SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Use of premises.
6. Owner's occupancy requirements.
7. Specification formats and conventions.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: **Dorton Park**

1. Project Location: 5650 Poplar Tent Road, Concord NC 28027

B. Owner: **City of Concord, NC**
Owner's Representative: **Rick Blat, Deputy City Engineer**

The work of this contract includes but is not limited to, construction of a restroom building, restroom renovation, picnic shelter renovation, playground graded pad, disc golf course, soccer field, stream restoration, pedestrian bridges, concrete sidewalks, parking lot extension, asphalt trails, gravel trails, tennis court resurfacing, fencing, sports netting all with the associated grading, stormwater infrastructure, utilities, erosion control, and plantings at Dorton Park.

1. Contractor shall furnish all material, labor, tools, supplies, equipment, transportation, temporary construction of every nature, insurance, taxes, contributions and all services and facilities, unless specifically excepted, and install all materials, items and equipment required to complete the construction of the Project, as set forth in the Contract.
2. Coordination of owner provided and owner installed equipment. General Contractor shall coordinate all trades with owner’s contractor for these items.
3. The General Contractor shall act as the Project Expediter and be responsible for coordinating the work and schedules of other trades.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK PHASES

1. The Work shall be conducted in one phase. Work of this phase shall be substantially complete and ready for certification of completion within **12 months (365 days)** after the notice to proceed

1.6 USE OF PREMISES

A. All construction activities shall be coordinated with the Town of Davidson.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to all fill and cut areas associated with the project and generally 10 feet outside of this for constructability.
2. Driveways and Entrances: Keep all construction access and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012500 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. The bidding contractor shall provide unit prices for the following items. Unit prices are subject to owner review and consideration as part of the overall bid. All unit prices shall remain firm through the initial contract period.

B. Price decreases are acceptable at any time, need not be verifiable, and are required should the contractor/producer/processor/manufacturer experience a decrease in costs associated with the execution of the contract.

C. All unit prices are to be fully inclusive of all expenses including travel, materials and all fees and be the final cost to the owner

D. Should the awarded vendor, at any time during the life of the contract, sell materials of similar quality to another customer, or advertise special discounts or sales, at a price below those quoted within the contract, the lowest discounted prices shall be offered to the owner

E. Measurement and Payment: See individual Specification Sections for work that requires

establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

F. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

G. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1

Description: UP-1 – Base bid to anticipate removal and replacement in-kind of 350sqft of 2x6 southern yellow pine #1 t&g roof deck for the 3 shelters. contractor to provide square foot unit cost for removal and replacement of 2x6 southern yellow pine #1 t&g roof deck beyond 350sqft. base bid amount

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, necessary equipment and services to complete the Alternates work, as indicated on the drawings, as specified herein or both. Contractors are responsible for payment of all applicable fees and taxes in association with their contract.

1.2 USE OF ALTERNATES

A. Submit alternate/base bid proposals as described herein and in the "Bid Form" stating the total difference in cost to the stipulated Lump Sum Bid for adding or deducting the following alternates to that specified and/or shown on the drawings.

1. Include all applicable omissions, additions, and adjustments of all other applicable trades as required.

PART 2 - PRODUCTS

2.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Provide extended parking lot and all associated features.

B. Alternate No. 2: Provide tennis court resurfacing, striping and repair.

END OF SECTION 012300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities

B. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

C. Temporary utilities include, but are not limited to, the following:

1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service.
7. Lighting.
8. Telephone service.

D. Support facilities include, but are not limited to, the following:

1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Project identification and temporary signs.
4. Waste disposal facilities.
5. Field offices as required.
6. Storage and fabrication sheds.
7. Lifts and hoists.
8. Temporary elevator usage.
9. Temporary stairs.
10. Construction aids and miscellaneous services and facilities.

E. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.

6. Security enclosure and lockup.
7. Barricades, warning signs, and lights.
8. Temporary enclosures.
9. Temporary partitions.
10. Fire protection.

F. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
2. Division 1, of the Technical Specifications Section "Execution Requirements" for progress cleaning requirements.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Consultant, permanent or temporary roofing is complete, insulated, and weather tight; exterior walls are insulated and weather tight; and all openings are closed with permanent construction or substantial temporary enclosures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Consultant and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Owner's construction forces.
2. Consultant.
3. Testing agencies.
4. Personnel of authorities having jurisdiction.
5. Occupants of Project

B. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Project site.

C. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.

D. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

E. Communications: Pay all charge associated with communications.

F. Streets, Sidewalks, and Temporary Easements: Pay all charges associated with the Work where charges will occur.

1.5 SUBMITTALS

A. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.6 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.

1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if indicated on the plans and/or specifications. Provide materials suitable for use intended.

B. Chain-Link Fencing: Minimum 2-inch , 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts**,** with 1-5/8-inch- OD top rails.

C. Portable Chain-Link Fencing: Minimum 2-inch 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.

D. Water: Potable.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated or Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure and the requirements of the local Governing agency.

D. Self-Contained Toilet Units: Single-occupant units of chemical or aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

F. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

G. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

H. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. If existing easements can not be used, the Contractor shall consult and coordinate with the Consultant and Owner to secure as necessary to obtain the temporary easement. Add provisions for work not in the Contract but served by temporary facilities if required.

B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
2. Connect temporary sewers to municipal system or private system indicated as directed by sewer department officials.
3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Subparagraph below may be excessive for small- and medium-size projects.

3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations as required. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
4. Drinking-Water Facilities: Provide drinking-water.

E. Heating and Cooling: Provide temporary heating and cooling as required by construction activities.

F. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear as required.

G. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities.

1. At each telephone, post a list of important telephone numbers in Spanish and English.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Consultant's office.
e. Engineers' offices.
f. Owner Representative’s office.
g. Principal subcontractors' field and home offices.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: If required, Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Maintain support facilities until approved by the Consultant to be removed.

B. Temporary Roads and Paved Areas: If applicable/as needed, construct and maintain temporary roads and paved areas to avoid damage to the site. Locate temporary roads and paved areas in same location as permanent roads and paved areas. If applicable, extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

D. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs. The General Contractor shall provide one construction sign. The construction sign shall be installed within the first two weeks of construction and shall be removed when the project is substantially complete. The sign shall be as follows:

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with “Construction and Demolition Waste Management Recycling.

F. Common-Use Field Office: If required, provide an insulated, weather tight, air-conditioned and heated field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings.

G. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Storm water Control: Comply as indicated on the erosion control plan/measures before any earth disturbing activities start.

C. Tree and Plant Protection: Comply with the plans and specifications for protection.

D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather tight enclosure for building exterior.

G. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

H. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

B. Temporary Facility Changeover: Except for using permanent fire protection as soon as available. Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1, of the Technical Specifications Section "Closeout Procedures."

END OF SECTION 015000

SECTION 017000 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Progress cleaning.
4. Starting and adjusting.
5. Protection of installed construction.
6. Correction of the Work.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1, of the Technical Specifications Section "Submittal Procedures" for submitting surveys.
3. Division 1, of the Technical Specifications Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 1, of the Technical Specifications Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
5. Division 1, of the Technical Specifications Section “Construction Waste Management” method of disposal of construction waste.

1.3 SUBMITTALS

A. Qualification Data: For land surveyor to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Consultants and owners, and other information specified.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer as required.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A licensed professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility, Owner, and Consultant that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Consultant, Owner, adjacent property owners not less than **two** days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Consultant's and Owner's written permission.

C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Consultant. Include a detailed description of problem encountered, together with recommendations for modifications of the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Consultant promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Consultant when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
7. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
8. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
9. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Consultant.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Consultant. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Consultant before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations. Dispose of material accordance to Division 1, Section “Construction Waste Management”.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean surfaces and similar features before applying paint or other finishing materials.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration until Substantial Completion.

J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017000

SECTION 017310 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Divisions 2 through 16, of the Technical Specifications Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

    a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or those results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.

3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specified firm.

a. Processed concrete finishes.
b. Stonework and stone masonry.
c. Ornamental metal.
d. Roofing.
e. HVAC enclosures, cabinets, or covers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of the Technical Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of the Technical Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and

wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

END OF SECTION 017310

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project As-Builts Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1, of the Technical Specifications Section "Construction Progress Documentation" for submitting Final Completion construction photographs and negatives.
3. Division 1, of the Technical Specifications Section “Construction Waste Management” method of disposal of construction waste.
4. Division 1, of the Technical Specifications Section "Execution Requirements" for progress cleaning of Project site.
5. Division 1, of the Technical Specifications Section “Project Record Documents”.
6. Division 1, of the Technical Specifications Section “Operation and Maintenance Data”.
7. Divisions 2 through 16, of the Technical Specifications Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: The Contractor shall, before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, “As-Builts” drawings operation and maintenance manuals, Final Completion construction photographs and photographic negatives if required, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Consultant will either proceed with inspection or notify Contractor of unfulfilled requirements. Consultant will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Consultant, that must be completed or corrected before certificate will be issued. The Consultant’s Substantial Completion list is composed by verification of the punch list submitted by the Contractor and any additional defects in the work observed by the Consultant.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1, of the Technical Specifications Section "Payment Procedures."
2. Submit certified copy of Consultant's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Consultant. The certified

copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes if required.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Consultant will either proceed with inspection or notify Contractor of unfulfilled requirements. Consultant will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. The Contactor shall take immediate steps to correct the stated deficiencies, and send a written notice to the Consultant, certifying the Project is complete, at which time the Consultant will re-inspect the Work. This review and additional reviews by the Consultant where the Work is not considered Substantial Completion or Final Completion will be considered an additional service from the Consultant. The Contractor will be charged for these additional services incurred by such failure including travel time, observation time, and administrative time at the Consultant's hourly rate, as well as all expenses associated with the distribution of a written notice stating the reasons for failure to reach final completion.

3. In the event the Contractor is granted Substantial Completion by the Consultant and the Contractor fails to complete and/or correct all of the items listed in the Substantial Completion within **30** calendar days of the date of Substantial Completion, the liquated damages shall start to accrued until all of the items on the Substantial Completion list are completed and/or corrected and have been approved by the Consultant.

4. If the Consultant is required to make more than two inspections for the project to achieve Substantial Completion, the Contractor shall pay for the Consultant's time and expensive.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, use the room number as indicated on the drawings and on the exterior areas include a location diagram indicating the defects.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Consultant.
d. Name of Contractor.
e. Page number.

1.6 PROJECT RECORD DOCUMENTS

A. The Contractor shall provide Project Record Documents, O&M, “As-Builts” Drawings, and Warrantees as indicated in Division 1, of the Technical Specifications Section Project Record Documents. Use Division 1, of the Technical Specifications Section "Project Record Documents".

1.7 OPERATION AND MAINTENANCE MANUALS

A. See Section “Operation and Maintenance Manuals” for additional Information.

1.8 **WARRANTIES**

A. Submittal Time: Submit written warranties on request of Consultant for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Provide copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Replace parts subject to unusual operating conditions.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
q. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017810 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. As-Built Drawings in Auto CAD.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications, Section "Closeout Procedures" for general closeout procedures.
2. Division 1, of the Technical Specifications, Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 2 through 16, of the Technical Specifications, Sections for specific requirements for Project Record Documents of products in those Sections.

1.3 SUBMITTALS

A. As-Built Drawings: Comply with the following:

1. Number of Copies: Submit two sets of marked-up As-Built Drawings to the Consultant for the Consultant to prepare the Record Drawings.

B. Record Specifications: Submit two copies of Project's marked up Specifications, including addenda and contract modifications.

C. Record Product Data: Submit two copies of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-Built Drawings.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Consultant's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.
    o. Clarification Drawings.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
7. Identify and date each As-Builts Drawing; include the designation "PROJECT AS-BUILTS DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

B. Newly Prepared As-Built Drawings: Prepare new Drawings instead of preparing As-Built Drawings where Consultant determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting a substitution or other modification.
2. Consult with Consultant for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared As-Built Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of the manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, As-Built Drawings, and Product Data where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, As-Built Drawings, and Product Data where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other of the Technical Specifications Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Consultant's reference during normal working hours.

END OF SECTION 017810

SECTION 017820 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Operation and Maintenance manuals for the care and maintenance systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1, of the Technical Specifications Section “Construction Waste Management” method of disposal of construction waste.
3. Division 1, of the Technical Specifications Section "Closeout Procedures" for submitting operation and maintenance manuals.
4. Divisions 2 through 50, of the Technical Specifications Sections for specific operation and maintenance manual requirements for products in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Final Submittal: Submit four copies of each manual in final form at least 15 days before final inspection. Consultant will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Consultant's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Consultant's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation include information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Operations and Maintenance Manuals shall be organized in CSI format.

B. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

C. List of Systems and Subsystems: List systems alphabetically.

D. List of Equipment: List equipment for each system, organized alphabetically by system.

E. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

F. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents.

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page to Include the following information:

1. Name and address of Project.
2. Name and address of Owner.
3. Date of submittal.
4. Name, address, and telephone number of Contractor and Subcontractors.
5. Name and address of Consultant.
6. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, model number, and serial number indexed to the content of the volume, and cross-referenced to of the Technical Specifications Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

Provide both hard copy and digital PDF copy.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with reinforced tabs for each section. Mark each tab to indicate contents.
3. If provided with the equipment, provide a Protective Plastic Sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch, white bond paper.
5. Drawings: Attach reinforced, punched on drawings and bind in manual with associated text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION AND MAINTENANCE MANUALS

A. Content: In addition to requirements in this section, include operation and maintenance data required in individual specification sections include including source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list & source information, maintenance service contracts, warranty, and bond information and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. Re-ordering information for parts.
11. Standard printed maintenance instructions and bulletins.
12. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
13. Identification and nomenclature of parts and components.
14. List of items recommended to be stocked as spare parts.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Routine and normal operating instructions.
3. Regulation and control procedures.
4. Instructions on stopping.
5. Normal shutdown instructions.
6. Seasonal and weekend operating instructions.
7. Required sequences for electric or electronic systems.
8. Special operating instructions and procedures.

D. Warranties and Bonds: Include copies of warranties and bonds for each piece of equipment and lists of circumstances and conditions that would affect validity of warranties or bonds. Also, include the Contractor’s Warranty for the project.

1. Include procedures required for notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

END OF SECTION 017820

SECTION 018200 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all Divisions of the Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 1, of the Technical Specifications Section "Project Management and Coordination" for requirements for pre-instruction conferences.
2. Division 1, of the Technical Specifications Section "Photographic Documentation" for preparing and submitting demonstration and training videotapes.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Consultant.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment.

1. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

2. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

3. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.

d. Economy and efficiency adjustments.

4. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

5. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times.

1. Schedule training with Owner, through Consultant**,** with at least seven days' advance notice.

C. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 018200

SECTION 023200 – GEOTECHNICAL INVESTIGATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This bid documents includes the following geotechnical report prepared by as an appendix to the Project Manual:

1. Subsurface Exploration report prepared by ECS Southeast, LLP

Geotechnical Engineering Report

Dorton Park

Concord, Cabarrus County, North Carolina

ECS Project No. 08:15441

March 15, 2023

1.2 REPORT AND ANALYSIS

A. All reports are made part of this section enabling the Contractor and all parties in the construction to have the same information available to the Owner and Consultants regarding the subsurface conditions.

B. This information shall not be a substitute for the Contractor's personal investigation or judgment of actual conditions found on site. If the Contractor requires additional subsurface information, it may be obtained at the Contractor's expense with Owner's approval.

C. Variations

1. The nature of variations may not become evident until construction begins. Should subsurface conditions differ significantly from the information in the reports included at the end of this section, the Contractor shall immediately notify the Engineer verbally, followed by a written notification.
2. No charge in the Contract Time or Contract Sum will be considered without an executed Change Order.

D. Regardless of the thoroughness of the geotechnical explorations, possibilities exist that subsurface conditions will differ from those at the boring locations or will not be as anticipated

by the design professionals. Therefore, the Owner and the Consulting Engineers assume no responsibility for the accuracy of the information in the geotechnical reports and shall be held harmless for any claims by the Contractor, or others, because of errors in the reports.

END OF SECTION 023200

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following storm water related structures:

1. Outlet structure anti-flotation blocks.
2. Pipe cradles.
3. Pipe collars.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.

7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Mockups: Cast concrete wall panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

1. Build panel approximately 15 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, deformed.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or F.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M[and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products:

a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
b. Concrete Sealants Inc.; Conseal CS-231.
c. Greenstreak; Swellstop.
d. Henry Company, Sealants Division; Hydro-Flex.
e. JP Specialties, Inc.; Earthshield Type 20.
f. Progress Unlimited, Inc.; Superstop.
g. TCMiraDRI; Mirastop.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:

a. Burke by Edoco; Cureseal 1315 WB.
b. ChemMasters; Polyseal WB.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
d. Euclid Chemical Company (The); Super Diamond Clear VOX.
e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
f. Lambert Corporation; UV Safe Seal.
g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
h. Meadows, W. R., Inc.; Vocomp-30.
i. Metalcrete Industries; Metcure 30.

j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
k. Tamms Industries, Inc.; LusterSeal WB 300.
l. Unitex; Hydro Seal 25.
m. US Mix Products Company; US Spec Radiance UV-25.
n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 3600 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent, for concrete exposed to weather.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. All concrete: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3600 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch 3/4-inch nominal maximum aggregate size.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M **and ASTM C 1116**, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces permanently concealed.
3. Class D, 1 inch for rough-formed finished surfaces permanently concealed.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.6 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other

requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

END OF SECTION 033000

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees and grass remain.
2. Removing existing trees and grass as noted
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place removing site utilities.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for temporary construction and support facilities, and temporary erosion and sedimentation control procedures.
2. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
3. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
4. Division 23 Section "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

A. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Engineer.

3.4 UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted and then only after arranging to provide temporary utility services according to requirements indicated:

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Earth Moving: The extent of earth moving is indicated on the drawings. The work, in general, includes the following:

1. Preparation of subgrade for dam embankment, riser structure, headwall, and spillway.
2. Controlling surface water and groundwater.
3. Excavation of cut-off trench for embankment.
4. Fill placement and compaction for dam embankment.
5. Installation of drains.
6. Rough and finish grading of slopes.
7. Furnishing Unit Prices for additional earthwork.

B. Related Sections include the following:

1. Division 01 Section Construction Progress Documentation for recording pre-excavation and earthwork progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
3. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
5. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for dam embankment.

C. Excavation Definition: “Excavation” consists of removal of all material encountered to required subgrade elevations indicated and subsequent disposal of all materials removed.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Excavation: Removal of all material encountered to required subgrade elevations indicated and subsequent disposal of all materials removed.

C. Fill: Soil materials used to raise existing grades.

D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Washed stone (No. 67)
2. Filtration geotextile

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

A. Inspections, Laboratory, and Field-Testing Services:

1. Geotechnical Engineer: The owner will engage a Geotechnical Engineer for soil inspections, laboratory testing, and field-testing services for quality control testing during earthwork operations and foundation construction.
2. Test classification and compaction of soils. Tests will be performed at the following locations and frequencies:

    a. Dam Embankment and Key: Perform one test per compacted lift, per 2,000 square feet or less of embankment area, per day, but in no case fewer than three tests.
    b. Perform Gradation, Atterberg Limits, and Triaxial Shear testing as required to verify the intent of the Subsurface Exploration Report in accordance with ASTM D-422 and D-4318 and D-4767.

3. Allow Geotechnical Engineer to inspect and test subgrade and each fill or backfill layer: Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
4. When subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing performed to determine compliance of corrected work with specified requirements shall be at Contractor’s expense.

D. Preinstallation Conference:

1. Before commencing dam embankment earthwork or construction, meet with representatives of governing authorities, Owner, Architect/Engineer, Civil Engineer, Geotechnical Engineer, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

E. Codes and Standards: Perform excavation work in compliance with all applicable requirements of governing authorities having jurisdiction.

F. Depth of Bearing Strata: It is to be understood that site soil conditions are variable across the site. Headwall foundation design dimensions and bearing elevations shown are minimums. The design of the footings is based on the assumed strata bearing capacity at the elevation shown on the drawings and as indicated in the General Notes. If the indicated depth of footing excavation is reached without developing the required strata bearing capacity, the Geotechnical Engineer will immediately advise the contractor for additional excavation to reach the required bearing elevation for each individual footing. Revisions will be paid for in accordance with the Contract condition relative to changes in the Work.

1.6 PROJECT CONDITIONS

A. Site Information:

1. The Contractor, by careful examination, shall inform himself as to the nature and location of the Work; the conformation of the ground, the nature of subsurface conditions; the locations of the groundwater table; the character, quality, and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can be in any way affect the Work.
2. The Contractor shall examine the site, available drawings, records of existing utilities and construction, record of test borings, and the subsurface exploration reports and the soil and rock samples to determine conditions under which the Work will be performed.
3. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be held responsible for interpretations or conclusions drawn by the Contractor. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

C. Existing Utilities:

1. Locate all existing underground utilizes in areas of work before proceeding. Provide adequate support and protection during earthwork operations of utilizes that are to remain in place. Demolish existing utilities as indicated and completely remove from the project site. Coordinate with utility companies, or governing entity, for proper shut-off of services for active lines.

2. If any active utility not indicated in the drawings is encountered, notify the Engineer and protect from damage until instructions for proper disposition of the utility are given by the Engineer. Perform the requested work in compliance with the rules and regulations of authority having jurisdiction.
3. Repair active utilities schedule to remain that are damaged by earthwork operations to the satisfaction of the utility owner.
4. If any inactive utility not indicated on the drawings is encountered, remove, plug, or cap as directed by the Engineer. Obtain any necessary data relative to proposed abandonment of existing utility service from authority having jurisdiction.
5. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by the Construction Manager and then only after acceptable temporary utility services have been provided. Provide minimum of 48-hour notice to Construction Manager, and receive written notice to proceed before interrupting any utility.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils: ASTM D 2487 Soil Classification Groups SM, ML, SC, and CL, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

B. Unsatisfactory Soils: Soil Classification Groups MH, CH, GW, GP, GM, GC, SW, SP, OL, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

C. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below topsoil or alluvium.

D. Approved Fill Material: All soil materials used for the project shall be approved by the Geotechnical Engineer prior to hauling and placement. Soil materials used for fill or backfill shall be retested and reapproved each time the source or properties of the material changes. The Select Granular Fill should be compacted to no more than 95 percent of the soil's standard Proctor maximum dry unit weight (ASTM D698). Select Granular Fill should be free from ice and snow, roots, sod, rubbish, debris, or other deleterious or organic matter. It should consist of durable, hard, non-carbonaceous soil particles conforming to the following requirements:

Table 3 – Select Granular Fill (k-min = 1.4 in/hr)

U.S. Seive Size	% Passing No. 200 Sieve)
2-in.	100
½-in.	100
No. 4	85-100
No. 10	70-100
No. 20	0-100
No. 40	0-95
No. 60	0-75
No. 100	0-40
No. 200	0-12

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Remove all existing trash, rubbish, debris, trees, roots, stumps, underbrush, shrubs, plants, and other vegetation from within the mass embankment limits.

3.2 PREPARATION

A. Survey Work, Grades, and Elevations:

1. Survey Work: Lay out dam centerline and headwall foundations after clearing but before excavation. Record actual measurements centerline location, deviation from specified tolerances, and all other pertinent data as required.
2. Grades and Elevations: Finished grades indicated by spot elevations and normal contour line elevations denote finished top surface elevations. Report conflicts, errors and inconsistencies in grades and elevations to the Engineer for resolution. Do not proceed with the work in questionable areas until conflicts are resolved by the Engineer.

3. Maintain all benchmarks and other reference points.
4. Set required lines and levels as required to accurately perform the excavation work.

B. Protection of Work:

1. Protect the surface of the embankment fill during construction by sealing off with a smooth drum roller prior to prolonged delay such as the end of the work week or before a forecasted storm. Scarify the smooth surface before placing the next lift.
2. Protect any existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
3. Protect and maintain erosion and sedimentation controls during earth moving operations.
4. Protect subgrades soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
5. Do not commence earth moving operations until temporary erosion and sedimentation control measures in place.
6. Do not commence earth moving operations until plant protection measures are in place.
7. The following practices are prohibited within protection zones:

    a. Storage of construction materials, debris, or excavated material.
    b. Parking vehicles or equipment.
    c. Erection of sheds or structures.
    d. Impoundment of water.
    e. Excavation or other digging unless otherwise indicated.
    f. Attachment of signs or wrapping materials around trees or plants unless otherwise indicated.

8. Do not direct vehicle or equipment exhaust towards protection zones.
9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

3.3 DEWATERING

A. Excavations should be kept dry at all times by means of cofferdams, trenches, sumps, pumps, and whatever equipment or arrangements are required.

B. Prevent surface water and subsurface or groundwater from flowing into excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation and/or subsurface seepage.

D. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavation as temporary drainage ditches. Do not use excavated trenches as temporary drainage ditches.

3.4 EXCAVATION, GENERAL

A. Excavation shall be unclassified and shall comprise and include the satisfactory removal and disposal of all materials encountered regardless of the nature of the materials and shall be understood to potentially include rock, boulders, fill and debris.

B. All excavation shall extend to the depths of the form and size required for the installation of the work as indicated on the Drawings. When excavations have reached the required depths, the Geotechnical Engineer shall make an inspection of the conditions.

C. Materials that in the opinion of the Geotechnical Engineer are not suitable for fill, any surplus earth, and rock shall be removed from the site and legally disposed of off-site.

D. The bottom of excavations shall be leveled off and graded to receive new compacted fill, outlet pipes, intake structure, etc.

E. Excavations made below the elevations shown or specified, unless authorized, shall be filled and compacted as hereinafter specified, at no additional cost.

3.5 EXCAVATION FOR STRUCTURE FOUNDATIONS

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

B. Subgrades shall be approved by the Geotechnical Engineer before proceeding with fill placement or installation of any structure or piping.

C. The top 12 inches of subgrade resulting from excavation shall be free of unsuitable material (fill, organics, debris, etc.) as judged by the Geotechnical Engineer.

D. Cut areas shall be excavated and graded to subgrade elevation per the Contract Drawings. The subgrade should be proof rolled with 10-ton roller compactor (vibration mode off). Any soft or wet areas, areas exhibiting pumping or areas that are otherwise unsuitable soils, as deemed by the Geotechnical Engineer, shall be removed and replaced.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Trenches for underground piping, where necessary, shall be excavated to the required depth and bell holes shall be provided where necessary to insure uniform bearing. Trench excavation lines shall provide sufficient clearance for proper execution of underground work.

B. Trenches shall be by open cut from the surface. No tunneling will be allowed. Irregularities at bottom of trench, or where excavation is below required depth, shall be refilled to required grade with compacted soil.

C. Where trenches are in wet or soft ground that in the opinion of the Geotechnical Engineer is unsuitable for supporting the pipe, concrete cradles or approved equivalent, shall be installed as directed by the Engineer.

D. Where necessary and per OSHA standards, the sides of trenches and excavations shall be properly sloped or supported by adequate sheeting and bracing to insure proper construction and safety of the workers. The Contractor will be held responsible for the sufficiency of sheeting and bracing and for all damages to property or injury to persons resulting from improper quality, strength, placing, maintaining and removing of same.

E. Backfill trenches with suitable fill. Scarify sides of excavation to facilitate bonding of soil. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Geotechnical Engineer or other authorized Owner's representative. Use care in backfilling to avoid damage or displacement of pipe system.

F. Immediately after piping has been installed, tested, inspected, and accepted, piping shall be filled around with special care to solidly fill voids without causing injury to piping. Up to 2 feet above, 4-inch layers shall be hand filled. For remainder of trench, 12-inch layers shall be filled in. Each layer shall be tamped before placing next layer. No stones larger than 2 inches in diameter shall be allowed in fill up to 2 feet above pipe and no stones larger than 4 inches in diameter shall be allowed in fill above. Backfill shall be in such a manner so as to prevent future settlement.

G. Existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor, at own expense.

H. As backfilling proceeds, all sheeting and shoring shall be removed in such a manner as to prevent the sides of the excavation from caving in or cracking. No backfilling of utility lines shall be done until any testing and inspection of the system or portion of the system has been completed and accepted.

I. Unless otherwise shown or specified, make trenches for piping and utilities not less than 16 inches no more than 24 inches wider than the outside width of the piping or utilities. Accurately grade bottoms of trenches with bell holes scooped out to provide uniform bearing and support of pipe and utilities on undisturbed soil throughout its entire length, except where other means of supporting pipe are indicated.

3.7 PLACING AND BACKFILL

A. General: Place fill or backfill on subgrades free of mud, frost, snow, or ice. It is to be understood that some selective reconnaissance and excavation will be required to obtain Embankment Fill Material.

B. Place Embankment Fill material in compacted, uniform, continuous layers. The more fine grained soils shall be placed in the central portion of the dam and in the cut-off trench areas.

C. Ground surface preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to fill placement. Plow, strip, or break-up slope

surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

D. Grading:

1. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
2. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within plus or minus 1 inch.
3. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

3.8 COMPACTION

A. General: Control all soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below. Place backfill and fill materials in layers not more than 8.0 inches in loose depth for material compacted by heavy compaction equipment, and not more than 3.0 inches in loose depth for material compacted by hand-operated compaction equipment.

B. Density Requirements: Compact fill to not less than the following percentages of maximum density for soils in accordance with [**ASTM D 698**]:

1. Embankment: Compact each lift of fill material to at least 95% of the material's maximum dry density while maintaining the soil moisture content within 2% below to 3% above optimum moisture content.

C. Moisture Control:

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, apply water as needed.
2. Remove and replace, or scarify and air dry, soil material that is too wet to compact to specified unit weight.
3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing or harrowing.

3.9 DRAINS

A. Construct subsurface drainage during grading operations at locations and dimensions shown on the approved drawings.

3.10 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. The Geotechnical Engineer shall review all laboratory test results and submit reports specified in this Section. Geotechnical Engineer will also observe, in the field, all earthwork related operations.

C. The Geotechnical Engineer will interpret the tests, state in each report whether or not the test specimens comply with all requirements of the Contract Documents and note any deviations therefrom.

D. The Geotechnical Engineer will identify when and where samples are to be obtained. Contractor shall collect samples and forward them to the Testing Laboratory for testing. As necessary, the Geotechnical Engineer will submit the following laboratory test reports on each type of borrow and fill material:

1. Gradation Analysis – ASTM D 422.
2. Atterberg Limits – ASTM D 4318.
3. Standard Moisture-Density Relationship – ASTM D 698.

E. The Geotechnical Engineer will determine the conformance of material to be used for fills.

F. Field Testing of Fill Areas: Prepared fill lifts will be tested and approved by the Geotechnical Engineer before construction of any further work thereon. Inspection and test of subgrades and fill layers will be taken as follows:

1. For each compacted fill layer, make a minimum of 2 field density tests for every lift. Perform field density tests in accordance with ASTM D 1556 or D 6938. Each lift shall meet the compaction requirement of Part 3.8 of this Section.

G. Footing Subgrades: Geotechnical Engineer shall inspect bearing surfaces and monitor proof rolling operations at foundation subgrade locations.

H. Contractor shall cooperate with Geotechnical Engineer in the performance of the required tests and inspections.

I. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained. Additional compaction and testing shall be at the expense of the Contractor.

3.12 MAINTENANCE

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. Scarify surface, reshape, and compact to required density prior to further construction.

C. Where settling is measurable or observable at excavated areas, add backfill material and compact. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Contractor. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Sections:

1. Division 01 Section Construction Progress Documentation for recording preexisting conditions and dewatering system progress.
2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
3. Division 33 Section "Subdrainage" for permanent dam embankment drainage.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:

a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
b. Geotechnical report.
c. Proposed site clearing and excavations.

1.5 PROJECT CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is included in the bid documents

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent structures and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if any damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 01 Section "Temporary Facilities and Controls Division 31 Section Site Clearing during dewatering operations.

3.2 INSTALLATION

A. Contractor shall furnish, install, operate, and maintain any pumping equipment, etc. needed for removal of water from various parts of the stormwater facility.

B. Contractor shall coordinate with Geotechnical Engineer as needed.

3.3 FIELD QUALITY CONTROL

A. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 312319

SECTION 31 25 00 – EROSION CONTROL

PART 1 - GENERAL

1.1 INTENT

A. The main concern associated with erosion on a construction site is the movement of soil off the site and its impact on water quality. It is the Owner's intent that the Contractor install and maintain sufficient erosion control practices to retain sediment within the boundaries of the site in addition to complying with regulatory authorities having jurisdiction and local erosion and sedimentation control laws and ordinances. All erosion control methods and devices used shall conform to the latest requirements imposed by federal, state, and local authorities. The Contractor shall be responsible for repair of any damage caused and shall be financially responsible for any penalties imposed.

B. If an erosion control drawing has been included in the drawings prepared by the landscape architect/engineer, it shall be the Contractor's responsibility to review the drawing prior to implementation. If an erosion control drawing is not included in the project documents, the Contractor shall submit, for approval, a proposed sequence of operations and a compatible method of preventing erosion.

1.2 SUMMARY

A. Work under this section shall include but not be limited to, installation and maintenance of both temporary and permanent soil erosion control measures, slope protection and stabilization measures, protection of all surface water and property both on and off site. This work shall include all labor, materials, and equipment necessary to meet all applicable requirements and as specified in the contract documents.

1.3 REFERENCE STANDARDS

A. All applicable standards and requirements of all regulatory authorities having jurisdiction, including local soil conservation agencies

1.4 QUALITY ASSURANCE

A. Soil erosion and sediment control measures shall be implemented in accordance with the requirements and procedures outlined in this specification, contract drawings and documents, the state standards or guidelines for soil erosion and sediment control, and all regulatory authorities having jurisdiction. Where conflict between requirements exist, the more restrictive rules shall govern.

B. The Contractor shall provide all temporary control measures shown on the drawings, or as directed by the Owner, Owner's representative, or soil conservation district for the duration of the contract. Erosion control drawings are intended to be a guide to address the stages of work shown. Additional erosion control measures not specified on the drawings may be necessary

and shall be implemented to address intermediary stages of work and any conditions that may develop during construction at no cost to the Owner.

C. Temporary control provisions shall be coordinated with permanent erosion control features to the extent practical to assure economical, effective and continuous erosion control throughout the construction and post-construction period.

D. Soil erosion and sediment control measures shall at all times be satisfactory to the Owner's Representative. Owner's Representative will inform the Contractor of unsatisfactory construction procedures and operations if observed. If the unsatisfactory construction procedures and operations are not responded to and corrected within 48 hours, the Owner's Representative may suspend the performance of any or all other construction until the unsatisfactory condition has been corrected. Such suspension shall not be the basis of any claim by the Contractor for additional compensation nor for an extension of time to complete the work. Any complaints, fines, etc. relating to ineffective erosion control, shall be the sole responsibility of the Contractor.

E. The Contractor shall inspect all soil erosion and sediment control measures at least at the beginning and end of each day to ascertain that all devices are functioning properly during construction. Maintenance of all soil erosion and sediment control measures on the project site shall be the responsibility of the Contractor until the project is 100% complete, and until the permanent soil erosion controls are established and in proper working condition.

F. The Contractor shall protect adjacent properties and watercourses from soil erosion and sediment damage throughout construction.

1.5 SEQUENCE OF CONSTRUCTION

A. The approved construction sequence, as permitted/approved shall be adhered to during the execution of work under this section. All soil erosion and sediment control measures shall be installed in accordance with the phasing sequence shown on the contract documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Contractor shall provide all materials necessary to perform the work.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Contractor shall comply with and implement the Erosion and Sedimentation Control Plans provided in the contract documents.

B. Review the soil erosion and sediment control drawings as they apply to current site conditions. Any deviation from the drawings must be submitted for approval to the owner/landscape architect in writing at least 72 hours prior to commencing that work.

C. All soil sediment and erosion control devices shall be in place prior to any earthwork construction, in their proper sequence, and maintained until permanent protection is established.

D. The limit of the area of any earthwork operations in progress shall be commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding and other such permanent control measures current and in accordance with the accepted schedule for construction phasing. Should seasonal limitations make such coordination unrealistic, as determined by the Owner's Representative, temporary erosion control measures shall be provided immediately by the Contractor at no expense to the Owner.

E. Temporary erosion control measures shall be used to correct conditions which develop during construction that are needed prior to installation of permanent control features, or that are temporarily needed to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

F. The Contractor shall incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls.

G. A temporary construction entrance pad shall be installed and maintained at any point where construction vehicles enter a public right-or-way, street or parking area. The pad shall be used to eliminate mud from the construction area onto public right-of-way. The pad shall be constructed as shown on the drawings. Any mud or debris tracked on streets shall be cleaned up immediately.

H. Any disturbed or stockpiled areas that will be left exposed more than 14 days, and not subject to construction traffic, shall immediately receive a temporary seeding. Mulch/straw shall be used if the season prevents the establishment of a temporary cover. Disturbed areas shall be limed and fertilized prior to temporary seeding.

I. Permanent vegetation shall be established as specified on all exposed areas within 14 days after final grading, unless otherwise directed by the Owner and permitted by appropriate regulations. Mulch as necessary for seed protection and establishment. Lime and fertilize seedbed prior to permanent seeding.

J. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and practical. Slopes that erode easily shall be temporarily seeded and mulched.

K. All storm drainage outlets must be stabilized, as specified, before the discharge points become operational. Equip all inlets with inlet protection immediately upon construction.

L. Discharge from de-watering operations for the excavated areas shall not be directed to surface waters without first properly removing the suspended sediment through filtration and/or settlement. The Contractor shall obtain any required permits associated with dewatering activities.

M. The quantity of silt fence to be installed will be affected by the actual conditions that occur during the construction of the project. Silt fence shall be installed at locations shown on the

drawings and any additional locations necessary for proper erosion control. The Contractor shall maintain the silt fence until the project is accepted and shall remove and dispose of the silt fence and silt accumulations.

N. Soil erosion and sediment control shall include but not be limited to the approved measures. The Contractor shall be responsible for providing all additional measures that may be necessary to accomplish the intent of the drawings.

O. Comply with all other requirements of authorities having jurisdiction.

END OF SECTION 312500

SECTION 321216 – ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide asphaltic concrete paving where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 321218 - Stone Base Course.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

A. Comply with pertinent provisions of the specifications

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Certificates, signed by the materials producer and the asphalt paving Subcontractor, stating that materials meet or exceed the specified requirements.

1.4 PRODUCT HANDLING

A. Comply with pertinent specification provisions.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and products used shall comply with pertinent sections of the North Carolina Department of Transportation's (NCDOT) Standard Specifications for Highway Construction and latest revisions and supplements and Town of Davidson standards for asphalt paving.

2.2 ASPHALTIC CONCRETE MIXTURE (BINDER COURSE)

A. Materials and composition of mixture shall comply with NCDOT standard asphalt specifications, latest revisions and supplements.

B. Provide hot plant mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 290ºF minimum, 320ºF maximum.
2. Temperature at time of placing: 280ºF minimum.

2.3 ASPHALTIC CONCRETE MIXTURE (SURFACE COURSE)

A. Materials and composition of mixture shall comply with NCDOT and Town of Davidson standard asphalt specifications, latest revisions and supplements.

B. Provide hot plant mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 290ºF minimum, 320ºF maximum.
2. Temperature at time of placing: 280ºF minimum.

2.4 EQUIPMENT

A. Comply with requirements of NCDOT and Town of Davidson standard specifications and latest revisions and supplements.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

1. Sweep primed surfaces if needed.
2. Adjust frames and covers if needed.

3.2 WEATHER RESTRICTIONS

A. Do not apply asphalt mixtures to a wet or frozen surface or when air temperature is below 40ºF in the shade and falling, or below 35ºF in the shade and rising.

3.3 SPREADING AND FINISHING

A. On arrival at point of use, dump directly into mechanical spreader.

B. Immediately spread and strike off true to the line, grade and cross section indicated, to such loose depth that when work is completed, the indicated thickness or weight per square yard will be secured.

C. Correct irregularities while the mixture is still hot.

D. At locations not readily accessible to mechanical spreaders, acceptable hand spreading methods may be used.

E. Finished surfaces placed adjacent to curbs, gutters, manholes, etc., shall be approximately 1/4" above the edges of these structures.

3.4 COMPACTION

A. Perform initial rolling with 3-wheel steel roller or a steel wheel 2-axle tandem roller.

B. Follow initial rolling with at least four complete coverages by a pneumatic tired roller.

C. Complete rolling with steel wheel 2-axle tandem roller.

D. Rolling shall start longitudinally at the sides and proceed gradually toward the center of the pavement, overlapping on successive trips approximately 1/2 the width of the roller.

E. Use hand or mechanical tampers in areas not accessible to powered rollers.

F. Surface mixture after compaction shall be smooth and true to the established crown and grade.

G. Finished paving smoothness tolerance:

1. Free from birdbaths.
2. No deviations greater than 1/8" in 6'.

3.5 PROTECTION OF SURFACE

A. Allow no traffic on surface until the mixture has hardened sufficiently to prevent distortion.

3.6 FLOOD TEST

A. Flood the entire asphaltic concrete paved area with water by use of a tank truck or hoses.

B. If a depression is found where water ponds to a depth of more than 1/8” in 6', fill or otherwise correct to provide proper drainage.

