PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Demolition and removal as indicated on Drawings and as required to accommodate new work, including, but not limited to:

1. Saw-cutting and removal of asphalt concrete paving.
2. Removal and capping of underground utilities.
3. Saw-cutting and removal of curbs and planter walls.
4. Removal of electrical items, including lights, boxes, vaults, audio boxes, and cables.

B. Salvage of existing materials, products, and equipment as indicated on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cleaning: Section 01740

B. Site Clearing: Section 02230.

C. Grading: Section 02310.

D. Excavating and Backfilling for Utilities: Section 02320.

E. Excavating and Backfilling for Structures: Section 02321.

F. Asphalt concrete paving: Section 02745.

1.03 PROJECT CONDITIONS

A. Dust control:

1. Use all means necessary to prevent spread of dust during performance of work. Thoroughly allay dust at all times.
2. Use of reclaimed water shall conform to requirements and guidelines of governing health authorities and be specifically approved by Owner.

B. Burning on-site: Not permitted.

C. Protection: Use all means necessary to protect existing objects designated to remain, including structures, utilities, flora, and trees. In the event of damage to existing objects designated to remain, repair or replace objects to satisfaction of Owner.

D. Security: Maintain integrity of security fences at all times. Conform to procedures and requirements of the Owner and Walt Disney World at all times.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide materials, equipment, shoring, and appurtenances of every kind required for completion of demolition work, including barricades, handrails, and waste receptacles.

B. Explosives: Not permitted.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Job site examination:

1. Prior to commencing work, examine entire job site for objects designated to be removed and protected, and limits of demolition.

2. Locate existing active utility lines and provide for their protection.

B. Clarification:

1. Drawings do not indicate all objects existing on job site.

2. Before commencing work, verify with Owner which objects are to be removed by Contractor, which objects are to be removed by Owner, and which objects are to be preserved.

C. Scheduling: Avoid interference with use of, and passage to and from, adjacent buildings and facilities.

D. Protection of utilities:

1. Preserve and maintain in operating condition all active utilities traversing site. Reroute, or remove and cap those which interfere with work of this Project. Coordinate extent of work with Owner.

2. Expeditiously repair damaged utilities at no cost to Owner.

a. Damage to high-voltage electric system shall be repaired by RCES, charged to Contractor, and deducted from Contract Price by Change Order.

b. Natural gas utility lines discovered or damaged by Contractor shall not be disturbed by Contractor. Work related to this utility shall be performed by the natural gas company. Specific instructions appropriate to issues shall be given to Contractor by responsible agencies and Owner. Damage to natural gas utility lines caused by Contractor shall be repaired only by qualified agencies as selected by Owner, and costs shall be reimbursed to Owner by Contractor in accord with provisions of Contract Documents.

E. Protection of flora:

1. Construct a physical barrier between existing flora to remain and area of new construction.

2. Protect existing trees, not otherwise indicated to be removed, against unnecessary cutting, or breaking, skinning, bruising of bark. Avoid smothering of trees with stockpiled building materials or excavated materials within the drip line. Avoid excess pedestrian or vehicular traffic and parking of vehicles within drip line.

3.03 DEMOLITION AND REMOVAL

A. Demolition and removal of materials shall be by skilled and properly equipped workers. Materials and equipment to be salvaged shall be removed under the direction of or by craftspersons who would normally install such items.

B. Cut concrete and asphalt concrete slabs, walks, pavement, and curbs with a concrete saw to a 2-inch depth along all joint lines before breaking out the portion to be removed.

C. Demolish and remove all foundations, walls, concrete slabs, asphalt concrete pavement, and other items designated for removal, or which are necessary to be removed to make way for new construction work.

D. Any organic material designated by the Owner must be chipped and delivered by the Contractor to the Owner's composting facility.

3.04 SALVAGE

A. All materials removed shall become the property of Contractor to dispose of or salvage, with the exception of items designated on Drawings to be subsequently reinstalled or returned to Owner or items "tagged" as salvage for return to Owner and not previously removed by Owner.

B. Identify (tag or similarly mark indelibly in an inconspicuous location) each salvage item, including detached component parts, with an extensive description of salvage item or component part's use, installed location, date of removal, and similar pertinent information as may be required for reinstallation or future reference by Owner. For salvage items not reinstalled in the Work, box, package or otherwise protect, and transport to Owner-designated locations.

C. Dispose of all materials.

D. Do not sell salvage materials to the general public at job site. This shall not preclude sale to and removal from job site of salvage materials to duly licensed salvage companies.

E. Temporarily store removed materials for subsequent reinstallation at confined areas designated by Owner. Carefully handle removed materials to prevent damage to areas outside immediate locations of the Work.

3.05 DISPOSAL

A. Except as specified otherwise, load debris resulting from demolition and removal as it accumulates, haul away from site promptly, and dispose of in a legal manner.

B. Prevent debris from migrating outside of construction areas. Use Owner-approved methods and materials to confine debris to construction areas. Failure to contain demolition debris is not permitted.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Clearing of site.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cleaning: Section 01740

B. Site demolition: Section 02220.

C. Grading: Section 02310.

D. Excavating and backfilling for utilities: Section 02320.

E. Excavating and backfilling for structures: Section 02321.

F. Planting: Section 02900.

1.03 DEFINITIONS

A. Clearing: Removal of trees, shrubs, bushes, and other organic matter found at or above original ground level.

B. Grubbing: Removal of stumps, roots, boards, logs, and other organic matter found at or below original ground level.

C. Topping: Removal of those portions of trees, bushes, and shrubs projecting above an elevation or plane shown or indicated on Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide all materials, equipment, and appurtenances required for completion of clearing work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work of this Section.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PROTECTION

A. Public and adjacent properties: Protect in accord with applicable laws and ordinances.

B. Existing on-site features, including flora scheduled to remain: Protect from damage at all times.

1. Do not allow earth-moving equipment within the branch spread perimeter (drip line) of existing trees which are to remain.

2. Do not impact, trespass upon, or otherwise violate areas designated on Drawings as easements, buffer zones, wetlands, or similar environmentally-sensitive areas.

3. Protect existing piezometers and monitoring wells located on-site which have been identified and flagged by Owner.

C. Utilities:

1. Protect all active utility lines on-site.

2. Remove from site abandoned lines encountered during clearing and grubbing operations.

3. Capping and/or rerouting of active utility lines encountered during clearing and grubbing operations shall be performed as part of the work of other Sections.

4. Expeditiously repair damaged utilities at no cost to Owner.

a. Damage to high voltage electric system shall be repaired by RCES, charged to Contractor, and deducted from Contract Price by Change Order.

b. Natural gas utility lines discovered or damaged by Contractor shall not be disturbed by Contractor. All work related to this utility shall be performed by the natural gas company. Specific instructions appropriate to the issues shall be given to Contractor by responsible agencies and Owner. Damage to natural gas utility lines caused by Contractor shall be repaired only by qualified agencies as selected by Owner, and all costs shall be reimbursed to Owner by Contractor in accord with provisions of Contract Documents.

D. Dust control:

1. Throughout entire construction period, effectively dust-palliate working area, unpaved roads, and involved portions of the site.

2. Palliation: Intermittently water and sprinkle with such frequency as will satisfactorily allay dust at all times. Chemical treatment of any type is not permitted.

3. Use of reclaimed water shall conform to requirements and guidelines of governing health authorities and be specifically approved by Owner.

3.03 CLEARING

A. Limit of clearing: Areas indicated on Drawings. Clearing limits shall be approved by Owner prior to starting clearing operations.

B. Remove trees, saplings, shrubs, bushes, vines, and undergrowth within limits of clearing.

3.04 GRUBBING

A. Limits of grubbing: As specified for clearing.

B. Remove tree stumps and root systems completely, unless removal damages roots of plants to remain. Refer to Section 02320 for protection of existing plants to remain.

C. For vegetation other than trees, remove stumps, roots, and matted roots to depths specified below:

1. Under footings: 18 inches

2. Under walks: 12 inches

3. Under roads: 18 inches

4. Under parking areas: 12 inches

5. Under planting areas: 12 inches
6. Under fills: 8 inches
7. Where footings, roads, walks, and other construction is on fill, the greater depth applies.

3.05 DISPOSAL

A. Burning of materials on-site is not permitted.

B. Removal:

1. Remove materials resulting from clearing and grubbing operations from site daily as they accumulate.
2. When work continues beyond normal working hours, do not allow materials to accumulate on-site for more than 48 hours.

3.06 TREE REMOVAL, RELOCATION, OR SALVAGE

A. Protect trees from damage until Owner removes trees indicated on Drawings to be salvaged or removed by Owner.

B. Cut and remove other trees from site unless designated on Drawings to remain or be relocated.

C. Verify with Owner which trees are to be salvaged, removed, or relocated.

END OF SECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The work to be performed under this section shall include the design and installation of temporary dewatering system until completion of construction to remove subsurface waters from retention pond, borrow area, structure or utility trench excavations as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Excavating and Backfilling for Utilities: Section 02320

B. Excavating and Backfilling for Structures: Section 02321

C. Grading: Section 02310

1.03 QUALITY ASSURANCE

A. The temporary dewatering system used for this project shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems.

B. The dewatering of any excavation areas and the disposal of water during construction shall be in strict accordance with all local and state government rules, regulations and permit conditions. In addition, the Contractor shall take any and all actions necessary to prevent subsidence or other damage to adjacent areas which might result from the dewatering operation.

1.03 SUBMITTALS

A. Submit to the to the Reedy Creek Improvement District Planning & Engineering Department for permitting of the dewatering operations prior to the pumping activities, the proposed method(s) of dewatering for the various portions of the Work. Dewatering methods selected by Contractor shall be subject to approval by Owner and Reedy Creek Improvement District Planning & Engineering Department. The Contractor shall remain responsible for the adequacy and safety of the methods.

1. Submittal shall include the following:

    a. Estimates of points of discharge

    b. Discharge flows

    c. Site map

    d. Dates and durations for all storm drainage items which will require dewatering, including, but not limited to, retention basins, weir structures and storm sewers.

    e. Number of proposed locations and specifications of all pumps.

    f. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.

    g. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.

    h. Include a written report outlining control procedures to be adopted if dewatering problems arise.

B. Pumping reports documenting time, duration, accumulated volume, location and type of pump used must be sent to the Reedy Creek Improvement District Planning & Engineering office weekly. Reports are due on the Monday prior to the week the work is to be accomplished.

1. Failure to properly maintain reports will result in shut down of all pumping activities for that project.

1.04 DEWATERING SYSTEM CRITERIA

A. The dewatering system shall be developed to the point that it is capable of dewatering the site surrounding all retention ponds, borrow areas, or structures as shown on the Drawings. Each well point systems shall be capable of dewatering and maintaining groundwater levels low enough for the proper performance of necessary operations or the respective retention ponds, borrow areas, or structures.

B. The permitting of dewatering operations with the regulatory agencies shall be the ultimate responsibility of the Contractor.

C. The maximum pumpage per day shall not exceed 10 million gallons per day (MGD). The total pumpage from the operation shall not exceed 900 million gallons. The duration of the dewatering operation shall not exceed 120 days. Note: the 10 MGD, 900 MG and 120 days duration are requirements of RCID's General Permit and apply to the sum of all dewatering operations throughout the RCID and represent maximum rates, duration and volumes. Each project will be evaluated for dewatering limits with respect to other on-going and projected dewatering works in the District, and consequently may be subject to restrictions more stringent than these maximum values.

D. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

E. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

F. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

PART 2 - PRODUCTS

2.0 GENERAL

A. The equipment utilized shall be standard dewatering equipment of proven ability as designed, manufactured and installed by firms having experience in the design and production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods.

PART 3 - EXECUTION

3.01 PUMPING AND DRAINAGE

A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering the proposed excavations, and shall keep such excavations dry so as to obtain a satisfactorily undisturbed subgrade foundation condition until the walls, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The dewatering system installed shall be in conformity with the overall construction plan and certification of this shall be provided by the Contractor The Contractor shall be required to monitor the performance of the dewatering systems during the progress of the work and require such modifications as may be required to assure that the systems are performing satisfactorily.

B. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation and to the integrity of adjacent structures. At a minimum, the water level shall be 2 feet below the trench or excavation bottom. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soils from the surrounding ground.

C. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.

D. The Contractor shall take all additional precautions required to prevent uplift of any structure during construction.

E. The conveying of water in open ditches or trenches will not be allowed except for the spreader or groundwater swale shown in the plans. This swale is shown as a minimum requirement and does not relieve the Contractor from the responsibility to take whatever actions are necessary to prevent damage to adjacent areas.

F. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.

G. Removal of dewatering equipment shall be accomplished after the Contractor and the Engineer agree that the system is no longer required; the material and equipment constituting the system shall be removed by the Contractor.

H. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, hydrocarbons, drilling fluids and other contaminates in order to prevent adverse effects on groundwater quality.

1. Fuel containment must be provided for each pump in the event of a leak or spill. This may be provided via an earthen berm covered with plastic or a double walled factory containment system. Volume must be at least 110 percent of fuel capacity.

I. Drain excavations and other prepared work areas occurring below groundwater level and maintain in a dewatered condition while performing work at those elevations.

J. Prevent surface water drainage from entering excavations, and ponding on subgrades and other prepared work areas.

K. Maintain dry excavations and subgrades by whatever means necessary while working in each area.

1. Reduce groundwater level to a sufficient depth to ensure that bottom soils are not saturated or develop a "quick" condition.

2. Reroute surface water drainage away from excavations, prepared subgrades, and other work areas.

3. Prevent excessive rainwater, to the extent that detrimental softening, undermining, washout, and similar damage would occur, from accumulating in excavations, upon subgrades, and at other prepared work areas.

4. Do not use excavations as temporary drainage.

L. In the event that erosion prevention and control devices shown in these plans prove to be ineffective, alternate methods for maintaining state water quality standards for discharge from the construction site shall be required.

3.02 PROTECTION AND SITE CLEAN-UP

A. At all times during the progress of the Work the Contractor shall use all reasonable precautions to prevent weather tampering with the wellpoints (if used) or the entrance of foreign material into the existing storm drain system.

B. The quality of all water discharged shall comply with the requirements of the United States Environmental Protection Agency, Florida Department of Environmental Regulation, South Florida Water Management District, Reedy Creek Improvement District and any other regulatory agency having proper jurisdiction. No pumped groundwater shall discharge to surface waters. In critical areas, dewatering discharge shall require additional turbidity monitoring by project personnel.

C. Immediately upon completion of the dewatering operations, the Contractor shall remove all of his equipment, materials, and supplies from the site of the work, removal of all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before the work started. The site shall be thoroughly cleaned and graded as directed by the Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Drilled soldier piles, tie-backs, and wood lagging.

B. Design and engineering of temporary shoring.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Excavating for structures: Section 02321.

B. Concrete: Section 03300.

1.03 DESCRIPTION OF SYSTEM

A. Temporary (or permanent if site access limitations prohibit temporary shoring), anchored excavation support system capable of resisting soil and hydrostatic pressure and supporting sidewalls of excavations.

1. Prevent surface water from entering excavations by grading, dikes, or other means.

2. Install excavation support systems without altering or damaging surrounding work or improvements (in-process or completed).

1.04 QUALITY ASSURANCE

A. Installer qualifications: Minimum of 5 years continuous experience in the installation of work of similar material, design, extent, complexity; as determined by the Owner, experience in installation of extremely dissimilar types of work or similar work of less complexity are not acceptable.

B. Welder's qualifications: Currently qualified by tests as prescribed in AWS D1.1, and certified by ICBO.

C. Installation qualifications: Ensure that the sequence of Work of this Section does not disturb or otherwise affect adjacent drilled shafts or other in-place work.

D. Shoring designer/engineer qualifications:

1. Minimum of 5 years continuous experience in the design and structural engineering of temporary (or permanent) shoring, sheeting, and cribbing for support of building excavations of similar size and depth, (30-50 feet depth), as indicated on Drawings.

E. Preservative-treated material qualifications: Identified with American Lumber Standards Committee-recognized agency’s quality mark and AWPA applicable standard.

F. Design criteria: Drawings indicate design intent only and do not include shoring design and engineering calculations required nor all considerations for varying site conditions or for trade industry practices. Provide complete structural design and engineering of temporary (or permanent shoring if required by site access limitations) shoring, sheeting, or cribbing, as necessary to resist soil, hydrostatic pressure, surcharges, dynamic live loads and to support sidewalls of excavations. Design and calculations must be performed by a Florida-licensed professional engineer.

G. Tests and inspections:

1. Procedure: In accord with Section 01455.

2. Required tests:

a. Test structural steel shapes not otherwise identified by mill or independent testing agency's analyses, certifications, or test reports.

b. Test concrete mixes: In accord with Section 03300.

c. Test steel strands for:

(1) Breaking strength.

(2) Yield strength under load.

(3) Elongation under load.

d. Test load capacity of tie-back installations.

3. Required inspections:

a. Inspect welds: In accord with AWS D1.1.

b. Inspect drilling and pressure injection equipment.

c. Inspect drilled shafts for soldier piles.

d. Inspect placement of structural steel soldier piles in drilled shafts.

e. Inspect concrete placement for soldier piles.

f. Inspect lagging placement.

g. Inspect drilled shafts for tie-backs.

h. Inspect tie-back placement, including placement of concrete.

3. Other testing agency services:

a. Verify material certifications, and test reports.

b. Verify concrete volumes for soldier piles.

c. Verify concrete volumes for tie-backs.

d. Verify welder's qualifications.

H. Reference specifications and standards:

1. ASTM: A36 Structural Steel.

2. ASTM A416 Uncoated Seven-Wire Steel Strand for Prestressed Concrete.

3. AWS: D1.1 Structural Welding Code - Steel.

4. AWS: A2.4 Symbols for Welding and Non-Destructive Testing.

I. Allowable tolerances:

1. Deviation of soldier piles and lagging from vertical or indicated batter: Maximum 1/4 inch per foot.

2. Deviation of record location of excavation support and protection systems from location indicated on Drawings: 2 inches maximum center-to-center.

J. Pre-installation conference:

1. At least two weeks prior to scheduled commencement of the work of this Section, arrange a meeting at project site with installers of the work of this Section, and all related work, including substrates to receive work of this Section, other work in and around the work of this Section which must precede or follow the work of this Section, Owner, and other representatives directly concerned with performance of the work. Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending.

2. Review methods and procedures related to the work of this Section, including but not necessarily limited to the following:

    a. Inspect representative areas to receive work of this Section and discuss condition of substrate, and related work performed by other trades.

    b. Review system requirements (Drawings, Specifications and other Contract Documents) for possible conflicts and resolve.

    c. Review required submittals, both completed and yet to be completed.

    d. Review and finalize construction schedule related to the work of this Section and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

    e. Review required inspection, testing, and certifying procedures.

    f. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary enclosures (if not a mandatory requirement).

