (of which 30 to 50% is derived from controlled release sources), eight percent (8%) available phosphoric acid, and eight percent (8%) soluble potash.

2.16 STAKES AND GUYING WIRES

- A. Provide stakes, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be 2-1/2" to 3" diameter x 8-foot long and pointed at one end and a notch on the other to receive guying cable.
- B. Guying cable shall be, as a minimum, 12 gage, 2-strand twisted, pliable annealed galvanized steel cable.
- C. Hose chafing guards shall be new or used 2-ply reinforced rubber hose of all the same color on the project.
- D. Turnbuckles shall be galvanized or cadmium plated and 3-inch minimum lengthwise opening fitted with screw eyes.

2.18 WATER

The Contractor shall be responsible to furnish his own supply of water to the site at no extra cost. Water shall be free from impurities injurious to vegetation. Water shall not contain elements toxic to plant life.

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant material locations and bed outlines on project site for approval by the COTR before any plant pits or beds are dug. The COTR may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION FOR PLANTING

- A. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turf before excavations are made in a manner that will protect turf areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the COTR may select other locations for plant material.
- C. Dig plant pits to match planting details as shown on the drawings. When pits are dug with an auger and the sides of the pits become glazed, scarify the glazed surface. Size the plant pits as shown on the details.
- D. Where ground cover and planting beds occur in existing turf areas, remove turf to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.
- E. Where existing soil is to be used in place, till new ground cover and plant beds to a depth of 4 inches. Spread peat uniformly over the bed to depth of 2 inches and thoroughly incorporate it into the existing soil to a depth of 4 inches using a roto-tiller or similar type of equipment to obtain a uniform and well pulverized soil mix. During tillage operations, remove all sticks, stones, roots, and other objectionable materials. Bring plant beds to a smooth and even surface conforming to established grades.
- F. In areas of new grading where existing soil is being replaced for the construction of new ground cover and plant beds, remove 4 inches of existing soil and replace with topsoil. Plant beds shall be brought to a smooth and even surface conforming to established grades. Till 2 inches of peat into the topsoil as specified.
- H. Treat plant saucers, shrub, and ground cover bed areas, prior to mulching, with an approved pre-emergent herbicide. Plant ground cover in areas to receive erosion control material through the material after material is in place.

3.3 SETTING PLANTS

- A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root

system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery, collecting field, or container. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil. Add slow release packet, tablet or pellet fertilizer as each plant is installed as per manufacturer's recommendation for method of installation and quantity.

- B. Backfill balled and burlapped and container-grown plants with planting soil mixture as specified to approximately half the depth of the ball and then tamp and water. For balled and burlapped plants, carefully remove excess burlap and tying materials and fold back. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill Planting Soil Mixture; then form earth saucers or water basins around isolated plants with topsoil.

3.5 STAKING AND GUYING

- A. Stake and guy plants as specified.
- B. Remove stakes and guy wires after one year.

3.7 MULCHING PLANTS

- A. Mulch within 48 hours after planting and applying a pre-emergent herbicide. Do not mulch in ground cover areas that shall have organic material placed before planting.
 - B. Placing Organic Material: Spread shredded pine bark mulch of to a uniform minimum thickness as indicated on the drawings.
 - C. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.
- A. Watering Trees and Shrubs:
 - a. The Contractor shall deep water all trees and shrubs twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the COTR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.
 - b. Water application shall be applied at a rate that will provide moisture penetration throughout the entire root zone with a minimum of water run-off. Should soil conditions be encountered that are not conducive to water absorption, the Contractor shall take whatever corrective actions may be required to correct this condition, without additional cost to the Government.
 - c. If at any time during the Plant Establishment Period, adverse weather conditions (such as extended period with no rain or continuous drying winds) cause the plant zone to dry out, the COTR may direct the Contractor to deep water all trees and shrubs. Any supplemental watering is to be done immediately and at no additional cost to the Government.