C. Feather and smooth the edges of fill so that the joint between fill and original surface is invisible.

3.7 MEASUREMENT AND PAYMENT

A. Measurement of length and width of paved areas will be made.

B. Payment will be made at the unit price per square yard as stated in the Bid Form.

END OF SECTION 321216

SECTION 321218 – STONE BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide crushed stone base constructed on the compacted subgrade for all asphalt parking, driveways and trail areas where shown on the Drawings, as specified herein, and as needed for a complete and proper installation. This specification does not apply to the gravel trail section.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. Section 02513 - Asphaltic Concrete Paving.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

A. Comply with all pertinent specification provisions.

B. Certificates, signed by materials producer, stating that materials meet the specified requirements.

1.4 PRODUCT HANDLING

A. Comply with all pertinent specification provisions.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE

A. Furnish a coarse aggregate (retained on No. 4 sieve) consisting of hard, durable particles of stone, reasonably free from soft, thin, elongated or laminated pieces and deleterious substances.

B. Furnish aggregate with an abrasion loss of less than 65% as measured by the Los Angeles Abrasion Test.

C. Aggregate stone must meet NCDOT and Town of Davidson specifications for asphalt paving.

2.2 FINE AGGREGATE

A. Furnish a fine aggregate consisting of material produced by stone crushing operations.

B. Liquid limit shall not exceed 25 and the plasticity index shall not exceed 6 when tested in accordance with AASHTO T-89 and T-90, respectively.

C. Aggregate stone must meet NCDOT and Town of Davidson specifications for asphalt paving.

2.3 COMPOSITE MIXTURE

A. Produce in one crushing operation or by blending the fine and coarse aggregate in proper proportions.

B. After the materials have been mixed, laid down, and initial compaction operations begun, the composite mixture shall conform to the following:

Sieve Designation	Percent by Weight Passing
2"	100
1-1/2"	95-100
1"	70-100
1/2"	48-75
No. 4	30-50
No. 30	11-30
No. 200	0-12
Liquid Limit	25 max.
Plasticity Index	6 max.

C. Aggregate stone must meet NCDOT and Town of Davidson specifications for asphalt paving.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

A. Proofroll all areas to receive crushed stone paving.

1. Make not less than three passes over the full area, using a 35 to 50 ton rubber tired roller.

B. Remove all soft, unstable or unsuitable material that will not compact readily.

1. Remove to full depth of unsuitable material, or to a depth of 30", whichever is less.
2. Replace with satisfactory materials.

C. Fill all holes, ruts or depressions which develop in the subgrade with approved on-site material, bringing subgrade to indicated line and grades.

D. Compact subgrade using suitable construction procedures to provide not less than 95% Standard Proctor Maximum Dry Density.

E. Seal roll the subgrade surface with a steel wheel roller, sealing the surface against excessive water infiltration.

3.2 PLACING AND MIXING OF PAVING MATERIAL

A. Place aggregates using spreader boxes or other approved spreaders uniformly on one operation.

B. Take care to avoid segregation of the fine from the coarse aggregate during handling, spreading or shaping operations.

C. Mix, while at proper moisture, with motor grader or other equipment and maintain to required section and grade until thoroughly compacted.

3.3 ROLLING AND COMPACTING

A. Perform using 3-wheel steel wheel roller weighing not less than 10 tons, tandem roller weighing at least 8 tons, or other rollers approved by the Engineer.

B. Start rolling at edges and proceed toward the center, continue rolling until aggregates are firmly keyed or set.

C. When initial compaction is completed, should voids remain, place fine aggregates on the surface in an amount only sufficient to fill the voids.

D. Broom, wet and roll until coarse aggregate is set, bonded and thoroughly compacted for full width and depth.

3.4 ALLOWABLE TOLERANCES

A. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 1/2".
1. Depth measurements will be made by digging through the base at intervals no closer than 250', nor greater than 500' apart.
2. Where thickness is less than depth specified minus 1/2", it shall be corrected as directed by the Engineer.

B. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/8" in 10', parallel to the center line of the roadway nor more than 1/2" from a template conforming to the cross sections shown on the plans.

C. Deviations: Correct by removing materials, replacing with new materials, and reworking or recompacting as required.

3.5 PLACING PRIME COAT

A. Allow base course to season sufficiently to permit uniform penetration.

B. Do not apply to wet surfaces or when the temperature is below 60ºF in the shade and falling, or below 55ºF in the shade and rising.

C. Clean surfaces of all dust, dirt, clay, etc. using mechanical brooms, etc.

D. Apply prime material, using pneumatic mounted distributors, at a rate of 0.25 to 0.30 gallon per square yard.

E. Permit no traffic on primed surfaces until bituminous material has penetrated and dried sufficiently that it does not pick up under traffic.

3.6 MEASUREMENT AND PAYMENT

A. No separate measurement or direct payment will be made for this work and all costs for same shall be included in the price bid for the work to which it pertains.

END OF SECTION 321218

SECTION 321373 – PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type and color of joint sealant required.

C. Product certification and test reports.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer.

1.3 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to AASHTO M153 for Type I,II, or III; or be a bituminous type that meets AASHTO M213 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 32 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 32 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

1. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations and coordination with architect.

2.3 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Available Products:
   a. Crafco Inc.; RoadSaver Silicone.
   b. Dow Corning Corporation; 888.
   c. NCDOT approved equal

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

   a. Crafco Inc.; RoadSaver Silicone SL.
   b. Dow Corning Corporation; 890-SL.
   c. NCDOT approved equal.

2.4 HOT-APPLIED JOINT SEALANTS

A. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 6690.

1. Available Products:

   a. Koch Materials Company; Product No. 9005.
   b. Koch Materials Company; Product No. 9030.
   c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
   d. NCDOT approved equal.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Type L – A closed-cell expanded polyethylene foam backer rod. Use in roadway and bridge joints with Type NS silicone only.

C. Type M – A closed-cell polyolefin foam backer rod which has closed-cell skin over an open-cell core. Use in roadway and bridge joints with both silicon sealant types

D. Backer Rods for Cold-Applied Sealants: ASTM D 1622, 2lbs/cf minimum; ASTM D 1623 25 psi minimum; ASTM C 509 0.5% by volume maximum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.

C. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

D. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability. Do not leave gaps between ends of backer materials. Do not stretch, twist, puncture, or tear backer materials. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

E. Install sealants at the same time backings are installed to completely fill recesses provided for each joint configuration and to produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

G. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 321373

SECTION 32 31 13 – BLACK VINYL CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl Chain-link fences and gates

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete post footings.
2. Division 01 Section "Temporary Facilities and Controls".

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 8 feet high, and post spacing not to exceed 10 feet.
2. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified and on the following:
   a. Wind Loads: 105 mph.
   b. Exposure Category: B.
   c. Fence Height: Varies
   d. Material Group: IA, ASTM F 1043, Schedule 40 steel pipe or stronger if warranted to meet wind load requirements. Contractor to verify prior pipe material prior to bid and installation.

B. Fence posts, footers and fabric not structurally designed for wind/privacy screen applications. Any wind/privacy screens installed after construction will be at the owner's discretion and risk.

C. Fence system shall meet all applicable ASTM standards. Including but not limited to

1. F 668 - Specification for Poly (Vinyl Chloride)/(PVC) - Coated Steel Chain Link Fabric
2. F 567 - Practice for Installation of Chain Link Fence
3. F 669 - Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence
4. F 900 - Specification for Industrial and Commercial Swing Gates
5. F 934 - Standard Colors for Polymer-Coated Chain Link Fence Materials
6. F 1083 - Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded,

for Fence Structures

7. F 1234 - Specification for Protective Coatings in Steel Framework for Fences

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components, and finishes for chain-link fences and gates.
   1. Fence, rails, and fittings.
   2. Chain-link fabric, reinforcements, and attachments.
   3. Lighting Protection

B. Samples for Initial Selection: For components with factory-applied color finishes.

C. Product Certificates: For each type of chain-link fence from manufacturer.

D. Product Test Reports: For framing strength, according to ASTM F 1043.

E. Field quality-control reports.

F. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
   1. Polymer finishes.

G. Warranty: Sample of special warranty.

H. Other Informational Submittals:
   1. Record drawings.

1.5 QUALITY ASSURANCE

A. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

B. Preinstallation Conference: Conduct conference at Project site.
   1. Inspect and discuss work specified.
   2. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY – 1 year all parts and labor

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

2.2 VINYL CHAIN-LINK FENCE FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. 2 B Fused and Ponded Black PVC coated wire Fabric: ASTM F 1183 ASTM F 668
    a. Mesh Size: 1.75 inches x 1.75 inches 9 Gauge core
    b. Thermally bonded polyvinyl chloride (PV), plastic resin finish over galvanize steel wire. Comply with ASTM F668, Class 2, not less than 10 mils (0.10”) thick.
    c. All fabric shall be commercial grade
    d. Color: Black
2. Bracing Members:
    a. Tubular Aluminum:

2.3 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Aluminum Alloy 6063.

F. Tension Bars: Aluminum Fiberglass, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Mill-finished aluminum rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
    a. Aluminum: ASTM B 211; Alloy 1350-H19; 0.148-inch- diameter, mill-finished wire.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.
2. Aluminum: Mill finish.

2.4 POLYMER FINISHES

A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide

fence components with polymer coating.

B. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 1.

C. Metallic-Coated Steel Framing and Fittings: Comply with ASTM F 626 and ASTM F 1043 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.

1. Polymer Coating: Not less than 10-mil thick PVC polyester finish.

D. Color: Black, complying with ASTM F 934.

2.5 COLOR

A. All fence and gate accessories and components to be Black in color.

2.6 CAST-IN-PLACE CONCRETE

A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94/C 94M. Measure, batch, and mix Project-site-mixed concrete according to ASTM C 94/C 94M.

1. Concrete Mixes: Normal-weight concrete with not less than 3600-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

B. Materials: Dry-packaged concrete mix complying with ASTM C 387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

2.7 GATES

A. Contractor to provide full shop drawings and specifications for approval of all gates and all components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by owner’s representative.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

1. Install fencing on established project boundary lines inside property line as shown on Drawings.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

b. Concealed Concrete: Top 2 inches below grade to allow covering with surface material.

c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

d. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

3. Mechanically Driven Posts: Drive into soil to depth of 30 inches. Protect post top to prevent distortion.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more.

D. Line Posts: Space line posts uniformly on center per detail.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at mid-height of fabric on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

G. Intermediate and Bottom Rails: Install and secure to posts with fittings.

H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing per manufacturer requirements. Attach hardware using tamper- resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

B. See Electrical Specifications and Drawings for all gate locations that will have key pad access.

3.6 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 328423 - IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide an automatic underground irrigation system as shown and specified. The work includes installation of an underground irrigation system for the Dorton Park irrigation system.

1. Obtaining and paying for permits, fees, inspections and tests required for the installation of an underground irrigation system.
2. Providing valves, piping, sprinklers, fittings, and accessories as indicated.
3. Performing excavating, backfilling, and pipe pulling to install the system.
4. Providing controller and accessories to complete the system interior and exterior.
5. Testing and demonstration.

1.3 PRICING PACKAGE

A. **Base Bid** – Provide irrigation products as specified and approved equals.

1.4 QUALITY ASSURANCE

A. Installer's qualifications: Single firm specializing in irrigation work with a minimum of (10) ten years' experience installing irrigation systems of comparable size. The Contractor must provide a list of five (5) projects of similar size, complete with contact names and phone numbers.

B. Materials, equipment, and methods of installation shall comply with the following codes and standards:

1. The Cabarrus County Plumbing Requirements and Conditions
2. American Society for Testing and Materials, (ASTM).
3. National Sanitation Foundation, (NSF).
4. North Carolina Irrigation Contractor Licensing Board
5. Minimum Irrigation Standards.
6. The Irrigation Association

C. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, plantings and architectural features.

D. All work called for on the drawing by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

E. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade difference or discrepancies in area dimensions exist that might not have been known in engineering. Any discrepancies are brought to the attention and reviewed by the Owners representative. The Contractor shall have a Project Manager on the job site during all installation work.

1.5 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each of the system components.

B. Submit shop drawings for the irrigation system. Include piping layout and details illustrating location and types of sprinkler heads, valves, control systems and wiring, and list of fittings. Show sprinkler head coverage. (If other than specified)

C. Submit product data for each type of product required for approval.

D. Upon irrigation system acceptance, submit written operating, maintenance and winterization instructions. Provide format and contents as directed by the Owner.

E. Upon completion of the project, the Contractor shall submit to the Owner or Owner's representative prior to the final acceptance of the project, one final, reproducible "as-built" drawing and computer generated AutoCAD drawing on diskette or CD-recordable disc prepared by a qualified AutoCAD designer. The Owner or Owner's reserve the right to reject "as-built" submittals if "as-built" is not complete or legible.

F. The Contractor shall dimension from two (2) permanent points of reference, i.e. building corners, sidewalk or road intersections.

1. Connection to existing water lines (point of connection)
2. Routing of sprinkler pressure lines (dimension max. 100ft. along routing)
3. Sprinkler control valves
4. Quick coupling valves
5. Gate valves
6. Other related equipment as directed by Owner or Owner's Representative

G. The Contractor shall also indicate any non-pressure pipe routing changes on the "as-built" drawing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

1.7 PROJECT CONDITIONS

A. Locate existing underground utilities in areas of work. If utilities are to remain, provide adequate means of protection during the system installation. Repair utilities damaged during the work to the satisfaction of the utility owner and at the Contractor's expense. Notify local Utilities Protection Service 2 working days prior to beginning excavation work.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, notify the Owner or Owner's representative immediately for direction as to procedure. Cooperate with Owner and utility companies in keeping active services and facilities in operation.

C. The Contractor shall be responsible for the preservation and protection of all trees, plants, monuments, structures and paved areas from damage due to this work. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to the satisfaction of the Owner, and all injury to living plants shall be repaired by the Owner or such persons as he may employ to accomplish this work. All the costs of such work shall be charged to and paid promptly by the Contractor.

D. Promptly notify Owner of unexpected subsurface conditions.

E. Irrigation system layout is diagrammatic. Exact locations of piping, sprinkler heads, valves, and other components shall be established by Contractor in the field at time of installation.

1. Space sprinkler components as indicated on drawing.
2. Minor adjustments in system layout will be permitted to clear existing fixed obstruction, final system layout shall be acceptable to the Owner.

F. Cutting and Patching:

1. Cut through concrete and masonry with core drills, Jack hammers are not permitted.
2. Materials and finishes for patching shall match existing cut surface materials and finish. Exercise special care to provide patching at openings in exterior walls water tight.
3. Methods and materials used for cutting and patch shall be acceptable to the Owner or Owner's representative

1.8 WARRANTY

A. During the period of one (1) year from and after the final acceptance of the completed irrigation system, the Contractor shall at his own expense, make all needed repairs or replacement due to defective workmanship or materials which in the judgment of the Owner or Owner's representative, shall become necessary during such period. If, within seven (7) calendar days after mailing of a written notice or verified communication by the Owner to the Contractor or his agent, requesting such repairs or replacement, the Contractor shall neglect to make repairs, Owner may make such repairs at the Contractor's expense. In the case of emergency where, in the judgment of the Owner, delay could cause serious loss, hazard or damage to persons or property, then repairs, replacement and security, both temporary and /or permanent, may be provided by such persons as the Owner may employ, after verbal communication with Contractor without notice being sent to the Contractor, and the Contractor shall pay all costs related thereto.

B. Contractor and Owner recognize that vandalism is a potential problem. Any vandalism before final acceptance, up to $500.00 shall be borne by Contractor, while vandalism $500.00 and over shall be divided equally between Contractor and Owner.

1.9 COORDINATION

A. Coordinate work of this Section with that of other trades, under this and other Contracts with the Owner, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

B. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Landscape Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

C. Do not interrupt existing services without Owner’s approval. Schedule interruptions in advance, according to Owner’s instructions. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner’s operations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Equipment Manufacturer: As shown on drawings or approved equal.

B. Manufacturer’s Qualifications: Irrigation products (i.e.: all sprinklers, all valves, all controllers,) shall be by a single manufacturer. All irrigation system components shall be supplied by the regionally authorized distributors to provide single source responsibility for warranty service and operations to conform to specifications in all respect.

C. Any request for accepted equivalent shall be submitted in writing to Owner or Owner's representative seven (7) days prior to start of construction. Request shall include manufacturer's cut sheets, performance data, and list of five (5) projects similar in nature in which product or products have been installed during the last two (2) year period. Owner or Owner's representative shall respond to request within three (3) days of receipt.

2.2 MATERIALS

A. General:

1. Provide only new materials, without flaws or defects, and of highest quality of their specified class and kind.
2. Comply with pipe sizes indicated. No substitution of smaller pipe than shown on plan will be permitted. Larger sizes may be used subject to acceptance of the Owner or Owner's representative. Remove damaged and defective pipe from the site.
3. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (NSF) approval.

B. Plastic pipe, fittings, and connections:

1. Polyvinyl chloride pipe: ASTM D2241, rigid, unplasticized PVC, extruded from virgin parent material. Provide pipe homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles, and dents.
   a. 1"- 3” diameter pipe : SDR 21, Class 200 solvent weld
   b. 4”- 6” diameter pipe : SDR 21, Class 200 gasketed pipe
   c. All mainline pipe shall be SDR21 Class 200 gasketed pipe

2. Pipe fittings: 2 1/2” diameter and under, ASTM D2241 schedule 40 PVC molded fittings suitable for solvent weld, slip joint seal, or screwed connections. Fittings made of other materials are not permitted.
   a. Size slip fitting socket taper to permit a dry unsoftened pipe end to be inserted no more than halfway into the socket. Saddle and cross fittings are not permitted.
   b. All threaded PVC fittings shall be SCH 80.
   c. Use of male adapters will not be allowed.

3. Mainline Fittings: 3” diameter and over, ductile iron fittings grade 65-45-12 ASTM A-536. Fittings shall have deep bell push joints with gaskets meeting ASTM F-477. Approved ductile iron fittings shall be Harco or Leemco.

   NOTE: Transition gaskets are not permitted.

C. Large Sports Rotors

1. The rotor body, stem and nozzle, shall be constructed of heavy-duty and ultra-violet resistant plastic.
2. Shall have a heavy-duty stainless steel retract spring for positive pop-down.

3. Shall have a brass reinforced turret for increased side impact durability.
4. Shall have a non-strippable drive mechanism to prevent damage from vandals.
5. Shall have the Rain Bird® Memory Arc™ feature to return the rotor to its original arc setting.
6. Shall have integrated seals and method for clearing debris.
    a. Oversized pressure activated wiper seal prevents leaks and protects internals from debris.
    b. Precision controlled flush at pop-down to clear debris from the unit, to assure positive stem retraction in all soil types.
7. Left and right-side adjustable trips allow easy arc alignment.
8. Full and part circle in one unit. Reversing 50-330° arc adjustment through the top of the rotor requires only a flat blade screwdriver or non-reversing full 360° rotation.
9. 10.13-inch body height; 5.0 inch pop-up height (measured to center of nozzle).
10. Operating range of 39 to 81 feet.
11. Operating pressure range of 50 to 100 psi.
12. Shall have a precipitation rate of 0.48 to 1.28 in/hr.
13. Shall include check valve (Rain Bird® Seal-A-Matic™ (SAM)) with up to 10 feet of elevation hold up.
14. Shall include a stainless-steel riser stem to deter vandalism on public turf areas and prevent scoring of stem from debris preventing leaks.
15. Exposed surface diameter shall measure 2.1 inch.
16. Shall include 1 inch NPT female threaded bottom inlet.
17. Shall be available with twelve nozzles with indicated flow rates from 3.8 to 36.3 gpm and an exit trajectory of 25°.
18. All rotor body components shall be removable from the top without special tools in order to provide quick and easy flushing and maintenance of the sprinkler.
19. Shall include slot in cover for use of a pull up tool for ease of nozzle installation and replacement.
20. Shall include nozzle retention screw that may also be used to reduce spray radius by 25%.
21. Shall have a filter screen in the stem to protect the drive from clogging and to simplify removal for cleaning and flushing the system.
22. Shall utilize 3-port Rain Bird® Rain Curtain™ nozzles with micro-ramp technology to deliver even distribution over the entire radius including large wind resistant droplets and gentle close-in-watering.
23. Shall include a five-year trade warranty.
24. Large Rotor shall be the Rain Bird 8005 manufactured by Rain Bird® Corporation, Azusa, California.

D. Irrigation Controller

1. Irrigation controller specifications include but are not limited to:
    a. The controller shall be of a hybrid type that is microelectronic circuitry capable of fully automatic or manual operation.
    b. The controller shall be housed in a wall-mountable, weather resistant plastic cabinet with a key-locking cabinet door suitable for outdoor installation.

c. The controller shall have a base station capacity of 8 or 12 stations with three slots capable of receiving 4, 8, or 12 station expansion modules for a controller capacity of up to 48 stations.
d. All stations shall have the capability of independently obeying or ignoring the weather sensor as well as using or not using the master valve.
e. The weather sensors shall include but are not limited to a rain/freeze sensor, a rain sensor for monitoring rainfall, and a anemometer with pulse monitor. The controller shall be compatible with a control device that enables weather-based management.
f. The controller shall have 4 separate and independent programs which can have different start time, start day cycles and station run times.
    i) Each program shall have up to 8 start times per day for a total of 32 possible start times per day.
    ii) The programs shall be allowed to overlap operations based on user-defined settings which control the number of simultaneous stations per program and total for the controller.
g. The controller shall come standard with a feature which allows the user to define up to five 24 VAC, 7VA solenoid valves to operate simultaneously.
h. The controller shall have a cycle and soak water management feature which is capable of operating each station for a maximum cycle time and a minimum soak time to reduce water run-off.
i. The controller shall incorporate a flow manager feature that shall provide real-time flow, power, and station management; a flow sensor module option; and a flow sensor module which learns the normal flow rate of each station.
j. The controller shall be compatible with a specified central control system utilizing specialized network communication cartridges with 2 years of IQ4 cellular service.
k. Shall include a 1-year trade warranty.

2. Controller shall be provided in a wall mount enclosure.

3. The controller shall be manufactured by Rain Bird Corporation model ESPLXME with flow and IQ model.

E. Electric Control Valves:

1. Remote control valve for turf areas 50-200 gpm maximum 200 psi. Irrigation valve specifications include but are not limited to:
    a. The valve body and bonnet shall be constructed of heavy-duty and ultra-violet resistant plastic.
    b. The bonnet shall be assembled to the body using multi-drive screws for use with flathead, Phillips, or hexagonal tools.
    c. Shall possess a water tight seal between the body and bonnet.
    d. Shall be a normally closed, forward flow design.
    e. Shall have a filtered pilot flow to resist debris and clogging.
    f. Shall be slow closing to prevent water hammer from causing subsequent system damage.
    g. Shall have a 1 inch to 2 inch NPT globe inlet as well as a 1 inch to 2 inch NPT outlet.

h. Shall have a manual internal bleed capability to operate the valve without allowing water into the valve box.
i. Shall have an external bleed to permit flushing of debris from the system.
j. Shall have a flow control handle to adjust water flow as needed.
k. Shall include a 24 VAC 50/60 Hz solenoid capable of 2-wire operation.
   1) Inrush current: 0.41A at 60Hz
   2) 2. Holding current: 0.14A at 60Hz
l. Operating flow rate of 50-200 gpm.
m. Operating pressure range of 20-200 psi.
n. Water temperature: Up to 150°F
o. Ambient temperature: Up to 150°F.
p. Shall accommodate an optional field-installed pressure regulating dial.
q. Shall accept an optional latching solenoid for use with battery operated controllers.
r. Shall be available with an optional purple flow control handle for use with non-potable water applications.
s. Shall have a heavy-duty stainless-steel spring for positive diaphragm closure.
t. Shall include be manufactured by Rain Bird corporation model PEB or approved equal.

F. Control Wire

1. All control wire shall be single strand 14-1 PE cable and consist of one hot (RED) and one common (WHITE) wire from irrigation controller to each electric valve.

2. Include four 14-1 (BLUE) tracer wire that home runs from irrigation controller to zone 11 on irrigation system.

3. Wire shall be manufactured by Regency Wire or approved equal.

G. Gate Valves / Backflow Preventer:
1. Gate Valve for electric valve assembly shall be manufactured by NIBCO model number T-FP-600A or approved equal.
2. Mainline Gate Valve shall be manufactured by NIBCO model number P619-RW or approved equal.
3. The irrigation backflow preventer shall be manufactured by ZURN model number 975XL Reduced Pressure Principal Assembly.
4. Backflow Preventer cover shall be manufactured by strong box model number SBBC-30SS and PBB30 Insulation cover.

H. Pipe Sleeves

1.

Pipe Size	Sleeve Size	Sleeve Type
2” to 2-1/2”	4-inch	Sch. 40 pipe
3 inch	6-inch	Sch. 40 pipe
4 inch	8-inch	Sch. 40 pipe
6 inch	10-inch	Sch. 40 pipe

(Sleeve sizes and locations are based on a single pipe being installed in a sleeve. Contractor shall verify sleeve sizes with drawing.)

I. Rain Sensor

1. Irrigation controls shall incorporate a rain sensor to cancel the irrigation program if a preset amount of rain has fallen. Rain sensor shall use a water-absorptive material to measure rainfall, and have a U.V. stabilized thermoplastic switch housing and aluminum mounting bracket. Sensor shall be adjustable from 1/8"-1". The rain sensor, shall be manufactured by Hunter Industries, or Rain Bird.

J. Grounding

1. The controller shall be grounded to 10 OHMS or less to insure proper surge and lightning protection. Grounding system shall include U.L. listed 5/8" x '10 copper clad ground rod; 4"x 96" grounding plate with '25 of #4 bare copper wire and 100 pounds of grounding enhancing material and Cadweld GT1161G igniter.

K. Master Valve and Flow Sensor assembly

1. Located outside of the time building shall be a 2” Rain Bird EPB-CP normally closed master valve.
2. The master valve shall be installed below grade connecting to the 3” mainline pipe.
3. The master valve shall be installed inside in a separate jumbo valve box.
4. A 2” Creative Sensor Technology FSI-T20-001 flow sensor shall be installed downstream of the master valve with a straight run minimum 5x pipe diameter distance from the master valve and 10x pipe diameter on the discharge of the flow sensor.
5. A P7171D-REV5 shielded communication cable shall be used to connected the output signal from the flow sensor to in input signal of the irrigation controller. The irrigation controller has have the necessary hardware to properly communicate with the creative sensor technology flow sensor.
6. The flow sensor shall be installed in a separate jumbo valve box.

L. Irrigation Point of Connection

1. The point of connection shall be a 2” domestic water meter with the ability to produce 75 GPM at 93 PSI.

2. Contractor to test and confirm adequate pressure is available as shown on irrigation plan.

2.3 ACCESSORIES

A. Splice Kits

1. Low voltage wire connectors: As manufactured by 3M model #DBR-2, designated for below grade waterproof irrigation wire splices.

B. Valve access boxes:

1. Boxes and Valve Box Covers Tapered rib reinforced enclosure of rigid plastic material comprised of fibrous components chemically inert and unaffected by moisture, ultraviolet light corrosion and temperature changes.
2. Base 12" deep x 18" long x 12" wide standard valve box.
3. Lid, green in color with lock.
4. Valve Box shall be manufactured by NDS, Carson, or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Layout and stake the location of each pipe run and all sprinkler heads and sprinkler valves. Obtain Owner or Owner's representative acceptance of layout prior to excavating.

3.3 INSTALLATION

A. Excavating and backfilling:

1. Excavation shall include all materials encountered, except materials that cannot be excavated by normal mechanical means.
   a. Rock excavation: Submit a unit cost per foot of trench for rock excavation. Include in price additional backfill materials required to replace excavated rock.

2. Excavate trenches for sufficient depth and width to permit proper handling and installation of pipe and fittings.
   a. All PVC (over 2" diameter) piping is to be trenched.

   b. Areas where the trenching method is to be used, all sod shall be removed & reinstalled within 24 hours, if applicable.

3. The pulling method may be used on all laterals; the pipe "plow" shall be a vibratory type. Starting and finishing holes for pipe pulling shall not exceed a 1'-0" by 3'-0" opening.
4. Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.
5. Fill to match adjacent grade elevation with approved earth fill material. Place and compact fill in layers not greater than 6" depth to achieve 85% of maximum dry ASTM D698 standard proctor method.
   a. Provide approved earth fill or sand to a point 4" above the top of pipe.

b. Fill to within 6" of final grade with approved excavated or borrowed fill materials free of lumps or rocks larger than 3" in any direction.
c. Provide clean topsoil fill free of rocks and debris for top 6" of fill.

6. Except as indicated: install irrigation mains with a minimum cover of 16" & a maximum cover of 24" based on finished grades. Install irrigation laterals with a minimum cover of 12" based on finished grades.
7. Excavate trenches and install piping and fill during the same working day. Do not leave open trenches or partially filled trenches open overnight.
8. Contractors shall not crown and backfill on the trench area with the thought that it will eventually settle; this will not be acceptable as a finished job. The Contractor will guarantee all trenches to be free from heaving or settling more than 1/2". Should it become necessary to adjust the grade, the Contractor shall remove the sod, regrade the trench and replace the sod. This no settlement clause shall extend over the entire period of the
9. Contractors guarantee of the job. Any bad areas shall be completely resodded by the Contractor, at his expense, the following Spring and the sod shall contain grasses similar to existing grass in the area to be corrected. Trenches shall be finish graded prior to walk through of system with Owner or Owner's representative. Contractor shall restore disturbed areas to original condition.

B. Plastic Pipe

1. Install plastic pipe in accordance with manufacturer's installation instructions. Provide for thermal expansion and contraction.
2. Saw cut plastic pipe. Use a square-in-sawing vice, to ensure a square cut. Remove burrs and shavings at cut ends prior to installation.
3. Make plastic to plastic joints with solvent weld joints or slip seal joints. Use only solvent recommended by the pipe manufacturer. Install plastic pipe fittings in accordance with pipe manufacturer's instructions. Gasketed pipe shall be lubricated with approved lubricant only. (Non-petroleum based). Contractor shall make arrangements with pipe manufacturer for all necessary field assistance.
4. Make solvent weld joints as follows:
   a. Thoroughly clean the mating pipe and fitting with a clean dry cloth. Clean fittings with Oatey PVC-ABS plastic pipe fitting cleaner or approved other.
   b. Apply a uniform coat of solvent/cement to the outside of pipe with non- synthetic bristle brush.
   c. Apply solvent/cement to fittings in similar manner.
   d. Re-apply light coat of solvent/cement to pipe and quickly insert it into fitting.
   e. Give pipe or fitting a quarter turn to ensure even distribution of solvent/cement and verify pipe is inserted to full depth of fitting socket.
   f. Hold in position for 30 seconds.
   g. Wipe off excess solvent/cement that appears at outer shoulder of fittings.

5. Do not use excessive amounts of solvent/cement. An excess amount of solvent/cement will cause a burr or obstruction to form of the inside of the pipe.
6. Allow joints to set at least 24 hours before pressure is applied to the system.

7. Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods when pipe installation is not in progress.

C. Sprinklers, fittings, valves, and accessories:

1. Install fittings, valves, sprinklers heads, risers, and accessories in accordance with manufacturer's instructions, except as otherwise indicated.
2. Set sprinkler heads perpendicular to finished grades, except as otherwise indicated.
3. Obtain Owner or Owner's representative review and acceptance of height for proposed sprinkler heads and valves prior to installation.
4. Locate sprinkler heads to assure proper coverage of indicated areas. Do not exceed sprinkler head spacing distances indicated.
5. Install field sprinklers with Lasco Swing Joint #G132-212 Assembly as indicated. If not shown differently in detail drawings.
6. Install quick-coupling valves with Lasco Snaplok Assembly #G33S-212 as indicated. If not shown differently in detail drawings.
7. Install all control valves in valve access boxes as indicated.
8. Install all gate valves in a 10” round valve box.
9. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the access box.
10. Seal threaded connections on pressure side of control valves with teflon tape or approved plastic joint type compound.

D. Flushing, testing and adjustment:

1. After sprinkler piping and risers are installed and before sprinkler heads are installed, open control valves and flush out the system with full head of water.
2. Perform system testing upon completion of each section. Make necessary repairs and re-test repaired section as required.
3. The Contractor shall adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways and buildings as much as possible. If it is determined that the irrigation adjustments will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to final acceptance at direction of Owner or Owner's representative at no additional expense. Adjust sprinklers after installation for proper and adequate distribution of the water coverage pattern. Adjust for the proper arc coverage. Use matched precipitation rate nozzles as per accepted industry standards. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling as required.
4. Adjust all electric remote control valve pressure regulators and flow control stems for system balance and optimum performance.
5. Test and demonstrate the controller by operating appropriate day, hour, and station selection features as required to automatically start and shut down irrigation cycles to accommodate turf requirements and weather conditions.

3.4 DISPOSAL OF WASTE MATERIAL

A. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash, and debris. Maintain disposal route clear, clean, and free of debris.

3.5 ACCEPTANCE

A. The Contractor shall arrange for presence of Owner or Owner's representative 72 hours in advance of anticipated walk-through.

B. Entire system shall be completely installed and operational prior to the scheduling of the walk-through.

C. The Contractor shall operate each zone in its entirety for the Owner or Owner's representative at time of walk-through and will additionally open all valve boxes for observation by Owner or Owner's representative.

D. Owner or Owner's representative shall generate a "punch" list indicating all items to be corrected prior to scheduling of final walk-through.

E. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate or inappropriate, without bringing it to the attention of the Owner or Owner's representative.

F. The Contractor shall arrange for the presence of Owner or Owner's representative 72 hours in advance of anticipated walk-through.

G. The Contractor shall show evidence the Owner or Owner's representative has received all accessories, charts, record drawings, and equipment as required before final acceptance will be scheduled.

H. The Contractor shall operate each zone, indicated on "punch" list, in its entirety for the Owner or Owner's representative at time of walk-through to insure correction of all items on "punch" list.

I. Any items deemed not acceptable by the Owner or Owner’s representative shall be reworked to the complete satisfaction of the Owner.

J. If after request by the Contractor to the Owner or Owner's representative for a final walk-through of the irrigation system, the Owner or Owner's representative finds items during the final walk-through which have not been properly adjusted, reworked, or replaced as indicated on the "punch" list generated from the preliminary walk-through, the Contractor shall be back charged for all Payment and /or retainage to Contractor, in the amount equal to the additional time and expenses required by Owner or Owner's representative to conduct and document any further walk-throughs as deemed necessary by Owner or Owner's representative to insure compliance with contract drawings and specifications.

3.6 CLEAN UP

A. Clean-up shall be a continuous operation throughout the duration on the work. Materials brought into the area shall be neatly stockpiled upon completion of each day. Contractor shall be responsible for disposing of, off site, at no additional expense, any trash or debris generated by the installation of the work. Debris shall not be allowed to accumulate and will be removed from the project area at least once weekly or more often if necessary in order to maintain a safe, neat and attractive appearance in the project area. All dirt, mud or debris shall be removed from sidewalks and paved areas at the end of each work day and sidewalks shall be left broom cleaned.

3.7 WINTERIZATION

A. Contractor shall include in his bid proposal and shall be responsible for winterizing the complete system at the conclusion of the irrigation season (in which the system received final acceptance) within 12 days upon reasonable notification by the Owner. The system shall be voided of water using compressed air or similar method which is approved by the various system components manufacturers' and Owner or Owner's representative. Contractor shall re-open, operate and adjust system malfunctions accordingly.

END OF SECTION 328423

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Sodding.
3. Hydroseeding.

B. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 33 Section "Subdrainage" for subsurface drainage.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

F. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 REFERENCES

A. Comply with applicable requirements for the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM)
   C 136 Sieve Analysis of Fine and Course Aggregates
   D 422 Particle-Size Analysis of Soils
   E 11 Wire-Cloth Sieves for Testing Purposes

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod and native seed mix. Include identification of source and name and telephone number of suppliers.

C. Qualification Data: For qualified landscape Installer.

D. Product Certificates: For soil amendments and fertilizers from manufacturer.

E. Material Test Reports: For standardized ASTM D 5268 topsoil existing native surface topsoil existing in-place surface soil and imported or manufactured topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A North Carolina Board of Landscape Contractors certified Landscape Contractor whose work has resulted in successful turn establishment. The Contractor’s company and Field Supervisor must be Board certified.
1. Experience: Five years minimum experience in turf installation.

a. Installer to show a minimum of 5 project examples and owner point of contacts for project similar in scope and quality completed in the last 5 years.

2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
4. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.

a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Preinstallation Conference: Conduct conference at Project site.

E. Provide appropriate treatment for fire ant infestation on plant material prior to shipment from nursery as required by the North Carolina Department of Agricultural and Consumer Services Guidelines.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Seed: Deliver seed in original, sealed, labeled, and undamaged containers

D. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.8 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting Seeding: Feb 1 - Apr 15.
2. Fall Planting Seeding: Aug 25 – Nov 1.
3. Sod Planting May 1 to Oct 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: **Certified**, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Sod Species: **Bermuda 419 or alternate**

2.2 GRASS SEED

A. Provide fresh, clean, new crop lawn seed mixture. Furnish to Owner dealers guaranteed statement of composition of mixture and percentage of purity and germination of each variety.

B. Seed Mixture: Provide seed of grass species and varieties, proportions by weight and minimum percentages of purity, germination, and maximum percentage of weed seed. Reference Plans for Seed mixture. Below is the general seed recommendation by pound per acres. Substitution mixes may be submitted for review and approval.

March 1 - August 31		**September 1 - February 28**	
50#	Tall Fescue	50#	Tall Fescue
10#	Centipede	10#	Centipede
25#	Bermudagrass (hulled)	35#	Bermudagrass (unhulled)

2.3 ORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
3. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through [1-inch] sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.5 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 to 4 percent nitrogen and 10 to 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.6 PLANTING SOILS

A. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Mix soil amendments as necessary per Landscaper recommendations.

2.7 MULCHES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

C. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.8 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.9 FIRE ANT TREATMENT / PREVENTION

A. Bait Applications of AMDRO per acre or approved equal.

B. Drench Applications of Orthene on each active hill or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches to 8 inches Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. Mix lime with dry soil before mixing fertilizer.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches to 8 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches to 6 inches of soil. Till soil to a homogeneous mixture of fine texture.

a. Apply fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate indicated on plans.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 per erosion control plans.

E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of [2 tons/acre] to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch peat mulch planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre] dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of [1000 lb/acre].

3.6 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Landscape Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs [**or steel staples**] spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

D. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

3.7 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
3. The Contractor is responsible for watering all seeded and sodded areas for a period of 90 days. Method of water to be determined by the contractor at their expense.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow zoyisa to a height to 1.4 inches.
2. Mow bluegrass and other cool season grasses to a height of 1-1/2 to 2-1/2 inches.
3. Native Grasses:
    a. Initiate mowing of turf grass areas when grass has attained height of 3 feet and roots are firmly established. Maintain turf grass height at 3 feet. Mow in fall after grass turns brown (becomes dormant) and in spring for early season weed control (once weeds/grasses get to about 18 inches high – can be cut back to 6 – 8 inches). Mow native grass areas no more than 3 times per year.

D. If lawn or grass is established in the fall and maintenance is required to continue into the spring months, lawn and grass shall receive an application of lime and fertilizer in the spring. Lime and fertilizer shall be spread in a uniform layer over the entire lawn surface, at the following rates.
1. Lime: 100 lb. / 1000 sq. ft.
2. Fertilizer: 20 lb. / 1000 sq. ft.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner’s property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in “Turf Maintenance” Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 90 days from date of planting completion.
    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
2. Sodded Turf: 90 days from date of planting completion.

END OF SECTION 329200

SECTION 32 93 00 - LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials and perform all work in accordance with these specifications, drawings, and instructions provided by the Owner, so that the intended vegetative cover, plants, trees, etc., flourish beyond the time limits set by their guarantee.

B. The work shall include everything shown on the drawings and required by the specifications and everything to which in the judgment of the Owner is incidental to what is shown on the drawings or required by the specifications.

1.2 REFERENCE STANDARDS

A. Plant material shall, as a minimum, in all cases conform with requirements of the American Standard for Nursery Stock latest versions of rules and grading adopted by the American Association of Nurserymen, Inc., unless upgraded as to meet the additional requirements as presented in these specifications and on the drawings.

1.3 SUBMITTALS

A. Owner shall pre-approve all trees prior to being moved on-site.

B. Submit list of plant material citing source and location of plant material to be installed.

C. Mulch to be approved by Owner prior to installation.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Registered Landscape Contractors who have 5 years experience are skilled in installing plant material similar and to the extent of that indicated for this Project and whose projects have a record of successful performance.

B. Registered Landscape Contractors shall submit project references for projects completed similar to the extent of this Project.

C. All work completed and materials furnished and installed shall be of the best quality and shall be in strict accordance with the intention of the drawings, specifications and samples. The Contractor shall cooperate with the Owner so that no error or discrepancy in the drawings or specifications shall cause defective or inappropriate materials to be used or poor workmanship to be allowed and so that the work may proceed in the most efficient and effective manner. If there is a discrepancy between the graphic count of plants and the drawing list count of plants on the landscape drawing, the graphic count shall govern.

D. Work must be carried out only during weather conditions favorable to landscape construction and to the health and welfare of plants.

E. Before commencing work, all trees and shrubs which are to be saved must be protected from damage by the placement of fencing flagged for visibility or some other suitable protective procedure approved by the Owner. No work may begin until this requirement is fulfilled.

F. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.

G. The Contractor shall use any and all precautionary measures when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this contract.

H. The Contractor shall adjust depth of earthwork and topsoil when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.

I. Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage shall be cause for rejection. All plants shall be kept moist, fresh, and protected. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.