1.05 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Temporary shoring drawings and engineering design calculations: Provide signed and sealed engineering drawings and calculations for required temporary (or permanent shoring if required by site access limitations), shoring, sheeting, or cribbing for approval prior to start of installation of shoring, sheeting, or cribbing.

1. Obtain approvals from Reedy Creek Improvement District office of Building and Safety of temporary shoring plans and engineering design calculations.

2. Plans, elevations, sections, and details, including layout of components and accessories. Structural design and calculations must be signed and sealed by a Florida-licensed professional engineer.

    a. Indicate dimensions of each or typical drilled shaft for soldier piles and tie-backs, typical clearance between shaft and structural steel soldier pile, typical clearance between shaft and steel strand tie-back, materials, and anchorage to surrounding construction.

    b. Indicate sequence of drilling of shafts; include sequence of placement of soldier piles, concrete, and slurry, in relation to drilling of adjacent shafts.

    c. Design details for typical and unique site conditions.

    d. Include calculated volume of concrete for each or typical soldier pile foundation.

    e. Include calculated volume of grout for each or typical tie-back anchor.

3. Indicate welds in accord with AWS A2.4.

4. Engineering calculations: Complete set of calculations, including structural engineering assumptions, to support structural design. Surcharge around perimeter of excavation shall include an allowance for static and dynamic loads imposed by heavy excavation and construction equipment.

C. Certificates, certifications, and test reports:

1. Structural steel and steel strands: Mill or independent testing agency's analyses, certifications, or test reports.

2. Concrete, and slurry mixes: Certified mix designs for initial and any subsequent changes in mix designs.

3. Welder's certifications.

4. Wood treatment: Certification from treatment processor that pressure-treated materials conform to specified requirements.

1.06 PROJECT CONDITIONS

A. Existing conditions:

1. Do not conceal or cover any work until required tests or inspections have been performed and accepted.

2. Do not fabricate items which require fitting to other elements until dimensions have been verified at the site.

B. Protection: Protect completed installation from damage of subsequent construction activities.

C. Sequencing and scheduling:

1. Coordinate and sequence the application, erection, or installation of work of this Section with adjacent or integral materials, products, and work specified in other Sections. Such work includes but is not limited to the following:

a. Earth fill surcharge or loading.

b. Excavation.

c. Utility services.

2. Order specified materials, and similar items sufficiently in advance of scheduled installation, or erection dates to permit any required shop or field alteration, fabrication, or modification and to not delay the scheduled progress of the Work. Such items include but are not limited to the following:

a. Structural steel shapes.

b. Items of rare ("short") supply, or non-standard or custom fabrication.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural steel for soldier piles: ASTM A36 rolled shapes and plates.

B. Concrete, and slurry: Conform to Section 03300, except testing is not required for slurry mix materials.

1. Slurry aggregate: At Contractor's option, either 1) material selected from excavation, imported material, or a combination thereof, which is free of organic material and other deleterious substances, or 2) commercial quality concrete sand. Material selected from excavation, imported material, or a combination thereof shall meet the following grading:

Sieve Size	% Passing Sieve by Weight
1-1/2 in.	100
1 in.	80 - 100
3/4 in.	60 - 100
3/8 in.	50 - 100
No. 4	40 - 80
No. 100	10 - 40

C. Tie-backs:

1. Steel strands: ASTM A416, Grade 270.

2. Anchoring devices: As manufactured by Dywidag Systems International, Long Beach, CA.

D Welding materials: Conform to AWS D1.1.

E. Lagging: Well seasoned S4S Coast Region Douglas Fir, or equivalent, conforming to WCLIB Grading Rules for West Coast Lumber or WWPA Western Lumber Grading Rules, Structural Joists and Planks; nominal thickness of 3 inches, No. 2 grade or better, unless otherwise indicated on Drawings. Permanent lagging shall be preservative-treated, pressure-type, in accord with AWPA C1, C2, and C15.

F. Miscellaneous and accessory materials: As necessary for complete excavation support system.

2.03 MIXES

A. Concrete: Conform to Section 03300.

B. Slurry:

1. Lean concrete mixture consisting of a fluid, workable mixture of aggregate, cement, and water.

2. Proportion either by weight or by volume. Use not less than 1-1/2 sacks of cement for each cubic yard of slurry mix produced. Use sufficient water content to produce a fluid, workable mix that will flow and can be pumped without segregation of aggregate while being placed.

3. Thoroughly machine mix materials in a pugmill, rotary drum, or other approved mixer. Continue mixing until cement and water are thoroughly dispersed throughout the material.

4. Discard slurry mix not placed within 1 hour after mixing.

2.04 FABRICATION

A. Soldier piles:

1. General: In accord with AISC Design, Fabrication and Erection of Structural Steel for Buildings, and AISC Code of Standard Practice, as applicable.

2. Fabricate structural steel for soldier piles in shop to greatest extent possible.

3. Fabricate in single, continuous lengths.

4. Drill and ream holes; burning of holes is not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work of this Section.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that may occur during excavation support system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support systems to ensure minimum interference with other adjacent work and processes.

1. Do not obstruct or hinder the work of adjacent areas. Provide alternate routes around obstructed traffic ways.

C. Constantly monitor excavation support systems during entire sequence of Work of this Section and until acceptance of entire Project. Promptly correct bulges, breakage, evidence of movement, or other deficiencies to ensure excavation support systems remain functional and stable.

D. Promptly repair damages to adjacent facilities caused by installing excavation support systems.

3.03 INSTALLATION/PERFORMANCE

A. Drilling shafts:

1. Drill shafts for soldier piles at intervals or locations and to full depths as indicated on approved shoring drawings.

2. Where necessary, provide casings to prevent sloughing or caving-in of shaft walls.

B. Soldier piles:

1. General: In accord with AISC Design, Fabrication and Erection of Structural Steel for Buildings, and AISC Code of Standard Practice, as applicable.

2. Install structural steel soldier piles in drilled shafts. Align flanges to vary not more than 2 inches from the intended plane and not more than 1:120 out of intended alignment.

3. Maintain alignment until concrete and slurry is poured and cured.

4. Avoid cutting off excess portions of soldier pile tops in the field. Where necessary and as approved by the Owner, any cutting off of tops shall be performed neatly, square with axis length of pile, and at elevations approved by Owner.

C. Concrete:

1. In accord with Section 03300.

2. Use tremie or similar method to place concrete at bottom of drilled shaft.

3. As concreting progresses, withdraw any casings, sleeves or similar items previously installed to protect drilled shafts.

4. Unless otherwise indicated on Drawings or directed by Owner, place concrete in shafts up to "slip plane" indicated on Drawings, in a single, continuous, uninterrupted operation.

D. Slurry:

1. Immediately remove foreign material which falls into drilled shafts prior to or during placing of slurry mix.

2. After testing agency has verified volume of concrete previously placed and concrete has set, place slurry mix in a uniform manner that will prevent voids in, or segregation of slurry mix, and will not shift or disturb soldier piles and drilled shafts.

3. Unless otherwise indicated on approved shoring drawings or directed by Owner, place slurry mix in shafts, above "slip plane" indicated on Drawings, in a single, continuous, uninterrupted operation, flush to grade elevations.

4. Unless otherwise indicated on approved shoring drawings, allow slurry mix to completely cure prior to commencing excavation procedures.

E. Excavation: In accord with Section 02321.

F. Lagging:

1. Chip out hardened slurry mix from between flanges of soldier piles to the extent necessary to install and properly align wood lagging.

2. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with earth fill, and compact.

3. Do not install wales or similar bracing or support on excavated side of excavation support systems.

G. Tie-backs:

1. Drill shafts at angles, elevations, locations, and lengths as indicated on approved shoring drawings. Where necessary, provide casings, sleeves, or implement equivalent methods to prevent sloughing, caving-in, or collapse of shafts.

2. Install steel strands and PVC sleeves in single, continuous lengths into drilled shafts.

3. Using a tremie or similar method to place concrete in drilled shafts.

4. Unless otherwise indicated on approved shoring drawings or directed by Owner, pressure inject concrete in shafts up to "slip plane" indicated on approved shoring drawings, in a single, continuous, uninterrupted operation. As pressure injection progresses, withdraw any casings, sleeves or similar items previously installed to protect drilled shafts.

5. After testing agency has verified volume of concrete previously placed and concrete has set, place slurry mix in a uniform manner that will prevent voids in, or segregation of slurry mix, and will not shift or disturb steel strands and drilled shafts.

6. Unless otherwise indicated on approved shoring drawings or directed by Owner, pressure inject slurry mix in shafts, above "slip plane" indicated on approved shoring drawings, in a single, continuous, uninterrupted operation, flush to face of excavations. As pressure injection progresses, withdraw any casings, sleeves or similar items previously installed to protect drilled shafts.

7. Allow concrete and slurry to fully cure.

8. After load-capacity testing of steel strands has been performed and test results accepted by Owner, tension steel strands and secure in place with anchoring devices at face of soldier piles as indicated on approved shoring drawings.

H. Continue excavating, install wood lagging, and install tie-backs to required excavation elevations indicated on approved shoring drawings.

3.04 FIELD QUALITY CONTROL

A. After initial and any subsequent load-capacity testing of tie-back assemblies, remove and replace, install additional tie-backs at adjacent locations, or otherwise remedy, as directed by Owner, those tie-back assemblies that fail load-capacity tests.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site grading, including:

1. Site stripping.
2. Removal of organic soils.
3. Import or export of soils as required to complete grading.
4. Rough grading and shaping of site.
5. Final finish grading and shaping of site.
6. Groundwater control and dewatering of excavations.
7. Removal from site and proper disposition of all debris and excess material resulting from the work.
8. Fill and compact holes resulting from tree removal.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Demolition: Section 02220.

B. Site clearing: Section 02230.

C. Dewatering: Section 02240

D. Excavating and Backfilling for Utilities: Section 02320.

E. Excavating and Backfilling for Structures: Section 02321.

F. Erosion and Sedimentation Control: Section 02370.

G. Fine grading for Asphalt Concrete Paving: Section 02745.

1.03 DEFINITIONS

A. Dewatering: Control of surface water runoff and ground water accumulation.

1.04 QUALITY ASSURANCE

A. Tests and inspections:

1. Procedure: In accord with Section 01455.
2. Required tests:
   a. Fill material: Determine suitability of fill material not previously evaluated.
   b. Maximum density tests: Determine optimum moisture content and maximum dry density of fill materials placed and compacted in accord with ASTM D1557, Procedure A.
   c. Field density tests: Determine in-place density of fill materials placed and compacted in accord with ASTM D1556, ASTM D2922, or ASTM D2937. Provide one test for every 10,000 sq. ft. per lift.
   d. Certification of all subgrade improvements and engineered fills and subgrades with respect to their adequacy and suitability values for intended uses.

e. Suitability and classification testing for all soils of unknown characteristics prior to use as compacted fills.

f. Other tests as may be required by Owner.

3. Required inspections and controls:

a. General inspection of stripping of surfaces and removal of root mat, peat, organic soils (muck), clay, and other unsuitable material.

b. Detailed inspection of exposed subgrades prior to finishing or placing fill materials.

c. Continuous control of placing and compacting of all engineered fills.

d. Continuous inspection and monitoring during placing and compacting operations.

e. Observation and consultation in processes of bank shaping, safety in excavations, dewatering, and identification of materials encountered.

B. Requirements of regulatory agencies: In addition to complying with other legal requirements, comply with the following.

1. Code of Federal Regulations Title 29 CFR Part 1926, Subpart P, Excavations.

2. Occupational Safety and Health Administration Document 2226.

3. Florida Statutes, Chapter 553 Building Construction Standards, Part VI, Trench Safety Act.

C. Reference specifications and standards:

1. ASTM: D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method.

2. ASTM: D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft^3).

3. ASTM: D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. ASTM: D2937 Density of Soil In-Place by the Drive-Cylinder Method.

5. CFR: Title 29 CFR Part 1926 Safety and Health Regulations for Construction.

6. Florida Statutes: Chapter 553 Building Construction Standards.

7. OSHA: Document 2226 Excavations.

D Allowable tolerances:

1. Grading elevations and contours: Accuracy of final grading elevations and contour shall be the responsibility of a land surveyor licensed in the State of Florida.

2. Refer to Section 01722.

PART 2 - PRODUCTS

2.01 MATERIALS

A. On-site and borrow fill:

1. Nonexpansive, predominantly granular material:

a. Particles less than 2 inches in any dimension;

b. Free of organic and inorganic debris;

c. Not more than 12% by weight passing the No. 200 sieve.

2. Acceptable to geotechnical engineer retained by Owner.

3. Top soil: All soil above the lower root line of fine vegetation (grasses and sod).

4. Borrow site: At location approved by Owner.

PART 3 - EXECUTION

3.01 PROTECTION

A. Public and adjacent properties: Protect in accord with applicable laws and ordinances.

B. Existing on-site features, plant life, including trees, scheduled to remain:

1. Protect from damage at all times.

2. Do not allow earth-moving equipment within the branch spread perimeter (drip line) of existing trees.

C. Utilities:

1. Protect all active utility lines on-site.

2. Remove abandoned utility lines encountered during grading, and dispose of off-site.

3. Cap and reroute indicated active utility lines encountered during grading operations performed as part of specific work section pertaining to utility encountered.

4. Repair damaged utilities expeditiously and at no cost to Owner.

a. Damage to high voltage electric system shall be repaired by RCES, charged to Contractor, and deducted from Contract Price by Change Order.

b. Natural gas utility lines discovered or damaged by Contractor shall not be disturbed by Contractor. All work related to this utility shall be performed by the natural gas company. Specific instructions appropriate to the issues shall be given to Contractor by responsible agencies and Owner. Damage to natural gas utility lines caused by Contractor shall be repaired only by qualified agencies as selected by Owner, and all costs shall be reimbursed to Owner by Contractor in accord with provisions of Contract Documents.

D. Dust control:

1. Throughout entire construction period, effectively dust-palliate working area, unpaved roads, and involved portions of site.

2. Palliation: Intermittently water and sprinkle with such frequency as will satisfactorily allay dust at all times. Chemical treatment of any type is not permitted.

3. Use of reclaimed water shall conform to requirements and guidelines of governing health authorities and be specifically approved by Owner.

3.02 STRIPPING AND CLEARING

A. Strip dry ground areas of all top soil, surface vegetation, muck, roots, organic material, and debris to result in a uniform surface of exposed clean, natural sand or soils.

B. Except as directed otherwise by Owner, dispose of all waste materials to legal off-site disposal areas.

C. Dispose of all waste material removed by above procedures to areas designated on-site as waste areas for this class of material. Disposal area shall be at a location designated by Owner.

3.03 EXCAVATIONS

A. Excavate materials of every nature to dimensions and elevations indicated. Use equipment of suitable type for materials and conditions involved.

B. Where additional excavation is required to remove unsatisfactory materials encountered, such additional work shall be paid for by means consistent with terms of the Contract.

C. Remove from site materials not approved for use as topsoil or fill and excess excavated materials.

3.04 FILLING, COMPACTING, AND GRADING

A. Filling:

1. Place fill in uniform lifts not exceeding 12 inches in loose thickness that will uniformly compact to the required densities.

2. Bring each layer to between ±4% of optimum moisture content before compaction. Add water by uniform sprinkling and mixing with soils. Add or blend additional fill materials or dry out existing materials as required.

3. When moisture content and condition of each layer is satisfactory, compact to specified density. Compact areas not accessible to motor-driven equipment with mechanical or heavy hand tampers.

4. Rework compacted areas failing to meet specified density as determined by tests. Recompact and retest as required or directed to achieve proper density.

5. Correct unauthorized excavation made below depth indicated, as acceptable to geotechnical engineer retained by Owner, at no additional cost to Owner.

6. Do not place fill materials until subgrade is acceptable to geotechnical engineer retained by Owner, nor until preceding fill layer is acceptable.

7. Prior to placing fill material on existing surfaces, scarify to a depth of 12 inches and re-compact to same degree of compaction as overlying fill material.

B. Compacting:

1. Parking and pavement areas: Compact soils below all parking areas, walks, slabs, and asphalt pavement to 95% of the Modified Proctor maximum dry density for full depth of fill.

2. Landscape areas: Compact soils below all landscape, planting, and sod areas to 85% of the Modified Proctor maximum dry density for the full depth of fill.

3. Building areas: Compact soils below all buildings and for a distance of 5 feet beyond perimeter footing to at least 95% of the Modified Proctor maximum dry density for the full depth of fill. Proof roll within these limits with a self-propelled vibratory compactor capable of imparting a maximum dynamic drum force of at least 36,000 pounds. Proof roll from a level that is 2 feet above ambient water table. This may require locally filling low areas prior to utilizing a vibratory compactor. Densify subsoils by making repeated overlapping coverages of roller as it operates at its full vibrational frequency, and at a travel speed of not more than 2 feet per second.

4. Minor structures: Support catch basins and other minor structures on bottom and all sides by soils compacted to 95% of the Modified Proctor maximum dry density for full depth of fill.

C. Grading:

1. Grade (cut or fill) site to the elevations indicated on Drawings within the following tolerances:

a. All cuts and fills: Within a tolerance ±0.10 feet for grades indicated on Drawings.

b. Structures at or on grade: Within 0.02 feet (including hardscape).

2. Elevations and contours indicated on Drawings are to finish grade unless otherwise indicated. Make allowances for pavement thickness, bases, and sod material where applicable.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Dewatering, excavating, shoring, sheeting, bracing, trenching, backfilling, and all other earthwork operations required for utility and other underground lines and appurtenances.

B. Providing access to open trenches after utility lines have been installed and bedded, but prior to backfilling being commenced, to permit recording of record or "as-built" survey information.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Dewatering: Section 02240

B. Excavation Support: Section 02260

C. Excavating and backfilling for structures: Section 02321.

D. Underground utilities marking: Section 02505.

1.03 QUALITY ASSURANCE

A. Tests and inspections:

1. Procedure: In accord with Section 01455.

2. Test methods:

a. Maximum dry density of backfill materials shall be determined by ASTM D1557, Procedure A.

b. Field density tests shall be determined by ASTM D1556, ASTM D2922, or ASTM D2937.

3. Required tests:

a. Backfill material: Determine suitability of backfill and bedding material not previously evaluated.

b. Maximum density tests: Determine optimum moisture content and maximum dry density of backfill and bedding materials placed and compacted.

c. Field density tests: Determine in-place density of backfill materials placed and compacted. One test for every 100 linear feet of trench and one test for each 1 foot vertical lift.

d. Other tests as may be required by Owner.

4. Required inspections:

a. Excavation inspection: Detailed inspection of exposed excavations prior to placing bedding and backfill material.

b. Bedding conditions: Determine and evaluate condition of bedding to receive utility lines.