3.18 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations, lay the material evenly and smoothly and in contact with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.
- B. For waterways, unroll the material in the direction of waterflow. When two or more strips are required to cover a ditch area, they shall overlap at least 4 inches. In case a strip is to be spliced lengthwise, the ends of the strips shall overlap at least 6 inches with the upgrade section on top.
- C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.
- D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 4 feet longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 1-foot intervals at the end. Firmly embed staples in the underlying soil.
- E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Guaranty Period.

3.19 RESTORATION AND CLEAN-UP

Where existing or new turf areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turf work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas is completed. Remove all debris, rubbish and excess material from the station.

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SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

Outside, underground footing underdrains for the pre-placed crypt fields. Underdrains shall be connected to solid drainage pipes that daylight, including end sections and slope protection. Crypt field underdrains shall daylight at outfall pipe connections, including end sections and slope protection. Storm sewer system work shall be installed complete, ready for operation, including all trench drains and required incidentals.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTHWORK.
- C. Concrete Work, Reinforcing, Placement and Finishing: CAST-IN-PLACE CONCRETE.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: 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. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23 SHOP DRAWINGS PRODUCT DATA AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Piping
 - 2. Trench Drains
 - 3. Jointing material
 - 4. Filter Fabric
 - 5. Cleanouts

5. Stone
6. End sections and slope protection

PART 2 - PRODUCTS

2.1 PIPING

A. Gravity Lines (Pipe and Appurtenances):

1. High Density Polyethylene (HDPE):

- a. Smooth Wall PE Pipe: Shall comply with ASTM A714, DR 21 for pipes 3 to 24 inches and SDR 26 for pipes 26 to 48 inches. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
- b. Corrugated PE Pipe: Shall comply with AASHTO M294,

Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Minimum Moment of Inertia in ⁴ /in
12 in	1.50 in ² /ft	.024
15 in	1.91 in ² /ft	.053
18 in	2.34 in ² /ft	.062
24 in	3.14 in ² /ft	.116
30 in	3.92 in ² /ft	.163
36 in	4.50 in ² /ft	.222
42 in	4.69 in ² /ft	.543
48 in	5.15 in ² /ft	.543
54 in	5.67 in ² /ft	.800
60 in	6.45 in ² /ft	.800

- c. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia in ⁴ /in
18 in	2.96 in ² /ft	.052

d. Corrugated PE Drainage Tubing: AASHTO M252 with the following exceptions:

6.7.1 and 6.7.2. The average elongation shall be 7.5 percent or less. 11.1 The manufacturer's certification and the report of the test results shall be furnished.

2.2 TRENCH DRAINS

A. Trench Drain:

1. Polycast 600, Zurn Z817-12, ACO Drain 620, or approved equal.

2.3 JOINTING MATERIAL

A. Concrete Pipe: Rubber gasket ASTM C443.

B. Polyvinyl Chloride (PVC) Pipe:

1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

C. PE Plastic Pipe:

1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
2. Corrugated PE Plastic Pipe: Watertight 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-16, Division II, for soil tightness and shall be as recommended by the manufacturer.
3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.

2.3 FLARED END SECTIONS

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.4 WARNING TAPE

- A. For under pavements, warning tape shall be standard, 4-Mil polyethylene 3-inch wide tape non-detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW."
- B. In areas not under pavements, warning tape shall meet all parts of the specification above, except it shall be detectable.

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS, UNDERDRAINS AND DRAINAGE STRUCTURES

Excavation of trenches and for appurtenances and backfilling for storm drains shall be in accordance with the applicable portions of Section 31 20 00, "Earthwork".

3.2 PIPE BEDDING

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 with the lowest one-fourth 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 be conform to ASTM A798.

3.3 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow storm drain shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. 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.
- E. 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.
- F. 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.
- G. Do not lay storm drain pipe in same trench with another pipe or other utility.
- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:

1. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with gasket joints.

J. Warning tape shall be continuously placed 12 inches above storm sewer piping.

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, the Contractor shall 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.
- C. The Contractor shall comply with all ILDOT confined space requirements when working within existing structures.

INSPECTION OF SEWERS

Inspect and obtain the COTR's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of storm drain is prohibited.

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