J. Where excavating, fill, or grading is required within the drip line of trees that are to remain, the work shall be performed as follows:

1. TRENCHING: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots;

2. RAISING GRADES: When the existing grade at tree is below the new finished grade, and fill not exceeding 16 inches is required, clean, washed gravel graded from 1 to 2 inches in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18 inches and finish approximately 2 inches above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding 16 inches is required, a dry laid tree well shall be constructed around the trunk of the tree. The tree well shall extend out from the trunk on all sides a minimum of 3 feet and to 3 inches above finish grade. Coarse grade rock shall be placed directly around the tree well extending out to the drip line of the tree. Clean, washed gravel graded from 1 to 2 inches in size shall be placed directly over the coarse rock to a depth of 3 inches. Approved backfill material shall be placed directly over the washed gravel to desired finished grade;

3. LOWERING GRADES: Existing trees in areas where the new finished grade is to be lowered shall have regrading work done by hand to elevation as indicated. Roots as required shall be cut cleanly 3 inches below finished grade and scars covered with tree paint; and,

4. Trees marked for preservation that are located more than 6 inches above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Trees

located more than 16 inches above proposed grades shall have a dry laid stone wall, or other retaining structure as detailed on the drawings, constructed a minimum of 5 feet from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil.

K. The Owner reserves the right to inspect and reject plants at any time and at any place.

L. The Owner shall have the final approval for acceptance of the landscaping.

1.5 QUALITY OF PLANTS

A. Plants shall in all cases conform to requirements of the American Standard for Nursery Stock latest versions of rules and grading adopted by the American Association of Nurserymen, Inc., but upgraded to meet the additional requirements herein.

B. Unless specifically noted otherwise, all plants shall be of selected specimen quality, exceptionally heavy, symmetrical, tightly knit, so trained or favored in their development and appearance as to be superior in form, number of branches, compactness and symmetry. All plants shall have a normal habit or sound, healthy, vigorous plants with well-developed root system.

C. Plants shall be free of disease, insect pests, eggs or larvae.

D. Plants shall not be pruned before delivery.

E. Trees with abrasion of the bark, sunscalds, disfiguring knots or fresh cuts of limbs over 1¼ inches, which have not completely calloused, shall be rejected.

F. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such condition for at least 2 years.

G. The root system of each shall be well provided with fibrous roots. All parts shall be sound, healthy, vigorous, well branched and densely foliated when in leaf.

H. All plants designated ball and burlap (B&B) must be moved with the root systems as solid units with balls of earth firmly wrapped with burlap. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous root feeding systems necessary for the healthy development of the plant. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting. The balls shall remain intact during all operations. All plants that cannot be planted at once must be heeled-in by setting in the ground and covering the balls with soil or mulch and then watering. Hemp burlap and twine is preferable to treated. If treated burlap is used, all twine is to be cut from around trunk and all burlap is to be removed.

I. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety.

J. The thickness of each shrub shall correspond to the trade classification No. 1. Single stemmed or thin plants shall not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in moist condition, free from dead wood, bruises or other root or branch injuries.

1.6 PLANT SIZES

A. Plants shall be measured when branches are in their normal position.

B. Shrubs shall meet the requirements for spread, height or container size stated in the plant list. The measurements are to be taken from the ground level to the average height of the shrub and not to the longest branch. Height and spread dimensions specified refer to the main body of the trees (measured from the crown of the roots to the tip of the top branch) shall be not less than the minimum size designated.

C. Caliper measurements shall be taken at a point on the trunk 6 inches above natural ground line for trees up to 4 inches in caliper, and at a point 12 inches above the natural ground line for trees exceeding 4 inches in caliper.

D. If a range of size is given, no plant shall be less than the minimum size, and not less than 50% of the plants shall be as large as the upper half of the range specified.

E. The measurements specified are the minimum size acceptable and, where pruning is required, are the measurements after pruning.

1.7 MAINTENANCE OPERATIONS BEFORE APPROVAL

A. Plant care shall begin immediately after each plant is satisfactorily installed and shall continue throughout the life of the contract until final acceptance of the project.

B. Care shall include, but not be limited to, replacing mulch that has been displaced by erosion or other means, repairing and reshaping water rings or saucers, maintaining stakes and guys as originally installed, watering when needed or directed, and performing any other work required to keep the plants in a healthy condition.

C. Contractor shall remove and replace all dead, defective and/or rejected plants as required before final acceptance.

D. Grassed areas damaged during the process of the work shall be the responsibility of the Contractor, who shall restore the disturbed areas to a condition satisfactory to the Owner. This may include filling to grade, fertilizing, seeding and mulching.

1.8 GUARANTEE

A. The condition of all new plant materials is the responsibility of the Contractor and shall be approved by the Owner.

B. Until final approval, any replacement of plant materials that may be necessary shall be at the expense of the Contractor.

C. Plants shall be guaranteed for a period of 1 year after final acceptance.

D. In addition to other standard provisions, the Contractor's bid amount shall also provide for the following:

1. Maintenance necessary during establishment period;

2. Replacement in kind of all plant materials not in a healthy growing condition or that have died back to the crown or beyond normal pruning limits; and,

3. The Contractor shall also be responsible for any damage caused by his operations and shall dispose of all rubbish and excess soil as directed.

PART 2 - PLANTING MATERIALS

2.1 PLANTING MIX

A. Planting mix may be developed by amending the existing soil or removing the existing soil and replacing with new planting mix. It shall be uniform composition throughout, with a mixture of subsoil. It shall be free of stones, lumps, live plants and their roots, sticks, and other extraneous matter. It shall contain no man-made materials unless otherwise specified. Planting mix shall not be used while in a frozen or muddy condition.

Unless otherwise specified in the contract documents the planting mix shall contain the following specified percentages of constituents:

CLAY	Minimum 10% - Maximum 30%
SAND	Minimum 10% - Maximum 20%
SILT	Minimum 20% - Maximum 30%
ORGANIC MATERIAL	Minimum 5% - Maximum 20%

Organic Material is defined as compost/humus such as sawdust or leaf mold that has completed the decompression process. Percentage of organic matter shall be determined by loss on ignition, of moisture free samples dried at 65 degrees.

Planting mix shall have an acidity range of pH 5.5 to 7.0.

A sample of the proposed planting mix shall be submitted to the Engineer 30 calendar days prior to installation and be approved prior to installation.

A list of per approved soil suppliers is available to the contractor upon request.

2.2 TOPSOIL

A. Work Included - Place topsoil in areas designated on the drawings or as specified herein.

B. Areas - All exterior ground within the limit of contract, except surfaces occupied and except areas indicated to be undisturbed, shall be topsoiled.

C. Preparation - Disk, drag, harrow or hand rake subgrade to a depth of 3 inches to provide bond for topsoil. Topsoil, which must be transported across finished walks, shall be delivered in such a manner that no damage will be done to the walks. The Contractor shall be responsible for the repair of such damage.

D. Placement of Topsoil - Before placing topsoil, rake subsoil surface clear of stones larger than 1½ inches, debris, and roots. Compact topsoil to form a layer with minimum depth of 4 inches in lawn areas and 12 inches in shrub beds. Topsoil shall be placed so that after final settlement there will be good drainage (and conforming to elevations shown on drawings). Contractor is to maintain surfaces and place any additional topsoil necessary to replace that which may have eroded before acceptance.

E. Topsoil: Natural, friable, fertile, fine loamy soil possessing the characteristics of representative topsoils in the vicinity which produces a heavy growth; free from subsoil, objectionable weeds, litter, sods, stiff clay, stones larger than 1 inch in diameter, stumps, roots, trash, toxic substances, or any other material which may be harmful to plant growth or hinder planting operations. Contractor is to verify amount stockpiled and supply any additional as needed.

1. Topsoil shall contain not less than 15% nor more than 25% organic matter as determined by the wet combustion method (chronic acid reduction); topsoil shall have a pH value of not less than 5.5 nor more than 7.0;

2. Topsoil shall meet the following mechanical analysis:

Size of Screen	% of Soil Retained	% of Soil Passing
0.025mm	0	100
0.006mm	3	97
No. 100	40-60	40-60

Imported topsoil in which more than 60% of the material passing a No. 100 sieve (clayey) shall be rejected. All percentages are to be based on the dry weight of the samples; and,

3. Laboratory tests of the topsoil shall be performed by a certified testing laboratory, and shall perform tests for the following:

a. Sieve analysis and percentage of clay

b. Hydrogen ion concentration

c. Percentage of organic matter

d. Amount of the following nutrients:

1) Ammonium nitrogen

2) Nitrate nitrogen

3) Available phosphorous

4) Available potassium

e. Recommended fertilizer and rate of application for low and medium level nutrient soils.

2.3 FERTILIZER

A. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Store fertilizer in a weatherproof place and in such a manner that it shall be kept dry and its effectiveness shall not be impaired.

B. Percentages of nitrogen, phosphorus and potash shall be based on laboratory test recommendations. For the purpose of bidding, assume 10% nitrogen, 6% phosphorus and 4% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water-insoluble nitrogen. At least 60% of the nitrogen content shall be derived from super-phosphate containing not less than 18% phosphoric acid or bone meal containing 25% - 30% phosphoric acid and 2% - 3% nitrogen. Potash shall be derived from muriate of potash containing 55% - 60% potash.

C. Grass or sodded areas shall have fertilizer applied with a thorough watering immediately following application at the rate of 35 pounds per 1,000 square feet harrowed into the top 2 inches of seedbed.

2.4 PEAT MOSS

A. Peat moss shall be Michigan peat moss or approved equal by the Owner in color and consistency, to be used for planting soil mixture only.

B. Peat moss shall be finely shredded to pass a ½ inch mesh and shall be no less than 90% organic material by weight, with an ash content by ignition of no more than 10%.

C. Material shall contain no less than 35% and no more than 66% moisture by weight, but shall have a water-holding capacity of 150% - 200%.

D. Material shall have a pH value between 4 and 5.

E. Material may be imported (supplied in bales) or domestic (furnished in bulk).

F. Peat moss shall <u>not</u> be used as mulch, except on ground cover.

2.5 DOUBLE SHREDDED HARDWOOD MULCH

A. Shredded pine bark mulch or approved equal shall be used as a 3 inch, after settlement, top dressing in all plant beds and around all trees planted by the Contractor. Single trees or shrubs shall be mulched to the outside edge of the saucer. Mulch shall be of sufficient character as not to be easily displaced by wind or water runoff.

2.6 STAKING MATERIAL

A. Stakes shall be 2" x 2" x 8' pressure treated wood. 3 stakes per tree.

B. Wire tree staking shall be pliable No. 12 galvanized soft steel wire.

C. Hose shall be two-ply fiber-bearing rubber garden hose, not less than ½ inch inside diameter, black or green, and of suitable length.

2.7 WATERING

A. Owner will provide water, if available on-site, however if water is not available the Contractor shall furnish all necessary water. The Contractor shall furnish hose and other watering equipment.

B. Contractor is responsible for watering all plant material for a period of 90 days after substantial completion.

PART 3 - PLANTING PROCEDURES AND EXECUTION

3.1 DIGGING AND HANDLING

A. Bare rooted shrubs shall be dug with adequate fibrous roots. Roots of these plants shall be covered with a uniformly thick coating of mud by being puddled immediately after they are dug, or packed in moist straw, or moss.

B. Balled and burlapped plants shall be dug with firm natural balls of earth of sufficient diameter and depth to include most of the fibrous roots.

C. Roots or balls of all plants shall be adequately protected at all times from the sun and from drying winds.

D. All balled and burlapped plants which cannot be planted immediately upon delivery shall be set on the ground and shall be well protected with soil, wet moss or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be heeled-in upon delivery. All shall be kept moist.

E. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots. During planting operations, bare roots shall be covered with canvas, hay or other suitable material. No plant shall be bound with wire or rope at any time so as to damage the bark or break the branches.

3.2 TREES AND SHRUB PLANTING OPERATIONS

A. Planting operations shall be performed at a steady rate of work unless weather conditions make it impossible to work. No plant material shall be planted in frozen ground.

B. The Contractor shall provide sufficient tools and equipment required to carry out the planting operation.

C. All plants too large for two men to lift in and out of holes shall be placed with a sling. Do not rock trees in holes to raise.

D. For soil mix for plant holes, see Article 2.01, Topsoil.

E. If rock or other underground obstructions are encountered, the Owner may require plant pits to be relocated, the pits enlarged or the plants deleted from the contract.

F. Locations containing unsuitable subsoil shall be treated in one of the following manners:

1. Where unsuitability within the construction site is deemed by the Owner to be due to excessive compaction caused by heavy equipment or by the presence of boards, mortar, concrete or other construction materials in subgrade, and where the natural subsoil is other than A.A.S.H.T.O. classification of A6 or 7, the Contractor shall loosen such areas with spikes, discs, or other means to loosen the soil to a condition acceptable by the Owner. The Contractor shall also remove all debris and objectionable material. Soil should be loosened to a minimal depth of 12 inches with additional loosening as required to obtain adequate drainage. Contractor may introduce peat moss, sand, or organic matter into the subsoil to obtain adequate drainage should he so desire. All such remedial measures shall be considered as incidental to the work and no extra payment shall be made for this part of the work; and,

2. Where subgrade is deemed by the Owner to be unsuitable because the natural subsoil falls into an AASHTO classification of A6 or 7 and contains moisture in excess of 30%, then such a condition shall be rendered suitable by installation of a subdrainage system or by other means described elsewhere in these specifications. Where such conditions have not been known or revealed prior to planting time and where they have not been recognized in the preparation of drawings and specifications, then the Owner shall issue a change order to install the proper remedial measures, all of which shall be in addition to the contract sum.

G. Adjustments in locations and outlines shall be made as directed. In the event that pits or areas for planting are prepared and backfilled with topsoil to grade prior to commencement of lawn operations, they shall be so marked that when the work of planting proceeds, they can be readily located. In case underground obstructions such as ledges or utilities are encountered, location shall be changed under the direction of the Owner without charge.

H. Holes for trees shall be at least 2 feet greater in diameter than the spread of the root system and at least 6 inches deeper than the root ball. Holes for shrubs and vines shall be at least 12 inches greater in diameter than the spread of the root system and at least 2 feet deep.

I. To the topsoil in the backfilling of tree holes and shrub beds, there shall be added as the progress of the work permits, ground limestone if soil tests indicate it is needed, and commercial fertilizer at the rate of 3 pounds for trees up to 3 inches in caliper, 1 pound per 1 inch in caliper for larger trees, 6 ounces for small shrubs and 8 ounces for each shrub 4 feet or over. Ground limestone shall be omitted in the case of acid soil plants. The, limestone and fertilizer shall be thoroughly mixed with the topsoil in the planting operation.

J. The plants shall be planted in the center of the holes and at the same depth as they previously grew. Topsoil shall be backfilled in layers of not more than 8 inches and each layer watered sufficiently to settle before the next layer is put in place. Topsoil shall be tamped under edges of balled plants. Enough topsoil shall be used to bring the surfaces to finish grade when settled.

1. A saucer shall be provided around each plant as shown on the drawings;

2. Plants shall be soaked with water twice within the first 24 hours of time of planting. Water shall be applied with low pressure so as to soak in thoroughly without dislodging the topsoil;

3. Approved weed mat shall be placed under all areas to be covered with mulch. Secure weed mat in place with a soil anchor, then cover with mulch as directed; and,

4. A 3 inch layer, after settlement, of mulch shall be applied directly on top of weed mat to the entire area of each saucer or planting bed.

3.3 MAINTENANCE DURING CONSTRUCTION

A. Maintenance shall begin immediately after planting. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated, and otherwise maintained and protected until 45 days after final acceptance. Settled plants shall be reset to proper grade and position, planting saucer restored and dead material removed. Stakes and wires shall be tightened and repaired. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.

B. If a substantial number of plants are sickly or dead at the time of inspection, acceptance shall not be granted and the Contractor's responsibility for maintenance of all plants shall be extended until replacements are made.

C. All replacements shall be plants of the same kind and size specified on the plant list. They shall be furnished and planted as specified above at no cost to the Owner.

D. All plants shall be guaranteed for a period of 1 year after final acceptance.

E. At the end of the Establishment Period, inspection shall be made again. Any plant required under this contract that is dead or unsatisfactory to the Owner shall be removed from the site. These shall be replaced during the normal planting season.

END OF SECTION 329300

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Grout.
4. Flowable fill.
5. Piping system common requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.4 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.4 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.
2. Density: 115- to 145-lb/cu. ft..
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved by the Engineer.

C. Install piping at indicated slopes.

D. Install piping free of sags and bends.

E. Install fittings for changes in direction and branch connections.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

E. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Cure placed grout.

END OF SECTION 330500

SECTION 331100 – WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide water distribution system as shown on the Drawings, specified herein, and needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
2. Section 02221 - Trenching, Backfilling for Utilities.
3. Section 02516 - Disinfection of Potable Water Lines.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All materials in this Section are to be 100% manufactured in the United States.

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01340.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01640.

B. Shipment of pipe: Protect pipe with tarp or other means during shipment to prevent truck exhaust from damaging pipe.

C. Storage of PVC pipe:

1. Store in unit packages as received from manufacturer until just prior to use.
2. Stack units in such manner as to prevent deformation to pipe barrel and bells.

3. Protect from direct sunlight by covering with opaque material if storage period will exceed six weeks.

D. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use any pipe material and associated fittings as specified herein, except where use of a particular material is indicated on the plans, or specified herein.

2.2 PIPE AND FITTINGS

A. General:

1. Pipe sizes 3" and larger: Use ductile iron or plastic pipes unless otherwise indicated. No asbestos cement pipe allowed.
2. Pipe less than 3" size: Use plastic pipe.
3. Any pipe, solder, or flux used shall be lead free (lead free is defined as less than 0.2% lead in solder or flux and less than 8.0% lead in pipes and fittings).
4. Gaskets are to be factory-installed and integral with the pipe.
5. All pipe 4" and larger shall be National Sanitary Foundation (NSF) approved and shall be third party certified as meeting the specifications of ANSI/NSF Standard 61.
6. All materials and products that contact potable water shall be third party certified as meeting the specifications of ANSI/NSF Standard 61.
7. All chemical or products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
8. For valves cast all markings integral on the valve body with the size of valve, year of manufacture and the class working pressure.
    a. Certifications to rate a 150B valve body to a Class 250 valve will not be acceptable.
9. For valves spray coat all interior wetted ferrous surfaces with two-component epoxy applied to a nominal thickness of 3 to 4 mils.
    a. Coating material to be AWWA and U.S. Food and Drug Administration approved for use with potable water.
10. Exterior Coatings: For ductile iron pipe
    a. For buried service provide bituminous coating.
    b. For exposed locations comply with Section 09900.

B. Pipe:

1. Ductile iron pipe (DIP):
    a. Comply with ANSI/AWWA C150/A21.50 or AWWA C151/A21.51, latest revision.
    b. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the

manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

c. Wall thickness in accordance with Table 50.5 of ANSI/AWWA C150/A21.50, depth of cover indicated and Type 3 bedding conditions, minimum Pressure Class as follows: 4" - 12" Pressure Class 350

d. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.

2. Plastic pipe (PVC):

a. General:

1) Marked with National Sanitation Foundation approval; date pipe was produced, type, and size at 18" intervals.

2) Minimum wall thickness for 8” diameter pipe is 0.410 inches.

3) Gaskets to comply with ASTM F 477.

a) Natural rubber gaskets are not acceptable.

b. 4" - 12": Comply with ANSI/AWWA C900, Table 2, Pressure Class 150 (DR18).

c. 14" and above: Comply with ANSI/AWWA C905, Table 2, Pressure Class 165 (DR 25).

d. Plastic pipe 3" and smaller: Comply with ASTM D 2241 for PVC 1120, SDR 21. 3" and below.

e. Color of pipe to be blue.

C. Joints:

1. Ductile iron pipe:

a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.

b. Use gaskets and lubricant complying with ANSI/AWWA C111/A21.11. Natural rubber gaskets are not acceptable.

c. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints.

1) NSF approved.

d. Exposed pipe:

1) Class 53 minimum.

2) Use flanged joints complying with ANSI/AWWA C115/A21.11, latest revision and:

a) Provide solid type flanges with country where cast stamped or cast into the flange.

b) Use full face, red rubber, factory cut, 1/16" thick for pipe up to 10" diameter and 1/8" thick for larger sizes.

c) Bolts and nuts shall be standard carbon steel machine bolts, hex head complying with ANSI A21.11/AWWA C111.

2. Plastic pipe:

a. Use integral bell or coupling type with elastomeric gaskets.

b. Integral bells to comply with ASTM D2672.
c. Couplings to comply with ANSI/AWWA C900.
d. Gaskets to comply with ASTM F477.
    1) Natural rubber gaskets are not acceptable.
e. Lubricants shall be compatible with pipe and gasket materials, shall not support bacteria growth and shall not adversely affect potable quality of line contents. Vegetable shortening shall not be used to lubricate joints.
    1) NSF approved.

D. Fittings and specials:

1. Ductile iron pipe:

a. Provide 250 psi rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10 and in accordance with ANSI/AWWA C111/A21.11.
b. Clearly cast the manufacturer's mark, country where cast, year in which the fitting was produced, and the letters "DI" or "Ductile" on the fitting."
c. Compact fittings for piping 3" - 16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
d. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.
e. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
f. The maximum phosphorous level in the casting will be 0.08%.
g. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
h. The manufacturer shall be ISO 9000 certified.
i. Markings: Each fitting shall have the following markings cast integrally to the fitting:
    1) Manufacturer's Name or Logo
    2) "MJ"
    3) Country of origin
    4) Manufacturer's Foundry Mark
    5) AWWA C-153 or C110
    6) Pressure Rating
    7) Nominal Diameter (each leg)
    8) "DI" or "Ductile"
    9) No. of Degrees (bends)

2. Plastic pipe 4" and larger:
    a. Use 250 psi pressure rated ductile iron fittings or specials unless otherwise indicated, complying with ANSI/AWWA C110/A21.10.
    b. Compact fittings for piping 3" - 16" may be provided in accordance with ANSI/AWWA C153/A21.53.88.b.
    c. Fittings for use with push-on joint pipe, comply with ANSI/AWWA C111/A21.11.

d. Provide adapter glands, gaskets, etc. as required to accommodate any differences in pipe and fitting dimensions.
e. Use cement mortar lining complying with ANSI/AWWA C104/A21.4, standard thickness.
f. The maximum phosphorous level in the casting will be 0.08%.
g. The fitting surface finish will conform to MSS SP-112 Quality Standard for Evaluation of Cast Surface Finishes.
h. The manufacturer shall be ISO 9000 certified.
i. Markings: Each fitting shall have the following markings cast integrally to the fitting:
    1) Manufacturer's Name or Logo
    2) "MJ"
    3) Country of origin
    4) Manufacturer's Foundry Mark
    5) AWWA C-153 or C110
    6) Pressure Rating
    7) Nominal Diameter (each leg)
    8) "DI" or "Ductile"
    9) No. of Degrees (bends)

3. Plastic pipe 3" and smaller: Use PVC fittings, 160 psi at 73ºF pressure rating, joint design to conform to pipe joints.

E. Couplings:

1. Provide couplings where needed to make piping connections and where located on the plans.
2. Provide mechanical joint ductile iron sleeve, full length, minimum 12".
3. Provide cutting-in sleeve where installing fittings in an existing line.
    a. Provide ductile iron with mechanical joint.
4. Provide restrained joint couplings where restrained joints are indicated on the plans.

F. Restrained joint pipe and fittings:

1. Provide restrained joint pipe and fittings on all piping at each fitting, including valve and fire hydrant connections, and on the pipe joints to a distance of 18' each side of the fitting for 12" piping and smaller and to a distance of 36' each side of the fitting for piping over 12".
    a. Provide one of the following:
        1) Snap-Lok by Griffin Pipe.
        2) American Cast Iron Pipe Company.
            a) Flex-Ring (4" - 36").
            b) Lok-Ring (42" - 64").
        3) TR-Flex by U. S. Pipe.
        4) Super-Lock by Clow (4" - 30").
        5) Fast Grip Gasket by American Cast Iron Pipe Company.
        6) Field Lok by U.S. Pipe.
    b. Ductile iron pipe:

1) Provide retainer glands for use with mechanical joint pipe and fittings.
2) Provide wedge type.
3) Provide ductile iron gland conforming to ASTM A 536-80. Provide split gland where standard gland cannot be installed.
4) Provide ductile iron set screws, heat-treated to a minimum hardness of 370 BHN with twist-off nuts and permanent standard hex head remaining.
5) Provide for the following rated pressure with minimum 2 to 1 safety factor; 3" - 16" 350 psi, 18" - 48" 250 psi.
6) Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest revision.
7) Provide "MEGALUG" series 1100 or series 1200 as manufactured by EBAA Iron, Inc., of Eastland, Texas, or approved equal.

c. Provide restraint for C900 PVC by mechanical means separate from the mechanical joint gasket sealing gland.
1) Provide wide, supportive contact around full pipe circumference as follows:

Size	**Restraint Width**
4", 6"	1-1/2"
8", 10", 12"	1-3/4"

2) Provide means of restraint by machined serrations on inside surface of restraint device designed to provide circumferential loading over the entire restrainer.
a) Design to be such that restraint increases with increased in-line pressure.
b) Provide a minimum of 8 serrations per inch of restraint width.
3) Restraint device to be pressure rated at 350 psi, or equal to the pipe on which it is used and capable of withstanding test pressures of 2 times pressured rating.
4) Fusion applied epoxy coating finish per AWWA C-213.
5) Provide series 1600 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.

d. Provide restraint for C905 PVC pipe 14" and larger by mechanical means separate from the mechanical joint sealing gland.
1) Restraint device to be a two-piece configuration with plurality of individually actuating gripping services.
2) Restraint device body to be manufactured from ductile iron conforming with ASTM A536.
3) Comply with AWWA C111, ANSI 21.11.
4) Pressure rating to match PVC pipe on which it is used with capability to withstand test pressure of 2 times rated pressure.
5) Fusion applied epoxy coating finish per AWWA C-213.
6) Provide series 2800 as manufactured by EBAA Iron, Inc. of Eastland, Texas, or approved equal.

e. Provide restraint for PVC pipe (PVC 1120, SDR 21) 12" and smaller by split serrated ring.
   1) Restraint device to be a two-piece configuration with plurality of individually actuating gripping services.
   2) Restraint device body to be manufactured from ductile iron conforming with ASTM A536.
   4) Pressure rating to match PVC pipe on which it is used with capability to withstand test pressure of 2 times rated pressure.
   5) Fusion applied epoxy coating finish per AWWA C-213.
   6) Provide series 6500 as manufactured by EBAA Iron, Inc., of Eastland, Texas, or approved equal.

f. Provide restraint between PVC and mechanical joint ductile iron fitting and/or valves where indicated on the plans.
   1) Provide device consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C111/A21.11.
   2) The device will have a working pressure rating equal to the pipe on which it is used and include a minimum design pressure safety factor of 2:1.
   3) Gland body, wedges and wedge actuating components will be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
   4) An identification number consisting of year, day, plant and shift will be cast into each gland body.
   5) Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
   6) Provide series 2000 PV by EBBA Iron, Inc. or equal.

G. Tee head bolts: Provide Cor-Ten or engineer approved equal steel tee head bolts for use on mechanical joints complying with ASTM A242.

H. Plugs or caps:

1. Provide at all pipe ends and unused branches of fittings.
2. All plugs and caps shall be tapped 2" and provided with 2" plug.
3. Plugs and caps to be restrained joint.

I. Polyethylene encasement:

1. Provide polyethylene encasement of pipe and fittings where indicated on the plans.
2. Minimum nominal thickness of 8 mils. ±10%.
3. Conform to AWWA C105.

2.3 COPPER TRACER WIRE

A. Provide a continuous 12 gauge blue insulated copper tracer wire when PVC or polyethylene pipe is used.

B. Approved for direct burial by the manufacturer.

C. Locate tracer wire a minimum of 6" above top of water main.

D. Terminate tracer wire at each valve and meter and make provisions to allow for connection of testing apparatus without interfering with the proper operation of valves and meters.

E. Connect to the water line with duct tape at every bell connection or every 20'-0" to ensure that the wire is directly over the top of the pipe.

F. Place in the trench with all service lines.

G. Splice at each service lateral and tee connection with an approved copper compression lug.

H. Test all tracer wire for conductivity in accordance with Part 3.

2.4 VALVES

A. General:

1. 1-1/2" and smaller: Use gate valves or ball valves.
2. 2" through 12": Use gate valves.
3. Open by turning counterclockwise.
4. End connections as required for the piping in which they are installed.
5. 2" metal operating nut with arrow indicating direction of opening.
6. Use valves designed for a working pressure of not less than 200 psi.
7. Provide stem extensions on all valves where the top of the operator nut is located greater than 36" below the top of the valve box.
8. Fully coat all internal ferrous metal surfaces with two-part thermosetting epoxy.
9. Design for external stem failure when excessive closing torque is applied with no failure of the pressure retaining parts.
10. Provide double disc gate valves with bevel gears, grease case, and other necessary appurtenances for horizontal installation.

B. Gate valves 1-1/2" and smaller:

1. Use all bronze ball valves, 1/4 turn with stop, 2" square nut operator.
2. Provide Ford Model B11-QT67 or equal.

C. Gate valves 2" through 12":

1. Use resilient seated wedge valves complying with ANSI/AWWA C509.
2. Provide integrally cast bronze stem nut on resilient seated wedge valves.
3. Suitable for working pressure of not less than 250 psi.
4. Design for external stem failure outside of the valve body or bonnet when excessive closing torque is applied with no failure of the pressure retaining parts per AWWA Section 3.2.
    a. Factory test with no leakage from either side of the disc.

b. Test shell to 500 psig.

5. Provide certified to NSF 61.
6. Resilient wedge valves:
   a. Completely encapsulate resilient iron wedge by an elastomer, without thin spots or voids.
   b. Provide polymer wedge guide bearing caps bearing surface between the encapsulated wedge and the interior epoxy coating, lowering operation torque and extending service life of the valve.
   c. The manufacturing plant to have ISO 9001 certification.
7. Acceptable Manufacturer: Mueller.

D. Valve operator:

1. Provide one T-handle operator for each ten buried valves with nut operator.
2. Provide one stainless steel T-handle operator for each four buried valves with "T" head.

2.5 VALVE BOXES

A. Provide at each buried valve.

B. Cast iron extension type, suitable for minimum cover of 3'-6" over the pipe.

C. Minimum inside diameter at the top of 5", minimum riser wall thickness 1/4" and thickness at the top of 11/16".

D. Have the word "WATER", "SEWER", "SLUDGE", etc., as applicable, cast into the cover.

E. Provide Tyler Series 6850.

F. Where depth requires more than a two-piece box use adjustable cast iron extensions.

G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.6 VALVE BOX PROTECTION RING

A. Provide at each valve box a precast concrete protection ring.

B. Provide two rings of No. 3 reinforcing steel, one 14" in diameter, and one 23" in diameter.

C. Inside dimensions to be 9-1/4".

D. Outside diameter to be 27".

E. Provide 5" thickness at interior with a continuous slope to 2" thickness at the outside.

F. Minimum weight of 110 lbs.

2.7 SERVICE SADDLE

A. Provide of the following materials:

Body	Type 304 Stainless Steel
Bales and Strips	Type 304 Stainless Steel
Studs	Type 304 Stainless Steel
Hardware	Type 304 Stainless Steel

B. Provide plastic lubricating washers.

C. Coat all stainless steel fasteners to prevent galling.

D. Provide for maximum working pressure of 150 psi.

E. Provide Romac Model 306 for up to 10” and Model 305 for 10” to 24” or engineer approved equal.

F. Connect to pipeline using a 6" stainless steel nipple.

1. Do not use a threaded PVC connection.

2.8 AIR RELEASE VALVES

A. Provide air release valves where indicated on the drawings.

B. Provide cast iron body with stainless steel internal trim and float.

C. Provide stainless steel seat with BUNA-N rubber valve.

D. Provide 1" NPT inlet.

E. Provide Crispin Model PL10 or engineer approved equal.

F. Provide a heavy-duty cast iron meter box to house valve.

1. USF 7634 heavy duty meter box with FM cover or equal.
2. Coat with two (2) shop coats of bitumastic paint.

2.9 MISCELLANEOUS PARTS AND ACCESSORIES

A. Use standard commercial grade suitable for the type of installation or system involved, and conforming to the applicable standards and specifications of the AWWA.

PART 3 - EXECUTION

3.1 HANDLING

A. Handle pipe accessories so as to ensure delivery to the trench in sound, undamaged condition:

1. Carry pipe into position. Do not drag.
2. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.
3. Use care not to injure pipe linings.
4. Do not damage pipe with chokers or lifting equipment.

B. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during laying operations by plugging or other method approved by the Engineer.

C. Before installation, inspect each piece of pipe and each fitting for defects.

1. Material found to be defective before or after laying: Replace with sound material meeting the specified requirements, and without additional cost to the Owner.

D. Gaskets: Store in a cool dark place until just prior to time of installation.

3.2 PIPE CUTTING

A. Cut pipe neatly and without damage to the pipe.

B. Unless otherwise recommended by the pipe manufacturer, and authorized by the Engineer, cut pipe with mechanical cutter only.

1. Use wheel cutters when practicable.
2. Cut plastic pipe square, remove all burrs, and grind bevel on end.

3.3 LOCATING

A. Water mains shall be laid at least 10'-0" edge-to-edge horizontally distanced from any existing or proposed sewer pipes.

B. Should a 10'-0" separation not be practical, then the water main may be located closer with North Carolina Department of Environmental Quality (DEQ) approval provided:

1. It is laid in a separate trench.
2. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.
3. In either of the above cases, crown elevation of the sewer shall be at least 18" below invert elevation of water line.

C. Where water lines cross over sewers, maintain 18" vertical separation between the outside of the sewer and the outside of the water line.

D. Where water lines cross under sewers, each line shall be cast iron or ductile iron.

1. A full length of water line shall be located over an existing sewer so that joints of each line will be as far from each other as possible.
2. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other.

E. No water pipe shall pass through or come in contact with any part of a sewer manhole.

F. Water lines shall not be laid within 25'-0" horizontally from any portion of a wastewater tile or spray field.

G. Water lines shall be located outside all contaminated areas, unless using pipe materials that will protect the water supply.

H. No flushing device or drain directly connected to any type of sewer is allowed.

I. No cross connections between water lines and any pipes, valves, tanks or pumps that are not part of the potable water system are allowed.

J. Water lines may come in contact with storm sewers or catch basins if there are no other practical alternatives provided that ductile iron is used and no joints of the water line are within the storm sewer or catch basin, and, provided that the joints are located as far as possible from the storm sewer or catch basin.

K. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected directly to any storm drainage or sewer system.

3.4 EXCAVATION AND BACKFILLING

A. Comply with pertinent provisions of Section 02221 and Section 02615 of these Specifications.

B. For PE Pipe, comply with manufacturer's recommendations.

3.5 ALIGNMENT OF PIPE

A. Pipelines intended to be straight shall be so laid.

B. Where vertical or horizontal alignment requires deflection from straight line or grade, such deflection shall not exceed maximum deflection recommended by the pipe manufacturer.

C. If alignment requires deflection exceeding recommended limits, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the allowable limits.

3.6 PLACING AND LAYING

A. General:

1. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the Engineer.
2. Do not dump or drop any of the materials of this Section into the trench.
3. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying.
4. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
5. Take up and relay pipe that has the grade or joint disturbed after laying.
6. Do not lay pipe in water, or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
7. Securely close open ends of pipe, fittings, and valves when work is not in progress.
8. Where any part of coating or lining is damaged, repair to the approval of the Engineer and at no additional cost to the Owner.
9. Structures containing valves, blowoffs, meters, air release valves, etc., shall not be connected to any storm drain or sewer system.

B. Ductile iron pipe:

1. Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600.
2. Gaskets: Handle, lubricate where necessary and install in strict accordance with manufacturer's recommendations.

C. Plastic pipe:

1. Clean gasket, bell or coupling interior, especially groove area.
2. Lubricate and insert gasket as recommended by manufacturer.
3. Align spigot to bell, insert spigot into bell until it contacts gasket uniformly.
4. Bell pipe using manufacturer's approved leverage bar.
   a. Do not use machinery to push pipe "home".
5. Push pipe "home" until reference mark is at proper location and clearly visible.
6. Follow all pipe manufacturers installation instructions.

D. Flanged joints:

1. Provide true face flanges, field clean and fit with one full face gasket and make bolts up finger tight.
2. Use torque wrench to alternately tighten bolts 180 degrees apart until full gasket flow and seal are secured.
3. Bias cut or unusual refacing of any flange will not be acceptable.

E. Restrained joints:

1. Install in accordance with manufacturer's instructions.

2. Tighten set screws to the manufacturer's rated torque using a torque wrench. If twist-off nuts are provided, tighten screws until nut breaks loose.

F. Polyethylene encasement: Comply with AWWA C105.

3.7 TRACER WIRE TESTING

A. General:

1. Utilize an approved magnetic locating device, M Scope or Equal.
2. Connect a cable conductively from the transmitter to a metal ground rod and to the tracer wire.
3. Locate the line following the instructions of the magnetic locating device.
4. If interference is encountered form adjacent utilities or if the depth of bury or line length interferes with the signal, install a dummy valve box with access to the tracer wire at no additional cost to the owner.
5. Where there is a break in the tracer wire, repair with 3M DBY or ILSCO #IK-8 repair kit and wrap with poly wrap for cathodic protection.

B. Creek crossing and wetland areas:

1. Send a prescribed frequency with a shore line base signal ejector between 25 and 1024 HZ down a metal medium and read by a receiver.
2. Select a frequency based on the depth and the amount of linear feet of the line.
3. If the tracer wire has a break, reinstall the cable and repeat the conductivity test at no additional cost to the owner.

C. Notify in advance and conduct all testing in the presence of the Engineer.

3.8 SETTING VALVES AND VALVE BOXES

A. General:

1. Center valve boxes on the valves, setting plumb.
2. Tamp earth fill around each valve box to a distance of 4'-0" on all sides, or to the undisturbed trench face if less than 4'-0".
3. Install shaft extensions plumb without any binding.
4. Fully open and close each valve to assure that all parts are in working condition.
5. Place valve box protection ring around top of valve box as indicated on the plans.
    a. Install ring level with top 1" above finished grade.
    b. Top of ring to be level with or no more than 1" above the top of the valve box.

3.9 HYDROSTATIC TESTING

A. General:

1. Pressure and leakage testing must be conducted in accordance with AWWA Standards C600.
2. Clean and flush line of air, dirt and foreign material.
3. Do not perform hydrostatic tests until at least five days after installation of concrete thrust blocking.
4. Test pump, pipe connection, pressure gauges, measuring devices and all other necessary appurtenances to conduct tests are to be provided by the Contractor.
5. Install brass corporation cocks at all high points that do not have permanent air vents. Corporation cocks are to be left in place and all costs for providing such cocks are to be borne by the Contractor.
6. Conduct tests on each line or valved section of line.
7. Test pressures to be 150 psi, or 1.5 times the maximum working pressure, whichever is greater, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge.
8. Do not test pipe at pressures exceeding manufacturer's recommendations.
9. The Contractor must provide documentation of the pressure and leakage tests. Documentation must include length of lines, diameter of pipe(s), amount of water required to fill line after test was performed, and amount of allowable leakage.
10. The witness to the hydrostatic testing is to be someone other than the Contractor or the utility installing the lines.

B. Pressure tests:

1. After the pipe is laid, the joints completed, and the trench backfilled, subject the newly laid piping and valved sections of the piping to the test pressure specified in Part A above.
2. Open and close each valve within the section being tested several times during the test period.
3. Conduct the pressure test using a 4" diameter glycerin filled gauge with a snubber attached prior to the gauge to remove pulsations.
    a. Obtain prior approval of the testing gauge approved by the Engineer prior to its use.
    b. Provide a range of no greater than twice the test pressure and not less than 50% greater than the test pressure.
    c. Calibrate with cal sticker on gauge face or provide appropriate supporting paperwork.
4. Replace or remake joints showing leakage.
    a. Remove cracked pipe, defective pipe, and cracked or defective joints, fittings and valves. Replace with sound material and repeat the test until results are satisfactory.
    b. Make repair and replacement without additional cost to the Owner.

C. Leakage test:

1. Conduct leakage test after the pressure test has been completed satisfactorily.
2. Duration of each leakage test: At least two hours.
3. During the test, subject water lines to the test pressure specified in Part A above.

4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
   a. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula(s):

      $L = S \times D \times \sqrt{P} / 148{,}000$; where

      L = allowable leakage in gallons per hour;
      S = length of pipe tested in feet;
      D = nominal diameter of pipe in inches; and
      P = average test pressure psi gauge.

   b. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size will be allowed.
      1) Should any test of pipe disclose leakage greater than that specified above, locate and repair the defective joint or joints until the leakage is within the specified allowance, and at no additional cost to the Owner.
      2) Repair all visible leaks regardless of test results.

3.10 STERILIZATION

A. Sterilize in accordance with Section 02516 - Disinfection of Potable Water Lines.

3.11 DECHLORINATION OF CHLORINATED STERILIZATION WATER

A. Dechlorinate in accordance with Section 02516 – Disinfection of Potable Water Lines.

3.12 MEASUREMENT AND PAYMENT

A. All work under this Section will be measured and paid for as follows:

B. Pipe will be paid for at the unit prices per linear foot as stated in the Bid Form and shall include cost of excavation, backfilling, copper tracer wire, cleanup, testing, sterilizing, dechlorinating, etc. Measurement will be from center to center of fittings; no deduction will be made for the space occupied by valves or fittings.