B. Requirements of regulatory agencies: In addition to complying with other legal requirements, comply with the following.

1. Code of Federal Regulations Title 29 CFR Part 1926, Subpart P, Excavations.

2. Occupational Safety and Health Administration Document 2226.

3. Florida Statutes, Chapter 553 Building Construction Standards, Part VI, Trench Safety Act.

C. Reference specifications and standards:

1. ASTM: D422 Particle-Size Analysis of Soils.

2. ASTM: D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM: D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
4. ASTM: D2419 Sand Equivalent Value of Soils and Fine Aggregate.
5. ASTM: D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM: D2937 Density of Soil In-Place by the Drive-Cylinder Method.
7. CFR: Title 29 CFR Part 1926 Safety and Health Regulations for Construction.
8. Florida Statutes: Chapter 553 Building Construction Standards.
9. OSHA: Document 2226 Excavations.

1.04 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Drawings and engineering design calculations: Signed and sealed engineering drawings and calculations for required shoring, sheeting, or cribbing for approval prior to starting installation of shoring, sheeting, or cribbing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Source of materials: Materials may be obtained by selective stockpiling of excavated soils and/or from an on-site or off-site borrow pit approved by the Owner.

1. Select bedding material shall be clean, natural, excavated sand, free from roots, organic material, trash or other debris, maximum size 1 inch containing less than 15 percent by weight passing the No. 200 sieve.
2. Backfill material for pipe zone shall be free from stones, roots, foreign material and organic material. Maximum size of particles shall be 1-inch with less than 15 percent by weight passing the No. 200 sieve. This material may be clean natural sand or gravel, imported quarry waste or select excavated material, provided that such material consists of loam, sand, sandy clay loam, gravel or other materials of the GM/GC classification, as classified in accordance with ASTM D2487.
3. Backfill above the pipe zone shall be excavated material obtained from the Contractor's excavations. Such materials shall be free of roots, trash, debris, deleterious materials, broken concrete or paving materials, organic materials, boulders, rocks or stones larger than three (3) inches and expansive soils.
4. Gravel shall be 1-inch minus crushed rock, meeting the requirements of No. 57 aggregate as specified in Section 901 of the FDOT Standard Specifications.
5. Deficiency of Backfill: Where excavated material is indicated as backfill on the drawings or specified herein and there is a deficiency due to the rejection of part of the material, the required quantity of sand, gravel or other approved backfill material shall be obtained from a source secured by the Contractor.

PART 3 - EXECUTION

3.01 PROTECTION

A. Public and adjacent properties: Protect in accord with applicable laws and ordinances.

B. Existing on-site features, plant life, including trees, scheduled to remain:

1. Protect from damage at all times.

2. Do not allow earth-moving equipment within the branch spread perimeter (drip line) of existing trees.

3. Do not cut tree roots over 2 inches in diameter without prior approval from Owner.

4. Support trees during excavation in an approved manner.

5. When excavation adjacent to existing trees is necessary, use all possible care to avoid injury to trees and tree roots. Excavate by hand all areas where 2 inches and larger roots occur. Tunnel under and heavily wrap with burlap roots 2 inches and larger in diameter, except directly in the path of pipe or conduit, to prevent scarring or excessive drying. When a trenching machine runs close to trees having roots smaller than 2 inches in diameter, hand trim wall of trench adjacent to tree, making clean cuts through roots. Paint roots 1 inches and larger in diameter with two coats of Tree Seal, or Owner-approved equivalent. Close trenches adjacent to trees within 24 hours; when this is not possible, shade side of trench adjacent to tree with burlap or canvas.

6. All work around and adjacent to existing trees, including inspection prior to backfill, shall be approved by Owner. Obtain Owner's approval in writing for all procedures prior to commencement of work. Trees that die due to damage or unacceptable work shall be back-charged to Contractor.

C. Where utility line excavation occurs in lawn, grassed, or landscaped areas, carefully remove and stockpile sod and plants to preserve for transplanting.

1. Place excavated material from trenches on lawn or grass, provided a drop cloth or other approved method is employed to protect lawn or grass from permanent damage. Do not keep stockpiled materials on lawn or grass for more than 72 hours

2. Immediately after completion of backfilling and testing of utility lines, replace sod and replant plants in a manner to restore lawn, grass, and landscaping to its original condition within practical limits. Replace damaged landscaping at no cost to Owner as part of the work of this Section.

D. Where utility line excavation occurs in paved areas, saw-cut existing pavement along straight, uniform lines such that the amount of pavement cut and removed shall be the minimum consistent with safe excavation practices.

1. Do not use removed pavement as backfill material.

2. Replace removed pavement with new pavement to match existing in accord with Project Specifications.

3. Roadway cuts shall be made between the hours of 2:00 a.m. and 6:00 a.m. to minimize disruption of traffic unless otherwise directed and approved by the Owner’s Representative. Roadways shall be in safe operating condition by not later than 7:00 a.m. The Contractor shall provide safe, temporary detours for traffic during open cut construction.

E. Open trenches: Barricade all open trenches during work hours and cover at the close of each day’s work. Maximum length of open trenches shall be 350 feet.

F. Utilities:

1. Where utility line excavation occurs near existing utilities, whether or not indicated on Drawings, maintain existing utility services fully operational. Protect and support utility lines in a manner to prevent damage. Method of protection is subject to Owner's approval.

2. Excavation in close proximity to existing utilities shall be performed in such a manner so as to prevent damage to the existing utilities. Hand digging may be required by the Owner to prevent damage.

3. Expeditiously repair utilities damaged at no cost to Owner.

   a. Damage to high voltage electric system shall be repaired by RCES, charged to Contractor, and deducted from Contract Price by Change Order.

   b. Natural gas utility lines discovered or damaged by Contractor shall not be further disturbed by Contractor. All work related to this utility shall be performed by RCES. Specific instructions appropriate to the issues shall be given to Contractor by responsible agencies and Owner. Damage to natural gas utility lines caused by Contractor shall be repaired only by qualified agencies as selected by Owner and all costs shall be reimbursed to Owner by Contractor in accord with provisions of Contract Documents.

4. Remove abandoned lines encountered during excavating and dispose of off-site. Report unidentified lines to Owner prior to removal.

G. Dust control:

1. Throughout entire construction period, effectively dust-palliate working area, unpaved roads, and involved portions of site.

2. Palliation: Intermittently water and sprinkle with such frequency as will satisfactorily allay dust at all times. Chemical treatment of any type is not permitted.

3. Use of reclaimed water is accepted and preferred and shall conform to requirements and guidelines of governing health authorities and be specifically approved by Owner. Consult with Owner’s Representative for nearest source of reclaimed water.

H. Water control:

1. Maintain trenches and other excavations free of water while lines are being placed and until backfill has been completed and approved.

2. Maintain adequate pumping equipment at all times to provide for emergencies.

3. Dispose of water in such a manner as not to create a nuisance, cause damage to property, or interfere with activities of other contractors. Prevent water from migrating outside of construction areas. Use Owner-approved methods and materials to confine water to construction areas. Failure to contain water is not permitted.

4. Dewater as required to maintain site in a relatively dry condition, including well point dewatering.

5. Methods of dewatering and disposal of water are subject to Owner's approval.

I. Bracing and shoring:

1. The Contractor shall furnish, install and maintain sheeting, bracing, shoring and sloping required to support the sides of the excavation, and to prevent any movement which may damage adjacent utilities, pavements or structures, damage or delay the work or endanger life and health. All voids outside the supports shall be immediately filled and compacted.

2 Support excavations in accord with all legal requirements.

3. Set and maintain sheet piling and shoring timbers in a manner that will prevent caving of walls of excavations or trenches and not impose other loads or surcharges on lines.

4. When it is impractical to remove shoring and bracing, obtain approval from Owner to leave in place. Record locations of such "in-place" shoring and bracing on Project Record Documents and indicate type of material and thickness.

J. Stockpiled excavated materials: Confine excavated materials to immediate area of stockpiled location.

K. Where utility line excavations occur near Monorail pier pile caps and piles, limits of excavation shall not extend below a 1-1/2:1 (horizontal:vertical) plane extending down from the top of adjacent Monorail pier pile cap. Excavations that extend closer to the previously described zone require shoring.

L. Temporary shoring to protect Monorail pier piles and caps:

1. Provide shoring to protect the load capacity of the existing Monorail piles and pile caps during open excavation.

2. Shoring used for retaining over 15 feet of soil or adjacent to existing structures (i.e., closer than the 1-1/2:1 plane extending down from the adjacent structure at lowest grade) shall utilize tie-backs or shall be internally braced. Shoring used for retaining less than 15 feet of soil or not adjacent to existing structures (i.e., outside of the 1-1/2:1 plane extending down from the adjacent structure at lowest grade) may be cantilevered. Refer to geotechnical data. Limit deflection of shoring. Provide continuous lagging between soldier piles.

3. The critical zone for protection of pile caps/piles is indicated on Drawings under operational and non-operational conditions and shall not be permitted to be disturbed.

M. Boring and jacking, where required, shall be conducted with no interference with traffic, even if this should require that the work be done between the hours of 2 a.m. and 6 a.m., unless directed otherwise by the Owner’s Representative.

N. When obstructions that are not shown on the plans are encountered during the progress of the work and an alteration or revision to the plans is required, the Owner will have the plans revised or may order the removal, relocation or reconstruction of the obstruction.

3.02 EXCAVATION

A. General: Include removal of materials and obstructions that interfere with the execution of the Work.

1. Unless indicated otherwise, excavation for utilities lines shall be by open trench.

2. Sides of trenches shall be as nearly vertical as practicable.

3. Obtain prior approval from Owner for use of tunneling.

4. It shall be the Contractor's responsibility to obtain an RCES Utility Location Ticket to locate and flag all existing underground utilities at the work site not less than five (5) working days prior to the commencement of trenching and excavation.

5. The excavation and preparation of trenches shall not proceed in advance of pipe installation more than 100 feet, except as approved by the Owner. Trenching shall not, under any conditions, exceed the quantity of pipe that can be bedded, inspected, tested, backfilled and compacted in one working day.

B. Trench widths:

1. Lines less than 6 inches outside diameter: 18 inches, minimum.

2. Larger lines: Clear distance on each side of line of not less than 12 inches.

C. Trench depth: Excavate trenches to lines and grades as necessary for construction of utility lines indicated.

D. Over-excavation: Backfill over-depth excavations to required grade with specified bedding and backfill material at no additional cost to the Owner. Compact bedding and backfill material to specified density.

E. Perform any dewatering and pumping required to keep excavations free of standing water.

F. Refer to geotechnical reports for seasonal high groundwater table elevation estimates. It is the sole responsibility of contractor to make its own judgments as to the actual conditions, and to draw its own conclusions as to means and methods required for performance of the work. Provide dewatering, if required, at whatever elevation groundwater is actually encountered.

G. A plan for any proposed dewatering shall be submitted for approval prior to commencement of any such work. Any permitting for dewatering which may be required shall be the responsibility of Contractor.

H. Sequence, schedule, coordinate, and perform the work so as to maintain safe, unobstructed passage as required for emergency egress and general site access. Provide any and all bridging of trenches of work, barricades, etc., that may be required to comply with this requirement.

I. When the trench bottom is found to contain unsuitable material which is unstable to such a degree that in the judgment of the Owner it cannot be removed, a foundation for the pipe, structure and/or appurtenance shall be constructed using piling, treated timber, concrete or other material approved by the Owner.

1. Unsuitable materials are soils, exposed at the trench bottom that are compressible, expansive, contain extraneous rubble, offer uneven foundation support, or have a natural moisture content three (3) percent in excess of the soils optimum moisture content. Unsuitable materials/soils shall include, but not be limited to, muck, peat, expansive clays, boulders, soils in a quick condition, rubble, any portion of trees, roots or similar vegetation, wood or other unyielding material.

2. The Contractor shall notify the Owner immediately when unstable material is encountered. The Owner will investigate the questionable material to determine its stability. Should the Owner require soils testing to aid in his determination, then all tests revealing suitable materials shall be paid for by the Contractor.

3. Where the Owner determines that unstable material is present below the pipe envelope which will not provide adequate support for the pipe, the Contractor shall remove the unstable material and replace with a minimum of six (6) inches of Gravel up to the bottom of the pipe envelope.

3.03 BACKFILL

A. General:

1. Backfill consists of bedding, backfill, and restoration of surface.

2. Do not cover lines until they have been inspected and approved for alignment and grade and recording of record or "as-built" survey information has been performed.

3. The minimum distance between test sampling points along the trench shall be in accordance with the following table:

			RELATIVE DENSITY	
TRENCH ZONE	STANDARD PROCTOR ASTM D1557	FIELD DENSITY ASTM D1556	GREEN AREA	PAVED AREA
PIPE BEDDING	ONE TEST	ONE TEST	98%	98%
HAUNCHING	FOR EACH	FOR EVERY	98%	98%
PIPE ZONE	SOIL	100 LINEAR	95%	95%
BACKFILL ABOVE PIPE ZONE	TYPE	FEET *	95%	98%
MANHOLE FOUNDATION	FOUND	ONE PER MANHOLE *	95%	98%

* Per lift

4. The Contractor shall not achieve compaction by the use of heavy rolling equipment or by running heavy construction equipment on or in the trench. Backfilling and compaction shall have been completed, tested and the degree of compaction verified before heavy equipment is operated over the trench.
5. Puddling or flooding with water to achieve compaction shall not be permitted.
6. When unsatisfactory compaction is revealed, the Contractor shall immediately re-excavate the trench, replace and re-compact the backfill to the required relative densities over the entire depth of the trench.
7. Partial Backfill During Testing: When conditions require that pipe testing should be accomplished before completion of backfilling or with pipe joints accessible for examination, sufficient backfill material shall be placed over the pipe barrel, between the joints, to prevent pipe movement.

B. Bedding: Bedding is defined as material supporting and extending to the invert of utility line. Provide 6 inches minimum layer of Select Granular Bedding and compact bedding to 98% of the maximum dry density in accord with ASTM D1557 using mechanical equipment. Bedding shall not be required under or around structures, except at utility lines.

C. Backfill: Backfill includes material from 12 inches above the lines to, and including, surface restoration.

1. Commence backfilling immediately after approval and survey information recording, to preclude damage to utility lines.
2. Carefully place backfilling around utility lines so as not to displace or damage line, and fill symmetrically on each side of line to 12 inches above top of line.
3. Do not backfill against structures until concrete has attained sufficient strength to withstand loads, and structures have been approved.
4. Place backfill in loose uniform lifts not exceeding 8 inches, unless otherwise specified.
5. Use mechanical compactors for compaction of backfill.
6. Pipe Zone Backfill

a. Backfill the pipe zone to 12 inches above the top of the pipe for the full width of the trench with Backfill Material For Pipe Zone as specified in paragraph 2.01.A.2.

b. Haunching (Up to Springline of Pipe): Place in the trench in horizontal lifts not exceeding 6 inches in uncompacted thickness on both sides of the pipe. Thoroughly tamp and compact the material to obtain a relative density of not less than 98 percent of the maximum density. Use particular attention in placing material on the underside or haunches of the pipe to provide a solid backing to eliminate any voids.

c. Remainder of Pipe Zone: Place on both sides of the pipe. Tamp and compact the material to obtain a relative density of not less than 95 percent of maximum density.

7. Trench Backfill Above Pipe Zone

a. Place Backfill Material For Pipe Zone as specified in paragraph 2.01.A.3 in all areas beneath structures, piping, utilities, roads, pavements, or other facilities. Compact each lift to not less than 98% maximum density.

b. In other areas, backfill the trench above the pipe zone with material conforming to Backfill Above The Pipe Zone. Place in 12-inch layers and compact each layer by means of mechanical tampers or vibratory compactors to 95% maximum density in field areas and to 98% maximum density under all roadways, walks, paved surfaces and structures. Backfill to the required surface grade and compact so that no surface settlement occurs.

8. Coordinate and ensure installation of underground utilities marking in accord with Section 02505.

D. Minor structures

1. Support catch basins, vaults, manholes and other minor structures on bottom and all sides by soils compacted to 95% of the maximum dry density in grass or filed areas and to 98% maximum dry density under all roadways, walks, paved surfaces and structures in accord with ASTM D1557 for full depth of fill.

a. The pre-cast vaults shall be carefully placed on the prepared foundation so as to be fully and uniformly supported in true alignment, making certain that the pipe can pass through on the designed line and grade.

b. Pre-cast vaults shall be handled by lifting rings only.

c. Pre-cast vaults and manholes shall be placed and aligned to provide vertical alignment with not more than one eighth (1/8) inch maximum tolerance for five (5) feet of depth. The completed unit shall be rigid, true to dimensions and alignment.

E. Maintain the surface of the backfilled trench level with the existing grade until the entire project is accepted by the Owner. Any subsequent settlement of the finished surface during the warranty period shall be considered to be as a result of improper or insufficient compaction and shall be promptly repaired by the Contractor at no cost to the Owner.

1. The maintenance shall include, but not be limited to, the addition of roadway material to keep the surface of backfilled trenches reasonably smooth, free from ruts and potholes, and suitable for normal traffic flow.

3.04 ADJUST AND CLEAN

A. Surface restoration:

1. Restore surface areas over trenches equivalent to conditions which existed prior to start of work.

2. Reconstruct surfaces in accord with applicable Sections of the Specifications.

B. Disposal:

1. Debris:

   a. Remove and dispose of all rubbish, debris, and vegetation as it accumulates.

   b. Dispose of debris off-site or at an on-site disposal area designated by Owner.

2. Excess soil: Stockpile at an on-site area designated by Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavating, backfilling, and compacting for structures.

B. Restore grades to required elevations.

C. Remove excess materials from site.

D. Pumping and dewatering.

E. Support of excavations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Dewatering: Section 02240

B. Excavation Support: Section 02260.

C. Excavating and Backfilling for Utilities: Section 02320.

1.03 QUALITY ASSURANCE

A. Tests and inspections:

1. Procedure: In accord with Section 01455.

2. Test methods:

a. Maximum dry density of backfill materials shall be determined by ASTM D1557, Procedure A.

b. Field density tests shall be determined by ASTM D1556, ASTM D2922, or ASTM D2937.

3. Required tests:

a. Backfill material: Determine suitability of backfill material not previously evaluated.

b. Maximum density tests: Determine optimum moisture content and maximum dry density of backfill materials placed and compacted.

c. Field density tests: Determine in-place density of backfill materials placed and compacted. one test for every 100 cubic yard of material placed and one test for each 1-foot vertical lift

d. Other tests as may be required by Owner.

4. Required inspections:

a. Excavation inspection: Detailed inspection of exposed excavations prior to placing backfill material.

b. Placement and compaction inspection: Continuous inspection and monitoring.

B. Requirements of regulatory agencies: In addition to complying with other legal requirements, comply with the following.