C. Ductile iron fittings will be paid at the unit price per each as stated on the bid form. The unit price will include all cost of fitting, accessories, retrained joint accessories, excavation, testing, etc., for a complete installation.

D. Fittings other than ductile iron: No measurement will be made and cost for these fittings shall be included in the price bid per linear foot of the pipe with which they are used. No extra payment will be made for these fittings.

E. Valves will be paid for at the price for "each" as stated in the Bid Form. This payment shall include valve, stem extensions, valve box, valve box protection ring, and installation.

F. Restrained joint pipe will be paid for at the unit price per linear foot as stated in the Bid Form and include all items described in "B" above and the cost of all restrained joint accessories.

G. Hydrants will be paid for at the unit price for "each" as stated in the Bid Form. This payment shall include hydrant, reflector and offset fitting. Piping and valve to the hydrant will be paid for under paragraphs B. and E. above.

H. Tie-ins to existing lines: Where connection to an existing main is made by removing an existing plug, no payment will be made for this work.

I. Air release valves: Payment will be made at the cost per each as stated in the Bid Form. This payment will include air release valve, corporation and curb stops, piping from main to valve and box.

END OF SECTION 331100

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure storm drainage associated with the stormwater management facilities, with the following components:

1. Special fittings for expansion and deflection.
2. Precast concrete and Cast-in-place concrete structures.

B. Related Sections include the following:

1. Division 33 Section "Subdrainage" for installation of subdrainage piping of dam embankment.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silttight, unless otherwise indicated.

B. Pressure-Piping Pressure Rating: At least equal to system operating pressure but not less than 10 psi rated water tight joints.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.

B. Shop Drawings: For the following:

1. Stormwater Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.

C. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe, pipe fittings, and seals from dirt and damage.

B. Handle structures according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 DUCTILE-IRON CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.4 PVC PIPE AND FITTINGS

A. PVC Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2467, Schedule 80, socket-type fittings.

2.5 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with modified bell-and-spigot ends and confined O-ring gasketed joints with ASTM C 443, rubber gaskets. The pipe joints shall be Type R-4. The pipe shall be manufactured with no lift holes.
1. Class III, Wall B.

2.6 CONCRETE

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

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.7 STORMWATER STRUCTURES

A. Cast-in-Place Concrete, Stormwater Structures: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Anti-Flotation Block: Can either be cast-in-place or precast

a. If cast-in-place prior to constructing, the contractor shall insure the weight of the entire riser structures meets minimum specifications provided on Drawings, and shall submit shop drawings to the Engineer for review denoting the following:

1) Steel reinforcement
2) Connection mechanism to join anti-flotation block with riser section.

b. If precast, the anti-flotation block shall be included as part of the precast riser shop drawing submittals to the Engineer for review. It shall meet minimum specifications provided on Drawings.

2. Concrete Collar: Shall connect to riser structure and anti-flotation block to form a watertight connection between outlet barrel and riser structure. It shall meet minimum specifications provided on Drawings.

B. Steps: Provide steps as shown on the Drawings in manholes, risers, transition cones, and transition top sections in accordance with NCDOT STD 840.66. Steps shall be spaced at 16” O.C.

C. Emergency drawdown pipe shall be a M&H style 1820 eccentric valve or approved equal. This valve is in accordance with AWWA C-540 Sec 5.5, and shall be operable from top of outlet structure via a handwheel. Refer to valve specifications at the end of this section.

D. Trash rack: Prior to ordering, the contractor shall submit trash rack shop drawings to the Engineer for review. A minimum 2 foot x 3 foot access hatch opening is required and shall be

centered over access steps. Trash rack shall meet minimum specifications provided on Drawings.

2.8 PIPE OUTLETS

A. Head Walls: Precast reinforced concrete in accordance with NCDOT Standard 838.80.

B. Spillway Filter: Refer to installation procedures specified in Division 33 Section “Subdrainage”.
   1. Stone to be fine aggregate, natural, or manufactured sand meeting the requirements of ASTM C33.
   2. Collector Pipe shall be smooth wall, schedule 80 PVC, 4-inch nominal diameter with minimum 0.25-inch diameter perforations.
   3. Cleanout and Outlet Pipes shall be smooth wall, schedule 80 PVC, 4-inch nominal diameter, solid.
   4. Provide elbows, connections, fittings, etc. for piping as required furnished by pipe manufacturer for type of pipe used.

C. Energy Dissipaters: Refer to Drawings for shape and sizing; Design in accordance with NC Erosion and Sediment Control Planning and Design Manual.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

A. Gravity-Flow, Nonpressure Piping: Use the following pipe materials for each size range:
   1. NPS 4 to NPS 6: Ductile-iron culvert pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
   2. NPS 4 and NPS 6: PVC pipe and fittings, gaskets, and gasketed joints.
   3. NPS 8 to NPS 12: Ductile-iron culvert pipe, ductile-iron standard or compact fittings, gaskets, and gasketed joints.
   4. NPS 18 to NPS 36: Reinforced-concrete pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of storm piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install spillway filter and toe drain per direction of Geotechnical Engineer and Plans.

E. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow, at the specified slope as noted on Plans.
2. Install piping with 12-inch minimum cover.
3. Install piping below frost line.
4. Install ductile-iron culvert piping according to ASTM A 716.
5. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
6. Install PVC piping according to ASTM D 2321 and ASTM F 1668.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.4 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
2. Join PVC piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
   a. Joints shall be wrapped with a double layer of non-woven geotextile fabric (Mirafi 180N or approved equivalent) in 2-foot wide strips centered on joints.
4. Join dissimilar pipe materials with nonpressure-type flexible[**or rigid**] couplings.

3.5 STORMWATER OUTLET INSTALLATION

A. Construct inlet head walls, as indicated.

B. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

C. Construct energy dissipaters at outlets, as indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318/318R.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Crushed, broken, cracked, or otherwise damaged piping.
    c. Infiltration: Water leakage into piping.
    d. Exfiltration: Water leakage from or around piping.

2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Reinspect and repeat procedure until results are satisfactory.

3.8 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334100

1. PREFABRICATED PEDESTRIAN BRIDGE SUPERSTRUCTURE

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Falsework and Formwork Special Provision

C. Crane Safety Special Provision

1.2. SUMMARY

A. Section includes arch shaped prefabricated truss bridge superstructure.

B. All materials, construction, and fabrication shall meet the requirements of the *NCDOT 2018 Standard Specifications for Roads and Structures.*

1.3. PERFORMANCE REQUIREMENTS

A. Structural Performance: The prefabricated steel truss bridge, anchor bolts and bearing pads shall withstand the effects of all required loads and stresses within limits and under conditions indicated according to the *2009 AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges*, the *9th Edition of AASHTO LRFD Bridge Design Specifications*, *North Carolina Department of Transportation Bicycle Facilities Planning and Design Guidelines*, *NCDOT Structures Management Unit Manual*, and the *NCDOT 2018 Standard Specifications for Roads and Structures*.

1. Dead Loads: Self-weight of superstructure, including timber deck and safety railing.
   a. Utility lines attached to Bridge S2 = 25 lbs/ft
2. Live Loads: Pedestrian load shall not be considered to act concurrently with vehicular load. The dynamic load allowance need not be considered for vehicular load.
   a. Pedestrian Live Load = 90 psf
   b. Vehicular Live Load = AASHTO H-5
3. Railing Loads: Per AASHTO.
4. Wind Loads: Per AASHTO.
5. Water Loads: Per AASHTO.
6. Temperature: Per AASHTO/NCDOT.
7. Seismic: Per AASHTO.
8. Load Combinations: Per AASHTO.

9. Deflection Limits: Design framing system to withstand service loads without deflections greater than the following:
    a. Vehicular and/or pedestrian loads = Span/1000.
    b. Floor system members (floor beams and stringers):
        1) Vehicular and/or pedestrian loads = Span/360.
        2) Vehicular and/or pedestrian loads on cantilever arms = Span/375.
10. Vibration Limits: Per AASHTO.

B. Geometry and Component Requirements:

1. Span: Each prefabricated steel span shall be a simple-span bridge along the centerline of the proposed alignment. The Contractor is required to provide verification to the Engineer that the substructure and foundations are correctly laid out before placement of the bridge superstructure.

2. Width: The bridge clear width shall be as indicated in the drawings, and shall be measured between the inside faces of safety railing elements.

3. Depth: The depth of the superstructure measured from the top of deck to bottom of superstructure shall not greatly exceed the values shown in the plans except with approval of the Engineer. The values shown in the plans are estimates, and variations are expected so long as prior approval is given by the Engineer.

4. Elevations and Vertical Alignment with Substructure:

    a. The prefabricated superstructures will be constructed so that the top of the timber deck elevations align with the grade elevations shown on the plans. The bridge end bents are constructed at elevations that are dependent on the superstructure depths set by the prefabricated steel pedestrian bridge manufacturer. Any changes to the plan elevations shall be approved by the Engineer.

    b. Concrete approach slabs will be constructed on top of the 1’-0” wide concrete backwalls. The expansion joint will be constructed between the superstructure and the approach slab/backwall. See structure plans for substructure and approach slab details.

5. Bridge System Type: The bridge shall be an arch shaped truss bridge similar as shown in the plans. Interior vertical members may be plumb or perpendicular to the chord faces. Diagonal members shall be welded to the chords and/or verticals as determined by the Bridge Manufacturer.

    a. The bridge shall be designed utilizing floor beams placed between the bottom chords and verticals.

b. The Bridge Manufacturer shall determine the distance from the top of the deck to the top and bottom truss members based upon structural and/or shipping requirements. Additional requirements from Section 1.3.B.3 shall be followed.

6. Member Components: All members of the vertical trusses (top arched chords, bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing, and all their shop connections shall be fully welded. Other structural members and bracing shall be fabricated from structural steel shapes or square and/or rectangular structural steel tubing. Drain holes and weep holes shall be provided in all connections. Unless the floor fastenings are specifically designed to provide adequate lateral support to the top flange of open shape stringers (W-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location. Weep all tubular members as required for drainage.

7. Railings:

a. The safety railing system shall be placed on the structure to a minimum height of 48 inches above the deck surface (measured from the high point of the walking/riding surface). The safety system shall extend the full length of the bridge. The bridge manufacturer shall determine the placement of the horizontal and vertical rails such that a 4 inch diameter sphere cannot pass between successive rails. A safety toe rail or curb shall be provided. The safety rail shall be designed to accommodate the required loads per AASHTO.

b. Horizontal handrails are not needed for these structures.

c. Approach Rails shall be constructed at the specified bridge quadrants shown in the plans. See Approach Rail Special Provision and plans for details.

8. Utilities: The following utility lines are expected to be attached to Structure S2 after installation of the prefabricated bridge superstructure. Coordinate with the owner and/or utility companies responsible for installation of the lines for preferred locations of attachments.

a. (1) 2” PVC electrical conduit

b. (2) 1-1/4” PVC electrical conduits

c. (1) ¾” PVC electrical conduit

d. (1) 1” PEX water line

9. Camber: Each bridge shall have a vertical camber dimension at midspan equal to 100% of the full dead load deflection.

10. Corrosion Resistance: The prefabricated pedestrian truss superstructure shall be weathering steel. Components of the superstructure shall be hot dip galvanized, as specified in the plans and special provision.

11. Substructure: Notify the Engineer immediately if conflicts are identified with the pedestrian bridge substructure shown in the plans. Fabrication shall not begin until superstructure shop drawings are approved and pedestrian bridge installer has thoroughly reviewed all details in the plans.

1.4. SUBMITTALS

A. Product Data: For each type of product used. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for prefabricated steel truss bridges, anchor bolts, and bearings.

B. Shop Drawings: For prefabricated steel truss bridges, include plans, elevations, sections, details, and attachments to other members of this project. All pertinent design information such as geometries, member sizes, bridge reactions, splice locations, details, quantities and general notes shall be clearly specified on the drawings. All drawings shall be signed and sealed by a Professional Engineer who is licensed to practice in the State of North Carolina. The bridge designer/fabricator shall be NCDOT-approved for such work.

C. Bridge Reactions: A final set of bridge reactions shall be provided to the Engineer at the time of shop drawing submittal. Bridge Reactions should be supplied for the following load cases: Dead (DC), Dead (DW), Live (Pedestiran), Live (H5 Truck), Wind (WS), Wind (Overturning), Thermal (TU), and Seismic (EQ). The orientation and application of the loadings shall be clearly marked.

D. Structural Calculations: For prefabricated steel truss bridge, anchor bolts and bearing pads. The calculations shall include all design information necessary to determine the structural adequacy of the bridge, anchor bolts and bearing pads, and to demonstrate conformance with the current AASHTO code. All calculations shall be signed and sealed by a Professional Engineer who is licensed to practice in the State of North Carolina, and shall include the following, at a minimum:
   1. Design calculations for the individual truss members, floor beams and stringers, and decking.
   2. Checks for the critical connection failure modes for each individual truss member. Special attention shall be given to all welded tube on tube connections.
   3. Design calculations for all bolted splice connections.
   4. Main truss deflection checks, including individual truss member deflection checks.
   5. Design calculations for anchor bolts.
   6. Design calculations for bearings.

E. Erection plans and sequencing signed and sealed by a Professional Engineer licensed in the State of North Carolina. The erection plans and sequencing method shall include location(s) of crane(s) required for erection, as well as procedures for mitigating the amount of fallen debris. No debris will be allowed to collect in the channel of the waterway. All equipment locations and staging shall

occur within the right-of-way and easements established in the greenway plans and shall be indicated on the erection plans.

F. Qualification Data: For qualified fabricator and Professional Engineer.

G. Welding certificates.

H. Mill test reports for structural steel, including chemical and physical properties.

I. Product Test Reports: For the following:
   1. Bolts, nuts and washers including mechanical properties and chemical analysis.

J. Maintenance Data: For prefabricated steel Bowstring truss bridge to include in maintenance manuals.

K. Warranty: Sample of special warranty.

1.5. QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, “Structural Welding Code – Steel”.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Categories CBR and B-CMP, and is NCDOT approved for such work.

C. Comply with current edition of the applicable provisions of the following specifications and documents:

   1. AASHTO LRFD Guide Specification for the Design of Pedestrian Bridges.
   2. North Carolina Department of Transportation Bicycle Facilities Planning and Design Guidelines.
   3. North Carolina Department of Transportation Structure Design Manual.
   4. North Carolina Department of Transportation Standard Specifications for Roads and Bridges, and Special Provisions.
   5. AASHTO LRFD Bridge Design Specifications.
   6. RCSC’s “Specification for Structural Joints Using ASTM A325 or A490 Bolts.”

D. Preinstallation Conference: Conduct conference at Project Site prior to commencing construction of prefabricated steel pedestrian bridge.

1.6. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace any part of the steel Bowstring style truss bridge that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Weathering steel shall be stored under conditions that will prevent unsightly, uneven weathering and excessive corrosion. If uneven weathering occurs, the contractor shall reclean the steel to the satisfaction of the engineer. If cleaning does not produce satisfactory uniformity in appearance or if in the judgment of the engineer, excessive corrosion or chemical contamination has occurred, the contractor shall replace the material at the contractor's expense. As a minimum, the following conditions shall be avoided and the contractor shall take additional precautions as deemed necessary:

1. Storage in transit, open cars or trucks for an extended period of time.
2. Standing water on material in storage or entrapment of moisture.
3. Contact with chemically treated lumber used for blocking or other types of foreign matter.
4. Exposure to chlorides or other chemical contamination

C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry and rusty before use.

1.8. COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 – PRODUCTS

2.1. MATERIALS

A. Steel Structural Tubing: ASTM A 847, weathering steel; AASHTO M 270, Grade 50W.

B. Channels and Angles: ASTM A 588, weathering steel, AASHTO M 270, Grade 50W.

C. Steel Plates, Shapes, and Bars: ASTM A 588, weathering steel, AASHTO M 270, Grade 50W.

D. Anchor Bolts, High Strength Bolts, Nuts and Washers:

1. Anchor Bolts: ASTM A 449, Type 1 hot dip galvanized, heavy-hex steel structural bolts.
2. High-Strength Bolts: ASTM A 325 (AASHTO M 164), Type 3 weathering steel, heavy-hex steel structural bolts.
3. Nuts and Washers: Hot dip galvanized at anchor bolts and weathering steel for all high strength weathering steel bolts.
4. Bolts, nuts, and washers shall also be in accordance with Section 1072 of the NCDOT Standard Specifications.

E. The minimum corrosion index of the atmospheric corrosion resistant steel, as determined in accordance with ASTM G101, shall be 6.0.

F. Bearing Pads: Minimum 50 durometer hardness, conforming to NCDOT Standard Specifications and Special Provisions.

2.2. PREFABRICATED STEEL TRUSS BRIDGE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Contech Engineered Solutions
2. Pioneer Bridges
3. Wheeler
4. Bridge Brothers
5. TruNorth Steel

B. Manufacturers other than those listed above may be used provided the Designer or Owner evaluates the proposed supplier through a submittal in accordance with the General Conditions. The Contractor must provide the following documentation for any proposed supplier who is not pre-approved:
1. Product Literature
2. All documentation to ensure the proposed substitution will be in compliance with these specifications. This shall include:
   a. Representative design calculations.
   b. Representative drawings.
   c. Splicing and erection procedures.
   d. Warranty information.
   e. Inspection and maintenance procedures.
   f. AISC Shop Certification.

2.3. FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's 'Code of Standard Practice for Steel Buildings and Bridges".
1. Mark and match-mark materials for field assembly.
2. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to the greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

D. Drain Holes: Weep/ drain holes shall be provided in all tubular bridge members, for drainage at their lowest point, unless such members are free-draining, open-ended.

E. Cleaning: After fabrication, weathering steel shall be shop cleaned to a SSPC SP-6 finish.

2.4. SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.5. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

2.6. INSTALLATION

A. Delivery is made to a location nearest the site which is easily accessible to normal over-the-road tractor/trailer equipment. Contractor is to schedule a pre-installation meeting to discuss the method of erecting the bridge, as well as to verify the location(s) of the crane(s) required for erection. All equipment locations and staging shall occur within the right-of-way and easements established in the greenway plans. Contractor to verify prior to commencing bridge erection.

B. The Fabricator will provide detailed, written instructions in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of the Contractor.

C. No debris will be allowed to collect in the channel of the waterway. Contractor to provide measures to ensure debris is collected from the channel of the waterway as soon as is practical during construction.

PART 3 – CONSTRUCTION REQUIREMENTS

3.1. CONSTRUCTION REQUIREMENTS

A. Construction of bridge shall be in accordance with the *NCDOT 2018 Standard Specifications for Roads and Structure*s and shall conform to plans and special provisions. Any variations from these documents shall be approved by the Engineer and Owner.

PART 4 – MEASUREMENT AND PAYMENT

4.1. MEASUREMENT AND PAYMENT

A. The quantity for Prefabricated Pedestrian Bridge Superstructure to be paid for shall be measured on lump sum basis per Structure. No separate measurements will be made.

4.2. BASIS OF PAYMENT

A. The prefabricated steel truss bridge superstructure and all related components, including elastomeric bearing pads and anchor bolts, as described on the plans, in this Special Provision, and referenced NCDOT Standard Specifications and Special Provisions will be paid for at the contract lump sum price for each structure. Such price and payment will be full compensation for all work covered by this Special Provision, the plans, and applicable parts of the NCDOT Standard Specifications and Special Provisions and will include, but not be limited to, furnishing all engineering, labor, materials, equipment, delivery, erection, and other incidentals necessary to complete this work.

Payment will be made under:

Pay Item	**Pay Unit**
Bridge S1 Prefabricated Pedestrian Bridge Superstructure	LS
Bridge S2 Prefabricated Pedestrian Bridge Superstructure	LS

2. FALSEWORK AND FORMWORK

PART 1 – GENERAL

1.1. DESCRIPTION

A. Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

B. Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term “temporary works” is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

C. Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

PART 2 – PRODUCTS

2.1. MATERIALS

A. Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

PART 3 – DESIGN AND CONSTRUCTION REQUIREMENTS

3.1. WORKING DRAWINGS

A. Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

B. On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

C. When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints.

D. When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

E. If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders.

F. As an option for the Contractor, overhang falsework hangers may be uniformly spaced, at a maximum of 36 inches, provided the following conditions are met:

Member Type (PCG)	Member Depth, (inches)	Max. Overhang Width, (inches)	Max. Slab Edge Thickness, (inches)	Max. Screed Wheel Weight, (lbs.)	Bracket Min. Vertical Leg Extension, (inches)
II	36	39	14	2000	26
III	45	42	14	2000	35
IV	54	45	14	2000	44
MBT	63	51	12	2000	50
MBT	72	55	12	1700	48

G. Overhang width is measured from the centerline of the girder to the edge of the deck slab. For Type II, III & IV prestressed concrete girders (PCG), 45-degree cast-in-place half hangers and rods must have a minimum safe working load of 6,000 lbs.

H. For MBT prestressed concrete girders, 45-degree angle holes for falsework hanger rods shall be cast through the girder top flange and located, measuring along the top of the member, 1'-2 ½" from the edge of the top flange. Hanger hardware and rods must have a minimum safe working load of 6,000 lbs.

I. For links slabs, the tops of girders directly beneath the link slab shall be free of overhang falsework attachments or other hardware. Submit calculations and working drawings for overhang falsework in the link slab region.

J. The overhang bracket provided for the diagonal leg shall have a minimum safe working load of 3,750 lbs. The vertical leg of the bracket shall extend to the point that the heel bears on the girder bottom flange, no closer than 4 inches from the bottom of the member. However, for 72-inch members, the heel of the bracket shall bear on the web, near the bottom flange transition.

K. Provide adequate overhang falsework and determine the appropriate adjustments for deck geometry, equipment, casting procedures and casting conditions.

L. If the optional overhang falsework spacing is used, indicate this on the falsework submittal and advise the girder producer of the proposed details. Failure to notify the Engineer of hanger type and hanger spacing on prestressed concrete girder casting drawings may delay the approval of those drawings.

M. Falsework hangers that support concentrated loads and are installed at the edge of thin top flange concrete girders (such as bulb tee girders) shall be spaced so as not to exceed 75% of the manufacturer's stated safe working load. Use of dual leg hangers (such as Meadow Burke HF-42 and HF-43) are not allowed on concrete girders with thin top flanges. Design the falsework and forms supporting deck slabs and overhangs on girder bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

N. When staged construction of the bridge deck is required, detail falsework and forms for screed and fluid concrete loads to be independent of any previous deck pour components when the mid-span girder deflection due to deck weight is greater than ¾".

O. Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize these devices. Electroplating will not be allowed. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

P. Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads: Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph. In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone	Pressure, lb/ft^2 for Indicated Wind Velocity, mph				
feet above ground	70	80	90	100	110
0 to 30	15	20	25	30	35

30 to 50	20	25	30	35	40
50 to 100	25	30	35	40	45
over 100	30	35	40	45	50

1. Time of Removal

The following requirements replace those of Article 3.4.8.2.

Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph)	COUNTY	25 YR (mph)	COUNTY	25 YR (mph)
Alamance	70	Franklin	70	Pamlico	100
Alexander	70	Gaston	70	Pasquotank	100
Alleghany	70	Gates	90	Pender	100
Anson	70	Graham	80	Perquimans	100
Ashe	70	Granville	70	Person	70
Avery	70	Greene	80	Pitt	90
Beaufort	100	Guilford	70	Polk	80
Bertie	90	Halifax	80	Randolph	70
Bladen	90	Harnett	70	Richmond	70
Brunswick	100	Haywood	80	Robeson	80
Buncombe	80	Henderson	80	Rockingham	70
Burke	70	Hertford	90	Rowan	70
Cabarrus	70	Hoke	70	Rutherford	70
Caldwell	70	Hyde	110	Sampson	90
Camden	100	Iredell	70	Scotland	70
Carteret	110	Jackson	80	Stanley	70
Caswell	70	Johnston	80	Stokes	70
Catawba	70	Jones	100	Surry	70
Cherokee	80	Lee	70	Swain	80
Chatham	70	Lenoir	90	Transylvania	80
Chowan	90	Lincoln	70	Tyrell	100
Clay	80	Macon	80	Union	70
Cleveland	70	Madison	80	Vance	70
Columbus	90	Martin	90	Wake	70
Craven	100	McDowell	70	Warren	70
Cumberland	80	Mecklenburg	70	Washington	100
Currituck	100	Mitchell	70	Watauga	70
Dare	110	Montgomery	70	Wayne	80
Davidson	70	Moore	70	Wilkes	70
Davie	70	Nash	80	Wilson	80
Duplin	90	New Hanover	100	Yadkin	70
Durham	70	Northampton	80	Yancey	70
Edgecombe	80	Onslow	100		
Forsyth	70	Orange	70		

3.2. REVIEW AND APPROVAL

A. The Engineer is responsible for the review and approval of temporary works' drawings.

B. Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

C. The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

D. Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

3.3. CONSTRUCTION REQUIREMENTS

A. All requirements of Section 420 of the Standard Specifications apply.

B. Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

C. Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch. For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

3.4. MAINTENANCE AND INSPECTIONS

A. Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

B. Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement. Inspect other temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

3.5. FOUNDATIONS

A. Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

B. The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

C. Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

D. If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

E. The Engineer reviews and approves the proposed pile and soil bearing capacities.

3.6. REMOVAL

A. Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

B. Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

PART 4 – MEASUREMENT AND PAYMENT

4.1. MEASUREMENT AND PAYMENT

A. Unless otherwise specified, temporary works will not be directly measured.

B. Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

3. CRANE SAFETY

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration (OSHA) regulations.

Submit all items listed below to the Engineer prior to beginning crane operations. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

CRANE SAFETY SUBMITTAL LIST

A. **Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

D. **Certifications:** Crane operators shall be certified by the National Commission for the Certification of Crane Operators (NCCCO) or the National Center for Construction Education and Research (NCCER). Other approved nationally accredited programs will be considered upon request. In addition, crane operators shall have a current CDL medical card. Submit a list of crane operator(s) and include current certification for each type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

4. APPROACH RAIL

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All materials, construction, and fabrication shall meet the requirements of the *2018 NCDOT Standard Specifications for Roads and Structures*.

1.2. SUMMARY

A. Approach Rails are used at the beginning and end of each Pedestrian Bridge, and details are shown in the plans. Refer to plans for specific locations.

PART 2 – PRODUCTS

2.1. MATERIALS

A. Materials shall be in accordance with Section 1082 of the *2018 NCDOT Standard Specifications for Roads and Bridges*.

B. Concrete Post Supports: Class B concrete, per *2018 NCDOT Standard Specifications for Bridge and Structures.*

C. All screws, bolts, nuts, and washers are to be hot dipped galvanized.

PART 3 – CONSTRUCTION REQUIREMENTS

3.1. CONSTRUCTION METHODS

A. Construction of Approach Rails shall be in accordance with the *NCDOT 2018 Standard Specifications for Roads and Structure*s and shall conform to plans and special provisions. Any variations from these documents shall be approved by the Engineer and Owner.

PART 4 – MEASUREMENT AND PAYMENT

4.1. MEASUREMENT AND PAYMENT

A. The quantity of “Approach Rail” shall be incidental to the LS Prefabricated bridge item as shown in the Bid Form. The incidental “Approach Rail” shall include full compensation for all labor, materials, and equipment, including excavation, compacted stone or sand, forming, placing, finishing and curing of concrete, all screws, nuts, bolts, washers and their respective galvanization, timber

members, timber treatment, and all other required items of work associated with the Approach Rail.

No separate payment will be made for approach rails.

5. BRIDGE APPROACH SLAB

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All materials, construction, and fabrication shall meet the requirements of the *2018 NCDOT Standard Specifications for Roads and Structures*.

1.2. SUMMARY

A. Construct reinforced concrete slabs at the specified bridge approaches shown on the plans. Include subgrade and base course; furnish and place temporary slope drainage systems and subsurface drainage systems; remove any existing pavement or materials; furnish and place concrete, reinforcing steel, and other materials; finish and cure concrete.

B. Locate and construct all required expansion joints as shown in the plans. Immediately after removing the forms, inspect the expansion joint void carefully. Neatly remove any concrete or mortar in the joint.

C. Construct the approach slabs after the adjacent bridge is constructed.

PART 2 – PRODUCTS

2.1. MATERIALS

A. Refer to Division 10 of the *2018 NCDOT Standard Specifications for Roads and Structures*.

Item	**Section**
Curing Agents	1026
Portland Cement Concrete, Class AA	1000
Reinforcing Steel	1070
Stone, No. 78M	1005
Subdrain Fine Aggregate	1044-1

PART 3 – CONSTRUCTION REQUIREMENTS

3.2. CONSTRUCTION METHODS

A. Concrete Slabs

1. Construct the subgrade in accordance with Section 500. Construct the aggregate concrete base course in accordance with Section 520. Apply Section 420 to all concrete except as

otherwise provided herein. Finish the reinforced concrete bridge approach slabs in accordance with Article 420-14.

2. Apply a light broomed texture to the approach slabs before the concrete becomes non-plastic. Cure approach slabs in the same manner as specified for bridge decks in Subarticle 420-15(B).

3. Temporarily cover or fill the opening in the joint between the concrete approach and end of bridge until installation of the bridge expansion joint. Make sure that the covering or filler provides for drainage off the deck and keeps debris out of the voided joint and off the end bent cap.

4. Include any necessary temporary slope drainage systems to protect both the concrete approach slab. Use either corrugated polyethylene, corrugated steel or corrugated aluminum alloy for the temporary drainage pipe. Do not use perforated pipe. Provide temporary pipe of sufficient length for complete drainage away from the greenway embankment.

5. Backfill the approach slabs as soon as practical to prevent erosion adjacent to the slab.

PART 4 – MEASUREMENT AND PAYMENT

4.1. MEASUREMENT AND PAYMENT

A. The price and payment will be incidental to the LS Prefabricated Bridge item. This will serve as full compensation for all items referenced in this specification and required to construct a bridge approach slab.

No separate payment will be made for bridge approach slabs.

6. GROUT FOR STRUCTURES

PART 1 - GENERAL

This special provision addresses grout for use in pile blockouts, grout pockets, shear keys, dowel holes and recesses for structures. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, decks, end bent caps, or bent caps. Mix and place grout in accordance with the manufacturer's recommendations, the applicable sections of the Standard Specifications and this provision.

PART 2 – PRODUCTS

2.1. MATERIALS

Unless otherwise noted on the plans, use a Type 3 Grout in accordance with Section 1003 of the Standard Specifications.

Initial setting time shall not be less than 10 minutes when tested in accordance with ASTM C266.

Construction loading and traffic loading shall not be allowed until the 3 day compressive strength is achieved.

PART 3 – CONSTRUCTION REQUIREMENTS

Place and maintain components in final position until grout placement is complete and accepted. Concrete surfaces to receive grout shall be free of defective concrete, laitance, oil, grease and other foreign matter. Saturate concrete surfaces with clean water and remove excess water prior to placing grout.

PART 4 – MEASUREMENT AND PAYMENT

No separate payment will be made for "Grout for Structures". The cost of the material, equipment, labor, placement, and any incidentals necessary to complete the work shall be considered incidental to the structure item requiring grout.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HIGHWAY BUILDING
P. O. BOX 25201
RALEIGH, NORTH CAROLINA 27611

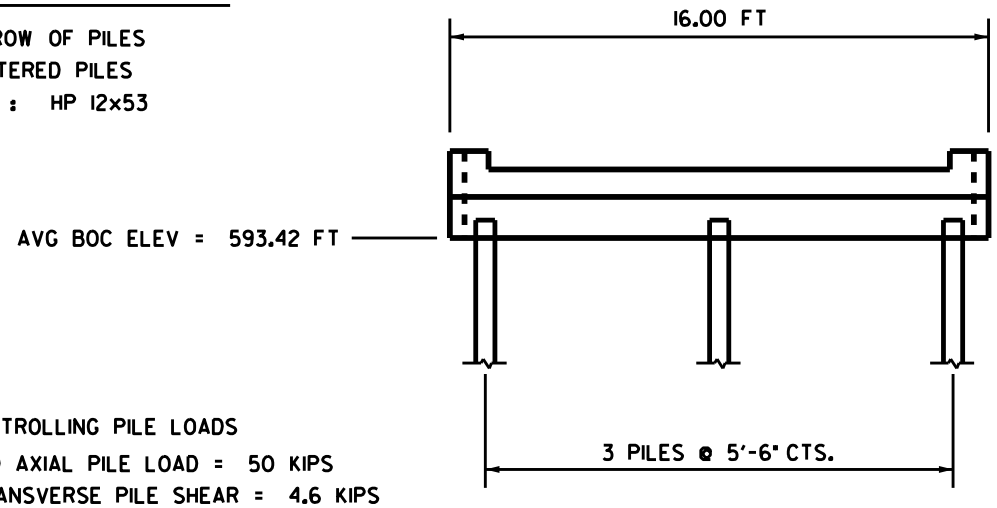
SUBJECT FACTORED GEOTECH LOADS
PEDESTRIAN BRIDGE LOADS

PROJECT DORTON PARK
CITY OF CONCORD

PREPARED BY JML DATE 03-2023 STATION 1+07.00
CHECKED BY MSR DATE 05-2023 STR NO SI SHEET 1 OF 2
1+79.00

BRIDGE SI - END BENT #1

SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP 12x53

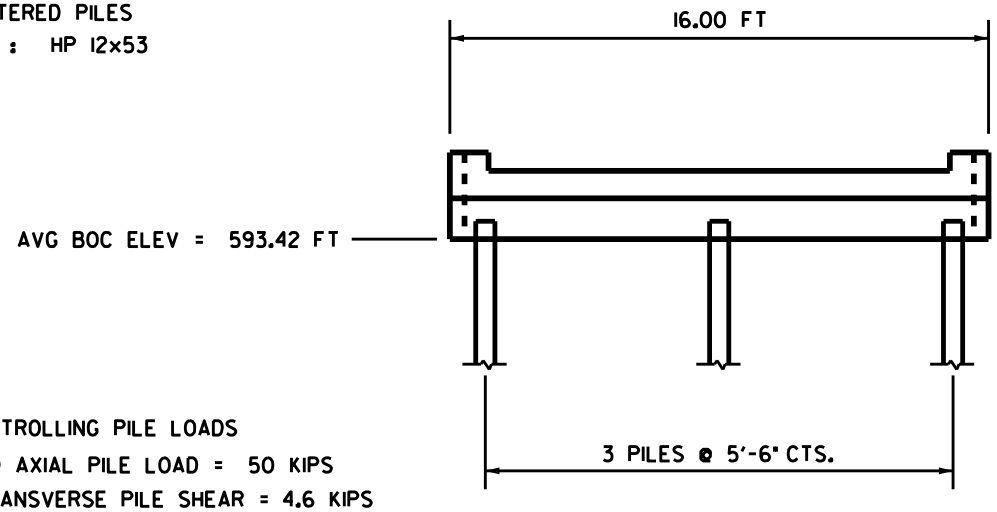


CONTROLLING PILE LOADS
FACTORED AXIAL PILE LOAD = 50 KIPS
FACTORED TRANSVERSE PILE SHEAR = 4.6 KIPS

END BENT SKETCH
NO SCALE

BRIDGE SI - END BENT #2

SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP 12x53



CONTROLLING PILE LOADS
FACTORED AXIAL PILE LOAD = 50 KIPS
FACTORED TRANSVERSE PILE SHEAR = 4.6 KIPS

END BENT SKETCH
NO SCALE

NO SCALE

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HIGHWAY BUILDING
P. O. BOX 25201
RALEIGH, NORTH CAROLINA 27611

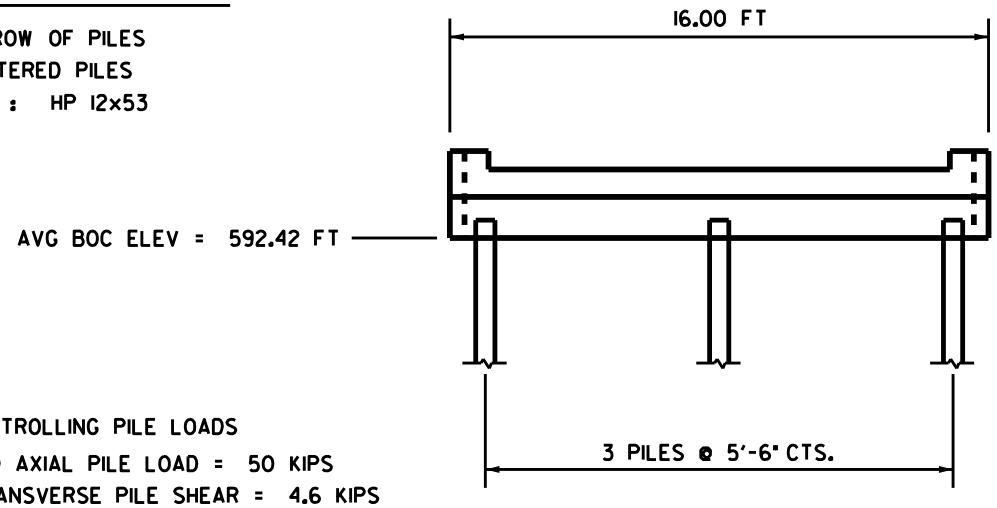
SUBJECT FACTORED GEOTECH LOADS
PEDESTRIAN BRIDGE LOADS

PROJECT DORTON PARK
CITY OF CONCORD

PREPARED BY JML DATE 03-2023 STATION 1+27.00 1+99.00
CHECKED BY MSR DATE 05-2023 STR NO S2 SHEET 2 OF 2

BRIDGE S2 - END BENT #1

SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP 12x53

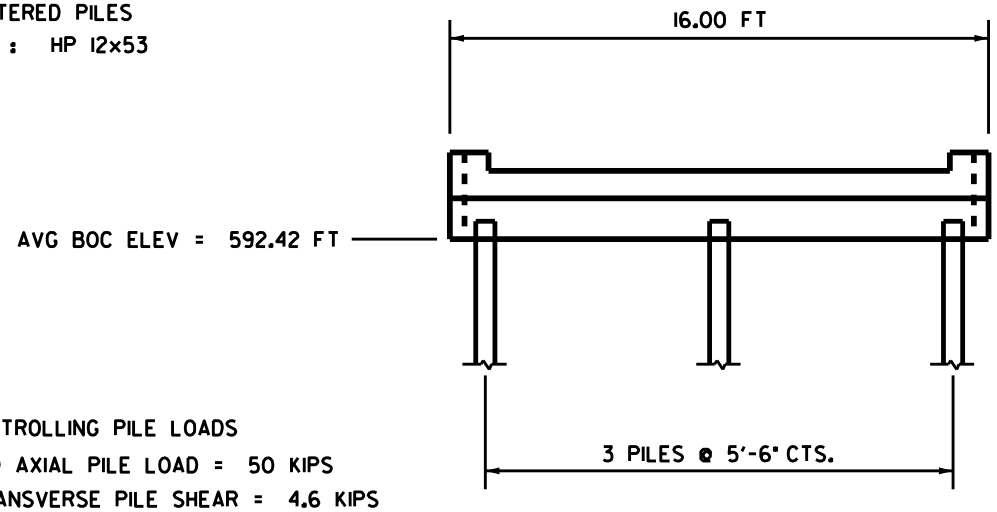


CONTROLLING PILE LOADS
FACTORED AXIAL PILE LOAD = 50 KIPS
FACTORED TRANSVERSE PILE SHEAR = 4.6 KIPS

END BENT SKETCH
NO SCALE

BRIDGE S2 - END BENT #2

SINGLE ROW OF PILES
NO BATTERED PILES
PILE TYPE : HP 12x53



CONTROLLING PILE LOADS
FACTORED AXIAL PILE LOAD = 50 KIPS
FACTORED TRANSVERSE PILE SHEAR = 4.6 KIPS

END BENT SKETCH
NO SCALE

NO SCALE

STREAM RESTORATION SEAL PAGE:

1. Stream Restoration Engineer
    a. Name: Rebecca Stubbs, PE
    b. License No: NC 049073
    c. Responsible for the following:
        i. 1.01 Silt Fence
        ii. 1.02 Silt Fence Outlet
        iii. 2.01 Stream Grading
        iv. 3.01 Stream Pump Around / Diversion Measures
        v. 3.02 Temporary Stream Crossings
        vi. 3.03 Temporary Seeding and Mulch
        vii. 3.04 Erosion Control Blanket
        viii. 4.01 & 4.02 Constructed Riffle – Native Material
        ix. 4.03 Angled Log Riffle
        x. 4.04 & 4.05 Boulder Sill
        xi. 4.06 & 4.07 Log Sill
        xii. 4.08 Boulder Cascade
        xiii. 4.09 Boulder Cross Vane
        xiv. 4.10 Log Cross Vane
        xv. 4.11 Boulder J-hook
        xvi. 4.12 Log Vane with Log Sill
        xvii. 4.13 Lunker Structure
        xviii. 4.14 Boulder Toe
        xix. 4.15 Brush Toe
        xx. 4.16 Soil Lifts
        xxi. 6.01 Permanent Seeding
        xxii. 6.02 Live Stakes
        xxiii. 6.03 Herbaceous Plugs
        xxiv. 6.04 Bare Root Planting
        xxv. 6.05 1-Gallon Tree Planting

1.01 Silt Fence

Description

Silt Fence is designed to protect water quality by intercepting sediment transported via overland runoff. Silt Fence provides a tight-weave mesh that slows and filters runoff, retaining sediment upgradient of the Silt Fence and allowing water to pass through the mesh. Silt Fence shall be used in conjunction with Silt Fence Outlets (see specification 1.02 Silt Fence Outlet).

Materials

The Contractor shall provide all materials and apparatus required to install and maintain the Silt Fence for the duration of the project and as described and specified in the Construction Drawings.

Construction

Silt Fence shall be constructed as described and specified in the Constructions Drawings. The Contractor shall install Silt Fence in all locations shown in the Construction Drawings and identified in the field at the earliest possible time. Silt fence shall be installed prior to starting construction activities in areas where clearing, grading, and/or other practices interfering with installation of the Silt Fence are not proposed. The Owner and Engineer may request installation of additional Silt Fence based on observations made during construction.

Maintenance

Silt Fence shall be maintained as specified in the Construction Drawings for the duration of the project, until the Erosion Control Inspector has issued final approval of the site. All Silt Fence shall be removed following final approval from the Erosion Control Inspector and accumulated sediments shall be spread throughout the area. Temporary and permanent seed shall be applied to areas where the Silt Fence was removed.

Method of Measurement

The quantity of Silt Fence shall be the total length of the proposed Silt Fence computed in linear feet from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Silt Fence to be measured for payment will be the actual linear feet of Silt Fence installed and accepted by the Engineer. This may require setting the Silt Fence, resetting the Silt Fence (potentially multiple times), and addition or subtraction of materials from what the Contractor originally sets until the Silt Fence is installed to the satisfaction and approval of the Engineer.

Basis of Payment

The quantity of Silt Fence will be paid for at the contract unit price per linear foot for “Silt Fence”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Silt Fence, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
1.01 Silt Fence ..... LF

1.02 Silt Fence Outlet

Description

Silt Fence Outlets are designed to allow accumulated runoff up-gradient of a row of Silt Fence to filter through the barrier, protecting and preserving the function of the Silt Fence. Sediment transported via overland runoff is retained upgradient of the Silt Fence Outlet and filtered runoff passes through the structure.

Materials

The Contractor shall provide all materials and apparatus required to install and maintain Silt Fence Outlets for the duration of the project and as described and specified in the Construction Drawings.

Construction

Silt Fence Outlets shall be constructed as described and specified in the Constructions Drawings. Silt Fence Outlets shall be installed where runoff is expected to accumulate upgradient of a row of Silt Fence and with maximum spacing of 100 linear feet, measured along the row of Silt Fence, specified in the Construction Drawings. The Contractor shall field verify the location of Silt Fence Outlets shown in the Construction Drawings prior to installation. The Owner and Engineer may request installation of additional Silt Fence Outlets based on observations made during construction.

Maintenance

Silt Fence Outlets shall be maintained as specified in the Construction Drawings for the duration of the project, until the Erosion Control Inspector has issued final approval of the site. All Silt Fence Outlets shall be removed following final approval from the Erosion Control Inspector and accumulated sediments shall be spread throughout the area. Coarse aggregates used in construction of the Silt Fence Outlets shall be removed from the site and disposed of by the Contractor. Temporary and permanent seed shall be applied to areas where the Silt Fence Outlets were removed.

Method of Measurement

The quantity of Silt Fence Outlets shall be the number of the proposed Silt Fence Outlets computed from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Silt Fence Outlets to be measured for payment will be the actual number of Silt Fence Outlets installed and accepted by the Engineer. This may require setting the Silt Fence Outlets, resetting the Silt Fence Outlets (potentially multiple times), and addition or subtraction of materials from what the Contractor originally sets until the Silt Fence Outlets are installed to the satisfaction and approval of the Engineer.

Basis of Payment

The quantity of Silt Fence Outlets will be paid for at the contract unit price for each “Silt Fence Outlet”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Silt Fence Outlets, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
1.02 Silt Fence Outlet..... EA

2.01 Stream Grading

Description

Site Grading is inclusive of all grade changes at the Site specified in the Construction Drawings, including but not limited to the import, export, stockpiling, compaction, loosening, testing, and disposal of specified earthen materials. At the request of the Contractor, the Owner or the Engineer will provide an earthwork report specifying the estimated total volume of cut and fill material generated from the proposed site layout as depicted in the Construction Drawings.

Materials

The Contractor shall provide all materials and equipment required to perform the proposed Site Grading as specified in the Construction Drawings.

Construction

The Contractor shall perform Site Grading using standard means and methods approved by the state in which the work is to be performed and all regulatory authorities issuing permit(s) for completion of the proposed work. The Owner and the Engineer reserve authority to disqualify Site Grading practices which are deemed to be insufficient or a hazard to the job site. The Contractor shall sequence Site Grading activities based on anticipated work schedule and current and forecasted weather patterns. The Owner and Engineer shall not be held liable for any loss of previously completed Site Grading which is to be disturbed to preform another task for site construction. The Owner and Engineer may request minor alterations to the proposed Site Grading based on observations made during construction. If the Contractor chooses to complete Site Grading based on a computer-generated model, it is the Contractor's sole responsibility to ensure the computer-generated model matches the grades and locations specified in the Construction Drawings.

Maintenance

The Contractor shall be required to maintain all existing and proposed grades as specified in the Construction Drawings throughout the duration of the project, until the Owner and the Engineer have issued final written approval of the Site.

Method of Measurement

The quantity of Site Grading shall be the total volume of earthen material to be altered to achieve proposed grades specified in the Construction Drawings, including any material specifications and/or surface preparation specified in the Construction Drawings. This may require grading areas of the site multiple times and addition or subtraction of materials until the Site Grading is completed to the satisfaction and approval of the Engineer.

Basis of Payment

The quantity of Site Grading will be paid for at the contract lump sum price for "Site Grading".

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining materials associated with the Site Grading, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
2.01 Site Grading..... LS

3.01 Stream Pump Around / Diversion Measures

Description

The contractor shall use a pump around to divert flowing water away from the working area. Any and all required pumping equipment shall be sized as required based on existing and forecasted field conditions and provided by the Contractor. The Owner and Engineer are not liable for any costs or problems associated with any onsite pumping. Pumping shall be maintained around the area of the stream being constructed such that water does not overtop the proposed stream bank at any time during the construction. Before anticipated larger storm events, channel construction shall be stabilized to reduce erosion. All water pumped from excavated/sediment-laden areas shall be pumped towards a sediment bag and not directly into the existing and/or constructed channel. Pump around and dewatering pump setups shall use temporary dissipation pads underlain with non-woven needle punched fabric, as specified in the Construction Drawings, to prevent scour (erosion) in areas where water is discharged.

Materials

The Contractor shall provide all hose, materials and apparatus required to install and maintain Stream Pump Around / Diversion Measures as required, possibly up to 24 hours a day, for the duration of the project and as described in the Construction Drawings.

Construction

The Contractor shall field locate Stream Pump Around / Diversion Measures based on field conditions at the time of construction, anticipated work schedule, and current and forecasted weather patterns. Stream Pump Around / Diversion Measures shown in the Construction Drawings are suggested sections of work and may be varied by the Contractor with approval of the Engineer.

Maintenance

The Stream Pump Around / Diversion Measures shall be maintained in working order such that the area of work is kept dry to prevent exposed sediments from washing downstream and loss of completed work. Pumps shall be regularly inspected for fluid leaks. If fluid leaks are observed during inspection, the pump shall be immediately shut off and repaired. In the event of a large chemical/fluid spill, the Contractor shall notify the erosion control inspector per the NCG01 Self-Inspection, Recordkeeping, and Reporting document in the Construction Drawings.

Basis of Payment

The quantity of Stream Pump Around / Diversion Measures will be paid for at the contract lump sum price for “Stream Pump Around / Diversion Measures”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, placing, moving, operating, and maintaining the Stream Pump Around / Diversion Measures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
3.01 Stream Pump Around / Diversion Measures ..... LS

3.02 Temporary Stream Crossings

Description

Temporary Stream Crossings are used to provide access across an active (flowing) channel. Temporary Stream Crossings are intended to limit impact to and prevent sediment deposition within active channels.

Materials

The Contractor shall provide all materials required for furnishing and maintaining Temporary Stream Crossings.

Construction

An example of an acceptable Temporary Stream Crossing is provided in the Construction Drawings. The Contractor may choose to use alternative materials and designs to establish a Temporary Stream Crossing with approval from the Engineer. The Contractor shall field locate Temporary Stream Crossings based on field conditions at the time of construction, anticipated work schedule, and current and forecasted weather patterns. Temporary Stream Crossings shown in the Construction Drawings are suggested crossing locations and may be varied by the Contractor with approval of the Engineer. The Owner and the Engineer reserve authority to require Temporary Stream Crossings to be removed, relocated, reconstructed, and/or modified if they are deemed to be insufficient, inappropriately placed, or a hazard to the job site. If Temporary Stream Crossings are located in areas where channel grading is not proposed, per the Construction Drawings, the area where the crossing is located shall be returned to its pre-construction contours. The Owner and the Engineer are not responsible for the design of, or engineering calculations associated with Temporary Stream Crossings established on Site.

Maintenance

Temporary Stream Crossings shall be maintained in good condition such that they are not a hazard to the job site or adjacent surface waters. Temporary Stream Crossings shall be regularly inspected for stability and any structural issues. Temporary Stream Crossings shall be inspected following every rainfall event. The Owner and the Engineer may request installation of additional erosion control measures, including but not limited to silt fence, silt fence outlets, and coarse aggregate, adjacent to Temporary Stream Crossings to prevent sediment runoff to adjacent surface waters. In the event that a temporary crossing fails, the Engineer shall be immediately notified.

Basis of Payment

The quantity of Temporary Stream Crossings will be paid for at the contract lump sum price for “Temporary Stream Crossings”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, placing, moving, operating, and maintaining the Temporary Stream Crossings, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
3.02 Temporary Stream Crossings ..... LS

3.03 Temporary Seeding and Mulch

Description

The work covered by this specification consists of furnishing and installing Temporary Seeding and Mulch and establishing temporary vegetative ground cover in areas specified in the Construction Drawings. This work consists of seeding and mulching all areas disturbed during construction. The quantity of temporary seed and mulch to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of Temporary Seeding may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work. Refer to Section 1620 for Temporary Seeding in the NCDOT Standard Specifications for Roads and Structures.

Materials

The contractor shall supply all seed and mulch necessary to establish temporary vegetative ground cover in accordance with the Construction Drawings, erosion control permit(s), and as directed by the Engineer. The Contractor shall follow the temporary seeding schedule, notes, and specifications included in the Construction Drawings. Mulch used protect and secure temporary seed shall clean wheat straw. Asphalt, or any other non-natural material, tack shall not be used to secure temporary seed and mulch.

All seed and seed varieties must be free of state and federally listed noxious weed seed. In addition, none of the following seed will occur in the mix:

- Bermuda bluegrass
- Bindweed
- Cocklebur
- Corn cockle
- Dodder
- Giant foxtail
- Horse nettle
- Annual bluegrass
- Spurred anoda
- Wild garlic
- Wild onion
- Lespedeza

Construction

All disturbed areas will be seeded with temporary seed and mulched. Seeding will be performed using a broadcast spreader. Other methods may be used but must be approved by Engineer in advance of installation. No seeding will be performed when ambient temperature is below 32° F or 0°C. No seeding will occur when ground is frozen. Groundcover must be established and maintained in accordance with the specifications in the Construction Drawings and the erosion control permit(s).

Maintenance

Maintenance shall begin immediately after the seeding and mulching operation and continue until Final Acceptance. Maintenance of seeded areas shall consist of watering, weed and pest control, fertilization, erosion repair, reseeding, and incidental operations as necessary to establish a healthy, vigorous, weed free and disease fee uniform stand of grass.

The Contractor is responsible for reseeding portions or the entirety of the project site following rain events that remove seed from previously seeded areas. The directive to reseed will be at the sole discretion of the Engineer and Owner.

Groundcover must be established and maintained in accordance with the specifications in the Constructions and the erosion control permit(s). For projects where an erosion control permit is not required, the Contractor will be required to achieve 90% coverage of all disturbed soils with not bare areas greater than five square feet prior to receiving approval from the Engineer.

Method of Measurement

The quantity of Temporary Seeding and Mulch shall be the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings. The quantity of permanent seeding to be measured for payment will be the actual number of acres of area seeded and mulched and accepted by the Engineer. The cost of ripping, fertilizer, seed, additives, mulching, and various other items covered by this section will be incidental to temporary seeding and mulching. Payment for temporary seeding and mulch will be the full compensation of all material, equipment, labor and all related expenses.

Basis of Payment

The quantity of Temporary Seeding and Mulch will be paid for at the contract unit price per acre of "Temporary Seeding and Mulch".

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
3.03 Temporary Seeding and Mulch ..... AC

3.04 Erosion Control Blanket

Description

Erosion Control Blankets (ECBs) are a woven matting designed to protect soil from surface erosion by lying over the ground to form a semi-permanent cover. ECBs protect soil against wind and water erosion by reducing raindrop impact and slowing runoff as it flows across a surface. EBCs stabilize disturbed soil areas and retain soil moisture, thereby improving conditions for seed germination and vegetation establishment. ECBs provide open weaves that can be seeded to encourage plant growth and protection, which further helps with water filtration and erosion control. ECBs can be used effectively for erosion control on shallow to moderate hillsides or slopes, of up to 2(H):1(v).

Materials

The Erosion Control Blanket shall consist of a machine-produced blanket made of coconut fiber, be 100 percent biodegradable, and be equivalent or better than the performance and physical requirements specified in the Construction Drawings.

The Contractor shall supply all stakes necessary for the installation of the ECB. Stakes used shall be 100% biodegradable material and shall be designed to safely and effectively secure the ECB.

The Contractor shall not use single netted straw blankets or single netted straw blend blankets under this specification. Soil stabilization matting which uses plastics, metals, or other man-made materials in the construction of the material will not be permitted.

Construction

Grade areas to be treated with ECBs and compact as indicated on the plans or directed by the Engineer. Remove large rocks, soil clods, vegetation, twigs, debris, and other sharp objects that could keep the ECB from intimate contact with subgrade. Prior to ECB placement, prepare soils according to manufacturer's specification. Add seed, lime and fertilizer as outlined on the Construction Drawings.

1. Install the ECB at the elevation and alignment indicated on the plans. Refer to the Construction Drawings for location, extent, and specifications. If there are questions or problems with the location, extent, or methods of installation, contact the Engineer or responsible personnel on the site for assistance. If the ECB is not installed correctly the first time, it will have to be reinstalled.

2. Dig a trench at top of the installation area. Key-in edges of matting a minimum of 6 inches into finished grade. After securing the top and bottom ends, care should be taken that soil is compacted properly and no loose gaps exist.

3. Lay matting shingled downstream to upstream, overlapping at edges a minimum of one foot.

4. Anchor ECB with stakes to ensure good ground contact of the matting to withstand high flows. Stakes shall be 100% biodegradable and installed per the manufacturer's specifications including, but not limited to, the manufacturer's recommended density and pattern.

5. Key-In edges of matting a minimum of six inches, particularly near structures, boulders, logs, etc.

Maintenance

Materials, equipment, and personnel must be available for maintenance at all times.

1. Inspect the ECBs.

a. During Construction: Inspect ECB to see if machinery or construction activity has damaged the matting; if damaged, repair the EBC. Check matting for loose ends, flaps, or other weaknesses or damage which may cause it to become loose under flow conditions. Ensure blankets overlap and are in continuous contact with the subgrade. Make sure anchors are intact and that no erosion is evident underneath the blanket. Inspect regularly until grass or vegetation is firmly established.

b. Rainfall Events: Inspect ECB prior to and following precipitation events until vegetation becomes permanently established. Inspect if runoff has undermined the matting; if so, repatch grading, revegetate, and make repairs to the ECB.

2. Ensure the anchoring pattern is consistent with that shown on the manufacturer's installation sheet. If there is evidence that the ECB is not securely fastened to the soil, install additional stakes to prevent the ECB from becoming dislodged.

3. Repair or replace any damaged or failing sections of the ECB immediately and exercise care when doing so to minimize damage to adjacent blanketed areas.

4. Reposition or replace blanket(s) that have moved along the slope or have been damaged.

5. Repair undermining beneath blankets as needed. For erosion evident underneath the blanket, facilitate stabilization by addressing any runoff that may be causing the erosion. Pull back the blanket(s), fill and regrade eroded area, revegetate, and then firmly secure the blanket(s).

Method of Measurement

The quantity of Erosion Control Blanket shall be the total area of the proposed matting computed in square yards from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Erosion Control Blanket to be measured for payment will be the actual square yards of matting installed and accepted by the Engineer. This may require setting the matting, resetting the matting (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the matting is installed to the satisfaction and approval of the Engineer.

Basis of Payment

The quantity of Erosion Control Blanket will be paid for at the contract unit price per square yard of "Erosion Control Blanket".

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Erosion Control Blanket, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
3.04 Erosion Control Blanket ..... SY

4.01 & 4.02 Constructed Riffle – Native Material

Description

Constructed Native Material Riffles are in-stream structures constructed for the purpose of grade control and/or habitat improvement. Constructed Native Material Riffles are constructed as shown in the Construction Drawings and the following specifications. Constructed Riffles shall consist of salvaged native and/or quarried stone of the specified gradation and size, placed below the invert of the proposed channel at the elevations and locations shown on the Construction Drawings or as directed by the Engineer.

Materials

Native Material Riffles shall be constructed with stone of gradation and size listed in the Construction Drawings. The contractor shall salvage and stockpile native stone from the existing channel for re-use in proposed structures whenever possible. If salvaged stone does not meet the gradation and size requirements listed in the Construction Drawings, the Contractor shall supplement the salvaged stone with quarried stone sufficient to meet the specifications listed in the Construction Drawings.

Construction

The Constructed Native Material Riffle shall be installed according to the locations, grades, and elevations shown on the Construction Drawings. The riffle shall be constructed starting at the downstream end and proceed upstream. Stone shall be placed in successive lifts to the specified elevations and locations. Riffle subgrade stone shall be placed in such a manner as to produce a riffle that mimics the turbulence of a natural riffle at the specified grade. Stone salvaged from the existing channel shall be placed on the surface of the Constructed Native Material Riffle.

The surface of the Constructed Native Material Riffle structure shall be finished to a smooth compact surface in accordance with the lines, grades, and elevations shown in the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of Constructed Native Material Riffles shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Constructed Native Material Riffles to be measured for payment will be the actual linear feet of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Constructed Native Material Riffles will be paid for at the contract unit price per linear foot of “Constructed Riffle – Native Material”. Contractor shall specify unit price for Constructed Native Material Riffles for each project stream.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Constructed Native Material Riffle structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:

4.01 Constructed Riffle – Native Material – Afton Run ..... LF
4.02 Constructed Riffle – Native Material – UT1 ..... LF

4.03 Angled Log Riffle

Description

Angled Log Riffles are in-stream structures constructed for the purpose of grade control and/or habitat improvement. Angled Log Riffles enhance flow diversity and turbulence under base flow conditions, promoting aquatic habitat, nutrient processing, and re-aeration of stream flow, benefiting water quality. Angled Log Riffles are constructed as shown in the Construction Drawings and the following specifications. Logs incorporated in Constructed Angled Log Riffles shall not be mobilized under defined flow conditions. Angled Log Riffle structures shall consist native stone of specified gradation and size and logs of the specified size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer.

Materials

Angled Log Riffles shall be constructed of logs of size(s) specified in the Construction Drawings. Logs must be hardwood and relatively straight. The Contractor shall re-use logs from trees removed for construction whenever possible. The Contractor shall supply any and all logs needed to construct the proposed Angled Log Riffles in addition to those harvested on site. The Engineer shall approve of all logs to be used prior to construction.

Native stone used to backfill between the installed logs shall meet the gradation and size requirements listed in the Construction Drawings. The contractor shall salvage and stockpile native stone from the existing channel for re-use in proposed structures whenever possible. If salvaged stone does not meet the gradation and size requirements listed in the Construction Drawings, the Contractor shall supplement the salvaged stone with quarried stone sufficient to meet the specifications listed in the Construction Drawings.

The filter fabric installed at each log shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place logs within the Angled Log Riffle as described in the Construction Drawings or as directed by the Engineer, to the thickness, widths, and lengths shown in the Construction Drawings and described in the details within or directed by the Engineer. All logs shall be placed to form a riffle structure in accordance with the Construction Drawings and shall meet the approval of the Engineer. Native stone shall be used to backfill between the installed logs to a thickness equal to the depth of the header (and any footer) logs. Stone salvaged from the existing channel shall be placed on the surface of the Angled Log Riffle.

The surface of the Angle Log Riffle structure shall be finished to a smooth compact surface in accordance with the lines, grades, and elevations shown in the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of Angled Log Riffles shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Angled Log Riffles to be measured for payment will be the actual linear feet of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Angled Log Riffle structures will be paid for at the contract unit price per linear foot of "Angled Log Riffle".

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Angled Log Riffle structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.03 Angled Log Riffle ..... LF

4.04 & 4.05 Boulder Sill

Description

Boulder Sill structures are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance, and/or habitat improvement. Boulder Sills shall be constructed as shown in the Construction Drawings and the following specifications. Boulder Sill structures shall consist of boulders of the specified size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer. Boulder Sills will establish grade control and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Boulder Sills shall be constructed of boulders of size(s) specified in the Construction Drawings. The contractor shall salvage and stockpile boulders of appropriate size from the existing channel for re-use in proposed structures whenever possible. The Contractor shall supply any and all boulders needed for the construction of the proposed Boulder Sill(s) in addition to those salvaged on site. The Contractor is responsible for ensuring that all boulders provided by the Owner used to construct Boulder Sill structures meet the requirements specified in the Construction Drawings and this specification. Boulders used for Boulder Sills shall consist of blasted granite quarry stone or boulders stockpiled onsite and approved by the Engineer. All boulders shall be native structural stone or shot rock, angular, tabular, flat rock with a minimum of two parallel sides. Rounded edges are acceptable so long as rounded edges are not bearing or supporting. Approximate dimensions of boulders and dimension tolerances are specified in the Construction Drawings.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Boulder Sill, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place boulders and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All stone shall be placed to form a Boulder Sill in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Boulder Sill structures shall consist of header boulders underlain with footer boulders unless otherwise directed by the Engineer. Footer boulders shall provide a stable base by being the same size or larger than the header boulders to be placed on top. Footer boulders shall be placed individually and keyed into the channel, and streambank as described in the Construction Drawings or otherwise directed by the Engineer. Each header boulder should rest on two footer boulders along the profile. Place header boulders so their top surface slopes slightly against the flow direction and create a uniform surface from left bank to right bank. Header boulders should be set back from the front of the footer boulders, as specified in the Construction Drawings. No part of the structure shall be placed above the design channel stream bed at that location. Header and footer boulders shall be placed linearly with tight and contiguous surface contact with adjacent boulders to minimize all gaps between boulders. Prior to placement of filter fabric, any voids between boulders shall be chinked with backfill stone approved by the Engineer. Filter fabric shall be placed along the upstream face of the header and footer boulders and extend upstream along the bottom of the streambed. Coarse backfill shall be placed behind the Boulder Sill and on top of the filter fabric to a thickness equal to the depth of the header and footer boulders. Material excavated for

the footer boulder or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Boulder Sill. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Boulder Sill shall be trimmed.

The surface of the Boulder Sill structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of Boulder Sill structures shall be the number of Boulder Sills computed from the lines drawn in the Construction Drawings. The quantity of Boulder Sill structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Boulder Sill structures will be paid for at the contract unit price per each “Boulder Sill”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Boulder Sill structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.04 Boulder Sill – Afton Run ..... EA
4.05 Boulder Sill – UT1 ..... EA

4.06 & 4.07 Log Sill

Description

Log Sill structures are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance, and/or habitat improvement. Log Sills shall be constructed as shown in the Construction Drawings and the following specifications. Logs Sill structures shall consist of logs of the specified size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawing or directed by the Engineer. Log Sills will establish grade control and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Log Sills shall be constructed of logs of size(s) specified in the Construction Drawings. Logs must be hardwood and relatively straight. The Contractor shall re-use logs from trees removed for construction whenever possible. The Contractor shall supply any and all logs needed to construct the proposed Constructed Log Sill(s) in addition to those harvested on site. The Engineer shall approve of all logs to be used prior to construction.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Log Sill, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all anchors used to secure the Log Sill structure(s). Anchors shall be ¼ inch rebar or drift pins of sufficient length to pass through the logs and into the soils below as specified in the Construction Drawings and/or these specifications.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place logs and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All logs and stone shall be placed to form a Log Sill in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Log Sill structures shall consist of header logs underlain by footer logs unless otherwise directed by the Engineer. Logs shall be secured with anchors installed with a maximum spacing of 2 feet on center. Anchors shall be ¼ inch rebar or drift pins. Anchors shall pass through the header and footer logs and extend into the ground a minimum of 6 inches. All gaps/voids larger than 1 inch between the header and footer logs shall be chinked with limbs and/or brush on the upstream side prior to placement of the filter fabric. Filter fabric shall be nailed to the entire length of the header log on the top of the structure with galvanized nail with plastic cap every 12 inches. Filter fabric shall extend upstream of the Log Sill on the bottom of the stream channel and be overlain with coarse backfill to a thickness equal to the depth of the header (and any footer) logs. Material excavated for the footer logs or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Log Sill. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Log Sill shall be trimmed.

Header and footer logs shall be installed perpendicular to the channel unless otherwise directed by the Engineer. Header and footer logs shall be keyed into the channel and streambanks as described in the Construction Drawings, or otherwise directed by the Engineer.

The surface of the Log Sill structure shall be finished to a smooth compact surface in accordance with the lines, grades, and elevations shown in the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of Log Sill structures shall be the number of Log Sills computed from the lines drawn in the Construction Drawings. The quantity of Log Sill structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Log Sill structures will be paid for at the contract unit price per each “Log Sill”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Log Sill structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.06 Log Sill – Afton Run ..... EA
4.07 Log Sill – UT1 ..... EA

4.08 Boulder Cascade

Description

Boulder Cascades are in-stream structures constructed for the purpose of grade control and/or habitat improvement. Boulder Cascades enhance flow diversity and turbulence under base flow conditions, promoting aquatic habitat, nutrient processing, and re-aeration of stream flow, benefiting water quality. Boulder Cascades are engineered to provide stable grade transitions within channels, at slopes greater than those typically suitable for constructed riffles. Boulder Cascades are constructed as shown in the Construction Drawings and described in the following specifications. Boulders incorporated in Boulder Cascades will not be mobilized under defined flow conditions. Boulder Cascades shall consist of boulders of specified size and native stone of specified gradation and size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer.

Materials

Boulder Cascades shall be constructed of boulders of size(s) specified in the Construction Drawings. The contractor shall salvage and stockpile boulders of appropriate size from the existing channel for re-use in proposed structures whenever possible. The Contractor shall supply any and all boulders needed for the construction of the proposed Boulder Sill(s) in addition to those salvaged on site. The Contractor is responsible for ensuring that all boulders provided by the Owner used to construct Boulder Sill structures meet the requirements specified in the Construction Drawings and this specification. Boulders used for Boulder Cascades shall consist of blasted granite quarry stone or boulders stockpiled onsite and approved by the Engineer. All boulders shall be native structural stone or shot rock, angular, tabular, flat rock with a minimum of two parallel sides. Rounded edges are acceptable so long as rounded edges are not bearing or supporting. Approximate dimensions of boulders and dimension tolerances are specified in the Construction Drawings.

Native stone used to backfill between the installed boulders shall meet the gradation and size requirements listed in the Construction Drawings. The contractor shall salvage and stockpile native stone from the existing channel for re-use in proposed structures whenever possible. If salvaged stone does not meet the gradation and size requirements listed in the Construction Drawings, the Contractor shall supplement the salvaged stone with quarried stone sufficient to meet the specifications listed in the Construction Drawings.

The filter fabric installed upstream of each boulder structure with the Boulder Cascade shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place boulders within the Boulder Cascade as described in the Construction Drawings or as directed by the Engineer, to the thickness, widths, and lengths shown in the Construction Drawings and described in the details within or directed by the Engineer. All boulders shall be placed to form a cascade structure in accordance with the Construction Drawings and shall meet the approval of the Engineer.

Boulder Cascades consist of two typical sections: a cascade sequence and a step pool sequence. The cascade sequence consists of multiple shallow boulder steps of maximum height specified in the Construction Drawings. Downstream of each shallow step in the cascade sequence, a micro pool shall be constructed as specified in the Construction Drawings. The step pool sequence consists of a single, taller boulder step, or multiple steps depending on the proposed grade, of maximum height specified in the Construction Drawings. Downstream of each boulder step in the step pool sequence, a scour pool shall be constructed as specified in the Construction Drawings. The two typical sections of the Boulder Cascade

are alternated throughout the structure, at the discretion of the Contractor or as directed as by the Engineer, to achieve the grades and elevations specified in the Construction Drawings.

Each boulder step in the Boulder Cascade shall consist of header boulders underlain with footer boulders unless otherwise directed by the Engineer. Footer boulders shall provide a stable base by being the same size or larger than the header boulders to be placed on top. Footer boulders shall be placed individually and keyed into the channel and streambanks as described in the Construction Drawings or otherwise directed by the Engineer. Place header boulders on top of footer boulders horizontally so that each half of the step rock rests on one half of a footer rock below. Each header boulder should rest on two footer boulders along the profile. Place header boulders so their top surface slopes slightly against the flow direction. Header boulders should be set back from the front of the footer boulders, as specified in the Construction Drawings, such that part of the header boulder is resting on porous backfill. Header and footer boulders shall be placed with tight and contiguous surface contact with adjacent boulders to minimize all gaps between boulders. Prior to placement of filter fabric, any voids between boulders shall be chinked with backfill stone approved by the Engineer. Filter fabric shall be placed along the upstream face of the header and footer boulders and extend upstream along the bottom of the streambed. Coarse backfill shall be placed behind the boulder structure and on top of the filter fabric to a thickness equal to the depth of the header and footer boulders. Material excavated for the footer boulder or native streambed material may be used as additional fill material to seal the structure on the upstream side of the boulder structure. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed boulder structure shall be trimmed.

Boulder steps shall be constructed such that a meandering thalweg is created through the Boulder Cascade, as specified in the Construction Drawings. Boulder steps shall have horizontal and vertical angle, specified in the Construction Drawings, such that flow is directed away from the streambanks. Boulder steps shall span the entire bankfull channel and be keyed into each streambank as specified in the Construction Drawings.

Native stone of specified gradation and size shall be used to backfill between the installed boulder structures to a thickness equal to the depth of the header (and any footer) boulders. Stone salvaged from the existing channel shall be placed on the surface of the Boulder Cascade.

The surface of the Boulder Cascade shall be finished to a smooth compact surface in accordance with the lines, grades, and elevations shown in the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of Boulder Cascades shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Boulder Cascades to be measured for payment will be the actual linear feet of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Boulder Cascade structures will be paid for at the contract unit price per linear foot of “Boulder Cascade”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing,

and maintaining the Boulder Cascade structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.08 Boulder Cascade..... LF

4.09 Boulder Cross Vane

Description

Boulder Cross Vanes are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance, and/or habitat improvement. Boulder Cross Vanes shall be constructed as shown in the Construction Drawings and the following specifications. Boulder Cross Vanes shall consist of boulders of the specified size, placed below the invert of the proposed channel at elevations and locations shown in the Construction Drawings or as directed by the Engineer. Boulder Cross Vanes will establish grade control, reduce bank erosion, and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Boulder Cross Vanes shall be constructed of boulders of size(s) specified in the Construction Drawings. The contractor shall salvage and stockpile boulders of appropriate size from the existing channel for re-use in proposed structures whenever possible. The Contractor shall supply any and all boulders needed for the construction of the proposed Boulder Cross Vane(s) in addition to those salvaged on site. The Contractor is responsible for ensuring that all boulders provided by the Owner used to construct Boulder Cross Vane structures meet the requirements specified in the Construction Drawings and this specification. Boulders used for Boulder Cross Vanes shall consist of blasted granite quarry stone or boulders stockpiled onsite and approved by the Engineer. All boulders shall be native structural stone or shot rock, angular, tabular, flat rock with a minimum of two parallel sides. Rounded edges are acceptable so long as rounded edges are not bearing or supporting. Approximate dimensions of boulders and dimension tolerances are specified in the Construction Drawings.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Boulder Cross Vane, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place boulders and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All stone shall be placed to form a Boulder Cross Vane in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Boulder Cross Vane structures consist of three sections: the throat (or sill) and two vane arms. Each section of the structure shall consist of header boulders underlain with footer boulders unless otherwise directed by the Engineer. Footer boulders shall provide a stable base by being the same size or larger than the header boulders to be placed on top. Footer boulders shall be placed individually and keyed into the channel and streambanks as described in the Construction Drawings or otherwise directed by the Engineer. Place header boulders on top of footer boulders horizontally so that each half of the step rock rests on one half of a footer rock below. Each header boulder should rest on two footer boulders along the profile. Place header boulders so their top surface slopes slightly against the flow direction. Header boulders should be set back from the front of the footer boulders, as specified in the Construction Drawings, such that part of the header boulder is resting on porous backfill. Header and footer boulders shall be placed linearly with tight and contiguous surface contact with adjacent boulders to minimize all gaps between boulders. Prior to placement of filter fabric, any voids between boulders shall be chinked with backfill stone approved by the Engineer. Filter fabric shall be placed along the upstream face of the

header and footer boulders and extend upstream along the bottom of the streambed. Coarse backfill shall be placed behind the boulder structure and on top of the filter fabric to a thickness equal to the depth of the header and footer boulders. Material excavated for the footer boulder or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Boulder Cross Vane. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Boulder Cross Vane shall be trimmed.

Boulder Cross Vane arms shall be angled from the upstream bank and shall have a vertical angle as specified in the Construction Drawings. Each vane arm shall span approximately one-third the bankfull channel width with the throat of the Boulder Cross Vane occupying the remaining one-third the bankfull channel width. The downstream end of each vane arm shall be keyed into the streambank to a depth specified in the Construction Drawings. The throat section of the Boulder Cross Vane shall be nearly flat and coincide with the streambed elevations shown in the Construction Drawings.

The surface of the Boulder Cross Vane structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Boulder Cross Vanes shall be the number of Boulder Cross Vanes computed from the lines drawn in the Construction Drawings, or as directed by the Engineer. The quantity of Boulder Cross Vane structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Boulder Cross Vanes will be paid for at the contract unit price per each “Boulder Cross Vane”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Boulder Cross Vane structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.09 Boulder Cross Vane ..... EA

4.10 Log Cross Vane

Description

Log Cross Vanes are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance, and/or habitat improvement. Log Cross Vanes shall be constructed as shown in the Construction Drawings and the following specifications. Log Cross Vane structures shall consist of logs of the specified size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer. Log Cross Vanes will establish grade control, reduce bank erosion, and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Log Cross Vanes shall be constructed of logs of size(s) specified in the Construction Drawings. Logs must be hardwood and relatively straight. The Contractor shall re-use logs from trees removed for construction whenever possible. The Contractor shall supply any and all logs needed to construct the proposed Log Cross Vane(s) in addition to those harvested on site. The Engineer shall approve of all logs to be used prior to construction.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Log Cross Vane, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all anchors used to secure the Log Cross Vane structure(s). Anchors shall be ¼ inch rebar or drift pins of sufficient length to pass through the logs and into the soils below as specified in the Construction Drawings and/or these specifications.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place logs and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All logs and stone shall be placed to form a Log Cross Vane in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Log Cross Vanes consist of three sections: the throat (or sill) and two vane arms. Each section of the structure shall consist of a header log underlain by footer logs unless otherwise directed by the Engineer. Logs shall be secured with anchors installed with a maximum spacing of 2 feet on center. Anchors shall be ¼ inch rebar or drift pins. Anchors shall pass through the header and footer logs and extend into the ground a minimum of 6 inches. All gaps/voids larger than 1 inch between the header and footer logs shall be chinked with limbs and/or brush on the upstream side prior to placement of the filter fabric. Filter fabric shall be nailed to the entire length of the header log on the top of the structure with galvanized nail with plastic cap every 12 inches. Filter fabric shall extend upstream of the Log Cross Vane on the bottom of the stream channel and be overlain with coarse backfill to a thickness equal to the depth of the header (and any footer) logs. Material excavated for the footer logs or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Log Cross Vane. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Log Cross Vane shall be trimmed.

Log Cross Vane arms shall be angled from the upstream bank and shall have a vertical angle as specified in the Construction Drawings. Each vane arm shall span approximately one-third the bankfull channel width with the throat of the Log Cross Vane occupying the remaining one-third the bankfull channel width. The upstream and downstream end of each vane arm shall be keyed into the channel bed and streambank respectively, as specified in the Construction Drawings. The throat section of the Log Cross Vane shall be nearly flat and coincide with the streambed elevations shown in the Construction Drawings.

The surface of the Log Cross Vane structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Log Cross Vanes shall be the number of Log Cross Vanes computed from the lines drawn in the Construction Drawings, or as directed by the Engineer. The quantity of Log Cross Vane structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Log Cross Vane structures will be paid for at the contract unit price per each “Log Cross Vane”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Log Cross Vane structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.10 Log Cross Vane ..... EA

4.11 Boulder J-Hook

Description

Boulder J-Hooks are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance, and/or habitat improvement. Boulder J-Hooks shall be constructed as shown in the Construction Drawings and the following specifications. Boulder J-Hooks shall consist of boulders of the specified size, placed below the invert of the proposed channel at elevations and locations shown in the Construction Drawings or as directed by the Engineer. Boulder J-Hooks will establish grade control, reduce bank erosion, and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Boulder J-Hooks shall be constructed of boulders of size(s) specified in the Construction Drawings. The contractor shall salvage and stockpile boulders of appropriate size from the existing channel for re-use in proposed structures whenever possible. The Contractor shall supply any and all boulders needed for the construction of the proposed Boulder J-Hook(s) in addition to those salvaged on site. The Contractor is responsible for ensuring that all boulders provided by the Owner used to construct Boulder J-Hook structures meet the requirements specified in the Construction Drawings and this specification. Boulders used for Boulder J-Hooks shall consist of blasted granite quarry stone or boulders stockpiled onsite and approved by the Engineer. All boulders shall be native structural stone or shot rock, angular, tabular, flat rock with a minimum of two parallel sides. Rounded edges are acceptable so long as rounded edges are not bearing or supporting. Approximate dimensions of boulders and dimension tolerances are specified in the Construction Drawings.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Boulder J-Hook, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place boulders and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All stone shall be placed to form a Boulder J-Hook in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Boulder J-Hooks consist of two sections: the sill and the vane arm. Each section of the structure shall consist of header boulders underlain with footer boulders unless otherwise directed by the Engineer. Footer boulders shall provide a stable base by being the same size or larger than the header boulders to be placed on top. Footer boulders shall be placed individually and keyed into the channel and streambanks as described in the Construction Drawings or otherwise directed by the Engineer. Place header boulders on top of footer boulders horizontally so that each half of the step rock rests on one half of a footer rock below. Each header boulder should rest on two footer boulders along the profile. Place header boulders so their top surface slopes slightly against the flow direction. Header boulders should be set back from the front of the footer boulders, as specified in the Construction Drawings, such that part of the header boulder is resting on porous backfill. Header and footer boulders shall be placed linearly with tight and contiguous surface contact with adjacent boulders to minimize all gaps between boulders. Prior to placement of filter fabric, any voids between boulders shall be chinked with backfill stone approved by the Engineer. Filter fabric shall be placed along the upstream face of the header and footer boulders, and

extend upstream along the bottom of the streambed. Coarse backfill shall be placed behind the boulder structure and on top of the filter fabric to a thickness equal to the depth of the header and footer boulders. Material excavated for the footer boulder or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Boulder J-Hook. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Boulder J-Hook shall be trimmed.

Boulder vane arm shall be angled from the upstream bank and shall have a vertical angle as specified in the Construction Drawings. The vane arm shall span approximately one-third the bankfull channel width with the sill spanning the remainder of the bankfull channel width. The downstream end of each vane arm shall be keyed into the streambank as specified in the Construction Drawings. The sill shall have a vertical angle and be keyed into the streambank opposite of the vane arm as specified in the Construction Drawings.

The surface of the Boulder J-Hook structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Boulder J-Hooks shall be the number of Boulder J-Hooks computed from the lines drawn in the Construction Drawings, or as directed by the Engineer. The quantity of Boulder J-Hook structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Boulder J-Hooks will be paid for at the contract unit price per each “Boulder J-Hook”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Boulder J-Hook structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.11 Boulder J-Hook..... EA

4.12 Log Vane with Log Sill

Description

Log Vane with Log Sill structures are in-stream structures constructed for the purpose of grade control, energy dissipation, pool maintenance and/or habitat improvement. Log Vane with Log Sill structures shall be constructed as shown in the Construction Drawings and the following specifications. Log Vane with Log Sill structures shall consist of logs of the specified size, placed below the invert of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer. Log Vane with Log Sill structures will establish grade control, reduce bank erosion, and maintain channel capacity, while maintaining sediment transport capacity and sediment competence.

Materials

Log Vane with Log Sill structure shall be constructed of logs of size(s) specified in the Construction Drawings. Logs must be hardwood and relatively straight. The Contractor shall re-use logs from trees removed for construction whenever possible. The Contractor shall supply any and all logs needed to construct the proposed Log Vane with Log Sill(s) in addition to those harvested on site. The Engineer shall approve of all logs to be used prior to construction.