1. Code of Federal Regulations Title 29 CFR Part 1926, Subpart P, Excavations.

2. Occupational Safety and Health Administration Document 2226.

3. Florida Statutes, Chapter 553 Building Construction Standards, Part VI, Trench Safety Act.

C. Reference specifications and standards:

1. ASTM: D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method.

2. ASTM: D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft^3).
3. ASTM: D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM: D2937 Density of Soil In-Place by the Drive-Cylinder Method.
5. CFR: Title 29 CFR Part 1926 Safety and Health Regulations for Construction.
6. Florida Statutes: Chapter 553 Building Construction Standards.

1.04 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Drawings and engineering design calculations: Signed and sealed engineering drawings and calculations for required shoring, sheeting, or cribbing for approval prior to start of installation of shoring, sheeting, or cribbing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. On-site materials and borrow fill:

1. Nonexpansive, predominantly granular material:
   a. Particles less than 2 inches in any dimension.
   b. Free of organic and other deleterious materials.
   c. Not more than 12% by weight passing the No. 200 sieve behind retaining walls and 25% elsewhere.
2. Acceptable to a geotechnical engineer retained by Owner.
3. Top soil: All soil above the lower root line of fine vegetation (grasses and sod).
4. Borrow site: At location approved by Owner.

PART 3 - EXECUTION

3.01 PROTECTION

A. Public and adjacent properties: Protect in accord with applicable laws and ordinances.

B. Existing on-site features, plant life, including trees, scheduled to remain:

1. Protect from damage at all times.
2. Do not allow earth-moving equipment within the branch spread perimeter (drip line) of existing trees.
3. Do not cut tree roots over 2 inches in diameter without prior approval from Owner.
4. Support trees during excavation in an approved manner.

5. When excavating adjacent to existing trees is necessary, use all possible care to avoid injury to trees and tree roots. Excavate by hand areas where 2 inches and larger roots occur. Tunnel under and heavily wrap with burlap roots 2 inches and larger in diameter, except directly in the path of pipe or conduit, to prevent scarring or excessive drying. When a trenching machine runs close to trees having roots smaller than 2 inches in diameter, hand trim wall of trench adjacent to tree, making clean cuts through roots. Paint roots 1 inch and larger in diameter with two coats of Tree Seal, or Owner-approved equivalent. Close trenches adjacent to trees within 24 hours; when this is not possible, shade side of trench adjacent to tree with burlap or canvas.

6. All work around and adjacent to existing trees, including inspection prior to backfill, shall be approved by Owner. Obtain Owner's approval in writing for all procedures prior to commencement of work. Trees that die due to damage or unacceptable work shall be back-charged to Contractor.

C. Utilities:

1. When utility line excavation occurs near existing utilities, whether or not indicated on Drawings, maintain existing utility services fully operational. Protect and support utility lines in a manner to prevent damage. Method of protection is subject to Owner's approval.

2. Expeditiously repair damaged utilities at no cost to Owner.

   a. Damage to high voltage electric system shall be repaired by Reedy Creek Energy Services, charged to Contractor, and deducted from Contract Price by Change Order.

   b. Natural gas utility lines discovered or damaged by Contractor shall not be further disturbed by Contractor. All work related to this utility shall be performed by Reedy Creek Energy Services. Specific instructions appropriate to the issues shall be given to Contractor by responsible agencies and Owner. Damage to natural gas utility lines caused by Contractor shall be repaired only by qualified agencies as selected by Owner and all costs shall be reimbursed to Owner by Contractor in accord with the provisions of the Contract Documents.

3. Remove abandoned lines encountered during excavating and dispose of off-site. Report unidentified lines to Owner prior to removal.

4. Capping and rerouting of indicated active utility lines encountered during Work of this Section will be performed as part of the work of Divisions l5 and l6.

D. Dust control:

1. Throughout entire construction period, effectively dust-palliate working area, unpaved road, and involved portions of site.

2. Palliation: Intermittently water and sprinkle with such frequency as will satisfactorily allay dust at all times. Chemical treatment of any type is not permitted.

3. Use of reclaimed water shall conform to requirements and guidelines of governing health authorities and be specifically approved by Owner.

E. Water control:

1. Maintain excavation free of water while foundations are being placed and until backfill has been completed and approved.

2. Maintain adequate pumping equipment at all times to provide for emergencies.

3. Dispose of water in such a manner as not to create a nuisance, cause damage to property, or interfere with activities of other contractors. Prevent water from migrating outside of construction areas. Use Owner-approved methods and materials to confine water to construction areas. Failure to contain water is not permitted.

4. Dewater as required to maintain site in a relatively dry condition, including well point dewatering.

5. Methods of dewatering and disposal of water is subject to Owner's approval.

F. Cribbing and shoring:

1. Provide temporary or permanent cribbing, sheeting, and shoring as necessary to safely retain earth banks and protect excavations from caving or other damage.

2. Design, install, and maintain cribbing, sheeting, and shoring and remove after use.

G. Stockpiled excavated materials: Confine excavated materials to immediate area of stockpiled location.

3.02 STRIPPING

A. Stockpile materials from excavations suitable for use in fill and backfill.

B. Remove from site materials not approved for use as topsoil, fill or backfill, and excess excavated materials.

3.03 EXCAVATING

A. Excavate materials of every nature to dimensions and elevations indicated on Drawings. Use equipment of suitable type for materials and conditions involved.

B. Extend excavation a sufficient distance from walls to allow for forming and shoring, application of waterproofing, installation of services, and approvals. Do not excavate below indicated depths.

C. Correct unauthorized excavation made below depths indicated on Drawings, as recommended by geotechnical engineer retained by Owner, at no additional cost to Owner.

D. Where additional excavation is required to remove unsatisfactory materials encountered, such additional work shall be paid for by means consistent with terms of Contract.

3.04 FILL, BACKFILL, AND COMPACTION

A. Fill and backfill:

1. Place earth fill and backfill in layers that will uniformly compact to required densities, but in loose layers not more than 8 inches thick.

a. Place backfill only after walls have been supported by completion of interior floor systems or have been sufficiently braced to resist imposed loading.

b. Place backfill against walls below grade after waterproofing systems have been completed and approved.

c. Protect waterproofing systems during backfill operations.

d. If waterproofing is damaged, do not continue backfilling until membrane damage is repaired as approved by Owner.

e. Restore grades to indicated elevations.

2. Slurry cement (lean concrete) backfill:

a. Where specifically indicated on Drawings, slurry cement backfill consisting of a fluid, workable mixture of aggregate, cement, and water shall be used as foundation structure backfill.

b. Cement shall be Portland cement conforming to provisions in Section 03300, except that testing will not be required.

c. Water used for slurry cement backfill shall be free from oil, salts, and other impurities which would have an adverse effect on quality of backfill material.

d. At Contractor's option, aggregate shall be either 1) material selected from excavation, imported material, or a combination thereof, which is free of organic material and other deleterious substances, or 2) commercial quality concrete sand. Material selected from excavation, imported material, or a combination thereof shall meet the following grading:

Sieve Sizes	Percentage Passing
1-1/2 inches	100
1 inches	80-100
3/4 inches	60-100
3/8 inches	50-100
No. 4	40-80
No. 100	10-40

e. Aggregate, cement, and water shall be proportioned either by weight or by volume. Not less than 188 pound of cement shall be used for each cubic yard of material produced. Water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of aggregate while being placed.

f. Materials for slurry cement backfill shall be thoroughly machine-mixed in a pugmill, rotary drum, or other approved mixer. Mixing shall continue until cement and water are thoroughly dispersed throughout material. Slurry cement backfill shall be placed in the Work within 1 hour after mixing.

g. Slurry cement backfill shall be placed in a uniform manner that will prevent voids in, or segregation of, backfill and will not float or shift foundation structures. Foreign materials which fall into trench prior to or during placing of slurry cement backfill shall be immediately removed.

h. Placing material over slurry cement backfill shall not commence until 4 hours after slurry cement backfill has been placed.

B. Compaction:

1. Bring each layer to within ±4% of optimum moisture content before compaction. Add water by uniform sprinkling. Jetting and flooding are prohibited. Add and blend additional fill materials or dry out existing materials as required.

2. When moisture content and condition of each layer is satisfactory, compact to not less than 95% of maximum dry density in accord with ASTM D1557.

3. Compact areas not accessible to motor-driven equipment with mechanical or heavy hand tampers.

4. Rework compacted areas failing to meet specified maximum dry density, as determined by tests. Recompact and retest as required to achieve 95% of the maximum dry density in accord with ASTM D1557.

C. Grading:

1. Build compacted backfills to indicated or required finish grades, less allowances for thickness of slabs, paving, and required base courses.

2. Rough grade backfilled surfaces smooth, level to within 0.10 foot of intended surface. Compact loose material and maintain in a moist condition until covered.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Erosion, sedimentation and water pollution control features in place or relocated as indicated on Drawings, prior to start of all grading or construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Stormwater Pollution Prevention Plan: Section 01571

B. Erosion & Sedimentation Control: Section 01575

C. Dewatering: Section 02240

D. Grading: Section 02310.

E. Erosion Control Blankets and Mats: Section 02372.

1.03 DEFINITIONS

A. Control features: Includes, but not limited to, berms, erosion control blankets, pine straw bales, silt barriers, silt fences, and swales.

1.04 QUALITY ASSURANCE

A. Performance criteria:

1. Prevention, control and abatement of erosion, sedimentation, and water pollution shall be in accord with Florida Department of Transportation (FDOT) *Standard Specifications for Road and Bridge Construction*, Section 104, latest edition.

2. In addition to FDOT Section 104, provisions shall adhere to the following detailed specifications:

a. Maintenance of water quality is of utmost importance. During construction, operations involving modifications to shoreline where the possibility exists of runoff entering surrounding bodies of water, turbidity and suspended solids measurements shall be taken daily, each morning. These measurements shall be taken on workdays only. These samples and testing shall be taken by a Florida Department of Health and Rehabilitative Services State Certified Laboratory, at expense of Contractor. Contractor may elect to solicit these services from the RCID (Reedy Creek Improvement District) Environmental Services Labratory at Contractor's expense.

b. Environmental consultant shall be selected by Contractor and approved by Owner. Samples shall be taken using state-of-the-art practices. Sample gathering and laboratory practices and techniques, including test and evaluation equipment specifications, shall be submitted to Owner prior to start of construction for approval.

c. Samples shall be taken in areas designated by Owner.

d. Results from tests shall be forwarded to Owner the same day samples are taken. If levels of turbidity and/or suspended solids exceed limits stated below, Contractor shall stop work immediately and notify Owner. Contractor shall not restart work until written authorization to do so is received.

e. The acceptable level of turbidity is background plus 25 NTU or less. Background water quality is considered to be 5 NTU unless otherwise noted by RCID.

f. All water from a designated construction site (including dewatering activities) which does not meet water quality standards as established by FDEP, EPA, SFWMD, and RCID shall not be allowed to discharge off-site onto adjacent property, wetlands, and/or Waters of the State of Florida or the United States of America.

B. Reference specifications and standards:

1. FDOT: Standard Specifications for Road and Bridge Construction.

2. FHWA: FP-92 Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects.

1.05 SUBMITTALS

A. Procedures: In accordance with Section 01330.

B. Shop drawings: Plans and details, including layout and locations of erosion and sedimentation control features. Indicate dimensions, materials, and anchorage underlying substrates.

C. Product data:

1. Manufacturer's detailed technical materials and application data.

2. Submit filter fabric material specifications and installation configuration prior to start of construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Filter fabric for silt barriers:

1. Synthetic material, containing ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0°F to 120°F.

2. Pervious sheet of polypropylene, nylon, polyester, and certified by manufacturer or supplier to conform to Section 985 of the *FDOT Standard Specifications for Road and Bridge Construction*, latest edition.

3. Provide in continuous roll for cutting to single lengths and to minimize joints.

B. Filer Fabric for Placement Beneath Rip-Rap

1. Filter Fabric should be Mirafi 600X or approved equal.

C. Rip-Rap

1. Rubble type rip-rap consisting of broken stone meeting the requirements of Section 530-2.3 of the *FDOT Standard Specifications for Road and Bridge Construction*, latest edition.

D. Dissolvable Solid Polymers

1. Dissolvable polymers, such as flocculation logs, shall be used at the direction of the Owner's Representative, and shall be placed in the discharge stream at the most practical upstream location. Polymers/logs shall be replaced, as required, for the duration of the work. Polymer type shall be subject to Owner's approval.

E. Materials for other control features: In accord with referenced standards and specifications and approved submittals.

PART 3 - EXECUTION

3.01 GENERAL

A. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, artificial coverings, berms, pine straw, floating silt barriers, staked silt barriers, and staked silt fences.

B. Incorporate permanent erosion control features into the project at the earliest practical time. Correct conditions, using temporary measures, which develop during construction to control erosion prior to the time it is practical to construct permanent control features.

C. Construct temporary and permanent erosion and sediment control measures and maintain them to prevent the pollution of adjacent water ways in conformance with the laws, rules and regulations of Federal, State and local agencies.

3.02 INSTALLATION

A. The following items shall be installed in accordance with the FDOT *Standard Specifications for Road and Bridge Construction*, Section 104. The procedures are only generally described herein.

1. Temporary Grassing: This work shall consist of furnishing and placing grass seed.

2. Temporary Sod: This work shall consist of furnishing and placing sod. Unless indicated other wise on the drawings, sod shall be Bahia or match the existing and adjacent turf grass.

3. Temporary Mulching: This work shall consist of furnishing and applying a two-inch to four-inch thick blanket of pine straw and then mixing or forcing the mulch into the top two inches of the soil in order to temporarily control erosion. Only decayed pine straw, which can readily be cut into the soil, shall be used. Other measures for temporary erosion control such as hydro-mulching, chemical adhesive soils stabilizers, etc., may be substituted for mulching with pine straw with the approval of the Owner. When permanent grassing operations begin, temporary mulch materials shall be plowed under in conjunction with preparation of the ground.

4. Sandbagging: This work shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

5. Slope Drains: This work shall consist of constructing slope drains, utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete, plastic sheeting, or other acceptable materials, in accordance with the details shown in FDOT Design Standards, Index No. 102, or as suitable to adequately perform the intended function.

6. Sediment Basins: Sediment basins shall be constructed in accordance with the details shown in FDOT Design Standards, Index No. 102, or as suitable to adequately perform the intended function. Sediment basins shall be cleaned out as necessary.

7. Artificial Coverings: This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

8. Berms: This work shall consist of construction of temporary earth berms to divert the flow of water from an erodible surface.

a. This work shall consist of constructing pine straw dams or earth berms to protect against downstream accumulations of silt. The pine straw dams shall be constructed in accordance with the details shown in FDOT Design Standards, Index No. 102.

b. The berm dam shall be placed so as to effectively control silt dispersion under conditions present on this project. Alternate solutions and usage of materials may be used if approved.

9. Filter Fabric for placement beneath rip-rap:

a. Unroll filter fabric adequately longitudinally with the swale.

b. Install anchoring pins in the fabric to protect the material from wind uplift.

c. Toe filter fabric into soil a minimum of 12 inches at the top and bottom of the slope.

10. Rubble Rip-Rap:

a. Rip-rap should be placed carefully to not damage or displace the filter fabric. Filter fabric which rips or becomes displaced during rip-rap placement should be repaired. The placement of the rip-rap should proceed from the bottom up to the top of the slope. At no time should the rip-rap be dumped onto the fabric from the tip of the slope and allowed to roll down the surface of the fabric.

b. Placement of rip-rap shall be in accordance with Section 530-3.3 of the FDOT *Standard Specifications for Road and Bridge Construction*, latest edition.

c. Minimum thickness of rip-rap layer is 2 feet.

3.03 ERECTION - SILT BARRIERS

A. General: Install staked silt barriers in existing inlets and outfall swale, and floating silt barriers as indicated on Drawings.

1. Staked silt barriers:

a. Erect around the existing inlets in accord with FDOT Design Standards, Index No. 102.

b. Silt barrier shall be staked type with stakes installed vertically.

c. Height of the silt barrier fabric shall be a minimum of 15 inches and a maximum of 18 inches

d. Stakes shall be wood, 1 foot x 2 feet x 3 feet long, and spaced a maximum of 6 feet apart at barrier location and driven securely into the ground.

e. Excavate a trench approximately 4 inches wide x 4 inches deep along the line of stakes and upward of inlet. Tie or staple filter fabric to wood stakes with 8 inches of fabric extended into trench. Staples shall be heavy-duty wire, at least 1/2 inches long. Backfill trench and compact soil over filter fabric.

f. When joints are necessary, filter fabric shall be spliced together only at a support post, with a 6 inch overlap, and securely sealed.

2. Floating silt barriers:

a. Locate floating silt barriers as indicated on Drawings. Place prior to start of all construction or grading.

b. Floating silt barriers shall conform to or exceed FDOT Design Standards, Index No. 102.

B. Maintenance:

1. Inspect silt barriers immediately after each rainfall event and at least once a day during periods of prolonged rainfall events. Immediately repair silt barriers to maintain intended function and performance.

2. Replace filter fabric that exhibits damage, decomposition, or is otherwise ineffective.

3. Prevent excessive accumulation of sediment deposits. Remove sediment deposits at a frequency of not less than after each rainfall event.

4. Dress sediment deposits remaining in place, after silt barrier is removed, to conform to existing grade, and prepare for seeding or sodding.

3.04 CONTROL OF CONTRACTOR'S OPERATIONS WHICH MAY RESULT IN WATER POLLUTION

A. Take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, wetlands and other sensitive areas with silt, sediment, fuels, oils, bitumens, calcium chloride, or other harmful materials. Conduct and schedule operations so as to avoid or otherwise minimize pollution or siltation of such surface waters, etc. and to avoid interference with movement of migratory fish. Do not pump the residue from dust collectors or washers into any water body.

B. Construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals, and other impoundments shall be restricted to those areas where it is necessary to perform filling or excavation to accomplish the work shown in the Contract Documents and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear rivers, streams, and impoundments of all obstructions placed therein or caused by construction operations.

C. Except as necessary for construction, do not deposit excavated material in rivers streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or run-off.

D. Where pumps are used to remove highly turbid waters from enclosed construction areas such as cofferdams or forms, treat the water prior to discharge into State waters. Pump the water into grassed swales, appropriately vegetated areas, or sediment basins, or confine it by an appropriate enclosure such as siltation curtains when other methods are not considered appropriate. Do not contaminate State waters. As a last resort, if no other options are successful and upon the approval of the Owner or Engineer, discharge the turbid water to a nearby sanitary sewer. The background condition of all waters to be discharged from the site must be approved by RCID Environmental Services.

E. Do not disturb lands or waters outside the limits of construction, unless approved in advance and in writing by the Owner. No operations within non-permitted wetlands or upland buffers are allowed.