The Contractor shall supply all stone necessary to backfill the channel upstream of each Log Vane with Log Sill, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all anchors used to secure the Log Vane with Log Sill structure(s). Anchors shall be ¼ inch rebar or drift pins of sufficient length to pass through the logs and into the soils below as specified in the Construction Drawings and/or these specifications.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place logs and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All logs and stone shall be placed to form a Log Vane with Log Sill in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Log Vane with Log Sill consist of two sections: the sill and the single vane arm. Each section of the structure shall consist of a header log underlain by footer logs unless otherwise directed by the Engineer. Logs shall be secured with anchors installed with a maximum spacing of 2 feet on center. Anchors shall be ¼ inch rebar or drift pins. Anchors shall pass through the header and footer logs and extend into the ground a minimum of 6 inches. All gaps/voids larger than 1 inch between the header and footer logs shall be chinked with limbs and/or brush on the upstream side prior to placement of the filter fabric. Filter fabric shall be nailed to the entire length of the header log on the top of the structure with galvanized nail with plastic cap every 12 inches. Filter fabric shall extend upstream of the Log Vane with Log Sill on the bottom of the stream channel and be overlain with coarse backfill to a thickness equal to the depth of the header (and any footer) logs. Material excavated for the footer logs or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Log Vane with Log Sill. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Log Vane with Log Sill shall be trimmed.

The vane arm shall be angled from the upstream bank and shall have a vertical angle as specified in the Construction Drawings. The vane arm shall span approximately one-third the bankfull channel width with the sill spanning the remainder of the bankfull channel width. The upstream and downstream end of the vane arm shall be keyed into the channel bed and streambank respectively, as specified in the Construction Drawings. The sill shall be nearly flat and coincide with the streambed elevations shown in the Construction Drawings. The sill shall be keyed into the streambank opposite of the vane arm as specified in the Construction Drawings.

The surface of the Log Vane with Log Sill structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Log Vane with Log Sill structures shall be the number of Log Vane with Log Sill structures computed from the lines drawn in the Construction Drawings, or as directed by the Engineer. The quantity of Log Vane with Log Sill structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Log Vane with Log Sill structures will be paid for at the contract unit price per each “Log Vane with Log Sill”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Log Vane with Log Sill structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.12 Log Vane with Log Sill..... EA

4.13 Lunker Structure

Description

Lunker Structures are in-stream structures constructed for the purpose of habitat improvement. Lunker Structures shall be constructed as shown in the Construction Drawings and the following specifications. Lunker Structures shall be constructed of non-treated hardwood lumber of specified dimension, placed at the maximum depth of the proposed channel, at elevations and locations shown in the Construction Drawings or directed by the Engineer.

Materials

Lunker Structures shall be constructed of non-treated hardwood lumber of size(s) specified in the Construction Drawings. Lumber may be rough cut to the approximate dimensions shown in the Construction Drawings. The Contractor shall supply all lumber necessary to construct the proposed Lunker Structure(s). The Engineer shall approve of each constructed Lunker Structure prior to installation.

The Contractor shall supply all gravel required to construct a leveling base beneath the proposed Lunker Structure as specified in the construction drawings.

The Contractor shall supply all galvanized 20d nails used to construct the Lunker Structure(s).

The Contractor shall supply all boulders used to anchor the proposed Lunker Structure(s) as specified in the Construction Drawings.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place the proposed structures in locations shown in the Construction Drawings or as directed by the Engineer, as shown in the Construction Drawings, and described in the details or directed by the Engineer. All Lunker Structures shall be placed to fit uniformly with the proposed channel grading in accordance with the Construction Drawings and shall meet the approval of the Engineer.

The Contractor shall construct the proposed Lunker Structure of non-treated hardwood lumber, fastening the lumber together using galvanized 20d nails. Small gaps shall be left between adjacent lengths of lumber to allow swelling. The Contractor shall over-excavate the streambank in which the Lunker Structure is to be installed and construct a gravel leveling base as specified in the Construction Drawings. The Lunker Structure shall be placed such that it is level, and the front of the structure is in line with the toe of the streambank. A backboard should be installed on the proposed Lunker Structure to prevent filling. Filter fabric shall be placed overtop of and behind the Lunker Structure. Filter fabric shall be nailed to front edge of the Lunker Structure along its entire length with galvanized nails with a plastic cap every 12 inches. Material excavated for installation of the Lunker Structure or native streambed material may be used to backfill around the structure. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Log Cross Vane shall be trimmed.

The surface of the Lunker Structure and adjacent streambank shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Lunker Structures shall be the number of Lunker Structures computed from the lines drawn in the Construction Drawings, or as directed by the Engineer. The quantity of Lunker Structures to be measured for payment will be the actual number of structures installed and accepted by the Engineer. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Lunker Structures will be paid for at the contract unit price per each “Lunker Structure”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Lunker Structure(s), along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.13 Lunker Structure ..... EA

4.14 Boulder Toe

Description

Boulder Toe structures are streambank stabilization structures constructed for the purpose of withstanding near bank scour and minimizing streambank erosion. Boulder Toe structures shall be constructed as shown in the Construction Drawings and the following specifications. Boulder Toe structures consist of boulders of the specified size(s), placed along the toe of the proposed channel at elevations and locations shown in the Construction Drawings or as directed by the Engineer.

Materials

Boulder Toe structures shall be constructed of boulders of size(s) specified in the Construction Drawings. The contractor shall salvage and stockpile boulders of appropriate size from the existing channel for re-use in proposed structures whenever possible. The Contractor shall supply any and all boulders needed for the construction of the proposed Boulder Toe in addition to those salvaged on site. The Contractor is responsible for ensuring that all boulders provided by the Owner used to construct Boulder Toe structures meet the requirements specified in the Construction Drawings and this specification. Boulders used for construction of the Boulder Toe shall consist of blasted granite quarry stone or boulders stockpiled onsite and approved by the Engineer. All boulders shall be native structural stone or shot rock, angular, tabular, flat rock with a minimum of two parallel sides. Rounded edges are acceptable so long as rounded edges are not bearing or supporting. Approximate dimensions of boulders and dimension tolerances are specified in the Construction Drawings.

The Contractor shall supply all stone necessary to backfill behind the Boulder Toe structure, as described in the Construction Drawings. Backfill material shall meet the specifications included in the Construction Drawings and be approved by the Engineer.

The Contractor shall supply all filter fabric. Filter fabric shall meet the requirements specified in the Construction Drawings.

Construction

The Contractor shall place boulders and stone in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All stone shall be placed to form a Boulder Toe in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Boulder Toe structures shall consist of header boulders underlain with footer boulders unless otherwise directed by the Engineer. Footer boulders shall provide a stable base by being the same size or larger than the header boulders to be placed on top. Footer boulders shall be placed individually and keyed into the stream bed and bank as described in the Construction Drawings or otherwise directed by the Engineer. Each header boulder should rest on two footer boulders along the profile. Place boulders to create a uniform surface along the streambank. Header boulders should be set back from the front of the footer boulders, as specified in the Construction Drawings. Header and footer boulders shall be placed linearly with tight and contiguous surface contact with adjacent boulders to minimize all gaps between boulders. Prior to placement of filter fabric, any voids between boulders shall be chinked with backfill stone approved by the Engineer. Filter fabric shall be placed on the back side of the Boulder Toe along its entire length and depth. Coarse backfill shall be placed behind the Boulder Toe and on top of the filter fabric to a thickness equal to the depth of the header and footer boulders. Material excavated for the footer

boulder or native streambed material may be used as additional fill material to seal the structure on the upstream side of the Boulder Toe. Backfill material shall be compacted such that the future of settlement of the material is kept to a minimum. Any exposed filter fabric around the installed Boulder Toe shall be trimmed. Boulder Toe shall be constructed to achieve a maximum relative elevation specified in the Construction Drawings. Above the maximum relative elevation, the remainder of the streambank shall be graded as specified in the construction drawings.

The surface of the Boulder Toe structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Boulder Toe shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Boulder Toe structures to be measured for payment will be the linear footage of Boulder Toe installed and accepted by the Engineer measured along the centerline of the channel. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Boulder Toe will be paid for at the contract unit price per linear foot of “Boulder Toe”.

Such price and payment will be full compensation for all work covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Boulder Toe structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.14 Boulder Toe..... LF

4.15 Brush Toe

Description

Brush Toe structures are streambank stabilization structures constructed for the purpose of withstanding near bank scour and minimizing streambank erosion. Brush Toe structures shall be constructed as shown in the Construction Drawings and the following specifications. Brush Toe structures consist of woody material of the specified size(s), placed along the toe of the proposed channel at elevations and locations shown in the Construction Drawings or as directed by the Engineer.

Materials

Brush Toe structures shall be constructed of woody material of size(s) specified in the Construction Drawings. The Contractor shall harvest material to be used in the structure from trees removed for construction whenever possible. The Contractor shall supply any and all woody material needed to construct the proposed Brush Toe structure in addition to that which is harvested on site. The Engineer shall approve of all logs/brush to be used prior to construction. Woody material shall have been alive when recently harvested from the site. There shall be no invasive species used in the construction of Brush Toe.

Construction

The Contractor shall place woody material in locations shown in the Construction Drawings or as directed by the Engineer, to the thickness, widths, lengths, and elevations as shown in the Construction Drawings and described in the details or directed by the Engineer. All woody material shall be placed to form a Brush Toe in accordance with the Construction Drawings, neatly and uniformly, and shall meet the approval of the Engineer.

Brush Toe structures shall consist of layered woody material. Generally, mean diameter of the layered woody material should decrease moving from the bottom to the top of the Brush Toe structure, as specified in the Construction Drawings. Prior to placement, the Contractor shall ensure woody material is generally oriented in a uniform direction, minimizing voids between the woody material. Woody material shall be incrementally compacted such that the future of settlement of the material is kept to a minimum. Brush Toe shall be constructed to achieve a maximum relative elevation specified in the Construction Drawings. Above the maximum relative elevation, the remainder of the streambank shall be graded as specified in the construction drawings.

The surface of the Brush Toe structure shall be finished to a smooth compact surface in accordance with the Construction Drawings. The degree of finish for invert elevations shall be within 0.1 feet of the grades and elevations indicated in the Construction Drawings.

Method of Measurement

The quantity of the Brush Toe shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Brush Toe to be measured for payment will be the linear footage of Brush Toe installed and accepted by the Engineer, measured along the centerline of the channel. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Brush Toe structures will be paid for at the contract unit price per linear foot of “Brush Toe”.

Such price and payment will be full compensation for all material, labor, equipment and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Brush Toe structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.15 Brush Toe ..... LF

4.16 Soil Lifts

Description

Soil Lifts are streambank stabilization structures constructed for the purpose of creating stable vegetated earthen slopes that are capable of withstanding near bank scour and minimizing streambank erosion. These streambank slopes are generally steeper than the permissible limits of bare soils. Soil Lifts shall be constructed as shown in the Construction Drawings and the following specifications. Soil Lift structures consist of layers of suitable earthen material wrapped in a biodegradable Erosion Control Blanket, placed along the toe of the proposed channel at elevations and locations shown in the Construction Drawings or as directed by the Engineer.

Materials

The Contractor shall supply all coarse aggregate, Erosion Control Blanket, live cuttings, stakes, and seeding necessary in the construction of the Soil Lifts as specified in the Construction Drawings. The Erosion Control Blanket, live cuttings, and seeding shall meet the specifications listed in the Construction Drawings. Stakes shall be hardwood material with ample rigidity to enable being driven into hard ground, with sufficient flexibility to resist breakage. Length of the stake shall be equal to or greater than the thickness of the soil lift.

Construction

Install subgrade grading to proposed elevations, removing roots, twigs and other debris. Install coarse aggregate leveling base. For Soil Lifts without a hardened streambank revetment below, the coarse aggregate leveling base shall be placed at toe of the streambank and shall be minimum 4 inches thick. Place Erosion Control Blanket on top of the subgrade perpendicular to the direction of stream flow. Install the matting such that the upstream side will be on top and will overlap the downstream side by at least one foot to cover the longitudinal length required.

Place salvaged and/or furnished topsoil upon Erosion Control Blanket to appropriate grade elevation and bank slope, as specified in the Construction Drawings. Apply temporary and permanent seed to the topsoil in accordance with the planting schedules, seed mixes, and planting plans provided in the Construction Drawings. Encapsulate the salvaged and/or furnished topsoil with the unburied length of Erosion Control Blanket.

Fasten the Erosion Control Blanket with stakes as shown in the Construction Drawings. Handle the fabric and soil materials in a manner that does not damage the matting or deposit soil material in the stream channel. Repairs and fabric replacements will be performed at no additional cost.

Method of Measurement

The quantity of the Soil Lifts shall be the total length of the proposed structures computed in linear feet along the proposed centerline of the channel from the lines drawn on the Construction Drawings, or as directed by the Engineer. The quantity of Soil Lifts to be measured for payment will be the linear footage of Soil Lifts installed and accepted by the Engineer, measured along the centerline of the channel. This may require setting the structure, resetting the structure (potentially multiple times), and addition or subtraction of materials from what the contractor originally sets until the structure is installed to the satisfaction and approval of the designer.

Basis of Payment

The quantity of Soil Lifts will be paid for at the contract unit price per linear foot of “Soil Lifts”.

Such price and payment will be full compensation for all material, labor, equipment and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining the Soil Lift structures, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
4.16 Soil Lifts ..... LF

6.01 Permanent Seeding

Description

The work covered by this specification consists of furnishing and installing Permanent Seeding in areas specified on the plans. This work consists of site preparation, soil amendments, seedbed preparation, seeding and mulching.

Permanent Seeding shall occur in conjunction with Temporary Seeding where applicable. Ideally, Permanent Seeding shall occur during the planting season for each seed type. Areas fertilized for Temporary Seeding shall be sufficiently fertilized for Permanent Seeding; additional fertilizer is not required for Permanent Seeding.

The quantity of Permanent Seeding to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of Permanent Seeding may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

Materials

All plant sources and materials will be submitted to the Designer for approval prior to application. Seed will have a Pure Live Seed (PLS) certification equal to or greater than that rate specified on the plant schedules. If the PLS is less than specified, the Contractor will increase the seeding rate to compensate for the PLS difference. Seed may be mixed by the supplier and is not required to be mixed on site. Contractor shall provide detailed information including but not limited to germination rates, noxious weed seeds and date and location of harvest on seed mix.

All seed and seed varieties must be free of state and federally listed noxious weed seed. In addition, none of the following seed will occur in the mix:

- Bermuda bluegrass
- Bindweed
- Cocklebur
- Corn cockle
- Dodder
- Giant foxtail
- Horse nettle
- Annual bluegrass
- Spurred anoda
- Wild garlic
- Wild onion
- Lespedeza

Construction

The Contractor shall loosen the sub-grade to a minimum depth of 6-inches and grade to a rough non-uniform surface that will allow for pockets of water storage. The Contractor is to limit sub grade and finish grade preparation to areas that will be planted immediately. Prepared areas are to be restored if eroded or otherwise disturbed after fine grading and before planting.

Seed shall be sown with a spreader or a seeding machine. Seed is not to be broadcast or dropped when wind velocity exceeds 5 mph. Seed shall be evenly distributed by sowing in two directions at right angles to each other. Wet seed or seed that is moldy or otherwise damaged in transit or storage is not to be used. After being sown, the seed shall be raked into the top 1/9 inch of the topsoil, lightly rolled, and

watered with fine spray. Seeded areas on stream banks shall be protected with coir fiber matting. Other seeded areas are to be protected by spreading straw mulch uniformly to form a continuous blanket over seeded areas. Straw mulch is to be spread by hand, blower, or other suitable equipment.

Upon approval of the Engineer, the method of seeding may be varied by the Contractor under his responsibility to provide a healthy and vigorous uniform stand of grass.

Maintenance

Maintenance shall begin immediately after seeding operations and continue until Final Acceptance. Maintenance of seeded areas shall consist of watering, weed and pest control, fertilization, erosion repair, reseeding and incidental operations as necessary to establish a healthy, vigorous, weed free and disease-free uniform stand of grass. The Contractor is responsible for ensuring that all seed received adequate water per day.

The Contractor is responsible for reseeding portions or the entirety of the project site following rain events that remove seed from previously seeded areas. The directive to reseed will be at the sole discretion of the Engineer and Owner.

Groundcover must be established and maintained in accordance with the specifications in the Constructions and the erosion control permit(s). For projects where an erosion control permit is not required, the Contractor will be required to achieve 90% coverage of all disturbed soils with not bare areas greater than five square feet prior to receiving approval from the Engineer.

Method of Measurement

The quantity of Permanent Seeding shall be the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings. The quantity of permanent seeding to be measured for payment will be the actual number of acres of area seeded and accepted by the Engineer. The cost of ripping, fertilizer, seed, additives, mulching, and various other items covered by this section will be incidental to permanent seeding. Payment for permanent seeding will be the full compensation of all material, equipment, labor and all related expenses.

Basis of Payment

The quantity of Permanent Seeding will be paid for at the contract unit price per acre “Permanent Seeding”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
6.01 Permanent Seeding..... AC

6.02 Live Stakes

Description

The work covered by this specification consists of furnishing and installing Live Stakes on stream banks and other areas as applicable to the plans and details. Live Staking is a standard bioengineering technique which involves planting of dormant plant cuttings using species known to produce roots from cuttings.

The quantity of Live Stakes to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of these items may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

Materials

The Contractor shall supply all Live Stakes. Live Stakes shall meet the specifications in the Construction Drawings and be dormant at planting time. Species and number of Live Stakes planted shall follow the planting specifications in the Construction Drawings.

Construction

Plant material with excessive damage or oblique cuts, or with excessive damage to the bark, will not be acceptable. All live materials shall be properly stored to insure viability. Contractors shall protect plant materials from drying and overheating during transport and during the installation process.

Live plant material shall receive continuous shade and well as protection from the wind. Shade fabric, heeling, mulches, plastic and watering are all techniques that may be used.

Live Stake harvesting and installation shall occur outside the growing season. The growing season will be defined as that period of time with a 50% probability that the average daily temperature is more than 28 degrees, based on historic weather data.

Live Stakes shall be installed per the supplier's recommendations and as specified in the Construction Drawings or as directed by the Engineer. Live Stakes will be installed in the ground using a dead blow hammer. The stake will be placed so that 2/3 to 3/4 of the stake is buried below the ground surface and angled downstream. On sloped ground surfaces, stakes will be installed perpendicular to the finished grade slope. All live stakes shall be planted such that the stake is tamped and has full contact between the soil and cutting. In the event of hard ground, a 0.5" metal bar may be used to initiate a pilot hole for live stakes. The rod must be carefully removed without rotating to enlarge the hole.

Live Stakes should not be split during installation. Live Stakes which are split shall be removed and replaced, or if the split is less than 1/6 of the cutting length, the top may be re-trimmed after installation to remove the damaged portion.

Method of Measurement

The quantity of Live Stakes shall be the number of stems computed by dividing the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings, by the proposed Live Stake spacing, specified in the Construction Drawings. The quantity of Live Stakes to be measured for payment will be the actual number of stems planted and accepted by the Engineer. The payments for these items will be the full compensation of all

material, equipment, labor and related expenses. The Contractor must guarantee 80% Live Stake survivability for a period of one year from time of acceptance by the Engineer.

Basis of Payment

The quantity of Live Stakes will be paid for at the contract unit price of each “Live Stakes”.

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
6.02 Live Stakes..... EA

6.03 Herbaceous Plugs

Description

The work covered by this specification consists of furnishing and installing Herbaceous Plugs seedlings on stream banks and other areas as applicable to the plans and details.

The quantity of Herbaceous Plugs to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of these items may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

Materials

The Contractor shall supply all Herbaceous Plugs. Herbaceous Plugs shall meet the specifications in the Construction Drawings. Species and number of Herbaceous Plugs planted shall follow the planting specifications in the Construction Drawings.

Construction

Plant material with excessive damage will not be acceptable. All live materials shall be properly stored to insure viability. Contractors shall protect plant materials from drying and overheating during transport and during the installation process.

Live plant material shall receive continuous shade as well as protection from the wind. Shade fabric, heeling, mulches, plastic and watering are all techniques that may be used.

Herbaceous Plugs shall be installed per supplier's recommendations and as specified in the Construction Drawings or as directed by the Engineer.

Method of Measurement

The quantity of Herbaceous Plugs shall be the number of stems computed by dividing the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings, by the proposed Herbaceous Plug spacing, specified in the Construction Drawings. The quantity of Herbaceous Plugs to be measured for payment will be the actual number of stems planted and accepted by the Engineer. The payments for these items will be the full compensation of all material, equipment, labor and related expenses. The Contractor must guarantee 80% Herbaceous plug survivability for a period of one year from time of acceptance by the Engineer.

Basis of Payment

The quantity of Herbaceous Plugs will be paid for at the contract unit price of each "Herbaceous Plugs".

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
6.03 Herbaceous Plugs..... EA

6.04 Bare Root Planting

Description

The work covered by this specification consists of furnishing and installing Bare Root seedlings on stream banks and other areas as applicable to the plans and details.

The quantity of Bare Root seedlings to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of these items may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

Materials

The Contractor shall supply all Bare Root seedlings. Bare Root seedlings shall be dormant at planting time. Species and number of Bare Root seedlings planted shall follow the vegetation specifications in the Construction Drawings.

Construction

Plant material with excessive damage or oblique cuts, or with excessive damage to the bark, will not be acceptable. All live materials shall be properly stored to insure viability. Contractors shall protect plant materials from drying and overheating during transport and during the installation process.

Live plant material shall receive continuous shade and well as protection from the wind. Shade fabric, heeling, mulches, plastic and watering are all techniques that may be used.

Bare Root seedlings shall be installed per the supplier's recommendations and as specified in the construction drawings or as directed by the Engineer.

Method of Measurement

The quantity of Bare Root Plantings shall be the number of stems computed by dividing the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings, by the proposed spacing, specified in the Construction Drawings. The quantity of Bare Root seedlings to be measured for payment will be the actual number of stems planted and accepted by the Engineer. The payments for these items will be the full compensation of all material, equipment, labor and related expenses. The Contractor must guarantee 80% Bare Root seedling survivability for a period of one year from time of acceptance by the Engineer.

Basis of Payment

The quantity of Bare Root seedlings will be paid for at the contract unit price of each "Bare Root Plantings".

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
6.04 Bare Root Planting ..... EA

6.05 1-Gallon Tree Planting

Description

The work covered by this specification consists of furnishing and installing 1-Gallon Trees on stream banks and other areas as applicable to the plans and details.

The quantity of 1-Gallon Trees to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of these items may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

Materials

The Contractor shall supply all 1-Gallon Trees. Species and number of 1-Gallon Trees planted shall follow the vegetation specifications in the Construction Drawings.

Construction

Plant material with excessive damage or oblique cuts, or with excessive damage to the bark, will not be acceptable. All live materials shall be properly stored to insure viability. Contractors shall protect plant materials from drying and overheating during transport and during the installation process.

Live plant material shall receive continuous shade and well as protection from the wind. Shade fabric, heeling, mulches, plastic and watering are all techniques that may be used.

1-Gallon Trees shall be installed per the supplier's recommendations and as specified in the construction drawings or as directed by the Engineer.

Method of Measurement

The quantity of 1-Gallon Trees shall be the number of stems computed by dividing the cumulative area of all appropriate planting zone(s), as determined by the lines drawn in the Construction Drawings, by the proposed spacing, specified in the Construction Drawings. The quantity of 1-Gallon Trees to be measured for payment will be the actual number of stems planted and accepted by the Engineer. The payments for these items will be the full compensation of all material, equipment, labor and related expenses. The Contractor must guarantee 80% 1-Gallon Trees survivability for a period of one year from time of acceptance by the Engineer.

Basis of Payment

The quantity of 1-Gallon Trees will be paid for at the contract unit price of each "1-Gallon Tree Plantings".

Such price and payment will be full compensation for all material, labor, equipment, and related expenses covered by this section, including but not limited to furnishing, weighing, stockpiling, re-handling, placing, and maintaining adequate vegetative cover, along with disposal of any materials not incorporated into the project as directed by the Engineer.

Payment will be made under:
6.05 1-Gallon Tree Planting ..... EA

Section 03301 - CONCRETE

1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work. All concrete shall be air-entrained.

2. GENERAL. All cast-in-place concrete shall be accurately formed and properly placed and finished, as indicated on the drawings and specified herein.

The Contractor shall inform the Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.

3. MATERIALS.

3.01	Portland Cement	ASTM C150, Type I, IA, II, IIA, III or IIIA.
3.02	Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be acceptable.
3.03	Coarse Aggregate	Crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, except that clay and shale particles shall not exceed one percent. Smooth or rounded stone will not be acceptable.
3.04	Water	Clean and free from deleterious amounts of oil, acids, alkalies, and organic materials.
3.05	Admixtures	
	a. Water-Reducing	ASTM C494, Type A or D.
	b. Air-Entraining	ASTM C260.
3.06	Reinforcing Steel	
	a. Bars	ASTM A615,Grade 60, deformed in accordance with ASTM A305, except 1/4" bars may be plain.
	b. Welded Wire Fabric	ASTM A185.
	c. Bar Supports	CRSI Class 1, plastic protected, or Class 2, stainless steel protected.

3.07 Forms

a.	Plywood	Product Standard PS1, waterproof, resin-bonded, exterior type, Douglas fir.
b.	Lumber	Straight, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.
c.	Form Oil	Light-colored paraffin oil or other acceptable nonstaining material.

3.08 Polyethylene Film — Product Standard PS17, 6 mils or thicker.

3.09 Membrane Curing Compound — ASTM C-309, Type 2.

4. PRELIMINARY REVIEW. The source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to the Engineer for review at least 48 hours before concrete is placed.

5. LIMITING REQUIREMENTS. Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and finishable. Unless otherwise specified, concrete shall be controlled within the following limiting requirements.

5.01. Minimum Cement Factors. The quantity of portland cement, expressed in pounds per cubic yard, shall be not less than that indicated in the following table:

	Coarse Aggregate Size from No. 4 Sieve to			
Concrete Slump	3/8"	1/2"	3/4"	1"
	lbs/cy	lbs/cy	lbs/cy	lbs/cy
3 inches	629	592	564	536
4 inches	639	611	583	555
5 inches	658	630	602	573

5.02. Ratio of Fine to Total Aggregates. The ratio of fine to total aggregates based on solid volumes (not weights) shall be:

Coarse Aggregate Size	Minimum Ratio	Maximum Ratio
3/8 inch	0.45	0.60
1/2 inch	0.40	0.55
3/4 inch	0.35	0.50
1 inch	0.30	0.46

5.03. Total Water Content. Total water content of concrete shall not exceed 5.4 gallons of water per hundred pounds of cement in the mix.

5.04. Slump. Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the Engineer, slump shall be a minimum of 3 inches and a maximum of 5 inches.

5.05. Total Air Content. The total volumetric air content of concrete after placement shall be a minimum of 4% and a maximum of 6%.

5.06. Admixtures. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations. A water-reducing admixture and an air-entraining admixture shall be included in all concrete. No calcium chloride or admixture containing chloride from other than impurities from admixture ingredients will be acceptable.

5.07. Strength. The minimum acceptable compressive strength, as determined by ASTM C39, unless otherwise specified shall be:

Age	Minimum Compressive Strength
7 days	3,000 psi
28 days	4,000 psi

6. STORAGE OF MATERIALS. Cement shall be stored in suitable moisture-proof enclosures. Cement that has become caked or lumpy shall not be used.

Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.

Reinforcing steel shall be carefully handled and shall be stored on supports which will keep the steel from contact with the ground.

7. BATCHING AND MIXING. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

7.01. Consistency. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

7.02. Delivery Tickets. A delivery ticket shall be prepared for each load of ready-mixed concrete. A copy of each ticket shall be handed to the Engineer by the truck operator at the time of delivery. Tickets shall show the quantity delivered, the amount of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

8. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of concrete and shall be maintained in proper position and accurate alignment.

Forms for pavement, curbs, or gutters shall be made of steel and shall be supported on thoroughly compacted earth. The top face of pavement forms shall not vary from a true plane more than 1/4 inch in 10 feet.

Forms shall be thoroughly cleaned and oiled before concrete is placed.

Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least 4 inches.

8.01. Form Ties. Form ties shall be of the removable end, permanently embedded body type, and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

8.02. Edges and Corners. Chamfer strips shall be placed in forms to bevel all salient edges and corners, except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4 inch wide.

8.03. Form Removal. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead, live, and construction loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

9. REINFORCEMENT. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise indicated on the drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern. Mechanical connections shall be used only as indicated on the drawings.

All reinforcing bars and supplies shall be stored off the ground, and protected from oil, paint, grease, rusting, or scale. Bending of bars shall be done in accordance with the requirements of ACI 315. All bars shall be bent cold and in the shop.

Steel reinforcing shall be accurately positioned and secured against displacement by using concrete or metal chairs, spacers, or other devices to properly support and fasten the reinforcing. Splices shall not be made at points of maximum stress, nor shall all bars be spliced at the same location. All bars shall have a splice of a minimum 30 bar diameters.

Metal accessories shall include all spacers, ties, chairs, bolsters, and other devices required to support and fasten and hold the reinforcing steel in place, shall meet the requirements of ACI 315.

Wire mesh reinforcing shall have the spacing and gauge shown on the contract drawings. Mesh shall be pulled taut and furnished with sufficient support to hold it in position during placing of the concrete. Mesh shall be lapped one space at all splices and wired together at every other interval.

10. PLACEMENT. Concrete shall be conveyed to the point of final deposit and placed by methods that will prevent segregation or loss of ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Concrete shall be compacted by immersion-type vibrators, vibrating screeds, or other suitable mechanical compaction equipment. The use of jitterbug tampers to compact concrete flatwork will not be permitted.

Concrete shall not be placed in any forms until all reinforcing steel, pipes, sleeves, inserts, anchors, and other appurtenances have been installed and inspected.

Concrete that has contained its mixing water for more than 45 minutes shall not be placed. Concrete shall not be placed when the temperature is 40 degrees F and falling or when freezing temperatures are predicted for the next 24 hours. All concrete placed in weather above 90 degrees F shall be covered by shading, sprinkling, or other approved means for a minimum of 24 hours. Construction joints shall be made where shown on the contract drawings. When replacing existing concrete, the concrete shall be sawed, thoroughly cleaned and all laitance removed.

11. TESTING.

11.01. Air Content. An air content test shall be made from each batch of concrete from which concrete compression test cylinders are made. The Contractor shall provide all equipment and supplies necessary for the testing. Air content shall be determined in accordance with ASTM C173 or ASTM C231.

11.02. Slump. A slump test shall be made from each batch of concrete from which concrete compression test cylinders are made. Slump shall be determined in accordance with ASTM C143.

11.03. Test Cylinders. Compression test specimens shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and C39.

One set of concrete test cylinders shall be cast for each concrete pour. A set of test cylinders shall consist of four cylinders, two to be broken and to have compressive strengths averaged at 7 days, and two to be broken and to have compressive strengths averaged at 28 days. All concrete required for testing shall be furnished by the Contractor. No additional compensation will be paid to the Contractor for concrete so used.

Testing of the cured cylinders shall be performed by an independent testing laboratory at the expense of the Owner.

12. FINISHING. Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall be removed from all formed surfaces, except exterior surfaces that will be in contact with earth backfill.

Unless otherwise specified, unformed surfaces shall be screeded and given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface.

Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color. The completed finish for unformed surfaces shall be the finish produced by the second floating.

12.01. Pavement. Following placement, consolidation, and the disappearance of bleed water, the concrete surface shall be broom finished with a broom acceptable to the Engineer. The broom shall be not less than 18 inches wide and made from good quality bass or bassine fibers not more than 5 inches long. The broom finishing shall produce regular corrugations not over 1/8 inch deep. The broom shall be pulled square across the

surface, from edge to edge, with adjacent strokes slightly overlapped, and shall not tear the concrete surface.

The surface of pavements shall not vary more than 1/8 inch under a 10 foot straightedge placed parallel to the center line.

12.02. Curb and Gutter. Curb and gutter shall be finished to the shape indicated on the drawings. After the forms have been removed, all exposed edges shall be rounded, using an edging tool having a 1/8 inch corner radius. Exposed surfaces shall be float finished and given a light broom finish at the time of initial set, using a horsehair broom applied at right angles to the length of curb and gutter.

12.03. Sidewalks. Concrete surfaces shall be screeded to the proper elevation and contour. All aggregates shall be completely embedded in mortar. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface. Initial floating shall be followed by a second floating at the time of initial set.

Floated surfaces shall be given a light broom finish, using a horsehair broom, to provide a nonslip surface. Brooming shall be done at right angles to the length of the walk.

Sidewalks shall be edged, using a 3 or 4 inch wide edging tool having a 1/8 inch corner radius. Edger lap marks at corners of each slab shall be carefully removed. False joints shall be provided at right angles to the length of the walk, using a grooving tool with 1/8 inch radius. The finished edge on each side of the joint shall be the same width as the edging tool used. False joints shall divide each sidewalk into sections having a length equal to the width of the walk.

The finished surface of all sidewalks shall be neat in appearance, shall be sloped to drain, and shall not pond water.

13. CURING. Concrete shall be protected from loss of moisture by water saturation or by membrane curing for at least 7 days after placement.

Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. Unformed surfaces shall be covered with polyethylene film, tarpaulins, or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period.

Membrane curing compound may be used in lieu of water curing on concrete which will not be covered later with mortar or additional concrete. Membrane curing compound

shall be spray applied at a coverage of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within 30 minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces before they dry out. Curing compound shall be suitably protected against abrasion during the curing period.

Concrete shall be protected against freezing for at least 7 days after placement.

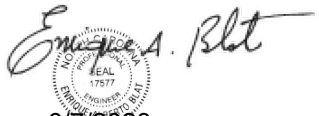
14. REPAIRING DEFECTIVE CONCRETE. Defects in concrete surfaces shall be repaired to the satisfaction of the Engineer. All concrete which is honeycombed or otherwise defective shall be cut out and removed to sound concrete, with edges square cut to avoid feathering.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

15. CONCRETE FOR MANHOLES, PIPE BLOCKING, AND PIPE ENCASEMENT. Concrete for manholes, buried blocking and encasement of pipe shall conform to the limiting requirements specified herein, except that the cement factor and total water content may be adjusted to provide a minimum compressive strength of 3,000 psi at 28 days. Concrete shall have a slump of not less than 3 inches nor more than 5 inches when placed.

16. DATA AND DRAWINGS. All submittals of data and drawings shall be in accordance with the submittals section, except as noted herein.

End of Section



6/7/2023

SP, TRAFFIC CONTROL

1.0 DESCRIPTION

Beginning Work and Street Closings: The Contractor is responsible for notifying the Concord Department of Transportation for any work where the number of travel lanes is reduced from normal conditions.

The Contractor shall install advance warning signs for the Project. These signs shall be in place for one week before construction activity begins. The Contractor shall begin construction activity on a street on the scheduled date for the closing of the travel lane.

Traffic Control Plan: Traffic control will be performed by the Contractor based upon the Traffic Control Special Provisions. The Traffic Control Special Provisions may refer to plan sheets for major work items or details, or both.

All traffic control devices and procedures shall conform to the requirements of the current edition of the Federal Highway Administration (FHWA) *Manual on Uniform Traffic Control Devices* (MUTCD), the current edition of the North Carolina Department of Transportation (NCDOT) Supplement to the *Manual on Uniform Traffic Control Devices for Streets and Highways*, the NCDOT Roadway Standard Drawings and the current edition of the NCDOT Standard Specifications for Roads and Structures.

The Contractor shall maintain the traffic control as described herein unless the Contractor submits an alternate traffic control plan to the Engineer and it is approved by the Engineer. The Engineer may direct the Contractor to modify the traffic control if, in the Engineer's opinion, traffic is not moving safely or efficiently.

Traffic Control Phasing for this project shall be in accordance with the Traffic Control Plans. The Contractor shall adhere rigidly to these plans. The standards are the minimum required. Additional signs, cones, drums, barricades and warning devices may be used, but at no time will less than what is specified on the plans or in the standards be acceptable.

Maintenance of Traffic: The Contractor shall maintain all travel lanes in accordance with the Traffic Control Plan sheets.

In areas of drop-offs and low shoulders, the Contractor shall backfill up to the edge and elevation of the existing pavement.

The Contractor will be required to maintain ingress and egress to all businesses and dwellings, and easy access to fire hydrants.

The Contractor shall provide adequate drainage under driveways and within the Project area for the duration of the Project.

The Contractor shall mark all hazards within the Project limits with well-maintained signs, barricades, warning and/or channelizing devices.

Traffic Control Devices: The Contractor shall furnish, install, operate, relocate, maintain and remove all temporary traffic control devices necessary for controlling traffic in accordance with the Traffic Control Plans and standards. The Contractor shall notify Engineer regarding conflicting permanent signs. Only Concord Department of Transportation personnel shall install, remove or relocate any permanent signs within the right-of-way. All construction signs and barricades shall remain in place until the appropriate permanent signs and pavement markings are installed.

Equipment and Material Storage: During periods of construction inactivity, all construction materials and equipment shall be stored by the Contractor. The right-of-way or temporary project easement may be used for this purpose, but equipment and materials must be placed safely 10 or more feet away from any open travel lane. It is recommended that all construction equipment and materials be stored on private property, which is posted against trespassing. It is the responsibility of the organization performing the work to obtain the permission to use a property for this purpose.

Excavation and Trenches: Excavations and trenches that cannot be properly backfilled and patched prior to the end of the workday shall be secured.

2.0 MEASUREMENT

There will be no separate measurement made for Traffic Control.

3.0 PAYMENT

Traffic Control will be paid at the lump sum price for "Traffic Control". This payment will be full compensation for all elements of work required to complete the Project as specified.

Partial payments will be made as follows:

- 25% of the lump sum price on the first partial payment estimate made after any work has been performed on the item of "Traffic Control".
- 25% of the lump sum price on the first partial payment after work is 25% complete.
- 25% of the lump sum price on the first partial payment after work is 50% complete.
- 25% of the lump sum price on the first partial payment after work is 100% complete.

Payment will be made under:

TRAFFIC CONTROL..... LS

SP, COMPREHENSIVE GRADING

Version Date: 03/21/2016

1.0 DESCRIPTION

This item shall include all elements of work covered by the referenced NCDOT Specifications and the numbered Additional City Specifications provided herein.

NCDOT Specifications

200, "Clearing and Grubbing"
225, "Roadway Excavation"
230, "Borrow Excavation"
235, "Embankments"
240, "Ditch Excavation"
250, "Removal of Existing Pavement"
260, "Proof Rolling"
340, "Pipe Removal"
412, "Unclassified Structure Excavation"
416, "Channel Excavation"
500, "Fine Grading, Sub-grade, Shoulders and Ditches"
545, "Incidental Stone Base"
560, "Shoulder Construction"
1530, "Abandon or Remove Utilities"

Additional City Specifications

1. Clearing and Grubbing: Clearing on this Project shall be performed to the slope stake line or the right-of-way or easement lines unless directed otherwise. The Contractor shall obtain permission from the Engineer prior to removing any trees in the easement areas.

2. Erosion Control: includes but is not limited to furnishing, installing, and maintaining, silt fence, diversion ditches, rock inlet sediment traps, rock pipe sediment trap, silt sacks, all stone for erosion control, rock check dams, block and gravel and inlet protection, catch basin inlet protection, temporary rock construction entrances, silt basins, temporary matting and all other erosion control measures required by, the plans, current ordinances, project permitting, and the Contractor's means and methods.

3. Fence Removal and Disposal and or Fence Relocation: as shown on the plans and any additional removal or relocation identified by the Contractor's means and methods shall be included in this item.

4. Hedgerow and or Planting bed Removal and Disposal: as shown on the plans and any additional hedgerow or planting bed removal identified by the Contractor's means and methods shall be included in this item. Hedgerows to be removed shall be approved by the Engineer prior to removal.

5. Mail Boxes and Site Amenities: remove, protect, and reset mail boxes and site amenities. The Contractor shall keep mailboxes in service at all times and allow / provide for other services, including but not limited to trash pickup.

6. Removal and Disposal of Existing Infrastructure: concrete curb**,** sidewalk, miscellaneous concrete, asphalt, driveways, pads, slabs, walls, structures, catch basins, manholes, etc. within the construction limits as shown on the plans and any additional infrastructure removal identified by the Contractor's means and methods shall be included in this item.

7. Shoring: The Contractor shall be responsible for all shoring to include means, methods, materials and engineering needed to construct the project.

8. Saw Cutting: all saw cutting required to build the Project. Where asphalt or concrete (curb, sidewalk, roadway, driveways, parking lots, etc.) is to be removed, the Contractor shall provide a neat edge along the pavement being retained by sawing the pavement a minimum of 2" deep and 1' wide before breaking and removing adjacent pavement. When the Contractor proposes to saw pavement more than one foot from the proposed pavement (curb, sidewalk, structure, etc.), the Contractor shall obtain approval from the Engineer prior to saw cutting and removing pavement. The cost of sawing asphalt or concrete shall be included in this item.

9. Seeding and Mulching: all temporary and permanent seeding and mulching required to complete the project in accordance with the plans and specifications shall be included in this item. All work shall be in accordance with the City "Landscape Construction Standards" Seeding and Sodding Turfgrass Section 04200 and included in this item.

10. Sidewalk and Curb Clean-up: The Contractor shall have all related sidewalk and curb work completed within ten (10) days of placement, including but not limited to 1) removal and disposal of construction debris; 2) related grading to include fine grading; 3) site restoration; 4) seedbed preparation and dress up work; 5) seeding and mulching; and 6) final cleaning.

11. Tree Protection: The Contractor shall provide tree protection as shown on the plans, including any pruning which shall be performed by a certified arborist in accordance with proper arboricultural standards, and any additional Tree Protection identified by the Contractor's means and methods shall be in accordance with the City "Landscape Construction Standards" Tree Preservation and Protection, Section 01000 and included in this item.

12. Tree and/or Stump Removal and Disposal: as shown on the plans and any additional tree and/or stump removal identified by the Contractor's means and methods shall be included in this item. Trees to be removed shall be approved by the Engineer prior to removal.

13. Utility Pipe/Conduit Removal and Disposal: existing public or private utility pipe / conduit, subsurface and shoulder drain pipe removal and disposal as shown on the plans

and any additional utility pipe / conduit removal identified by the Contractor's means and methods shall be included in this item.

14. Rock Excavation: all rock excavation required to build the project.

15. Property Access: all labor and materials required to maintain access to properties during construction as directed by the Engineer.

16. Real Estate Special Provisions: The contractor will be responsible for all work in *Real Estate Special Provisions* in this contract and paid from Comprehensive Grading.

17. Unsuitable Material: Unsuitable soil material that must be hauled off from the site will be incidental to this lump sum item. Suitable soils are defined as ASTM D 2487 Soil Classification Groups SM, ML, SC, and CL, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. It is the contractor's responsibility to dry all soils to within 3% of optimum moisture before the determination of suitability is made. Final determination will be at the discretion of the Engineer. The Engineer should be consulted before any material is declared unsuitable and removed from the site.

18. Parking Lot Alternate: Regardless of if the alternate for the parking lot addition is selected, the grading for the parking lot addition will still be completed and will be incidental to this lump sum item.

2.0 MEASUREMENT

There will be no separate measurement made for Comprehensive Grading.

3.0 PAYMENT

For the above-referenced NCDOT sections and numbered Additional City Specifications, there will be no direct measurement, payment or compensation, all cost incurred to complete the work as specified shall be included in the Lump Sum price bid for "Comprehensive Grading".

There will be **no separate measurement or payment** for the items listed or referenced in this specification.

Payment will be made under:

COMPREHENSIVE GRADING .....LS

SP, SILT FENCE OUTLET

1.0 DESCRIPTION

This special provision shall include all labor and materials to furnish material, construct, maintain and remove silt fence outlets in accordance with the construction plans and the contract.

2.0 MATERIALS

Refer to the construction plans.

3.0 CONSTRUCTION METHODS, MAINTENANCE AND REMOVAL

Install and maintain silt fence outlets in accordance with the plans and specifications.

Leave silt fence outlets in place until site stabilization and remove at project completion. Dress and seed and mulch all areas where silt fence outlets are removed in accordance with Section 1660.

4.0 MEASUREMENT AND PAYMENT

Silt Fence Outlets will be measured and paid for by the actual number of silt fence outlets installed and accepted. Such price and payment will be full compensation for all work covered by this section, including, but not limited to, furnishing all materials, labor, equipment and incidentals necessary to install the *Silt Fence Outlet*.

Seeding and Mulching will be measured and paid in accordance with Article 1660-8.

Payment will be made under:

SILT FENCE OUTLET .....EA

SP, STORM DRAIN INLET PROTECTION:

1.0 DESCRIPTION

The Work covered in this section consists of installing storm drain inlet protection as necessary help reduce the effects of soil erosion and to retain sediment.

2.0 INSPECTION AND MAINTENANCE OF SEDIMENT TUBES

Inspect filter sacks after installation to ensure that no gaps exist under the filter sack and the rim of structure.

Inspect filter sacks every seven (7) days. Repair any damage to filter sack or replace per engineer request.

Remove sediment deposits that impair the filtration capability of a filter sack when the sediment reaches sediment capacity line on filter. Remove and/or replace installed filter sacks as required to adapt to changing construction site conditions.

3.0 MEASUREMENT AND PAYMENT

The quantity of "Storm Drain Inlet Protection" is to be paid for per each filter sack installed and accepted. All work consisting of, but not limited to, purchases, storing, and installing the filter sack and all material, time, and labor costs associated will be considered incidental to the work.

Payment will be made under:

STORM DRAIN INLET PROTECTION.....EA

SP, SAFETY FENCE AND JURISDICTIONAL FLAGGING:

Description

Safety Fence shall consist of furnishing materials, installing and maintaining polyethylene or polypropylene fence along the outside riparian buffer, wetland, or water boundary, or other boundaries located within the construction corridor to mark the areas that have been approved to infringe within the buffer, wetland, endangered vegetation, culturally sensitive areas or water. The fence shall be installed prior to any land disturbing activities.

Interior boundaries for jurisdictional areas noted above shall be delineated by stakes and highly visible flagging.

Jurisdictional boundaries at staging areas, waste sites, or borrow pits, whether considered outside or interior boundaries shall be delineated by stakes and highly visible flagging.

Materials

(A) Safety Fencing

Polyethylene or polypropylene fence shall be a highly visible preconstructed safety fence approved by the Engineer. The fence material shall have an ultraviolet coating.

Either wood posts or steel posts may be used. Wood posts shall be hardwood with a wedge or pencil tip at one end, and shall be at least 5 ft. in length with a minimum nominal 2" x 2" cross section. Steel posts shall be at least 5 ft. in length, and have a minimum weight of 0.85 lb/ft of length.

(B) Boundary Flagging

Wooden stakes shall be 4 feet in length with a minimum nominal 3/4" x 1-3/4" cross section. The flagging shall be at least 1" in width. The flagging material shall be vinyl and shall be orange in color and highly visible.

Construction Methods

No additional clearing and grubbing is anticipated for the installation of this fence. The fence shall be erected to conform to the general contour of the ground.

(A) Safety Fencing

Posts shall be set at a maximum spacing of 10 ft., maintained in a vertical position and hand set or set with a post driver. Posts shall be installed a minimum of 2 ft. into the ground. If hand set, all backfill material shall be thoroughly tamped. Wood posts may be sharpened to a dull point if power driven. Posts damaged by power driving shall be removed and replaced prior to final

acceptance. The tops of all wood posts shall be cut at a 30-degree angle. The wood posts may, at the option of the Contractor, be cut at this angle either before or after the posts are erected.

The fence geotextile shall be attached to the wood posts with one 2" galvanized wire staple across each cable or to the steel posts with wire or other acceptable means.

Place construction stakes to establish the location of the safety fence in accordance with Article 105-9 or Article 801-1 of the *Standard Specifications.* No direct pay will be made for the staking of the safety fence. All stakeouts for safety fence shall be considered incidental to the work being paid for as "Construction Surveying", except that where there is no pay item for construction surveying, all safety fence stakeout will be performed by state forces.

The Contractor shall be required to maintain the safety fence in a satisfactory condition for the duration of the project as determined by the Engineer.

(B) Boundary Flagging

Boundary flagging delineation of interior boundaries shall consist of wooden stakes on 25 feet maximum intervals with highly visible orange flagging attached. Stakes shall be installed a minimum of 6" into the ground. Interior boundaries may be staked on a tangent that runs parallel to buffer but must not encroach on the buffer at any location. Interior boundaries of hand clearing shall be identified with a different colored flagging to distinguish it from mechanized clearing.

Boundary flagging delineation of interior boundaries will be placed in accordance with Article 105-9 or Article 801-1 of the *Standard Specifications*. No direct pay will be made for delineation of the interior boundaries. This delineation will be considered incidental to the work being paid for as *Construction Surveying,* except that where there is no pay item or construction surveying the cost of boundary flagging delineation shall be included in the unit prices bid for the various items in the contract. Installation for delineation of all jurisdictional boundaries at staging areas, waste sites, or borrow pits shall consist of wooden stakes on 25 feet maximum intervals with highly visible orange flagging attached. Stakes shall be installed a minimum of 6" into the ground. Additional flagging may be placed on overhanging vegetation to enhance visibility but does not substitute for installation of stakes.

Installation of boundary flagging for delineation of all jurisdictional boundaries at staging areas, waste sites, or borrow pits shall be performed in accordance with Subarticle 230-4(B)(5) or Subarticle 802-2(F) of the *Standard Specifications*. No direct pay will be made for this delineation, as the cost of same shall be included in the unit prices bid for the various items in the contract.

The Contractor shall be required to maintain alternative stakes and highly visible flagging in a satisfactory condition for the duration of the project as determined by the Engineer.

Measurement and Payment

Safety Fence will be measured and paid as the actual number of linear feet of polyethylene or polypropylene fence installed in place and accepted. Such payment will be full compensation including but not limited to furnishing and installing fence geotextile with necessary posts and post bracing, staples, tie wires, tools, equipment and incidentals necessary to complete this work.

Payment will be made under:

Pay Item	**Pay Unit**
Safety Fence	Linear Foot

SP, DISC GOLF PADS w/ TRAIL CONNECTIONS AND BASKETS:

1.0 DESCRIPTION

The Work covered in this section consists of installing disc golf concrete pads, disc golf baskets, and gravel trail connections to create a disc golf course at Dorton Park.

2.0 MATERIALS

Refer to construction plans. Materials include:

(A) NCDOT Class A Air Entrained Concrete per NCDOT Section 1000
(B) Innova DISCatcher Pro Permanent Disc Golf Baskets, or equivalent
- Yellow in color
(C) Gravel Connections to Trails, to be constructed with NCDOT Class II Type 1 Select Material per NCDOT Section 1016
(D) Type 4 Geotextile for Soil Stabilization, per NCDOT Section 270

3.0 MEASUREMENT AND PAYMENT

The quantity of "Disc Golf Pads w/ Trail Connections and Baskets" is to be paid for per each cumulative pad/basket/trail assembly installed and accepted. All work consisting of, but not limited to, purchases, storing, and installing the pads and all material, time, and labor costs associated will be considered incidental to the work.

Payment will be made under:

DISC GOLF PADS w/ TRAIL CONNECTIONS AND BASKETS .....EA

SP, PRECAST CONCRETE WHEEL STOPS:

1) **Description**. Install commercially produced concrete wheel stops at the locations detailed on the plans.

2) **Materials.** Provide wheel stops cast with a concrete that has a minimum strength equal to that of Class A concrete as defined in NCDOT Section 1000. Unless otherwise specified on the plans, each wheel stop must be 6 ft. in length.

   Minimum reinforcement for each wheel stop shall be 2 No. 4 bars placed longitudinally.

   Reinforcing steel must conform to the requirements of NCDOT Section 1070, "Reinforcing Steel."

3) Construction. Refer to the plans for type of anchor rod and method of anchoring.

4) Measurement. This Item will be measured as each wheel stop.

5) Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Precast Concrete Wheel Stops." This price is full compensation for furnishing, preparing, hauling and placing all materials, and for all equipment, labor, tools and incidentals.

ECS Southeast, LLP

Geotechnical Engineering Report

Dorton Park

Concord, Cabarrus County, North Carolina

ECS Project No. 08:15441

March 15, 2023

March 15, 2023

Mr. Dan Dodd
The Dodd Studio
314 Tom Hall Street
Fort Mill, South Carolina 29715

ECS Project No. 08:15441

Reference: Geotechnical Engineering Report
Dorton Park
Concord, Cabarrus County, North Carolina

Dear Mr. Dodd:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering recommendations for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to you during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design and construction phase to confirm subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

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3/15/23

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EXECUTIVE SUMMARY

This report contains the results of our subsurface exploration and geotechnical engineering recommendations for the proposed park improvements located at 5650 Poplar Tent Road in Concord, Cabarrus County, North Carolina.

- Lower consistency near surface soils, with an N-value of 6 bpf or less, were encountered at each boring location with the exception of B-07, and extended to depths ranging from approximately 5.5 to 12 feet below existing grade. Additionally, soft sediments may be present within existing drainage features/ravines. Depending on final site grades and construction phase testing (i.e., proofrolling, Dynamic Cone Penetrometer testing, etc.) lower consistency soils may require selective undercutting, moisture conditioning, and/or compaction, prior to fill placement or construction of pavements or structures.
- Partially Weathered Rock (PWR) was encountered at 6 of the 7 boring locations, beginning at depths ranging approximately 3 to 22 feet below existing grade. Auger refusal (i.e. possible rock) was encountered at 2 of the 7 boring locations at depths ranging from approximately 28.5 to 33.3 feet below existing grade. Depending on final site grades, difficult excavation and materials requiring rock excavation techniques may be encountered during mass grading, utility installation, and/or foundation excavation. The site civil designer should consider PWR and auger refusal depths when determining site grade and utility depths/locations.
- Groundwater was encountered at each boring location, with the exception of Boring B-07, at depths ranging from approximately 8 to 23 feet below existing grades. Depending on final foundation elevations, temporary dewatering may be necessary during excavation and/or installation of pedestrian bridge foundations.
- Based on the results of subsurface exploration, the proposed restroom structure can be supported on conventional shallow foundations bearing on low plasticity residual soils, or newly placed Structural Fill using an allowable bearing pressure of up to 1,500 psf.
- Due to lower consistency near-surface soil conditions in the vicinity of the planned bridge abutment areas, a deep foundation system (such as driven steel piles) should be anticipated for support of the proposed pedestrian bridges.
- A seismic site class “C” appears to be appropriate based on the average N-value method.

The above information summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the Executive Summary should not be utilized in lieu of reading the entire geotechnical report.

1.0 INTRODUCTION

The purpose of this study was to provide subsurface exploration and geotechnical information for the design of the proposed pedestrian bridges, restroom structure, and expanded parking and drive areas. The recommendations developed for this report are based on the project information supplied by the Client. Our services were provided in accordance with our Proposal No. 28631P, as authorized by the Client, and includes the Terms and Conditions of Service outlined within the agreement.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the geotechnical aspects of the project. The report includes the following items.

- Information on current site conditions, surface drainage features, and surface topographic conditions.
- Description of the field exploration and laboratory tests performed.
- Final logs of the soil borings and records of the field exploration and laboratory tests performed.
- Recommendations regarding foundation and slab support for the structures and settlement potential.
- Recommendations regarding slab-on-grade construction and design.
- Seismic site classification per the North Carolina Building Code using the average N-value method.
- Recommendations for standard duty pavement sections.
- Evaluation of the on-site soil characteristics encountered in the soil borings with respect to the suitability of the on-site materials for reuse as Structural Fill.
- Recommendations for minimum soil cover during frost heaving, compaction requirements for fill and backfill areas, and slab-on-grade construction.
- Recommendations regarding site preparation and construction observations and testing.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The project site is located at 5650 Poplar Tent Road in Concord, Cabarrus County, North Carolina as shown below and on the Site Location Diagram in Appendix A. According to the Cabarrus County Online Geographic Information Systems (GIS) website, the approximate 23-acre site is identified as Parcel Identification Number (PIN) 5600181343.

The site is currently developed as an active park and consists of two soccer fields, various shelters, and paved parking and drive areas. Two (2) existing pedestrian bridges cross a creek which bisects the central portion of the site in a generally north-south direction. Based on our review of available historic imagery, the site appears to have consisted of undeveloped wooded land since at least 1965. Sometime between 1965 and 1983, the land was cleared for what appears to be agriculture use. Sometime between 1983 and 1998, the site started to accumulate undergrowth. Between 1991 and 2001, Dorton Park was developed and has remained mostly unchanged since then. According to Cabarrus County GIS, existing site grade elevations range from approximately 585 feet along the central creek that divides the site to 615 feet in the southeastern portion of the site. The previous use discussion is not considered a comprehensive or in-depth review of the site history, rather a quick overview of available aerial imagery.

2.2 PROPOSED CONSTRUCTION

ECS understands that the proposed improvements will include the construction of a new restroom building, stream restoration, replacement of the two (2) pedestrian bridge crossings, and an expansion to the existing parking lot. We understand the bridges will be 10 feet wide prefabricated steel with spans of approximately 60 feet. Loading conditions were not provided to us; however, based on our experience with similar construction, we anticipate bridge abutment loads of on the order of approximately 200 kips. Grading plans were not provided at the time of the report; however, we understand that site cuts will be minimal and fill depths ranging from about 6 to 8 feet are anticipated in the areas of the proposed restroom structure and parking area expansion. The following information explains our understanding of the planned development.

PROJECT UNDERSTANDING	
SUBJECT	**DESIGN INFORMATION / ASSUMPTIONS**
Stories	One - Story
Usage	Restroom Structure
Framing	Masonry and/or wood
Wall Loads	2 kips per linear foot (klf) maximum

3.0 FIELD EXPLORATION AND LABORATORY TESTING

Our exploration procedures are explained in greater detail in Appendix B including the inserts titled Subsurface Exploration Procedure. Our scope of work included drilling seven (7) mechanical soil borings and performing two (2) hand auger borings. The borings were located using GPS technology and their approximate locations are shown on the Boring Location Diagram in Appendix A. The approximate ground surface elevations provided on the boring logs were estimated based on Google Earth and Cabarrus County GIS (Polaris 3D) and should be considered approximate. The users of the reported elevations do so at their own risk.

3.1 SUBSURFACE CHARACTERIZATION

The site is located in the Piedmont Physiographic Province of North Carolina. The native soils in the Piedmont Province consist mainly of residuum with underlying saprolites weathered from the parent bedrock, which can be found in both weathered and unweathered states. In a mature weathering profile of the Piedmont Province, the soils are generally found to be finer grained at the surface where more extensive weathering has occurred. The particle size of the soils generally becomes more granular with increasing depth and gradually changes first to weathered and finally to unweathered parent bedrock.

The following sections provide generalized characterizations of the subsurface materials. Please refer to the subsurface cross-sections in Appendix A and boring logs in Appendix B for more detailed information.

GENERALIZED SUBSURFACE CONDITIONS			
Approximate Depth (ft)	**Stratum**	**Description**	**Ranges of SPT(1) N-values (bpf)**
0 to 0.6	N/A	Surficial organic laden soil and/or gravel. (2)	N/A
0.5 to 22	I	RESIDUUM – Lean CLAY (CL), Sandy SILT (ML), FAT Clay (CH), and Silty SAND (SM). (3)	WOH to 79
3 to 38.8	II	PARTIALLY WEATHERED ROCK (PWR) – SAMPLED AS Silty SAND (SM) and Clayey SAND (SC). (4)(5)(6)	100+ (50/2" to 50/0")

Notes:
(1) Standard Penetration Testing in blows per foot (bpf).
(2) Surficial materials are driller reported and should not be used for takeoffs.
(3) Lower consistency soils were encountered at Borings B-01 through B-06.
(4) Partially Weathered Rock (PWR) is defined as residual material exhibiting SPT N-values greater than 100 bpf.
(5) PWR was encountered at Borings B-01 through B-05 and B-07 beginning at depths approximately 3 to 22 feet below existing grades.
(6) Auger Refusal materials (i.e possible rock) were encountered at Borings B-02 and B-03 at depths ranging of approximately 28.5 to 33.3 feet below existing grades, respectively.

3.2 GROUNDWATER OBSERVATIONS

Groundwater measurements were attempted at the termination of drilling and prior to demobilization from the site. Groundwater was encountered within Borings B-01 through B-06 at the time of drilling and ranged from approximately 2.5 to 11 feet below the existing ground surface. Cave-in depths were measured at each of the boring locations and ranged from approximately 6 to 32.5 feet below existing grades. Cave-in of a soil test boring can be caused by groundwater hydrostatic pressure, weak soil layers, and/or drilling activities. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors.

3.3 LABORATORY TESTING

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration. Classification, moisture content, percent fines (-200 wash), Atterberg limit tests, and Standard Proctor tests were performed.

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System, USCS). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

4.0 DESIGN RECOMMENDATIONS

4.1 RESTROOM STRUCTURE

4.1.1 Foundations

Provided subgrades and structural fills are prepared as recommended in this report, the proposed restroom structure can be supported by conventional shallow foundation systems bearing on low plasticity residual soils, or newly-placed Structural Fill. We recommend the foundation design use the following parameters:

FOUNDATION RECOMMENDATIONS [5]	
Design Parameter	**Wall Footing**
Net Allowable Bearing Pressure [1][5]	1,500 psf
Acceptable Bearing Soil Material	Low Plasticity Residual Soils, or Newly-Placed Structural Fill
Minimum Width	18 inches
Minimum Footing Embedment Depth (below slab or finished grade) [2]	18 inches
Minimum Exterior Frost Depth (below final exterior grade)	12 inches
Estimated Total Settlement [3]	1 inch or less
Estimated Differential Settlement [4]	½ inch or less

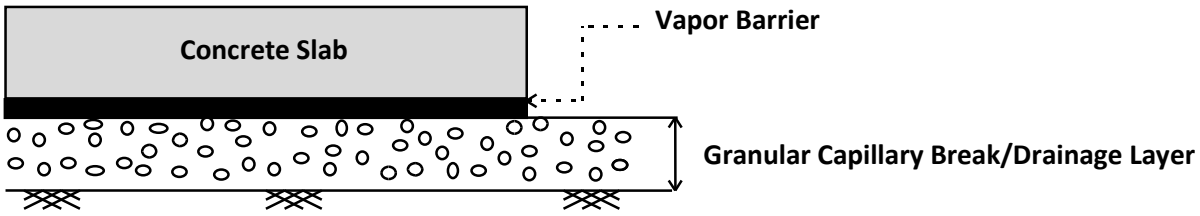
Notes:

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) For bearing considerations.
(3) Based on assumed structural loads. If final loads are different, ECS must be contacted to update foundation recommendations and settlement calculations.
(4) Based on maximum column/wall loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete.
(5) A grading plan and structural loading were not provided at the time of this report; therefore, our foundation recommendations should be considered preliminary until ECS has had the opportunity to review the site grading plan.

Potential Undercuts: Following placement of new Structural Fill, the soils at the foundation bearing elevations are anticipated to be acceptable for support of the proposed structure. If soft, or unsuitable soils are observed at the footing bearing elevations at the time of footing construction, the unsuitable soils should be undercut and replaced. Undercut areas should be backfilled with lean concrete (f'c > 1,000 psi at 28 days) or compacted crushed aggregate up to the original design bottom of footing elevation.

4.1.2 Slabs on Grade

Provided subgrades and structural fills are prepared as discussed herein, the proposed floor slabs can be constructed as Ground Support Slabs (or slab-on-grade). We assume that the slabs for will bear on low plasticity residual soils or newly-placed Structural Fill. The following graphic depicts our soil-supported slab recommendations:



1. Drainage Layer Thickness: 4 inches, minimum
2. Drainage Layer Material: GRAVEL (GP, GW), SAND (SP, SW)
3. Subgrade compacted to **100%** maximum dry density per ASTM D698

Soft or yielding soils may be encountered in some areas. Those soils should be removed and replaced with compacted Structural Fill in accordance with the recommendations included in this report.

Subgrade Modulus: Provided the Structural Fill and Granular Drainage Layer are constructed in accordance with our recommendations, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 90 pci (lbs per cubic inch). The modulus of subgrade reaction value is based on a 1 foot by 1 foot plate load test basis.

Vapor Barrier: Before the placement of concrete, a vapor barrier may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor barrier is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the Structural Engineer and/or the Architect may choose to eliminate the vapor barrier.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab such as in a turn down footing/monolithic slab configuration, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab.

4.2 PEDISTRIAN BRIDGES

4.2.1 Driven Steel H-Piles

We understand a deep foundation system consisting of driven steel piles is being considered as the foundation option for the pedestrian bridges. The steel piles will be driven to refusal in Partially

Weathered Rock (PWR) or on competent rock. Individual piles will develop their capacity through a combination of skin friction and end bearing. Common sizes of H-piles to consider for this project would be HP 12x53's or HP 14x73's. Allowable capacities of up to 100 tons/pile and 135 tons/pile, respectively, can be assumed for preliminary design.

Multiple driven piles connected with a pile cap will be required to support the bridge abutments. To optimize group interaction of individual piles within the group, piles should be spaced a minimum of 3 pile diameters within the pile cap. For example, HP 12x53 piles have an effective pile width of 12 inches; these piles should be spaced a minimum 3 feet on center. Since driving into PWR is anticipated, steel pile points should be considered to protect the ends of the piles during hard driving conditions.

If driven H-piles are selected as the primary foundation support system, additional testing may be required to further evaluate the corrosion potential of the piles. Noise ordinances, vibration limits, and site access should be considered for the use of a driven deep foundation system.

4.3 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The North Carolina Building Code (NCBC) requires site classification for seismic design based on the upper 100 feet of a soil profile. Three methods are utilized in classifying sites, namely the shear wave velocity (vs) method; and the Standard Penetration Resistance (N-value) method. The N-value method was used in classifying this site. The seismic site class definitions for the weighted average of SPT N-values in the upper 100 feet of the soil profile are shown in the following table:

SEISMIC SITE CLASSIFICATION			
Site Class	**Soil Profile Name**	**Shear Wave Velocity, Vs, (ft./s)**	**$\overline{N}$ value (bpf)**
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very Dense Soil and Soft Rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 50
E	Soft Soil Profile	Vs < 600 fps	<15

Based upon our interpretation of the subsurface conditions, the appropriate Seismic Site Class for the site is "**C**" as shown in the preceding table.

4.4 PAVEMENTS

Based on our past experience with similar developments and subsurface conditions, we present the following design pavement sections, provided the recommendations contained in this report are implemented and pavements are supported on low plasticity residual soils or newly placed Structural Fill. We have developed the pavement sections recommended below using AASHTO guidelines with an assumed CBR value of 4. ECS has estimated the provided pavement sections based upon a 20 year life, with equivalent single axle loadings of approximately 10,000 ESALs for standard-duty pavements.

ECS should be allowed to review these recommendations and make appropriate revisions based upon the formulation of the final traffic design criteria for the project. It is important to note that the design sections do not account for construction traffic loading.

PAVEMENT SECTION RECOMMENDATIONS		
MATERIAL	**FLEXIBLE PAVEMENT**	**STANDARD UTILITY RIGID PAVEMENT**
Asphaltic Concrete Surface Course (S9.5B)	2 inches	-
Portland Cement Concrete (f'c = 1,000 psi, air entrained)	-	5 inches
Aggregate Base Course (1)(2)	6 inches	6 inches

(1) Multiple lifts required to achieve noted thicknesses.
(2) Aggregate base course shall be compacted to 100% of the maximum dry density of the Modified Proctor (AASHTO T-180).

Vehicles servicing front-loading trash dumpsters frequently impose concentrated front-wheel loads on pavements during loading. This type of loading typically results in rutting of bituminous pavements and ultimate pavement failures and costly repairs. Therefore, we suggest that the pavements in centralized dumpster pickup areas, if provided, utilize a Portland Cement Concrete (PCC) pavement section. Such a PCC section would typically consist of 7 inches of 4,000 psi, air entrained concrete over not less than 6 inches of compacted aggregate base course. Appropriate steel reinforcing (if necessary) and jointing should also be incorporated into the design of PCC pavements.

We emphasize that good base course drainage is essential for successful pavement performance. Water buildup in the base course may result in premature pavement failures. The subgrade and pavement should be graded to provide effective runoff to either the outer limits of the paved area or to catch basins so that standing water will not accumulate on the subgrade or pavement.

4.5 CUT AND FILL SLOPES

ECS was not provided a grading plan at the time of this report; once grading plans are finalized, ECS should be provided the opportunity to review the drawings and revise our recommendations, if needed.

We recommend that permanent cut slopes with less than 15 feet crest height through undisturbed residual soils be constructed at 2:1 (horizontal: vertical) or flatter. Permanent fill slopes less than 15 feet tall may be constructed using Structural Fill at a slope of 2.5:1 or flatter. However, a slope of 3:1 or flatter may be desirable to permit establishment of vegetation, safe mowing, and maintenance. The surface of cut and fill slopes should be adequately compacted. To aid in obtaining proper compaction on the slope face, the fill slopes should be overbuilt with properly compacted Structural Fill and then excavated back to the proposed grades. Permanent slopes should be protected using vegetation or other means to prevent erosion.

A slope stability analysis should be performed on cut and fill slopes exceeding 15 feet in height to determine a slope inclination resulting in a factor of safety greater than 1.4. Upon finalization of site civil

drawings, ECS should be contacted to perform slope stability analyses and determine if further exploration is necessary.

The outside face of building foundations and the edges of pavements placed near slopes should be located an appropriate distance from the slope. Buildings or pavements placed at the top of fill slopes should be placed a distance equal to at least 1/3 of the height of the slope behind the crest of the slope. Buildings or pavements near the bottom of a slope should be located at least 1/2 of the height of the slope from the toe of the slope. Slopes with structures located closer than these limits or slopes taller than the height limits indicated should be specifically evaluated by ECS and may require approval from the building code official.

Temporary slopes in confined or open excavations should perform satisfactorily at inclinations of 2:1. Excavations should conform to applicable OSHA regulations. Appropriately sized ditches or other appropriate storm water controls should run above and parallel to the crest of permanent slopes to divert surface runoff away from the slope face.

4.6 SETTLEMENT MONITORING

Based on the provided grading information, ECS anticipate maximum fill depths of about 6 to 8 feet may be required to achieve final site grades. Due to the present condition of the subgrade material the placement of new fill may result in settlement of the subgrade soils and within the newly placed fill soils. To limit post construction settlement resulting from fill placement, we recommend a settlement monitoring period between fill placement and structure or pavement construction.

Settlement hubs and/or settlement plates should be placed within areas receiving fill to monitor compression of the fill and lower-consistency residual materials due to the presence of low consistency soils. The frequency of monitoring should be on a weekly basis, but this should be adjusted as necessary by ECS based upon fill placement rates and settlement rates. Typically, the settlement rates will accelerate during the fill placement, and decrease shortly after stopping any fill placement. ECS anticipates the settlement may take between 30 and 60 days to reach substantial completion after the end of fill placement. This timeline assumes rapid fill placement, and much of the settlement may occur during placement as site work will most likely take several months. The delay period may be terminated as soon as settlement reaches substantial completion as determined by ECS.

The timeline presented above is not intended to indicate a minimum or required hold period. A minimum of two weeks of settlement monitoring, post fill placement is required to demonstrate settlement has reached a tolerable settlement rate. Upon reaching a tolerable settlement rate, foundation construction may begin. To reduce the settlement monitoring period, implementation of a surcharge program and/or installation of wick drains may be considered.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping vegetation, rootmat, topsoil, existing structures and substructures, and soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits, and 5 feet beyond the toe of structural fills. Existing utilities should be abandoned and

removed or grouted in place. ECS should be retained to observe that topsoil and unsuitable surficial materials have been removed prior to the placement of Structural Fill or construction of structures.

5.1.2 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be observed by ECS. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of ECS. This procedure is intended to assist in identifying localized yielding materials.

Where proofrolling identifies areas that are unstable or "pumping", those areas should be repaired prior to the placement of any subsequent Structural Fill or other construction materials. Methods of stabilization include undercutting, moisture conditioning, or chemical stabilization. The situation should be discussed with ECS to determine the appropriate procedure. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed unstable materials, and to assist in selecting appropriate remedial actions to stabilize the subgrade.

5.2 EARTHWORK OPERATIONS

5.2.1 Lower Consistency/Loose Subgrade Soils

Lower-consistency/loose subgrade soils, with N-values of 6 bpf or less, were encountered at each of the boring locations with the exception of Boring B-07, at depths ranging from approximately 1 to 10 feet below existing ground surface. In their present condition, these soils are generally considered marginally suitable for the direct support of new Structural Fill, foundations, slabs and pavements. Depending on final site grades and their stability at the time of construction, remediation of lower consistency soils including densification or undercutting and replacement with Structural Fill, or settlement monitoring may be necessary. Additionally, reduced/lower allowable bearing pressures may be necessary/provided to limit estimated foundation settlements within tolerable limits.

5.2.2 Below Grade Excavation

Partially Weathered Rock materials were encountered at each boring location beginning at depths ranging from approximately 3 to 22 feet below existing grades. Auger refusal materials (i.e. possible rock) were encountered at Borings B-02 and B-03 at depths ranging from approximately 28.5 and 33.3 feet, respectively, below existing grades. If desired, additional subsurface exploration including test pits to further explore the extents and rippability of the PWR and auger refusal materials can be performed.

Detailed grading plans and proposed utility depths were not provided at the time of this report. The site civil engineer should consider PWR and auger refusal (i.e. possible rock) depths when determining final site grades and utility depths. ECS should be provided the opportunity to review grading plans and utility depths once more detailed plans are available, and revise our recommendations, if needed.

In mass excavation for general site work, dense soils and PWR can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking it out with large front-end loader. In confined excavations such as foundations, utility trenches, etc., removal of PWR may require use of heavy duty backhoes, pneumatic spades, or blasting. Rock excavation techniques and/or blasting should be anticipated for materials exhibiting auger refusal.

As a general guide, we recommend the following definitions be used to define rock:

General Excavation

Rip Rock: Material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.

Blast Rock: Material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds or by a front-end crawler loader with a minimum horsepower rating of 190hp, operation weight of 45,000 pound and bucket occupying an original volume of at least one (1) cubic yard.

Trench Excavation

Blast Rock: Material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds and bucket occupying an original volume of at least one-half (1/2) cubic yard.

As noted in the subsurface characterization section of this report, the weathering process in the Piedmont can be erratic and significant variations of the depths of the denser materials can occur in relatively short distances. In some cases, isolated boulders or thin rock seams may be present in the soil matrix.

5.2.3 Structural Fill

Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

Structural Fill Materials: Materials for use as Structural Fill should consist of inorganic soils classified as CL, ML, SM, SC, SW, SP, GM, or GC, or a combination of these group symbols, per ASTM D2487. These materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest diameter. Open graded materials and gravels (GW and GP), which contain void space in their mass, should not be used in Structural Fills unless properly encapsulated with filter fabric. Structural Fill material should have the index properties in the table below:

STRUCTURAL FILL INDEX PROPERTIES	
Subject	**Property**
Building and Pavement Areas	LL < 50, PI < 30
Maximum Particle Size	4 inches
Maximum Organic Content	5% by dry weight
Minimum Dry Unit Weight (ASTM D698)	90 pounds per cubic foot

STRUCTURAL FILL COMPACTION REQUIREMENTS	
Subject	**Requirement**
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction (greater than 24 inches below finished soil subgrade)	95% of Maximum Dry Density
Required Compaction (within 24 inches of finished soil subgrade)	100% of Maximum Dry Density
Moisture Content	-3 to +3 % points of the soil's optimum value
Loose Thickness (maximum) (1)	8 inches prior to compaction

(1) Thinner lifts may be required depending on compaction equipment utilized.

Unsatisfactory Materials: Unsatisfactory fill materials include materials which do not satisfy the requirements for Structural Fill materials, as well as topsoil and organic materials (OH, OL), Elastic SILT (MH), Fat CLAY (CH), and materials with a maximum dry density of less than 90 pcf per ASTM D698.

On-Site Borrow Suitability: Natural deposits of soils that meet the definition of Structural Fill are present on the site including residual soils classified as Sandy SILT (ML), Lean CLAY (CL), and Silty SAND (SM). Borrow soil materials excavated from creek restoration areas may require moisture conditioning (i.e. drying) to properly compact. Excavated PWR and/or rock materials may require processing (i.e. crushing and/or screening) to use as site Structural Fill depending on the resulting rock fragment size (i.e. greater than 4 inches nominal diameter) and ability of compaction equipment to break down the PWR/rock materials. Elastic SILT (MH) and Fat CLAY (CH) soils do not satisfy the specification criteria for satisfactory materials for Structural Fill. These soils may be placed within non-structural areas.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. Filling operations should be observed on a full-time basis by ECS to determine that the minimum compaction requirements are being achieved.

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts). A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified, and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts.

5.2.4 Site Temporary Dewatering

Based upon our subsurface exploration and depending upon final site design grades, we anticipate that temporary construction dewatering at this site may be required and could include removing accumulated rainwater and/or perched/laterally flowing water infiltration from footing and below grade excavations. Additionally, low-lying and drainage features may require temporary dewatering measures to prepare and compact subgrade soils. Dewatering systems if required, should control water a minimum of 2 feet below the exposed working surface.

We anticipate that temporary dewatering operations, if required, can be handled by the use of conventional submersible pumps directly in the excavation or temporary trenches to direct the flow of water and to remove water from excavations and drainage features. If temporary sump pits are used, we recommend they be established at an elevation 2 to 4 feet below the bottom of the working surface, excavation subgrade, or bottom of footing. A perforated 55-gallon drum or other temporary structure could be used to house the pump. For deeper and mass excavations, trenches, well points, and/or French drains may be necessary. Design and operation appropriate dewatering measures should be the responsibility of the contractor.

5.2.5 General Construction Considerations

Because portions of the site have been previously developed, we emphasize the importance of comprehensive subgrade evaluations prior to Structural Fill placement and/or other construction activities. These evaluations may include proofrolling the subgrade soils, performing hand auger borings, and excavation of test pits within previously disturbed and/or filled areas. The mentioned evaluations would help in identifying areas of soft, loose, otherwise unsuitable materials, or buried debris, which would require remedial activities. We recommend a contingency for unforeseen conditions in the earthwork phase of construction.

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used as Structural Fill provided it meets project specifications.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction

area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each workday, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Excavation Safety: Excavations and slopes should be constructed and maintained in accordance with OSHA excavation safety standards. The Contractor is solely responsible for designing, constructing, and maintaining stable temporary excavations and slopes. The Contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our Client. ECS is not assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

5.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the foundation bearing level. Therefore, foundation concrete should be placed the same day that excavations are made, and the bearing capacity has been verified. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 2 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Following new fill placement, most of the soils at the foundation bearing elevations are anticipated to be acceptable for support of the proposed structures. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Slab Subgrade Observations: Prior to placement of a drainage layer, the subgrade should be prepared in accordance with the recommendations found in Section 5.1.2 Proofrolling.

5.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes; however, difficult excavation may be encountered at utility excavations. PWR and/or rock materials encountered at utility subgrade excavations should be undercut an additional 6-inches and replaced with bedding material to reduce potential point load stress. The pipe subgrades should be observed and probed for stability by ECS. Loose or unsuitable materials encountered should be removed and replaced with suitable compacted Structural Fill, or pipe stone bedding material.