3.05 PROTECTION DURING SUSPENSION OF CONTRACT TIME

A. In the event that it is necessary that the construction operations be suspended for any appreciable length of time, shape the top of the earthwork in such a manner as to permit run-off of rainwater and construct earth berms along the top edges of embankments to intercept run-off water. Provide temporary slope drains to carry run-off from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes and impoundments. Should such preventative measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation.

3.06 OTHER CONTROL FEATURES

A. Erect and maintain in accord with referenced standards and specifications and approved submittals.

3.07 REMOVAL OF CONTROL FEATURES

A. Remove control features when directed by Owner.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide erosion control blanket at locations indicated on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grading: Section 02310.

B. Erosion and sedimentation control: Section 02370.

1.03 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Submit manufacturer's descriptive literature and technical data and including a 12 in. square sample.

1.04 PRODUCT HANDLING

A. Procedures: In accord with Section 01660.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Tensar Earth Technologies, Inc., Morrow, GA, Tel: (800) 836-7271, (404) 250-1290.

2.02 MATERIALS

A. Erosion control blanket: Web of polyolefin fibers between two, high-strength, bi-axially oriented nets, bound together by parallel stitching with polyolefin thread. Component materials of the blanket shall be stabilized against ultraviolet degradation and inert to chemicals normally encountered in natural soil environments, Tensar Erosion Blanket TB1000 as manufactured by Tensar.

B. The erosion blanket shall be in accord with the following physical properties:

Property	Test Method	Value
Thickness (in.)	ASTM D1777	0.40 (minimum)
Weight (oz. per yd.)	ASTM D3776	10 (minimum)
Specific gravity	ASTM D1505	0.91
Ground cover factor (%)[1]	Light Projection Test	65 (minimum)
Tensile strength (lb. per ft.)[2]	ASTM D1682 (2 in. strip)[3]	70 (minimum)
Elongation (%)[2]	ASTM D1682 (2 in. strip)[3]	40 (maximum)
Tensile strength at 15% elongation (lb. per ft.)[2]	ASTM D1682 (2 in. strip)[3]	50 (minimum)
Flexibility (mg-cm)[2]	ASTM D1388	10,000 (minimum)
Ultraviolet stability % strength retained after 1000 hours	ASTM D4355	80 (minimum)

Property	
Color:	Green
Roll dimensions	
Length (ft.)	100
Width (ft.)	6.5
Area (sq. ft.)	650
Weight (lb.)	45
Roll diameter (ft.)	2

Footnotes:

1 Ground cover factor represents "% shade" from light projection test.

2 Values apply to both machine and cross machine directions.

3 Machine direction specimen for 2 in. strip tests includes one machine direction polyolefin stitch line centered within its width and extending the full length of the specimen.

PART 3 - EXECUTION

3.03 INSTALLATION

A. Install in accord with manufacturer's recommendations

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work under this section includes the installation of steel casing pipe and all related items of work necessary for a complete installation as shown on the Drawings and specified therein.

1.02 GENERAL

A. Jack &Bore (J&B) is a method for installing a casing that will serve as a duct for a carrier (pipe, cable, or wire line products). It is a multi-stage process consisting of constructing a temporary horizontal jacking platform and a starting alignment track in an entrance pit at a desired elevation. The product is then jacked by manual control along the starting alignment track with simultaneous excavation of the soil being accomplished by a rotating cutting head in the leading edge of the product's annular space. The ground up soil (spoil) is transported back to the entrance pit by helical wound auger flights rotating inside the product. J&B typically provides limited tracking and steering as well as limited support to the excavation face.

1. Removal and disposition of excess material varies, is the responsibility of the contractor and is not covered under this Specification. However, the cost of removal or final disposition is included in the cost of the J&B operation.

2. No J&B conduit may be left open ended without approval of the Owner's Representative to prevent the conduit from acting as a drainage structure.

1.03 QUALITY ASSURANCE

A. The Reference Standards within Sections 02512, 02513, 02515, 02532, and 02533 apply as appropriate.

1.04 SUBMITTALS

A. PROCEDURES:

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01300, Submittals.

B. PRODUCT DATA:

1. The data to be submitted shall include, but not be limited to:

a. Casing pipe.

b. Casing insulators and end seals.

c. Proposed construction method(s) and equipment for the installation.

d. Certificates of inspection from pipe manufacturer certifying that pipe supplied meets specified requirements.

e. After the casing has been installed, if so requested by the Owner's Representative for reasons of casing misalignment, resubmit for Owner's Representative's approval, drawings of the installation, showing measures that should be taken to maintain the carrier pipe on line and grade.

PART 2 - PRODUCTS

2.01 STEEL CASING PIPE

A. Size: The minimum nominal internal diameter for casing pipe shall be equal to the carrier pipe bell outside diameter or largest outer diameter of the carrier pipe and its joint restraint plus 8 inches.

B. Type: Smooth steel pipe fabricated in sections for welded field joints. Casing pipe shall meet the requirements of ASTM A139, Grade B / API 2B, with a minimum yield of 35,000 psi.

1. The casing pipe shall be new, straight seam pipe or seamless pipe with smooth interior and exterior.

2. All steel pipe may be bare inside and out, with the manufacturer's recommended minimum nominal wall thicknesses to meet the greater of either installation, loading or carrier requirements.

3. All steel casing pipe must be square cut and have dead-even lengths which are compatible with the J&B equipment.

C. Use steel pipe casings and welds meeting or exceeding the thickness requirements to achieve the service life requirements noted in the FDOT Drainage Manual Chapter 6. For purposes of determining service life, ensure that casings installed under roadways meet or exceed cross drain requirements and casings under driveways meet or exceed side drain pipe requirements. For purposes of material classification, consider steel pipe casing as structural plate steel pipe. Ensure that steel pipe casing of insufficient length achieves the required length through fully welded joints. Ensure that joints are air-tight and continuous over the entire circumference of the pipe with a bead equal to or exceeding the minimum of either that required

D. Welding: Continuous butt weld at joints for rigid, watertight encasement.

E. Field and shop welds of the casing shall conform to the American Welding Society Standard Specifications. Field welds shall be complete penetration, single-bevel groove type joints. Welds shall be airtight and continuous over the entire circumference of the casing and shell not increase the outside casing diameter by more than 3/4 inch.

F. Minimum Wall Thickness:

Nominal Casing Diameter (Inches)	**Smooth Steel Pipe Minimum Thickness**
12 or smaller	3/16”
> 12 - ≤ 24	1/4”
> 24 - ≤ 30	5/16”
> 30 - ≤ 36	3/8”
> 36 up to 60	1/2”

2.02 AUGERING FLUIDS

A. Use a mixture of bentonite clay or other approved stabilizing agent mixed with potable water with a minimum pH of 6.0 to create the drilling fluid for lubrication and soil stabilization. Vary the fluid viscosity to best fit the soil conditions encountered. Do not use other chemicals or polymer surfactant in the drilling fluid without written consent of the Owner’s Representative. Certify in writing to the Owner’s Representative that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds or fire hydrants. Any water source used other than potable water may require a pH Test.

2.03 CASING INSULATORS/SPACERS

A. Casing insulators spacers shall be bolt-on style with a shell made in two sections of Type 304 stainless steel or fusion epoxy coated steel. The shell shall be lined with a PVC liner 0.090-inch thick with 85-90 durometer. All nuts and bolts are to be stainless steel. Runners shall be made of ultra high molecular weight (UHMW) polymer with high abrasion resistance and a low coefficient of friction. Runners shall be supported by risers made of Type 304 stainless steel or fusion epoxy coated steel. The supports shall be welded to the shell. The height of the supports and runners combined shall be sufficient to keep the carrier pipe bell at least 0.75 inch from the casing pipe wall at all times. Casing insulators shall be made by Cascade Waterworks Mfg. Co., BWM Co. of Forest City, NC, or equal.

B. Unless indicated otherwise on the drawings, casing spacers shall be placed at a minimum on 10 foot centers and one at least 2 feet or less from each end of the casing pipe. Adjust spacers as required to avoid bell joints or restrained joints. Spacers shall be a minimum of 8 inches wide for carrier pipe sizes under 24-inch diameter and 10 inches wide for larger size carrier pipe.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor shall take control of the operation at all times. Contractor shall have a representative who is thoroughly knowledgeable of the equipment, boring, and Owner procedures present at the job site during the entire installation and available to address immediate concerns and emergency operations. Notify the Owner’s Representative 48 hours in advance of starting work. Do not begin the installation until the Owner’s Representative is present at the job site and agrees that proper preparations have been made.

3.02 CONSTRUCTION PROCESS

A. For all installations, submit sufficient information to establish the proposed strategy for providing the following:

1. An indication of where the leading edge of the casing is located with respect to line and grade and the intervals for checking line and grade. Indication may be provided by using a water gauge (Dutch level) or electronic transmitting and receiving devices. Other methods must have prior approval. Maintain a record of the progress at the job site.

2. Equipment of adequate size and capability to install the product and including the equipment manufacturer's information for all power equipment used in the installation.

3. A means for controlling line and grade.

4. A means for centering the cutting head inside the borehole.

5. Provide a means for preventing voids by assuring:

   a. The rear of the cutting head from advancing in front of the leading edge of the casing by more than 1/3 times the casing diameter and in stable cohesive conditions not to exceed 8 inches [200 mm].

   b. In unstable conditions, such as granular soil, loose or flowable materials, the cutting head is retracted into the casing a distance that permits a balance between pushing pressure, pipe advancement and soil conditions.

   c. Development of and maintaining a log of the volume of spoil material removal relative to the advancement of the casing.

6. Adequate casing lubrication with a bentonite slurry or other approved technique.

7. An adequate band around the leading edge of the casing to provide extra strength in loose unstable materials when the cutting head has been retracted into the casing to reduce skin friction as well as provides a method for the slurry lubricant to coat the outside of the casing.
8. At least 20 feet [6.1 m] of full diameter auger at the leading end of the casing. Subsequent auger size may be reduced, but the reduced auger diameter must be at least 75% of the full auger diameter.
9. Water to be injected inside the casing to facilitate spoil removal. The point of injection shall be no closer than 2 feet [610 mm] from the leading edge of the casing.

3.03 CASING PIPE INSTALLATION

A. Install the casing pipe so that the carrier pipe can be installed true to line and grade.
   1. Casing pipe sizes shown on the Drawings are minimum sizes.
   2. Contractor has the option of providing larger pipe, to facilitate the installation, at no increase in contract price.
   3. Provide casing pipe of the minimum length shown on the Drawings.
   4. Provide pipe ends with temporary seals.

B. Install in strict accordance with the Drawings and Specifications.

C. Boring operations shall be conducted in such manner as not to be detrimental to the facility being crossed.

D. Provide extreme care to prevent voids from occurring outside the casing. If voids do occur, completely fill them by pressure grouting.

E. Leave casing bores not completed and abandoned, because of unforeseen subsurface conditions beyond the control of the Contractor, in a safe condition.
   1. Fill casing or bore to restore the structural integrity of the area to a condition equal to that prior to construction.
   2. Fill casing or bore completely with cement grout.

F. Provide access pits of sufficient size to permit safe access to the work area.

G. Place concrete traffic barricades as indicated on Drawings and/or in accordance with FDOT Standards and Specifications to prevent vehicular traffic from inadvertently dropping into the work areas.

H. After casings have been installed and the ends covered, place a 4 inch x 4 inch pressure-treated wooden post at each end of the casing to mark the locations.
   1. Provide pressure treated posts (AWPB LP-22) and extend at least 3 feet above finish grade.

I. Place suitable backfill in the access pits to restore the area to original grade.
   1. Compaction: 95% of ASTM D1557 for maximum dry density and not less than ASTM C2049 for relative density.

J. Provide dewatering equipment and shoring when required to keep the work areas accessible. Dewatering shall be in accord with the requirements of RCID and related sections of these specifications.

3.04 JACK AND BORE OPERATIONS

A. Installation Process: Provide continuous pressure to the face of the excavation to balance groundwater and earth pressures. Ensure that shafts are of sufficient size to accommodate equipment, the pipe selected and to allow for safe working practices. Provide entry and exit seals at shaft walls to prevent inflows of groundwater, soil, slurry and lubricants. Use thrust blocks designed to distribute loads in a uniform manner so that any deflection of the thrust block is uniform and does not impart excessive loads on the shaft itself or cause the jacking frame to become misaligned.

1. The jacking system must have the capability of pushing the pipe in J&B operations through the ground in a controlled manner and be compatible with the anticipated jacking loads and pipe capacity. Monitor the jacking force applied to the pipe and do not exceed the pipe manufacturer's recommendations.

2. Ensure that the pipe lubrication system is functional at all times and sufficient to reduce jacking loads. Use pipe lubrication systems that include a mixing tank, holding tank and pumps to convey lubricant from the holding tank to application points. Maintain sufficient fluids on site to avoid loss of lubrication.

3. Power Distribution System must be identified in the plans package or permit provisions as well as any noise constraints. Identity spoil removal capability and method to avoid creating hindrance to other activities which may be necessary in the area.

B. Excess Material and Fluids: Monitor the pumping rate, pressures, viscosity and density of the boring fluids to ensure adequate removal of soil cuttings and the stability of the borehole. Contain excess drilling fluids, slurry and soil cuttings at entry and exit points in pits until they are recycled or removed from the site.

1. Ensure that all boring fluids are disposed of or recycled in a manner acceptable to the appropriate local, state or federal regulatory agencies. When jacking and boring in suspected contaminated ground, test the boring fluid for contamination and dispose of appropriately. Remove any excess material upon completion of the bore. If it becomes evident that the soil is contaminated, contact the Owner’s Representative immediately. Do not continue boring without the Owner’s Representative’s approval.

C. Boring Failure: If an obstruction is encountered which prevents completion of the installation in accordance with the design location and specifications; the pipe may be taken out of service and left in place at the discretion of the Owner’s Representative. Immediately fill the product left in place with excavatable flowable fill. Submit a new installation procedure and revised plans to the Owner’s Representative for approval before resuming work at another location. If damage is observed to any property, cease all work until a plan of action to minimize further damage and restore damaged property is submitted and approved by the Owner’s Representative.

3.05 TESTING

A. When there is any indication that the installed product has sustained damage and may leak, stop the work, notify the Owner’s Representative and investigate damage. The Owner’s Representative may require a pressure test and reserves the right to be present during the test. Perform pressure test within 24 hours unless otherwise approved by the Owner’s Representative. Furnish a copy of the test results to the Owner’s Representative for review and approval. The Owner’s Representative shall be allowed up to 72 hours to approve or determine if the product installation is not in compliance with specifications. The Owner’s Representative may require non-compliant installations to be filled with excavatable flowable fill.

B. Testing Methods: Testing may consist of one of he following methods but must always meet or exceed Owner testing requirements.

1. Follow the Product Manufacturer's pressure testing recommendations.

2. A water tight pipe and joint configuration is required where the casing pipe is installed beneath any roadway. When under the roadway conduct an air pressure test for leaks in the presence of the Owner's Representative at a minimum test pressure of 20 PSI [137.90 kPa] by either of the following methods.

   a. Standard 24 hour pressure test with a recording chart or,

   b. A dragnet type leak detector or equivalent device capable of detecting pressure drops of 1 /2 PSI [3.45 kPa] for a time period recommended by the manufacturer.

3. When a product is not located under the pavement, the casing pipe and joint configuration must meet or exceed soil tight joint requirements. The test for a soil tight joint allows up to 0.1 gallon [0.4 liter] of water leakage at a sustained pressure of 2 PSI [13.79 kPa]. The water tight joint criteria allows no leakage at all for a sustained pressures of 5 PSI [34.47 kPa]. Conduct test for joint integrity for one hour.

3.06 PRODUCT LOCATING AND TRACKING

A. Install all facilities such that their location can be readily determined by electronic designation after installation.

3.07 DAMAGE RESTORATION

A. Take responsibility for restoring any damage caused by heaving, settlement, separation of pavement, escaping boring fluid (fracout) of the Jack & Bore operation at no cost to the Owner.

3.08 FAILED BORE PATH

A. If conditions warrant removal of any materials installed in a failed bore path, as determined by the Owner's Representative, it will be at no cost to the Owner. Promptly fill all voids by injecting all taken out of service products that have any annular space with excavatable flowable fill.

3.09 DOCUMENTATION REQUIREMENTS

A. As-Built Plans: Provide the Owner's Representative with a complete set of As-Built-Plans showing all bores (successful and failed) within 30 calendar days of completion of the work. Plans must be dimensionally correct copies of the Contract plans. Include notes on the plans stating the final bore path diameter, facility diameter, drilling fluid composition, composition of any other materials used to fill the annular void between the bore path and the facility or facility placed out of service. Note the size of the casing(s) as well as the size and type of carrier pipes to be placed within the casing(s) as part of the Contract work. Produce the plans as follows:

1. On the plan view, show the centerline location of each casing, installed or installed and placed out of service to an accuracy within 1 inch [25 mm] at the ends and other points physically observed. Show the remainder of the horizontal alignment of the centerline of each casing installed or installed and placed out of service and note the accuracy with which the installation was monitored.

2. As directed by the Owner's Representative, provide either a profile plan for each bore path, or a cross-section of the roadway at a station specified by the Owner's Representative, or a roadway centerline profile. Also show the ground or pavement surface and the crown elevation of each casing installed, or installed and placed out of service, accurately to within l inch [25 mm] at the ends and other points physically observed. Show the remainder of the vertical alignment of the crown of each facility installed, or installed and placed out of service and note the accuracy with which the installation was monitored. If the profile plan for the bore path is not made on a copy of one of the contract profile or cross-section sheets, use a 10 to 1 vertical exaggeration.

3. If a bore path is not completed, show on the plans the failed bore path along with the name of the utility owner and the final bore path. Note the failed bore path as "Failed Bore Path." Also show the location and length of the cutting head and any product not removed from the bore path.

4. Show the crown elevation, diameter and material type of all utilities encountered and physically observed during the subsoil investigation. For all other obstructions encountered during subsoil investigation or the installation, show the type of material, horizontal and vertical location, top elevation and lowest elevation observed, and note if the obstruction continues below the lowest point observed.

3.10 CARRIER PIPE INSTALLATION

A. The entire length of casing shall be complete before any carrier pipe is placed therein.

B. The carrier may be pushed or pulled (depending upon piping material, joint type and method of pipe support) into the casing as pipe lengths are assembled. The carrier shall be adequately blocked all around to prevent any movement and to attain the specified grade for gravity lines.

C. Install casing insulator around barrel of pipe, join pipe, and slide into casing., such that pipe barrel bears continuously on supports.