Utility Backfilling: Granular bedding material should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill and Fill Placement.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by the Client. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

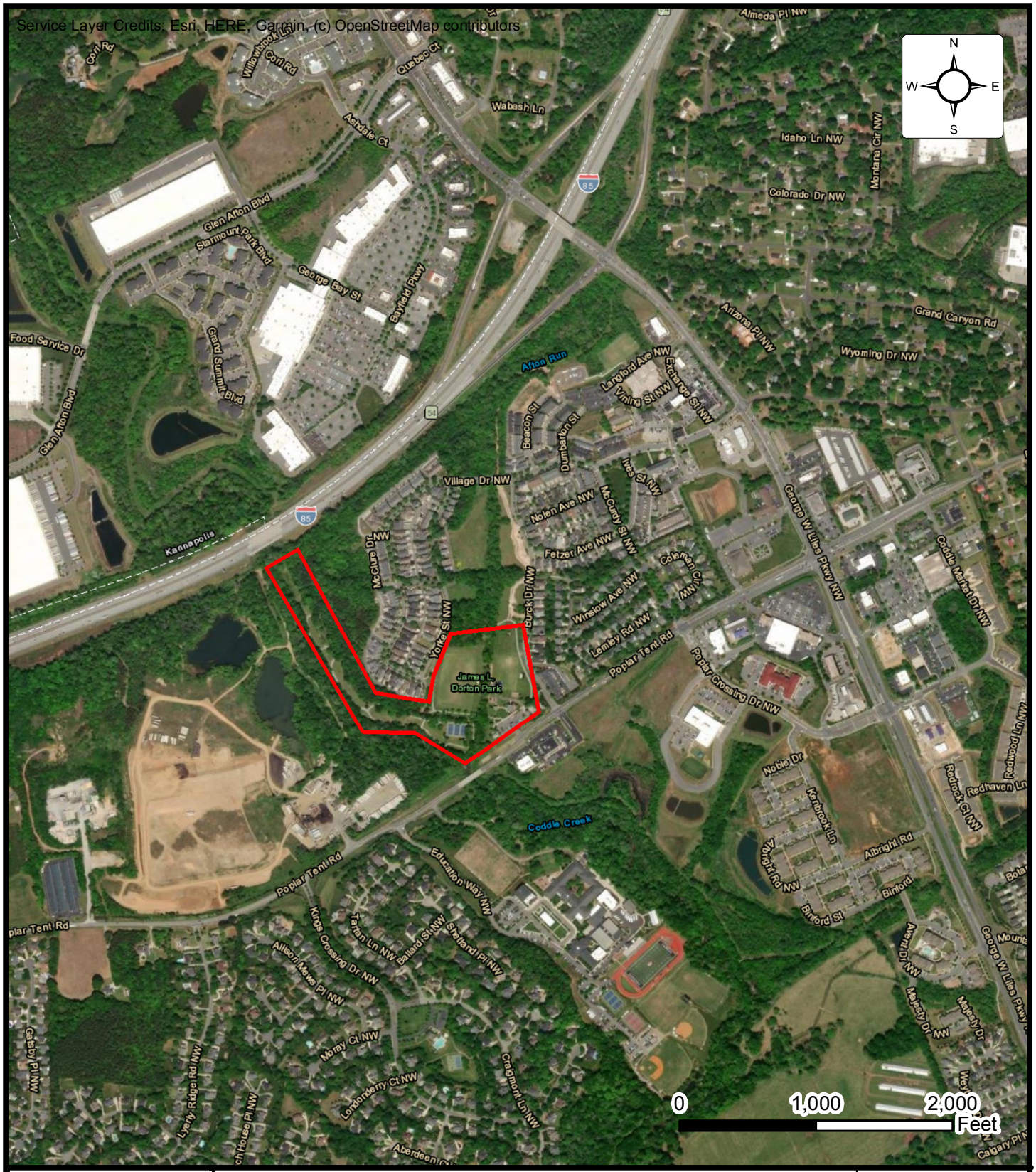
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. ECS should be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Diagrams & Reports

Site Location Diagram
Boring Location Diagram
Subsurface Cross Sections (A-A’ and B-B’)

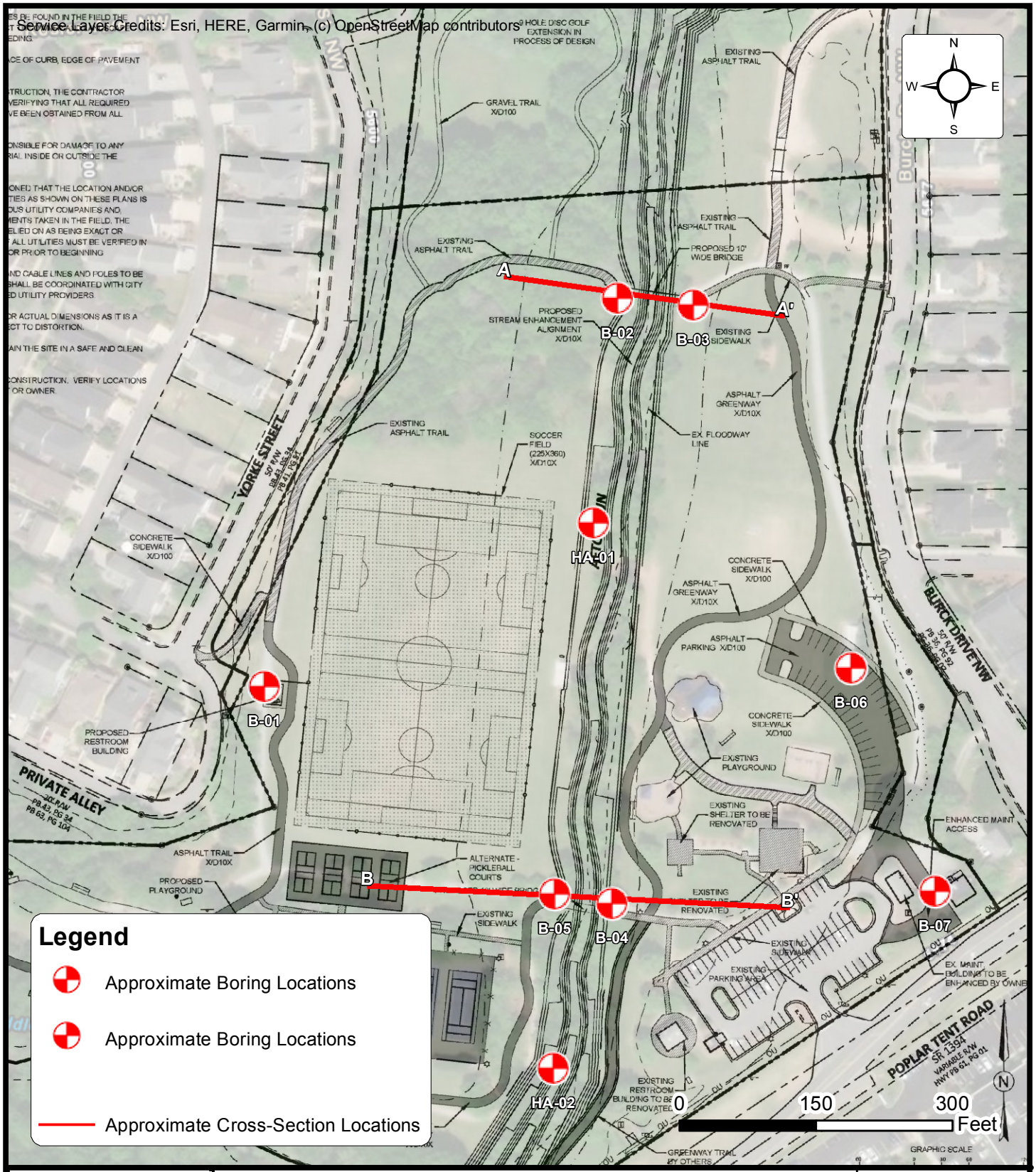


SITE LOCATION DIAGRAM
DORTON PARK IMPROVEMENTS

CONCORD, CABARRUS COUNTY, NORTH CAROLINA

THE DODD STUDIO

ENGINEER	CJC
SCALE	AS NOTED
PROJECT NO.	08:15441
FIGURE	1
DATE	3/15/2023

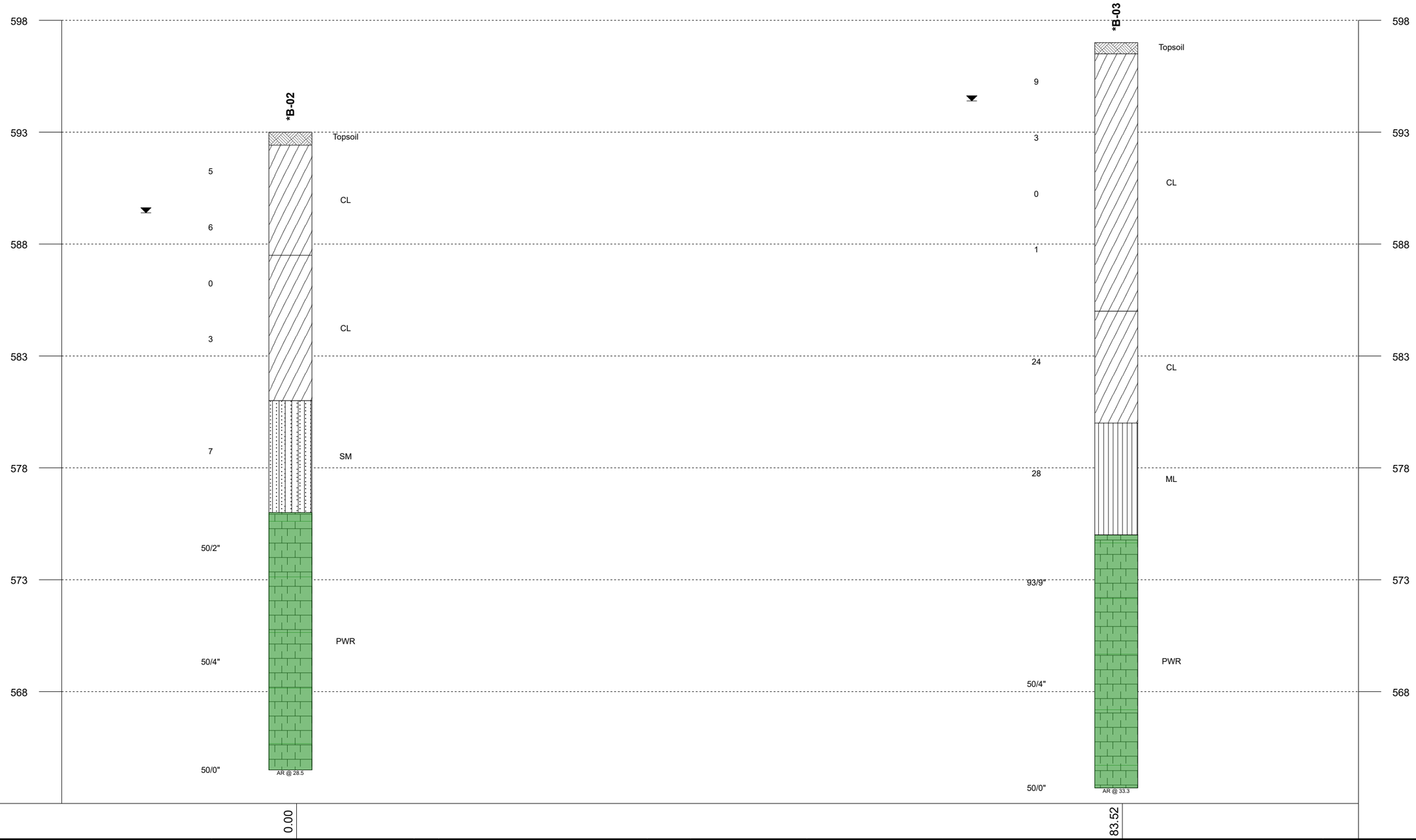


TESTING LOCATIONS DIAGRAM
DORTON PARK IMPROVEMENTS

CONCORD, CABARRUS COUNTY, NORTH CAROLINA

THE DODD STUDIO

ENGINEER	CJC
SCALE	AS NOTED
PROJECT NO.	08:15441
FIGURE	2
DATE	3/15/2023



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit (X — ● — △)	WL (First Encountered)	Fill	
[FINES CONTENT %]	WL (Completion)	Possible Fill	
BOTTOM OF CASING	WL (Estimated Seasonal High Water)	Probable Fill	
LOSS OF CIRCULATION	WL (Stabilized)	Rock	

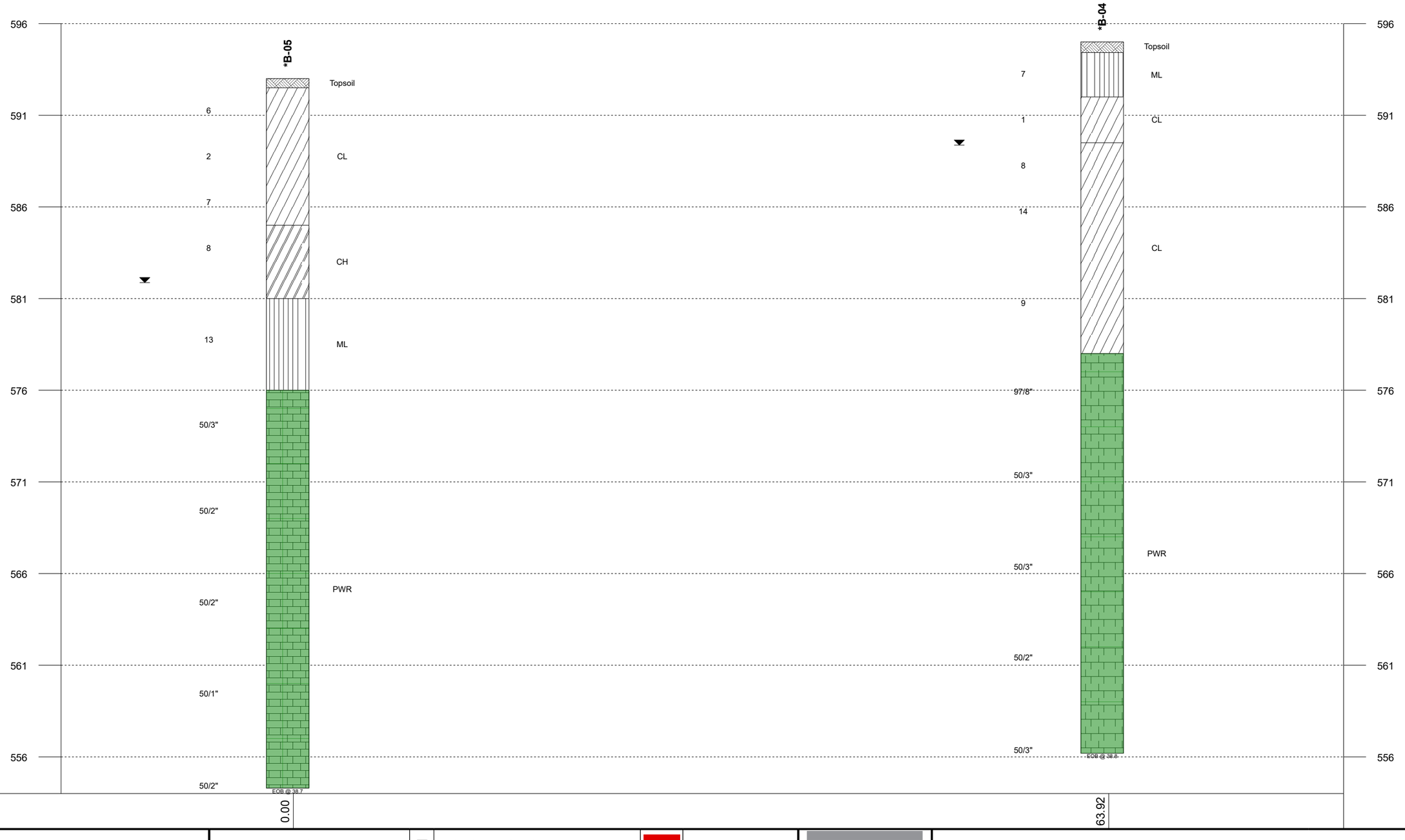
SUBSURFACE CROSS SECTION A-A'

Dorton Park Improvements

The Dodd Studio

5650 Polar Tent Road, Concord, North Carolina, 28027

Project No: 08:15441 Date: 03/15/2023



Legend Key

- Topsoil
- ML
- CL
- CH
- PWR

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit (X—●—△)	WL (First Encountered)		Fill
[FINES CONTENT %]	WL (Completion)		Possible Fill
BOTTOM OF CASING	WL (Estimated Seasonal High Water)		Probable Fill
LOSS OF CIRCULATION	WL (Stabilized)		Rock

SUBSURFACE CROSS SECTION B-B'

Dorton Park Improvements

The Dodd Studio

5650 Polar Tent Road, Concord, North Carolina, 28027

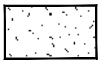
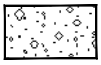
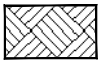
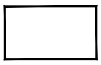
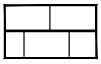
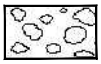
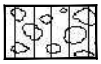
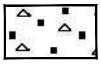
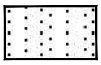
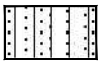
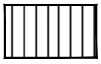
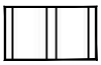
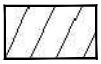
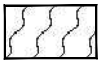
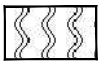
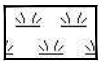
Project No: 08:15441 Date: 03/15/2023

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedure: Standard Penetration Testing (SPT)
Subsurface Exploration Procedure: Hand Auger Borings
Boring Logs
Hand Auger Logs

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

		ASPHALT
		CONCRETE
		GRAVEL
		TOPSOIL
		VOID
		BRICK
		AGGREGATE BASE COURSE
	GW	WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GP	POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GM	SILTY GRAVEL gravel-sand-silt mixtures
	GC	CLAYEY GRAVEL gravel-sand-clay mixtures
	SW	WELL-GRADED SAND gravelly sand, little or no fines
	SP	POORLY-GRADED SAND gravelly sand, little or no fines
	SM	SILTY SAND sand-silt mixtures
	SC	CLAYEY SAND sand-clay mixtures
	ML	SILT non-plastic to medium plasticity
	MH	ELASTIC SILT high plasticity
	CL	LEAN CLAY low to medium plasticity
	CH	FAT CLAY high plasticity
	OL	ORGANIC SILT or CLAY non-plastic to low plasticity
	OH	ORGANIC SILT or CLAY high plasticity
	PT	PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

- WL (First Encountered)
- WL (Completion)
- WL (Seasonal High Water)
- WL (Stabilized)

FILL AND ROCK

FILL | POSSIBLE FILL | PROBABLE FILL | ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 18-24 inches (in 3 or 4 Increments of 6 inches each)

- Auger is advanced* and an additional SPT is performed
- One SPT typically performed for every two to five feet. An approximate 1.5 inch diameter soil sample is recovered.

**Drilling Methods May Vary*— The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

SUBSURFACE EXPLORATION PROCEDURES:

HAND AUGER BORINGS
DYNAMIC CONE PENETROMETER (DCP) TESTS
WILDCAT DYNAMIC CONE PENETROMETER (WDCP) TESTS
KESSLER DYNAMIC CONE PENETROMETER (KDCP) TESTS

Hand auger borings coupled with dynamic cone penetrometer testing are often performed to evaluate shallow subsurface explorations and/or locations with limited access to larger equipment.

Hand Auger Boring Procedure:

The hand auger borings were conducted in general conformance with ASTM D1452. In this procedure, the auger boring is performed by manually rotating and advancing an auger to the desired depths while periodically removing the auger from the hole to clear and examine the auger cuttings. The auger cuttings were visually classified in the field. Stratification lines shown on the hand auger boring logs represent approximate boundaries between physical soil types.

Dynamic Cone Penetrometer (DCP) Test Procedure:

The dynamic cone penetrometer testing was performed in general accordance with ASTM SPT 399. In this procedure, a sliding hammer with a 15 pound steel mass is dropped 20 inches on a cone tip and the number of blows to penetrate 1.75 inches is recorded. The results are presented in blows per increment (bpi).

Wildcat Dynamic Cone Penetrometer (WDCP) Test Procedure:

For the WDCP test, a sliding hammer is dropped on a cone tip and the resulting penetration of the cone is recorded. The 35 lb hammer is repeated dropped from a height of 15 inches and the number of hammer drops (blows per increment) is recorded over continuous 10 centimeter lengths.

Kessler Dynamic Cone Penetrometer (KDCP) Test Procedure:

For the KDCP test, a sliding hammer is dropped on a cone tip and the resulting penetration of the cone is recorded. The Kessler DCP was improved and patented by the US Army Corps of Engineers. The Kessler DCP used for testing has a 4.8 kg (10 lb) or 8 kg (17 lb) hammer. The hammer is repeatedly dropped from a height of 22 inches and the penetration is recorded. The DCP is primarily used to determine in place soil shear strength in road construction. It has a CBR range from less than 0.5 to 100% and bearing value range from 430 to 10,800 psf.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-01**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608282.6**	EASTING: **1500760.0**	STATION:	SURFACE ELEVATION: **597**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[6"]		
	S-1	SS	18	18	(CL) Residuum, LEAN CLAY WITH SAND, dark brown, moist, stiff to soft		2-3-6 (9)
	S-2	SS	18	18			2-2-1 (3)
5	S-3	SS	18	18		592	1-2-2 (4)
	S-4	SS	16	16	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS CLAYEY SAND, dark brown		6-17-50/4" (67/10")
10	S-5	SS	9	9		587	40-50/3" (50/3")
					END OF BORING AT 14.3 FT		
15						582	
20						577	
25						572	
30						567	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Feb 13 2023**	CAVE IN DEPTH: **12.00**	
WL (Completion) **4.50**	BORING COMPLETED: **Feb 13 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **CME 550x**	LOGGED BY: **ACH1**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

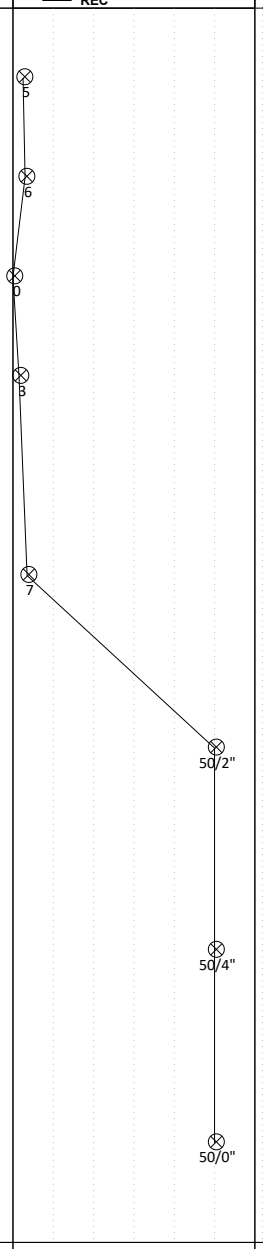
GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-02**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608709.0**	EASTING: **1501147.4**	STATION:	SURFACE ELEVATION: **593**	BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[7"]		
	S-1	SS	18	18	(CL) Residuum, LEAN CLAY WITH SAND, dark brown, moist, firm		2-3-2 (5)
	S-2	SS	18	18			2-3-3 (6)
5						588	
	S-3	SS	18	18	(CL) LEAN CLAY WITH SAND, dark brown, wet, very soft to soft		WOH-WOH-WOH (0)
	S-4	SS	18	18			1-1-2 (3)
10						583	
					(SM) SILTY SAND, gray, wet, loose		
	S-5	SS	18	18			2-2-5 (7)
15						578	
					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, grayish brown		
	S-6	SS	2	2			50/2" (50/2")
20						573	
	S-7	SS	4	4			50/4" (50/4")
25						568	
	S-8	SS	0	0	**AUGER REFUSAL AT 28.5 FT**		50/0" (50/0")
30						563	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)



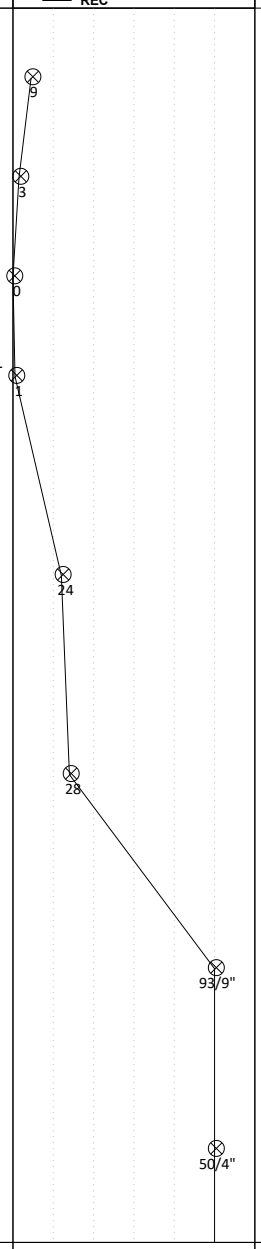
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

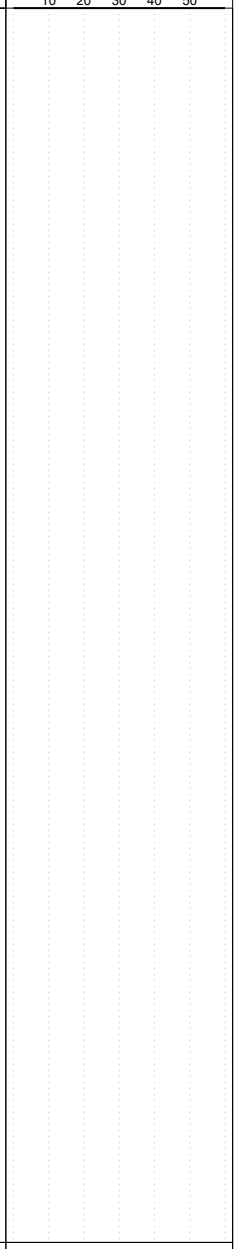
WL (First Encountered)	BORING STARTED: **Feb 13 2023**	CAVE IN DEPTH: **22.00**	
WL (Completion) **3.50**	BORING COMPLETED: **Feb 13 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **CME 550x**	LOGGED BY: **ACH1**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-03**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608701.4**	EASTING: **1501230.6**	STATION:	SURFACE ELEVATION: **597**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[6"]		
	S-1	SS	18	18	(CL) Residuum, LEAN CLAY WITH SAND, dark brown, stiff to very soft		3-4-5 (9)
	S-2	SS	18	18			1-2-1 (3)
5						592	
	S-3	SS	18	18			WOH-WOH-WOH (0)
	S-4	SS	18	18			WOH-WOH-1 (1)
10						587	
					(CL) LEAN CLAY WITH SAND, dark brown, very stiff		
	S-5	SS	18	18			9-11-13 (24)
15						582	
					(ML) SANDY SILT, grayish brown, wet, very stiff		
	S-6	SS	18	18			7-14-14 (28)
20						577	
					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILT WITH SAND, grayish brown		
	S-7	SS	15	15			22-43-50/3" (93/9")
25						572	
	S-8	SS	4	4			50/4" (50/4")
30						567	
					CONTINUED ON NEXT PAGE		





THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Feb 08 2023**	CAVE IN DEPTH: **23.20**	
WL (Completion) **2.50**	BORING COMPLETED: **Feb 08 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-03**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608701.4**	EASTING: **1501230.6**	STATION:	SURFACE ELEVATION: **597**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
35	S-9	SS	0	0	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILT WITH SAND, grayish brown **AUGER REFUSAL AT 33.3 FT**		562	50/0" (50/0")
40							557	
45							552	
50							547	
55							542	
60							537	

STANDARD PENETRATION BLOWS/FT: 20 40 60 80 100 — 50/0"
ROCK QUALITY DESIGNATION & RECOVERY: RQD, REC
LIQUID LIMIT / PLASTIC LIMIT
CALIBRATED PENETROMETER TSF: 1 2 3 4 5
WATER CONTENT % [FINES CONTENT] %: 10 20 30 40 50

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Feb 08 2023**	CAVE IN DEPTH: **23.20**	
WL (Completion) **2.50**	BORING COMPLETED: **Feb 08 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-04**	**1 of 2**

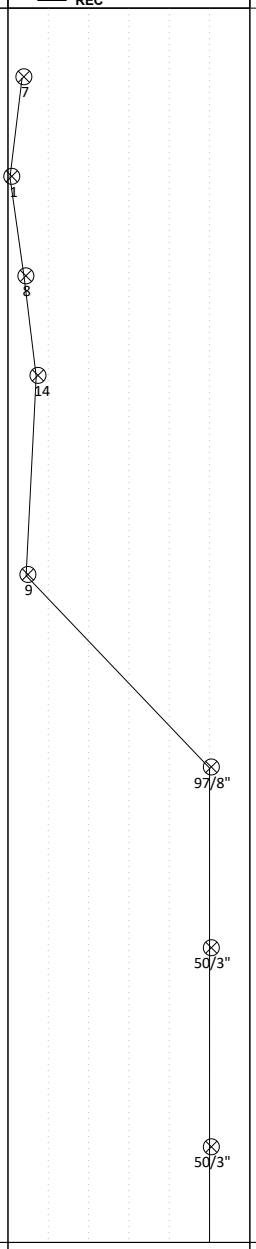
PROJECT NAME:	DRILLER/CONTRACTOR:
Dorton Park Improvements	**ECS**

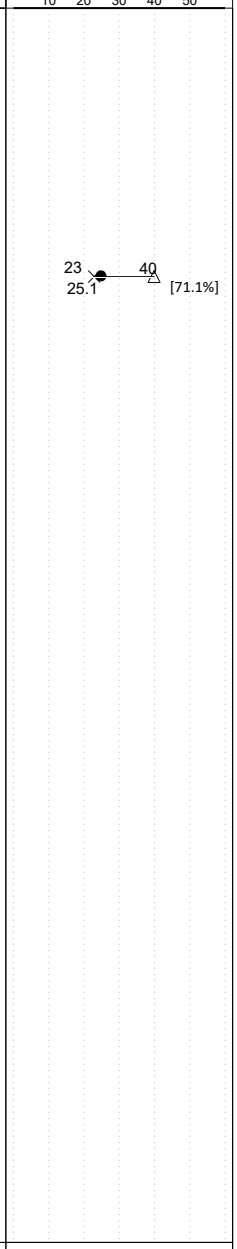
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:	BOTTOM OF CASING
608054.7	**1501078.8**		**595**	

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[7"]			
	S-1	SS	18	18	(ML) Residuum, SANDY SILT, brown, moist, firm			4-5-2 (7)
	S-2	SS	18	18	(CL) LEAN CLAY, brown, wet, very soft			WOH-WOH-1 (1)
5	S-3	SS	18	18	(CL) LEAN CLAY WITH SAND, grayish brown, wet, firm to stiff	▼	590	3-3-5 (8)
	S-4	SS	18	18				4-6-8 (14)
10							585	
	S-5	SS	18	18				2-2-7 (9)
15							580	
	S-6	SS	14	14	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, brown to grayish brown			32-47-50/2" (97/8")
20							575	
	S-7	SS	3	3				50/3" (50/3")
25							570	
	S-8	SS	3	3				50/3" (50/3")
30							565	





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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Feb 13 2023**	CAVE IN DEPTH: **32.50**	
▼ WL (Completion) **5.50**	BORING COMPLETED: **Feb 13 2023**	HAMMER TYPE: **Auto**	
▼ WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-04**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608054.7**	EASTING: **1501078.8**	STATION:	SURFACE ELEVATION: **595**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
35	S-9	SS	2	2	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, brown to grayish brown		560	50/2" (50/2")
40	S-10	SS	3	3	**END OF BORING AT 38.8 FT**		555	50/3" (50/3")
45							550	
50							545	
55							540	
60							535	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100) — 50/2" at 560; 50/3" at 555

ROCK QUALITY DESIGNATION & RECOVERY — RQD; REC

LIQUID LIMIT; PLASTIC LIMIT

CALIBRATED PENETROMETER TSF (1 2 3 4 5)

WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Feb 13 2023**	CAVE IN DEPTH: **32.50**	
WL (Completion) **5.50**	BORING COMPLETED: **Feb 13 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-05**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608044.2**	EASTING: **1501141.8**	STATION:	SURFACE ELEVATION: **593**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[6"]		
	S-1	SS	18	18	(CL) Residuum, LEAN CLAY WITH SAND, brown, moist, firm to soft to firm		3-3-3 (6)
	S-2	SS	18	18			WOH-WOH-2 (2)
5						588	
	S-3	SS	18	18			1-3-4 (7)
	S-4	SS	18	18	(CH) FAT CLAY WITH SAND, grayish brown, wet, firm		3-3-5 (8)
10						583	
	S-5	SS	18	18	(ML) SANDY SILT, gray, wet, stiff		5-5-8 (13)
15						578	
	S-6	SS	9	9	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, grayish brown		42-50/3" (50/3")
20						573	
	S-7	SS	2	2			50/2" (50/2")
25						568	
	S-8	SS	2	2			50/2" (50/2")
30						563	

WATER LEVELS

STANDARD PENETRATION BLOWS/FT
20 40 60 80 100
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF
1 2 3 4 5
WATER CONTENT %
[FINES CONTENT] %
10 20 30 40 50

CONTINUED ON NEXT PAGE

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	BORING STARTED: **Feb 10 2023**	CAVE IN DEPTH: **29.10**	
WL (Completion) **11.00**	BORING COMPLETED: **Feb 10 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-05**	**2 of 2**

PROJECT NAME:	DRILLER/CONTRACTOR:
Dorton Park Improvements	**ECS**

SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:	BOTTOM OF CASING
608044.2	**1501141.8**		**593**	

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
35	S-9	SS	1	1	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, grayish brown		558	50/1" (50/1")
40	S-10	SS	2	2	**END OF BORING AT 38.7 FT**		553	50/2" (50/2")
45							548	
50							543	
55							538	
60							533	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)

ROCK QUALITY DESIGNATION & RECOVERY — RQD, REC

LIQUID LIMIT, PLASTIC LIMIT

CALIBRATED PENETROMETER TSF (1 2 3 4 5)

WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)

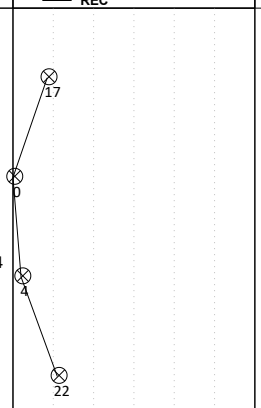
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

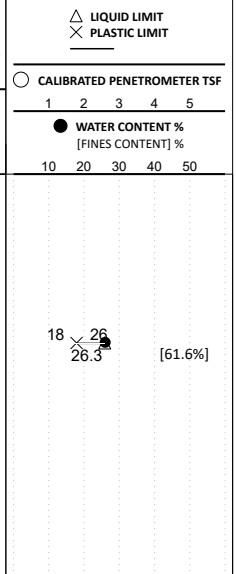
WL (First Encountered)		BORING STARTED: **Feb 10 2023**	CAVE IN DEPTH: **29.10**
WL (Completion)	**11.00**	BORING COMPLETED: **Feb 10 2023**	HAMMER TYPE: **Auto**
WL (Seasonal High Water)		EQUIPMENT: **ATV CME 550x** / LOGGED BY: **DVN**	DRILLING METHOD: **2.25 HSA**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-06**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION:			LOSS OF CIRCULATION
5650 Polar Tent Road, Concord, North Carolina, 28027			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
608303.3	**1501404.2**		**599**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness[6"]			
	S-1	SS	18	18	(CL) Residuum, LEAN CLAY, dark brown, moist, very stiff			6-8-9 (17)
	S-2	SS	18	18	(CL) LEAN CLAY WITH SAND, grayish brown, wet, very soft to soft	▼		WOH-WOH-WOH (0)
5							594	
	S-3	SS	18	18				WOH-WOH-4 (4)
	S-4	SS	18	18	(CL) LEAN CLAY WITH SAND, grayish brown, wet, very stiff			7-9-13 (22)
10					**END OF BORING AT 10 FT**		589	
15							584	
20							579	
25							574	
30							569	





THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

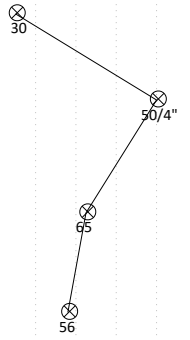
▽ WL (First Encountered)	BORING STARTED: **Feb 10 2023**	CAVE IN DEPTH:	**6.00**
▼ WL (Completion) **3.50**	BORING COMPLETED: **Feb 10 2023**	HAMMER TYPE:	**Auto**
▼ WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x** / LOGGED BY: **DVN**	DRILLING METHOD:	**2.25 HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
The Dodd Studio	**08:15441**	**B-07**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Dorton Park Improvements	**ECS**		
SITE LOCATION: **5650 Polar Tent Road, Concord, North Carolina, 28027**			LOSS OF CIRCULATION
NORTHING: **608057.6**	EASTING: **1501496.5**	STATION:	SURFACE ELEVATION: **612**
			BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness[6"]			
	S-1	SS	18	18	(ML) Residuum, SANDY SILT, orangish brown, moist, very stiff			7-12-18 (30)
	S-2	SS	10	10	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SILTY SAND, brown			15-50/4" (50/4")
5							607	
	S-3	SS	18	18	(SM) SILTY SAND, grayish brown, wet, very dense			17-28-37 (65)
	S-4	SS	18	18				20-24-32 (56)
10					**END OF BORING AT 10 FT**		602	
15							597	
20							592	
25							587	
30							582	

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC



LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**GNE**	BORING STARTED:	**Feb 10 2023**	CAVE IN DEPTH:	**6.70**
WL (Completion)	**GNE**	BORING COMPLETED:	**Feb 10 2023**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT: **ATV CME 550x**	LOGGED BY: **DVN**	DRILLING METHOD:	**2.25 HSA**
WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	SHEET:
The Dodd Studio	**08:15441**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Dorton Park Improvements	**HA-01**	**597**
SITE LOCATION:		STATION:
5650 Polar Tent Road, Concord, North Carolina, 28027		
NORTHING: **608470.8**	EASTING: **1501125.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness [4"]			S-1		
			(CL) Residuum, LEAN CLAY WITH SAND, gray brown, moist	E		S-2		
				E		S-3		
				E		D3S-11		
				E		S-4		
				E		S-5		
5		592	**END OF HAND AUGER AT 5 FT**					
10		587						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion) **GNE**		**BWR**	**Jan 30 2023**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
The Dodd Studio	**08:15441**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Dorton Park Improvements	**HA-02**	**593**
SITE LOCATION:		STATION:
5650 Polar Tent Road, Concord, North Carolina, 28027		
NORTHING: **607826.9**	EASTING: **1501060.6**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness [4"]					
			(CL) Residuum, LEAN CLAY WITH SAND, gray brown, moist	E		S-1		
				E		S-2 D3S-12		
				E		S-3 D3S-13		
				E		S-4		
				E		S-5		
5		588	**END OF HAND AUGER AT 5 FT**					
10		583						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High)	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion) **GNE**		**BWR**	**Jan 30 2023**	**English**	

HAND AUGER LOG

APPENDIX C – Laboratory Testing

Laboratory Testing Summary
Laboratory Compaction Characteristics (Standard Proctor)

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
HA-01	D3S-11	2-3	24.0	CL	45	23	22	55.5					
HA-02	D3S-13	0-5	26.9	CL	43	25	18	70.5	99.4	22.5			
HA-02	D3S-12	1-2	28.4	CL	37	24	13	62.0					
B-04	S-3	6-7.5	25.1	CL	40	23	17	71.1					
B-06	S-2	3.5-5	26.3	CL	26	18	8	61.6					

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

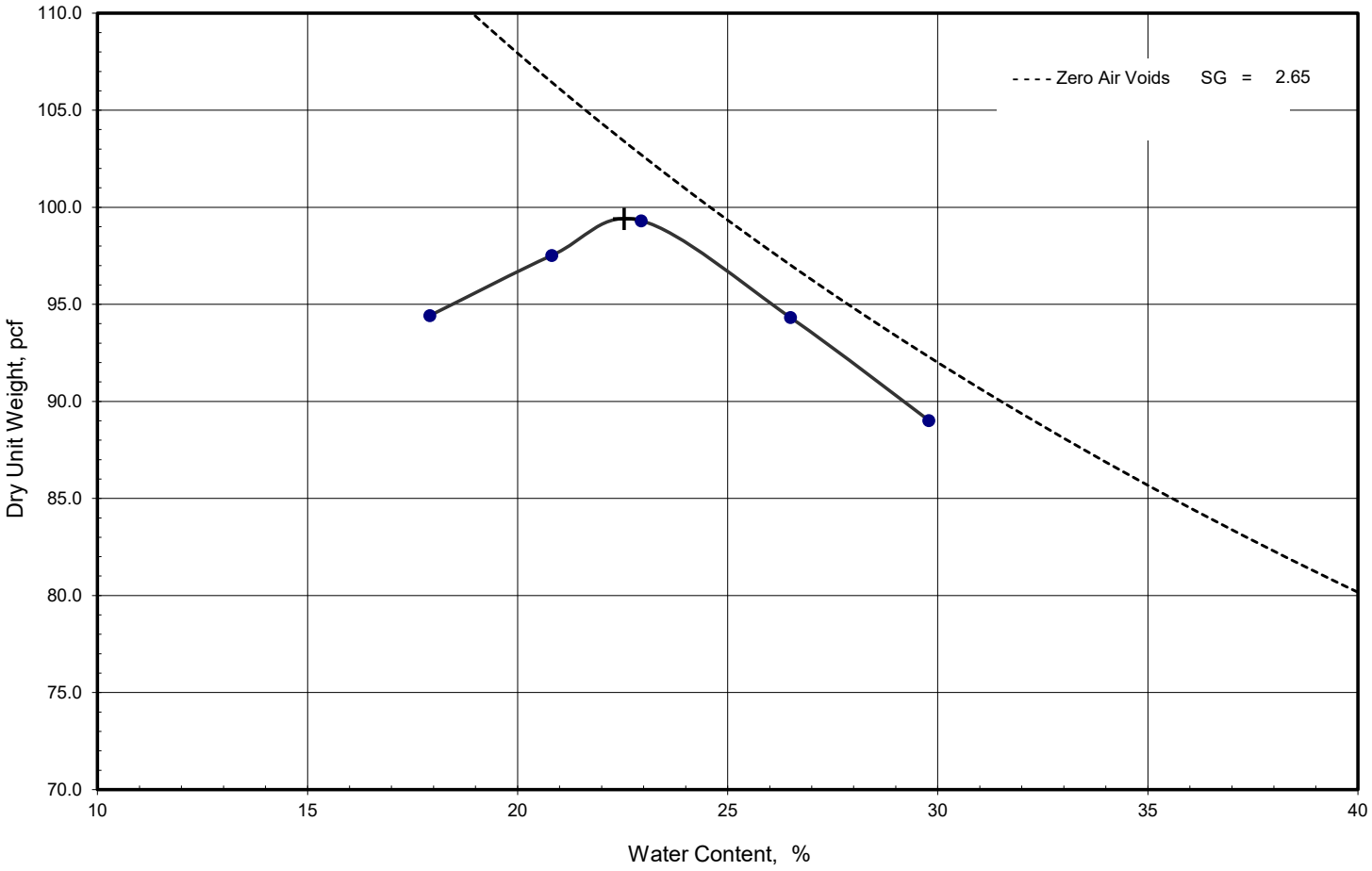
Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Dorton Park Improvements
Client: The Dodd Studio

Project No.: 08:15441
Date Reported: 3/15/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Charlotte	1812 Center Park Drive Suite D Charlotte, NC 28217	(704)525-5152 (704)357-0023

Laboratory Compaction Characteristics of Soil
Using Standard Effort



Optimum Moisture Content		**22.5**	%
Maximum Dry Unit Weight		**99.4**	pcf
Cumulative material retained on:	3/4 in. sieve	-	%
	3/8 in. sieve	-	%
	#4 sieve	-	%

Preparation	ASTM moist preparation	
Type of rammer	Manual - 5.5lbf (24.5N)	
Test Specfication / Method	ASTM D698-12e2-method A	
Specific gravity - D854 water pycnometer	2.65	Historical
Coarse Aggregate Specific Gravity -	2.65	Historical

Soil Description	Nat. Moist. %	Liquid Limit	Plasticity Index	%< #200	USCS	AASHTO
Brown Lean Clay with sand	26.9	43	18	70.5	CL	

Project: Dorton Park Improvements
Client: The Dodd Studio
Sample / Source HA-02
Test Reference/No.:

Project No.: 08:15441
Depth (ft.): 0 - 5
Sample No.: D3S-13
Date Reported: 3/15/2023

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Charlotte	1812 Center Park Drive Suite D Charlotte, NC 28217	(704)525-5152 (704)357-0023

APPENDIX D – Supplemental Documents

GBA Important Information about this Geotechnical-Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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