D. Pipe installation shall meet the requirements of the applicable pipe being installed, including testing.

3.11 SEALS

a. Install flexible rubber casing seals as per manufacturer's recommendations and as indicated on the drawings. Casing seals shall be either Link-Seal for small diameter carrier pipe (12 inches and under) or a synthetic rubber seal with stainless steel bands for larger diameters. Rubber seals shall be Model BWM ES by the BWM Co., or approved equal

3.12 CLEAN-UP

A. Return the work area to its original conditions, including sod and landscaping appearance, upon completion of the work except that the casing terminal markers must be visible above grade.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include but not be limited to all labor, equipment, tools, materials and incidentals required for the installation of below grade pipeline and/or conduit by the horizontal hydraulic directional drilling method.

B. The work shall include but not be limited to: High Density Polyethylene Pipe (HDPE), fittings and butt fusion techniques; steel pipe; boring equipment, reaming equipment and techniques; pilot boring; drilling heads and directional control; drill path profiles; drilling mud, treatment, storage and recovery of drilling mud; tensile strength of pipe materials and stresses encountered during pull back; sheeting, shoring and bracing of excavations, dewatering, slope and erosion control and protection; testing of pipe before and after installation, and all other work necessary to complete the installation of pipeline via the hydraulic directional drilling method.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID Specifications, which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall apply.

1. Submittals	Section 01330
2. Quality Assurance / Quality Control	Section 01440
3. Erosion and Sediment Control	Section 01575
4. Dewatering	Section 02240
5. Excavating and Backfilling for Utilities	Section 02320

1.03 DEFINITIONS

A. Horizontal Directional Drilling: a steer-able system for the underground installation of pipes, conduits and cables using a surface launched rig. A pilot bore is drilled using a rotating drill string and then is enlarged by a back reamer to the size required for the product pipe. The necessary deviation during pilot boring is provided by a slanted face to the drill head, an asymmetric drill head, eccentric fluid jets or a combination of these, usually in conjunction with an aboveground electronic locator or a remote guidance system.

B. Maxi (Conventional) HDD: typically used for the largest diameter pipelines/conduits and longest length installations. Pipe diameters are typically 18 inches or larger, lengths can exceed 1000 feet and the pullback force is typically in excess of 70,000 pounds. Remote tracking of the drill string is usually provided from sensors near the leading end of the drill string.

C. Mini HDD: typically used for the smaller diameter pipelines/conduits and for shorter distances. Pipe diameters are typically 6 inches or smaller, lengths less than 600 feet, and pullback forces are up to 20,000 pounds. Tracking of the drill string is typically achieved with a surface held walkover transmitter/receiver.

D. Midi HDD: typically used for intermediate sizes and lengths of pipelines/conduits. Pipelines are typically between 6 inches and 18 inches diameter, lengths up to 1000 feet and pullback forces from 20,000 to 70,000 pounds. Midi HDD equipment may employ similar capabilities to the Maxi HDD rigs, but have more limitations on capacity. Tracking of the drill string is typically achieved with a surface held walkover transmitter/receiver.

1.03 QUALITY ASSURANCE

A. Technical Guidance

1. Plastic Pipe Institute (PPI) Manual TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds
2. Plastic Pipe Institute Manual TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials

B. Reference Standards

1. ASTM D1248 Polyethylene Plastics
2. ASTM D1785 Schedule 40, 80 and 120 plastic pipe
3. ASTM D3035 Polyethylene Pipe based on Controlled Outside Diameter
4. ASTM D3350 Polyethylene Plastics Pipe and Fittings Materials
5. ASTM D3261 Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene Plastic Pipe and Tubing
6. ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
7. ASTM F2160 Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)
8. ASTM F1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

C. Inspection Upon Delivery

1. All pipe fittings and appurtenances shall be subject to visual inspection by a representative of the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit shall be rejected and shall be immediately removed from the job site.

2. The Owner's Representative may perform or cause to be performed all tests as specified in the applicable Standards, to ensure conformance with the standard. In the case of failure of the pipe or appurtenances to comply with such standards, the responsibility for replacement of the defective materials becomes that of the manufacturer or the Contractor.

3. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

1.05 EXPERIENCE

A. The contractor or his qualified subcontractor shall have no less than three (3) years of experience in the installation and construction of hydraulically directionally drilled pipeline of similar diameter and length to the requirements of the specific project.

B. The contractor shall provide documentation to the Owner/Engineer of his experience in similar projects and provide the names and contact numbers/addresses of at least five such examples. Conventional open trenching experience or bore and jacking experience will not be acceptable substitutes for hydraulic directional drilling experience.

C. The documentation for experience shall include but not be limited to the following:

1. Name and description of the projects
2. Resumes of Project Manager, Superintendent and driller assigned to the specific project
3. Pipe type, diameter and length
4. Bore diameter and equipment used
5. Soil conditions encountered
6. Start and completion dates
7. Contact names, numbers and addresses

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS – HDPE

A. Materials used for the manufacture of polyethylene pipe and fittings shall be PE 3408 High Density Polyethylene (HDPE), meting the ASTM D3350 cell classification of 345434E or 345434C. The material shall be listed in the name of the pipe and fitting manufacturer in PPI TR-4.

B. The material shall have a minimum hydrostatic design basis of 1600 psi at 73ºF when tested in accordance with PPI TR-3.

C. Polyethylene pipe and fittings shall be manufactured in accordance with ASTM F714, ASTM F 2160, ASTM D3035 and ASTM 3350.

D. Pipeline shall be identified by providing co-extruded longitudinal stripes at three separate locations along the length of the pipe – at 120 degrees, 240 degrees and at 0/360 degrees. Stripes shall be a minimum of 2 inches wide, except on pipe sizes under 6 inch nominal diameter. Background color of the pipe shall pigmented gray color or black with red stripe, on approval, and at least a 2% carbon black. Stripes shall be of the same material as the pipe and shall not be painted or printed on the outside of the pipe wall.

E. Fittings shall be made from the same material as the pipe and meet the same requirements as that for the pipe. All fittings shall be pressure rated to match or exceed the pressure rating of the pipe to which they are joined.

F. Fittings shall meet the requirements of ASTM D3261, where applicable. Molded fittings shall have butt fusion compatibility with the pipe to which they are joined.

G. Pipe and fittings shall be joined by the method of butt fusion, as outlined in ASTM D2657. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the Fusion Machine Manufacturer.

H. Pipe used for high-voltage electrical conduit systems shall be DR-11, minimum. Pipe used for fiber optic communication systems shall match the high-voltage pipe requirement when pull in the same drill or may be DR-13.5, minimum when pulled separate from high-voltage pipes.

2.02 BORING EQUIPMENT

A. Boring equipment shall be matched to the conditions of the project, but in no circumstances shall the equipment have a pulling force less than twice (2X) the maximum calculated peak-pulling requirement as calculated by proprietary software (such as DrillPath™) for this purpose for the particular job requirements.

B. Boring equipment shall have a mechanical drilling rig with a controlled directional boring head using either a fluid or mechanical cutting head (or combination of both), assisted and cooled by an approved drilling fluid of low pressure and volume.

C. Contractor shall provide to Owner/Engineer a description of the rig proposed for the project at each location, showing the method of control of the boring head, head type, pulling force of the equipment, age, reamer type(s), manufacturer type and other germane information. Approved boring equipment shall be that manufactured by American Augers, Case Construction, Charles Machine Works (Ditch Witch), Straight Line, Tulsa Rig Iron, Vermeer, or approved equal.

D. The location/tracking system employed for determining the location of the drilling head during the pilot bore shall include, but not be limited to: the position of the boring head, the roll angle, the tilt angle, depth below grade, temperature of data transmitter and remaining battery life.

E. The type of proposed drilling fluid shall be submitted to the Owner/Engineer for approval prior to the commencement of the work. Potable water or reclaimed water will be made available to the contractor, provided it is within a reasonable distance from the project site. Consumption of this water will be metered and invoiced to the contractor at the current effective rate.

F. For all carrier pipelines larger than 6 inches in diameter and prior to commencement of the work, the contractor shall submit to the Owner/Engineer the results of the proposed drill path profile analysis for approval. The analysis shall include as a minimum, the following:

1. Proposed profile/drill path
2. Proposed entry and exit angles
3. Proposed radii of curvature for all directional changes
4. Pipe deflection and pipe buckling calculations
5. External pressure and comparison to expected fluid pressure
6. A graph showing the calculated stresses along the entire path of the proposed profile
7. Method of buoyancy control (if required/utilized).

G. For pipelines 4 inches and smaller, the requirements of 2.02 F (above) shall be determined on a case-by-case basis. The Engineer may waive these requirements if the conditions of the project so warrant.

H. No work or drilling shall commence until the contractor has submitted the required information and received written approval from the Engineer of the drill path and related procedures.

PART 3 - EXECUTION

3.01 DIRECTIONAL DRILLING

A. The installation of the pipeline by horizontal directional drilling (HDD) shall be accomplished within the limits indicated on the drawings.

B. Before commencement of the drilling operation, all erosion control devices and dewatering shall be in-place and functional in accordance with Sections 01575 and 02240.

C. Entry and exit angles of the installed pipeline shall not be less than 8 degrees from the horizontal and not more than 45 degrees from the horizontal.

D. The contractor shall take precautions to protect the pipeline from damage and marring during the installation and pull back operation. Such precautions shall include but not be limited to: the use of rollers, pulleys, idlers and trunnions.

E. The boring rig shall be sufficiently and adequately anchored for the task.

F. A pilot hole shall be drilled for all installations of 6 inch diameter pipe and larger diameters. The pilot hole shall be conducted with a wire line guidance system. The pilot hole shall follow the designed bore path and shall not exceed the horizontal design plane in either direction by more than two (2) feet, nor more than one (1) foot in either direction, in the vertical plane. The boring shall be conducted using a mechanical boring head, assisted by and cooled by drilling fluid of low pressure and volume.

G. The contractor shall provide MSDS sheets for all drilling slurry compounds and additives.

H. The contractor shall submit calculations and data indicating the proposed path of the pilot bore, entry and exit angles, stresses on the pipeline during pull back throughout the length of the bore (both pull back and bending stress), external pressure throughout the length of the pull, proposed drilling flow rates, drilling pressures (maximum), radii of curvature for all directional changes, a chart showing the plan and profile of the proposed installation, and charts comparing the installation tension and tensile stress of the pipe to the calculated conditions during pullback. The use of software (such as DrillPath as developed by the Gas Research Institute) is recommended for this purpose.

I. Installed radius of curvature (in feet) for polyethylene pipe shall be a minimum of 25 times the exterior diameter of the pipeline to be installed (in inches). Actual radii utilized will be dependent on the specific job conditions. For alternate pipe materials, consultation with the Engineer shall be required for approval.

J. Total maximum stress on the pipeline during pull back shall not exceed one-half (½) of the tensile strength of the pipeline.

K. The pulling force of the drilling rig shall be at least twice that required of the maximum stress force calculated for the pull.

L. Upon completion of the pull, the contractor shall provide as-built information of the installed pipeline, including entry and exit locations and elevations (per the WDW Grid coordinate system and NGVD, respectively), and similar location information at 10 foot intervals along the entire length of the profile for profiles under non-submerged surfaces. For profiles under submerged surfaces (such as a lake, stream, canal or river) the frequency of the location interval shall be at a minimum of 20 foot increments. This information shall be provided to the Owner/Engineer within seven calendar days of the completion of each bore path.

M. Back reaming shall be required for all bores for pipelines exceeding 6 inches in nominal diameter. Back reaming shall be conducted in single or multiple passes of the borehole and shall enlarge the borehole to at least 1.4 times the outer diameter of the pipeline to be installed. The number of back reaming passes shall be proposed by the contractor and approved by the Engineer prior to commencement of the work. Larger reaming may be required dependent on subsurface conditions encountered.

N. In the event significant differing soils or strata (from those provided in the geotechnical data and reports) are encountered during the course of the pilot boring, the contractor shall be responsible for changing the drill head, slurry and other means as may be appropriate for completion of the bore. The Owner shall not be responsible for underground obstacles (such as boulders, tree stumps, loose and unconsolidated soils, hard rock, or other utilities) or structures that may be encountered during the course of the work.

O. During assembly and pull back of the pipe, the pipe must be laid out in such a way as to minimize disruption to and interference with vehicular and pedestrian traffic or other operational conflicts that the Owner/Engineer may identify. Additionally, the pipe must be laid out such that the radius of curvature (in feet) for HDPE pipe of any segment is less than 25 times the outer diameter of the pipe (in inches).

P. The contractor shall be responsible for maintenance of traffic (MOT) in the event the construction activities require such action. A MOT plan shall be submitted to the Owner/Engineer for approval prior to commencement of the work. The plan shall be in accordance with the Manual of Uniform Traffic Control Devices.

Q. The boring profile shall be deep enough to preclude hydraulic fracture or frac-out (loss of drilling fluid to the surface), and the contractor shall submit calculations to verify that the selected profile provides reasonable assurance to preclude fracture. Should hydraulic fracture occur, the contractor shall repair all related damages, including cleanup of fluids, and make corrections to preclude future events. Such corrections may include, but not be limited to: re-profiling the bore or changing the viscosity of the drilling fluid or plugging the fracture or a combination of these. In the event the borehole is abandoned and an alternate route is chosen, the abandoned borehole shall be filled with excavatable flowable fill.

R. Where construction activities are in close proximity to or under water bodies (lakes, creeks, canals, retention basins) or wetlands, special attention shall be given to the proposed profile to insure that hydraulic fracture does not occur under the water feature. Additionally, silt fences and similar approved erosion control devices shall be used to protect the water body(s) from the construction activities.

S. The contractor shall maintain logs of the construction progress at the job site. Such logs shall include a Guided Drilling Log, Mud Log and Driller's Log. The Guided Drilling Log shall record the progress of the pilot bore. The Mud Log shall record the quantity and quality of the drilling mud, pressure, flow rate and temperature of the mud. The Driller's Log shall record the progress of the reaming operation. Samples of each log sheet shall be submitted to the Owner/Engineer for approval prior to commencement of the work.

T. Upon completion of the pull back, the contractor shall "rest" the pipe segment to allow for any contraction and shrinkage for at least 24 hours. No additional work on the pulled pipeline segment shall be allowed during the resting period.

3.02 DRILLING FLUIDS AND THEIR DISPOSAL

A. The drilling fluids shall provide stabilization of the bore hole during the pilot and reaming operations, transport cuttings to the surface, cool the drill bit and controller, and lubricate the pipe during pull back. The drilling fluids shall be a bentonite slurry, polymer slurry, water or some combination of these. Bentonite is the preferred material for most applications, and use of water or a polymer will require the approval of the Owner/Engineer prior to commencement of the work.

B. Drilling fluids that are petroleum based or that contain additives that may contaminate the surrounding soils or groundwater will not be allowed.

C. The contractor shall adjust the viscosity of the drilling fluid to match the conditions of the project. The Owner shall bear no responsibility for loss of drilling fluid or loss of drilling equipment should an obstacle or unknown condition be encountered during the course of the work.

D. The contractor shall be responsible for transporting, containing and storing any water required for the drilling operations, cleanup and other needs.

E. All drilling fluid excess shall be contained in entry and/or exit pits and pumped/treated/stored as needed so as to preclude spills and escape to the surrounding environment. Ensure that entry and exit pits are of sufficient size and volume to contain the expected return of drilling fluids and cuttings. All excess fluids shall be properly disposed in an approved method and acceptable location. No fluids less than 14% solids content will be allowed to be disposed in a landfill.

F. Upon completion of the pipe installation, restore the pits, drill rig anchors and work areas to their pre-construction or better condition. Seeding shall not be allowed in lieu of sod unless granted in writing by the Owner/Engineer.

3.03 CHECKING AND CLEANING

A. The pipe shall be checked prior to its insertion and pull back for any flaws in manufacturing.

B. After pull back is complete, but before connections are made to adjoining piping, the pulled section shall again be checked for acceptable roundness by passing a segmented mandrel of no less than ½ inch of the pipe ID. Pipe failing this required roundness check shall be removed and repaired or abandoned and replaced at no additional cost to the Owner.

C. The installed and successfully checked pipeline shall be cleaned with stiff brushes followed by a swabbing mandrel sufficient to remove all debris including soils.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Underground warning tape for:

1. Electrical power duct banks.
2. Potable and non-potable water.
3. Reclaimed water.
4. Chilled water.
5. Natural gas.
6. Sanitary sewers and force mains.
7. Compressed air.
8. Chilled water.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Excavating and backfilling for utilities: Section 02320.

B. Color-tinted concrete ductbanks: Division 16.

C. Color-coding/pigmenting of potable water, reclaimed water and sewer pipes: See Sections 02512, 02513, 02515, 02532 or 02533 as appropriate.

1.03 QUALITY ASSURANCE

A. Reference specifications and standards:

1. ANSI: Z53.1 Safety Color Code for Marking Physical Hazards.

1.04 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Product data:

1. Manufacturer's detailed technical materials data, including technical bulletins, drawings, guides, and manuals, as applicable to the work of this Project.
2. For color coding of specific utilities not indicated on Drawings or not specified herein, submit samples of color coding tape markings for selection by Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Marking tape:

1. Empire Level Manufacturing Corporation (Thor Enterprises), Waukesha, WI, Tel: (414) 521-3171, (800) 558-0722.
2. Mutual Industries North, Inc., Philadelphia, PA, Tel: (215) 927-6000, (800) 523-0888.

3. Reef Industries, Inc. (Terra Tape), Houston, TX, Tel: (713) 507-4295, (800) 231-6074.
4. Stranco Inc., Michigan City, IN, Tel: (800) 348-3217.
5. Or approved equal.

2.02 MATERIALS

A. Pipe Detecting Wire For Non-Metallic Pipe: A 12-gauge THHN copper detecting wire shall be attached to the pipe at the 12 o'clock position as shown on the drawings.

B. Marking tape: Reinforced or unreinforced type, 6 inch wide, inert, virgin resin, plastic film formulated for extended use underground, imprinted with an appropriate legend to define type of utility line it identifies.

1. Nondetectable: Minimum 4 mils overall thickness. Text shall say "CAUTION BURIED (insert appropriate type of pipe) LINE BELOW".
   a. ShieldTec by Empire Level Manufacturing Corporation (Thor Enterprises).
   b. Non-Detectable Underground Marking Tape (No. 17783) by Mutual Industries North, Inc.
   c. Underground Warning Tape (PUWT-6XX series) by Stranco, Inc.
   d. Terra Tape Sentry Line 1350 by Reef Industries, Inc.
   e. Or approved equal.
2. Adhesive: Minimum 4 mils overall thickness. Text shall indicate type of fluid conveyed.
   a. Shield-Bond by Empire Level Manufacturing Corporation (Thor Enterprises).
   b. Or approved equal.
3. Color code: Black lettering on color backgrounds in accord with APWA/ULCC Uniform Color Code and ANSI Z53.1, except as follows.
   a. Red: Electric power ductbanks .
   b. Yellow: Natural gas distribution and transmission.
   c. Black or white lettering on blue background: Potable and nonpotable water systems.
   e. Black or white lettering on brown background: Sanitary and storm sewer force mains.
   f. Black or Yellow lettering on Pantone 522C purple background: Reclaimed water lines.
   g. Black lettering on light blue background: Compressed air systems.
   h. Black lettering on green background with brown band striping: Chilled water systems.
   i. Black lettering on silver background with orange band striping: Hot water systems.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pipe Detecting Wire For Non-Metallic Pipe

1. The wire shall be held in place with nylon cable ties at each end of the pipe and at midpoint. The cable ties shall be Ty-Rap as manufactured by T & B Electrical Co. or approved equal.

2. The wire shall be extended to the surface at air release and vacuum valves, valve boxes, pumps, etc. so that a current can be induced through the wire to detect the location of the pipe.

3. The wires shall be brought to the surface at each valve box through a length of 1/2-inch PVC pipe to protect the wire, and shall terminate with a tinned wire connector as shown on the standard detail drawings.

B. Marking tape:

1. Nondetectable tape: Install over all utility lines. Two (2) marking tapes shall be placed in the trench 12 inches above the pipe and 18 inches each side of the centerline of the pipe for all lines and conduits 4 inches diameter and larger. For single conduits and lines 3 inches diameter and smaller, a single marking tape shall be installed 12 inches above the conduit or line.

2. Adhesive tape. Adhesive tape shall be used on piping that is not color pigmented or painted with the appropriate color striping. Where required, install directly on each utility line (at the 12 o'clock, 3 o'clock and 9 o'clock positions for pipelines 12 inches and larger, and at the 12 o'clock position for smaller diameter lines) and shall be continuous for the entire length of the pipeline.

   Care shall betaken that the tape adheres properly to the pipe wall and is not torn, removed, or otherwise damaged upon pipe installation and backfilling. Pipe surface shall be clean and free of dirt, debris, oils and other foreign materials that could reduce the adhesion capabilities of the tape.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include, but not be limited to all labor, equipment, tools, materials and all incidentals required for the construction, installation, testing and disinfection of a non-potable water transmission system, including all appurtenances as shown on the plans and as specified herein.

B. The work shall include but not be limited to, ductile iron pipe, PVC pipe, valves, air release and vacuum valves, ductile iron fittings, strainers, tapping sleeves, tapping saddles, cast iron and plastic valve boxes, valve vaults and boxes, all restrained joints and concrete thrust blocking as required for all types of piping, all excavation, sheeting, shoring and bracing, dewatering, jacking and boring, where required, slope protection, backfilling, grading and drainage, concrete work, rip-rap, compaction, grass restoration, pavement restoration where required and all other work necessary to complete the construction, installation, flushing, testing and disinfection of the non-potable water transmission system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID standard specifications which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall prevail.

1. Submittals	Section 01330
2. Testing Laboratory Services	Section 01410
3. Excavating and Backfilling for Utilities	Section 02320
4. Boring & Jacking	Section 02445
5. Hydraulic Directional Drilling	Section 02448
6. Underground Utilities Marking	Section 02505

1.02 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Regulation.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900.

1.03 QUALITY ASSURANCE

A. TECHNICAL GUIDANCE

1. Handbook of Ductile Iron Pipe, latest edition, DIPRA

2. Recommended Standards for Water Works (Ten-State Standards), latest edition

3. Florida Department of Environmental Protection, FAC 62-555.

4. Handbook of PVC Pipe Design & Construction, latest edition, Uni-Bell Plastic Pipe Association.

5. Manual M23: PVC Pipe - Design & Installation, AWWA

B. REFERENCE STANDARDS

This specification references the following standards which form a part of this specification to the extent specified herein. The latest edition of each standard shall apply. In any case of conflict, the most restrictive standard shall prevail.

1. AWWA C104/ANSI A21.4 Cement-Mortar Lining For Ductile Iron Pipe and Fittings For Water.

2. AWWA C105/ANSI A21.5, Polyethylene Encasement For Ductile Iron Piping For Water and Other Liquids.

3. AWWA C110/ANSI A21.10 Ductile Iron Fittings, 3 inch. through 48 inch, for Water and other liquids

4. AWWA C111/ANSI A21.11 Rubber Gasket Joints For Ductile Iron Pipe and Fittings.

5. AWWA C115/ANSI A21.15, Flanged Ductile Iron Pipe

6. AWWA C151/ANSI 21.51 Ductile Iron Pipe.

7. AWWA C153/ANSI A21.53 Compact Ductile Iron Fittings.

8. AWWA C500, Gate Valves For Water and Sewage Systems.

9. AWWA C504, Rubber-Seated Butterfly Valves.

10. AWWA C509, Resilient Seated Gate Valves For Water and Sewerage Systems.

11. AWWA C600, Installation of Ductile Iron Water Mains and Appurtenances.

12. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe & Fittings for Water

13. AWWA C651, Disinfecting Water Mains.

14. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch, for Water Distribution.

15. AWWA C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 Inch through 36 Inch.

16. ASTM C478, Precast Concrete Valve Boxes and Vaults.

17. ASTM C150, Concrete, Type II.

18. ASTM D1784, Rigid Polyvinyl Chloride PVC Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

19. ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe.

20. ASTM D3139, Joints For Plastic Pressure Pipes Using Flexible Elastomeric Seals.

21. ASTM F477, Elastomeric Seals For Joining Plastic Pipes.

C. INSPECTION AND CERTIFICATION OF PIPE AND FITTINGS

1. All pipe fittings and appurtenances to be installed under this Specification may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturers' cooperation shall be required in these inspections.

2. The Contractor shall obtain from the pipe manufacturer a certificate of inspection stating that the pipe and fittings supplied for this Project has been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall be borne by the Contractor. Letters of certification shall be furnished for all inspections and tests prior to the installation of the pipe, fittings and appurtenances.

D. INSPECTION UPON DELIVERY

1. All pipe fittings and appurtenances shall be subject to visual inspection by a representative of the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit shall be rejected and shall be immediately removed from the job site.

2. The Owner's Representative may perform or cause to be performed all tests as specified in the applicable AWWA Standards, to ensure conformance with the standard. In the case of failure of the pipe or appurtenances to comply with such standards, the responsibility for replacement of the defective materials becomes that of the manufacturer or the Contractor.

3. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

E. INSPECTION OF PRECAST CONCRETE PRODUCTS

1. The quality of all materials, the process of manufacture and the finished precast concrete sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the precast products have been delivered.

   Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection at any time after delivery, due to failure to meet any of the specification requirements.

2. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site within 24 hours. Sections which have been damaged after delivery will be rejected and replaced at the Contractor's expense.

3. At the time of inspection, the precast sections will be carefully examined to assure compliance with ASTM C478, these specifications and the manufacturer's approved shop drawings.

4. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all precast sections shall be dense and close textured.
5. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.05 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of pipelines incorporating products and materials similar to those specified herein.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES) and the Reedy Creek Improvement District (RCID).

1.06 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01330, Submittals.

B. PRODUCT DATA

1. The data to be submitted shall include, but not be limited to:

a. Ductile iron pipe and fittings.

b. Polyvinyl chloride (PVC) pressure pipe.

c. Fusible C-900 PVC

d. High density polyethylene pipe

e. Elastomeric seals for ductile iron and PVC pipe joints.

f. Resilient seated gate valves.

g. Tapping valves.

h. Resilient seated butterfly valves.

i. Air release and vacuum relief valves.

j. Tapping saddles and tapping sleeves.

k. Cast iron and plastic valve boxes.

l. Precast concrete valve vaults.

m. Valve operators.

n. Mechanical joint retainer glands.

o. Corrosion protection materials.

p. Underground marking and identification tapes.

q. Underground tracer wire and appurtenances.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile iron pipe (DIP) for non-potable water service shall conform to AWWA C151.

1. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with a minimum yield strength of 42,000 psi.

2. Pipe shall be Pressure Class 200, minimum.

3. Ductile iron pipe for non-potable water main service shall have a cement mortar lining and a bituminous seal coat in accordance with AWWA C104 and a minimum 1.0 mil bituminous coating on the pipe exterior in accordance with AWWA C151.

4. Ductile iron pipe shall be supplied in lengths not in excess of a nominal twenty (20) feet and, unless otherwise specified, shall have rubber-gasket joints conforming to AWWA C111.

5. Single gasket push-on joints shall normally be used where joint restraint is not required.

6. Where joint restraint is required, restrained joints shall: be “T-R Flex” joints as manufactured by U.S. Pipe, “Flex-Ring” and “Lok-Ring” joints as manufactured by American Ductile Iron Pipe, or approved equal.

Joint restraint other than at fittings may also be accomplished with American "Fast Grip" or U.S. Pipe "Field Lok" gaskets, or approved equal.

Restrained joints at fittings shall utilize mechanical joints with a restraining gland. Restraining glands shall be EBAA Iron Series "1100" or "3000", Stargrip Series 3000, Series 300OS or Series 3100P or approved equal.

7. High strength, low alloy steel T-bolts and nuts for mechanical joint shall conform to AWWA C110, Appendix, and AWWA C111. Threads shall conform to ANSI B.1.

8. Where called for on the plans, polyethylene encasement for ductile iron pipe shall conform to AWWA C105.

9. Acceptable manufacturers:

   American, U.S. Pipe, Griffin Pipe or approved equal.

B. Ductile iron fittings for non-potable water transmission shall conform to AWWA C110 or C153. Minimum pressure rating shall be 250 psi.

1. Rubber gasket joints shall be mechanical joint in accordance with AWWA C111.

2. Fittings shall be lined and coated according to section 2.01 A.3 above.

3. All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline.

4. Only those fittings that are of domestic (United States) manufacture will be acceptable.

5. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's identification, country of manufacture, and number of degrees or fraction of the circle. The letters "D.I." or the word "Ductile" shall also be cast on the outside of the body.

6. Fusion bonded epoxy coated ductile iron fittings as manufactured by "One Bolt, Inc." are acceptable, provided they meet ASTM A 536 grade 65-45-12 and are installed in strict accord with the manufacturer's instructions.

C. Flanged ductile iron pipe and fittings with threaded flanges where called for on the plans, shall conform to AWWA C115. Flanges shall be furnished flat faced and drilled to 125 pound template in accordance with ANSI B16.1 full faced gaskets.

D. Polyvinyl chloride (PVC) pressure pipe for non-potable water service, in sizes 4-inch through 12-inch shall conform to AWWA C900. For sizes 16" through 36", PVC pipe shall conform to AWWA C905

1. Laying lengths shall be 20 feet +/- 1 inch for all sizes.

2. PVC pipe shall be Class 200 (DR 14) for sizes 12" and smaller, and DR-18 for sizes 16" through 24" and DR-21 for sizes 30" through 36" with cast iron outside dimensions.

3. PVC pipe joints shall have an integral wall-thickened bell end with gasket seal conforming to ASTM D3139. (Solvent weld joints will not be permitted.)

4. PVC pipe for non-potable water service shall be blue or white pigmented.

5. Fittings for use with AWWA C900 and C905 pipe shall be ductile iron conforming to section 2.01.B above.

6. Where joint restraint is required, restraining glands may be utilized. Restraining glands shall be specifically designed for use with C900 PVC pipe and shall be EBAA Iron "2000PV" or "3000" Series, Romac "GripRing", Sigma "PV-LOK", Tyler "MJR", Stargrip Series 4000 and Series 4100P or approved equal.

7. All PVC pipe shall be identified on the exterior of the pipe with the following information:

   a. Nominal pipe size and O.D. base: (e.g. 6-inch C.I.)

   b. Material code designation number: (PVC 1120)

   c. Dimension ratio (DR) number

   d. Pressure classification

   e. AWWA designation: C900 or C905

   f. Pipe manufacturer's name and production code.

   g. Date and shift of manufacture

   h. All PVC pipe shall bear the NSF mark indicating its approval for potable water.

8. Acceptable manufacturers:

   Johns Manville, Certainteed, H&W, Clow, or approved equal.

F. PVC pipe smaller than 4-inch in size shall conform to ASTM D2241, SDR21, with I.P.S. dimensions, and manufactured from PVC 1120 resin. Pipe shall be NSF approved for potable water. Appropriate requirements of paragraph 2.01D

above shall apply. Schedule 40 PVC shall not be allowed, unless specifically required by the Owner's Representative.

G. RESILIENT SEATED GATE VALVES 3" and larger, for non-potable water service shall conform to, or exceed all applicable requirements of AWWA C509/515.

1. All resilient seated gate valves shall have non-rising stems for counter clockwise operation and a 2-inch square operating nut.

2. Each valve shall have the manufacturer's name, pressure rating, the year of manufacture, and an arrow to indicate the direction of opening cast into the valve body.

3. The interior of the valve body and bonnet shall have a factory applied 2-part thermo setting epoxy resin lining equal to Endurall 3300.

4. Each valve shall be hydrostatically tested to a pressure equal to twice the specified working pressure prior to shipment from the factory. The manufacturer shall certify each valve.

5. Acceptable manufacturers:
   Clow, American Flow Control, Mueller, Crane, M & H, Kennedy, Keystone, U.S. Pipe, or approved equal.

H. RUBBER SEATED BUTTERFLY VALVES are not acceptable unless specifically required by the Owner and Engineer of Record and identified as such on the contract documents. Butterfly valves so identified for non-potable water service shall conform to, or exceed, all applicable requirements of AWWA C-504.

1. Butterfly valves shall be of the tight closing, rubber seat type with recess-mounted BUNA-N or equal seats securely fastened to the valve body, or attached to the valve disc.

2. The valve disc shall rotate a full 90-degrees from the full open position to the tight shut position. Butterfly valves shall meet the full structural requirements of the applicable sections of AWWA C-504, latest edition.

3. Butterfly valve bodies shall be constructed of cast iron conforming to ASTM A126, Class B (or ASTM A48, Class 40), or ductile iron conforming to ASTM A536, Grade 65-45-12.

4. Buried valves shall have integrally cast mechanical joint ends. All valves for above ground service shall be flanged. Flange drilling shall be in accordance with ANSI B16.1, Class 125.

5. Two trunions for shaft bearings shall be integral with each valve body. Valve body thickness shall be in strict accordance with the applicable provisions of AWWA C-504.

6. Valve discs shall be constructed of NI-RESIST, Type 1, or of ductile iron conforming to ASTM A536, Grade 65-45-12, with stainless steel seating edges. All disc seating edges shall be smooth and polished.

7. Valve shafts shall be of the "stub-shaft" type or a one piece shaft extending full size through the disc bearings and into the operating mechanism. Valve shafts shall be constructed of stainless steel conforming to ASTM A276, Type 304 minimum. Shafts shall be high tensile steel with stainless steel shaft journals, Teflon bushings and shaft seals.

8. Valve seats shall be of a natural rubber or a synthetic type rubber compound similar to BUNA-N. Seats shall be molded in, vulcanized and bonded simultaneously into the valve body and seat. The bond shall be capable of withstanding a test pull of not less than 75 pounds without failure in accordance with ASTM D429, Method B.

9. Valve seats that are attached to the valve disc shall be held in place by a stainless steel retaining ring conforming to ASTM A 296, Grade CF8. Cap screws extending through the rubber seat and the seat retaining ring must be provided for adjustment of the rubber seat. The mating valve body seat shall be constructed of Type 304 stainless steel.

10. Valves shall be equipped with corrosion resistant, self-lubricated sleeve type bearings. The bearing shall be such that the bearing load will not exceed the published design load for the bearing material.

11. Valve operators for manual operation shall be of the worm gear type and shall be fully enclosed.

    Valves furnished for underground service shall be fully gasketed and grease packed.

    Valves located above ground shall be equipped with handwheel operators and shall have a suitable indicator arrow to show the valve position from full open to fully closed.

12. All valves for underground service, designated to be furnished with above ground operators, shall be equipped with handwheel operators on extended bonnets. The operating shaft for buried valves shall be such that the handwheel shall set not less than 3-feet above finished grade. All other underground butterfly valves shall be furnished with a 2-inch square AWWA operating nut with valve box and cover. All valves buried deeper than 30” shall have cast iron valve extensions.

13. Handwheel operators shall be capable of withstanding a pull of 200 pounds when operator components are positioned at the extreme operator positions without sustaining damage. Valves with operating nuts shall be capable of withstanding an input torque of 300 ft.-lbs. without sustaining damage.

14. Acceptable manufacturers:

    Clow, American Flow Control, Mueller, M & H, Kennedy, Keystone, U.S. Pipe, Centerline Henry Pratt, or approved equal.

I. AIR RELEASE AND/OR VACUUM RELIEF VALVES for non-potable water service shall be installed as shown on the plans. The valves shall be constructed with a cast iron body, cover and baffle, stainless steel float, BUNA-N or viton seat and stainless steel trim. All fittings shall be threaded.

1. Air Release Valves shall be APCO 200 Series; Val-Matic Model 15, 22 or 25; Vent-O-Mat Series RBX, H-Tec Model 985 or approved equal.

2. Air and Vacuum Valves shall be APCO 140 or 150 Series; Val-Matic Series 100; Vent-O-Mat Series RBX, H-Tec Models 992 thru 997 or approved equal.

3. Combination Air Valves shall be APCO 140C or 1800 Series; Val-Matic Series 200; Vent-O-Mat Series RBX, H-Tec or approved equal.

   Note: APCO Series 140 or 150 or approved equivalent air and vacuum valves are still acceptable.

J. CORPORATION STOPS. The use of corporation stops for water service connections will not be allowed.

K. SERVICE SADDLES OR TAPPING SLEEVES shall be used for all non-potable water pipe taps. (Note: generally, service taps will not be allowed on non-potable water transmission mains).

1. Size-on-size taps using tapping saddles or sleeves will not be permitted.

   Where size-on-size outlets are required, a tee shall be installed in lieu of a tapping saddle or sleeve. Tapping saddles and tapping sleeves will only be permitted on lines that are at least one nominal pipe size or diameter larger than the proposed tap.

2. For taps 2"-2 1/2" on mains 4 inches or larger, use a double strap service saddle. Saddle body shall be bronze or fusion-coated ductile iron with BUNA-N gasket. Straps shall be bronze or stainless steel. Taps smaller than 2" diameter will not be allowed. If a smaller line is preferred, tap the carrier pipe with a 2" tap and provide reducers or bushings after the tap to the desired diameter.

   Acceptable manufacturers and models:
   Smith-Blair No. 323 or 317, JCM 406, Ford FC202, Mueller BR2B or approved equal.

3. Tapping sleeves shall be used for taps 4 inches and larger. Tapping sleeves shall be fabricated of stainless steel, fusion-bonded epoxy coated ductile iron, or fusion-bonded epoxy coated steel and designed for a test

pressure of at least 200 psi. The outlet of the tapping sleeve may be either extruded or welded to the tapping sleeve.

The flange shall conform to AWWA C-207, Class D, ANSI 150 lb. drilling. Bolt holes shall straddle the pipe centerline.

The sleeve shall be equipped with a 3/4 inch NPT test plug with a standard square head. The gasket shall be of 360-degree design, and manufactured of gridded virgin GPR compounded for water service and complying with ASTM D-2000-80M 4AA607. An 18-10 stainless steel armor shall be vulcanized to the gasket, to bridge the gap between the securing lugs.

All bolts and nuts shall be stainless steel with 5/8 inch NC threads. Bolt threads shall be fluorocarbon coated to prevent galling. Nylatron G.S. washers shall be provided for lubrication.

Approved manufacturers and models:

Smith-Blair Models 622, 662 or 663; JCM Models 422 or 432; Ford style FAST or FTSC; Mueller H304 or approved equal.

L. TAPPING VALVES

1. Valves for use with tapping sleeves shall meet or exceed all provisions of AWWA C509/515.

2. Valves for use with tapping sleeves shall be resilient seated wedge gate type and shall be designed for use with tapping equipment. The valves shall have non-rising stems and shall have an alignment ring to prevent misalignment with the tapping sleeves.

3. The valves shall close clockwise (right) and open counter clockwise (left), and shall be equipped with a standard 2-inch square operating nut. Valve outlets shall have a flanged mechanical joint.

4. Acceptable manufacturers:
   Clow, Mueller, American Flow Control, U.S. Pipe, Dresser Industries.

M. FLANGED COUPLING ADAPTERS. Flanged coupling adapters for ductile iron pipe shall be Smith-Blair Model 912, JCM Model 301, Dresser Model 127, or approved equal.

N. VALVE BOXES. Valve boxes for potable water service shall be adjustable, cast iron or heavy wall high density polyethylene (HDPE) suitably sized for the size and depth of the buried valve. HDPE boxes shall have all exterior components joined with stainless steel screws and be equipped with a telescoping, plated, square steel tube stem assembly that allows for variable height adjustment. The stem assemble shall be torque tested to 1000 ft-pounds. All valve boxes shall be designed for traffic bearing H-20 wheel loading with round cast iron lids marked "WATER". Valve boxes shall be Tyler Model 6850/6860, U.S. Foundry Model 7500, American Flow Control's Trench Adapter or approved equal.

O. Fire hydrants will not be allowed on non-potable water transmission lines.

2.02 PRECAST CONCRETE PRODUCTS

A. Precast concrete valve vaults and air release valve manholes shall be in accordance with ASTM C478.

1. Concrete for the construction of manhole sections and valve vaults shall be Class A concrete with a compressive strength of 4000 psi at 28-days and shall conform to ASTM C150, Type II cement.

2. Valve vaults and manholes shall be precast units with integral base slab and wall sections. Poured in place base slabs shall not be approved.

3. Precast sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of three (3) days after having been painted. Precast sections shall not be shipped for a minimum of seven (7) days after removal from the forms.

4. The interior and mating surfaces of all precast concrete products shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 mils. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 mils. The coatings shall be applied by the precast manufacturer in strict accordance with the paint manufacturer’s recommendations.

   Acceptable coating: Koppers 300M or Devtar 5A by ICI Devoe or approved equal.

5. The date of manufacture of the precast sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Fed. Spec. SS-S-210A and AASHTO M198.

7. Rubber ring joint seals for precast sections shall not be permitted.

8. Shallow valve vaults, where the depth of cover is less than four (4) feet, shall be capable of supporting the overburden plus a live load equivalent to AASHTO H-20 loading.

9. Valve vault base sections shall not be less than eight (8) inches thick and shall be reinforced with number five (5) bars at nine (9) inches on centers, each way and shall have number four (4) bars around each pipe.

10. All precast concrete products shall be wet cast. Dry casting, or low slump concrete will not be acceptable.

11. All precast concrete products shall have proper lifting loops in the base slabs, (minimum of three (3)). Penetrating lifting holes will not be acceptable in any structure.

    Where non-penetrating lifting holes are approved, their use will not be permitted within eight (8) inches of any joint or pipe penetration.

12. Precast concrete grade rings for manhole adjustment shall conform to ASTM C478. Grade rings shall be a minimum of two (2) inches thick and a maximum of five (5) inches thick and shall be reinforced with six (6) gauge or thicker reinforcing wire.

13. Acceptable Manufacturers:

    Hanson Precast, Inc., Green Cove Springs, FL
    Atlantic Concrete Products, Inc., Sarasota, FL
    Mack Concrete Products, Inc., Astatula, FL
    Southern Precast, Inc., Alachua, FL
    Old Castle Precast, Orlando, FL.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless indicated otherwise on the drawings or as specified herein, the minimum cover for non-potable water mains shall not be less than thirty-six (36) inches.

B. Unless indicated otherwise on the drawings, separation requirements between potable water lines and other FDEP regulated utilities shall be in accord with Chapter 62-555 FAC, which requires a minimum of 12" of vertical separation and 36" of horizontal separation. Preferred vertical separation is greater than18 inches and preferred horizontal separation is greater than 10 feet.

C. Non-potable water mains shall be laid in the dry. All work occurring at trench depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

2. The groundwater level shall be lowered only to sufficient depth to assure that trench bottom soils will not be saturated or develop quick conditions.

3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

5. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

D. Non-potable water mains and appurtenances shall be constructed using the materials indicated on the drawings and as specified herein. Substitutions shall not be made without the express approval of the Owner's Representative.

E. The Contractor shall not cover lines until they have been inspected and approved.

F. Conflict encasement shall be in accordance with the applicable standard.

3.02 HANDLING AND STORAGE OF PIPE FITTINGS AND APPURTENANCES

A. All pipe, fittings and appurtenances shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage.

1. Pipe, fittings and appurtenances shall not be dropped, rolled or skidded into or against pipe, fittings or other construction products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and appurtenances shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table.

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e.) bell, plain end; bell, plain end, etc. No less than two rows of timbers shall be placed between tiers. Chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between pipes in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis.

1. Gaskets for mechanical joint and push-on joint ductile iron pipe and fittings shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Mechanical joint bolts and locking segments for push-on joints shall be handled and stored in such a manner that will insure proper use in respect to pipe types and sizes.

3.03 LAYING NON-POTABLE WATER MAINS

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. Non-potable water mains shall be laid in accordance with the details shown in the plans, and as specified herein.

1. The trench bottom shall be graded to the proposed elevation of the pipeline and the bottom shaped to fit the lower quadrant of the pipe. Holes shall be excavated at each bell so the pipe will be uniformly supported along the entire length of the barrel only.

2. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer’s specifications and instructions for the type of pipe used and the applicable standards of the Owner’s Representative.

3. Any pipe having a defective joint, bell or spigot shall be rejected, removed from the work site and replaced with a sound unit.

4. All pipe shall be installed to the homing mark on the spigot. On field cut pipe, the Contractor shall provide a homing mark on the spigot end in strict accordance with the manufacturer's recommendations.

5. All pipe shall be retained in position so as to maintain alignment and joint closure until sufficient haunching and backfill has been placed to adequately hold the pipe in place.

6. Foreign materials shall be prevented from entering the pipe while pipe is being placed in the trench. No debris, tools, articles of clothing or other materials shall be placed in the pipe at any time.

7. At all times when pipe laying is not in progress for ten (10) minutes or more the open ends of the pipe shall be closed by a watertight plug to ensure that absolute cleanliness is maintained inside the pipe at all times. Plugs shall be one-piece plastic with gasket as manufactured by Taylor Made Plastics, Inc., Sarasota, FL, or approved equal.

3.04 JOINTING NON-POTABLE WATER MAINS

A. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative. Joints shall be in strict accordance with AWWA C600.

B. The Contractor shall take all reasonable precautions to provide assurance that the interior of the pipe and the jointing seal shall be free from sand, dirt, trash or other foreign material before installation in the line. Any pipe or fitting that has been installed containing dirt or other detrital material shall be removed, cleaned and re-laid. Extreme care shall be taken to keep the bells of the pipe free from sand, dirt or rocks so that the joint may be properly assembled without over stressing the bells.

C. All pipe shall be installed to the homing mark on the spigot. When field cutting of pipe is required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe, cut ends of pipe to be used with push-on bell shall be beveled to conform to the manufacturers spigot end. Care shall be taken to prevent damage to linings.

D. Deflection at pipe joints shall not exceed one half (1/2) the maximum pipe deflection recommended by the pipe manufacturer. If at any time joint deflections exceed the manufacturer's maximum recommended pipe deflections, an appropriate fitting shall be used.

3.05 PIPE JOINT RESTRAINTS AND THRUST BLOCKING

A MECHANICALLY RESTRAINED JOINTS

Mechanical pipe restraining mechanisms for push-on or mechanical joints will be used unless concrete blocking is specifically indicated on the plans, or as directed by the Owner's Representative.

Restraining glands, tie rods, clamps or other components of dissimilar metals shall be protected against corrosion by the application of a suitable coating at the direction of the Owner's Representative.

B. THRUST BLOCKING

Thrust blocking will not be allowed unless the job conditions dictate that conventional methods of mechanically restraining the pipe are not practical.

Where concrete thrust blocks are required due to the nature of the construction, vertical and horizontal reaction blocking shall be concrete having a compressive strength of not less than 2000 psi at 28 days. Thrust blocking shall be placed between undisturbed soil and the fitting to be restrained. The bearing area of the thrust blocking shall be adequate to prevent movement of the fittings and shall be of the size, weight and dimensions shown on the plans or as directed by the Owner's Representative.

Prior to placing concrete for thrust blocking all pipe joints, glands, flanges, bolts and other appurtenances shall be protected by 15 lb. roofing felt or other approved material. Plastic sheeting or other similar material shall not be used. Wood side forms shall be used when placing concrete for thrust blocking as shown in the applicable detail at the end of this section.

The blocking shall be located so as to contain the resultant force in such a way that the pipe and fittings will be accessible for repair. The blocking shall be sized to include soil conditions, pipe type and fittings, pressure conditions, cover, compaction, and all other variables that could affect the size of the thrust block and restraint required. An appropriate safety factor shall be applied to all thrust block sizing calculations.

C. RESTRAINT/CONCRETE THRUST BLOCK DESIGN

Mechanical restraints or concrete thrust blocking shall be sized for the working pressure plus surge allowance, or a test pressure of 200 psi, whichever is greater. Adequate factors of safety shall be employed.

D. FUSIBLE PIPING JOINT RESTRAINT

Fusion joining of PVC and HDPE piping materials may be used in lieu of conventional joint restraint where hydraulic directional drilling is required or selected or where special construction conditions may dictate this method of joint restraint. Butt fusion with standard heat fusion equipment shall be used and the fused joint shall have at least 96% of the tensile and burst strength of the pipe material. Pipe ends to be fused shall be machined flush and aligned with each other. Heat fusion shall be accomplished by standard heat fusion equipment in strict accord with the requirements of the pipe manufacturer. Fusible PVC C-900 pipe shall meet ASTM cell classification 12454B.

3.06 PIPELINE IDENTIFICATION

A. PIPE DETECTING WIRE FOR NON-METALLIC PIPE

See Section 02505

B. PIPE IDENTIFICATION

1. Plastic pipe (PVC and HDPE) shall be pigmented in a “safety” blue color. The entire pipe shall be pigmented or “safety” blue strips on the longitudinal axis of the pipe shall be pigmented. Each stripe shall be at least 2 inches in width. Pipelines smaller than 24 inch outside diameter shall have at least two stripes at the 12 and 6 o’clock positions. Pipelines 24” and larger in diameter shall have three stripes at the 12, 4 and 8 o’clock positions.

2. Non-metallic pipe not meeting the above requirements shall, upon approval by the Owner’s Representative, have adhesive marking tapes applied in accordance with Section 02505.

3. Metallic pipe (ductile iron or steel) can be painted with a safety "blue" stripe to designate non-potable water in lieu of the marking tape. Stripes shall be painted in 2 inch minimum widths at the same locations as required for plastic pipe. Paint shall be an acrylic aliphatic urethane, Devthane #378 or approved equal. Dry film thickness shall be greater then 2 mils. Paint shall be applied at least 24 hours prior to placement of the piping materials in the trench, to allow adequate time for drying.

C. UNDERGROUND WARNING TAPE

See Section 02505

D. VALVE BOX I.D. TAG

1. All valve boxes shall have concrete collars and I.D. tags, per the standard detail on the drawings.

3.07 CONNECTIONS FROM NEW TO EXISTING WATER MAINS

A. No connections will be allowed from new to existing non-potable water mains without written approval from the Owner's Representative, and cleared for use by FDEP (if an FDEP permit to construct was necessary).

1. Approval will be made only after a request form for alteration or connection has been submitted with approved plans.

2. The use of fire hydrants by other than authorized persons is prohibited. The Owner's Representative may permit the use of water from a fire hydrant for construction or other purposes provided the applicant shall properly meet the conditions as described in Section 1500 of these Specifications and as shown in the appropriate standard. The installation shall be under the supervision of the Owner's Representative.

3. Valves shall not be operated by any person other than Reedy Creek Energy Services Water Department personnel.

3.08 FLUSHING

A. Foreign material left in the pipelines during installation often result in valve and fire hydrant seat leakage during hydrostatic pressure testing. The Contractor shall make every effort to insure that lines are kept clean during installation.

B. Thorough flushing is required prior to hydrostatic pressure testing; flushing shall be accomplished by partially opening valves and fire hydrants several times under actual line pressures with pipeline velocities of not less than 3.0 feet per second in the largest line size to be flushed.

The pipelines shall be flushed full bore and shall not be less than three (3) times the total volume of the section being tested. Lines shall be flushed with only potable water.

3.09 PRESSURE AND LEAKAGE TESTING

A. Hydrostatic pressure and leakage testing of water mains shall be performed in accordance with Section 4 of AWWA C600 except as modified below. All testing shall be made using only potable water. Air testing shall not be permitted.

1. The Contractor shall furnish all gauges, meters, pressure pumps, and all other equipment required to pressure test the main at no additional cost to the Owner.

2. The Contractor shall submit his plan for testing the system to the Owner's Representative for review not less than ten (10) working days prior to starting the test.

3. The pipelines shall be tested in such sections as may be directed by the Owner's Representative or by installing temporary plugs as required. Pressure tests will not be allowed against closed valves unless approved by the Owner's Representative. In no case shall the test section exceed one thousand (1,000) linear feet unless approved by the Owner's Representative.

4. All sections which fail to meet the tests shall be repaired and the leakage eliminated, regardless of the total leakage as shown by the test.

5. All lines which fail to meet the tests shall be repaired and retested as necessary until the test requirements are complied with, at no additional cost to the Owner. All defective materials, pipes, valves and appurtenances shall be removed and replaced at the contractor's expense.

6. The Contractor shall provide accurate means for measuring the water required to maintain the test pressure. The quantity of water required to maintain the test pressure shall be the measure of the leakage.

B. The required pressure for the field hydrostatic pressure test shall be two (2) times the working pressure at the point of testing, but in no case shall the test be less than 200 psi, unless indicated otherwise on the construction plans or as designated in writing by the Owner's Representative, with no pressure loss.

1. The Contractor shall provide all temporary plugs and blocking necessary to maintain the required test pressure. Corporation cocks, service saddles, pipe risers and angle globe valves shall be provided at each dead-end in order to bleed air from the main. The cost of these items shall be included as part of the testing.

2. The duration of the pressure test shall be a minimum of four (4) hours. The costs of all required items shall be included as part of the testing.

C. TEST PRESSURE RESTRICTIONS

1. Test pressures shall not exceed the pipe or thrust-restraint design.

2. No test pressure variations for the duration of the test shall be allowed.

D. PRESSURIZATION OF THE LINES

1. Each section of the pipe shall be slowly filled with water and pressurized to the specified test pressure based on the elevation of the lowest point of the line or section under test, and corrected to the elevation of the test gauge by means of a force pump connected to the pipe in a manner satisfactory to the Owner's Representative.

2. In no case shall a line be tested while connected to an existing water main.

E. AIR REMOVAL BEFORE TESTING

1. Prior to applying the specified test pressure, all air shall be expelled from the pipe, valves and hydrants.

2. If permanent air relief valves or air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that all air can be expelled as the line is filled with water. After all air has been expelled from the line, the corporation cocks shall be closed and the test pressure applied.

3. After the main has been tested and accepted, the corporation cocks shall be removed and plugged.

F. EXAMINATION UNDER PRESSURE

All exposed pipe, fittings, valves, hydrants, joints, etc. shall be carefully examined during the test. Defective or damaged pipe, fittings, valves or other appurtenances that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory to the Owner's Representative.

G. ACCEPTANCE OF THE INSTALLATION

Final acceptance shall be determined on the basis of zero pressure drop. If the test of any section of pipe discloses leakage, the Contractor, at his own expense, shall locate and make all repairs necessary until all leakage is eliminated

3.10 DISINFECTION OF NON-POTABLE WATER PIPELINES

A. Prior to placing the water system in service, all non-potable water pipelines shall be chlorinated in accordance with AWWA C-651, "AWWA Standard For Disinfecting Water Mains" and the requirements of Chapter 62-555 FAC.

B. The Contractor shall notify the Owner's Representative not less than five (5) working days prior to commencement of disinfection of the lines and shall present his plan for chlorination to the Owner's Representative for approval.

C. The location of the sampling points and chlorination points shall be determined by the Owner's Representative and shall include all locations referenced in the required permits. All taps for chlorination and sampling shall be uncovered and backfilled by the Contractor at no additional expense to the Owner.

D. All line disinfection must be witnessed by the Owner's Representative. Owner's Representative will take bacteriological samples and have them tested.

E. After the line has been tested and accepted, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Owner's Representative. The Contractor shall repair any damage to pipe exterior coating prior to acceptance.

F. General procedure for disinfection of non-potable water systems.

1. Prevent contaminating materials from entering the water main during construction, repair or storage.

2. Remove by flushing any detritus that may have entered the water main during construction.

3. Chlorinate any residual contamination that may remain in the lines, through a tap at one end of the line.

4. Flush chlorinated water from the main after the required minimum detention time of 24 hours.

5. Determine the bacteriological quality of the water by laboratory examination in accordance with "Standard Methods For the Examination of Water or Wastewater" or AWWA Manual M12.

6. Satisfactory bacteriological test results shall be required before any potable water system is placed into service.

7. No new non-potable water piping shall be placed into active service until the line(s) have been cleared for use by the Florida Department of Environmental Protection.

G. FILLING AND CONTACT

When installation has been completed, and flushed clean, the main shall be filled with water from the existing potable water distribution system or other approved source of supply and shall be made to flow at a constant measured velocity no greater than 1.0 foot per second into the newly laid water main. The Contractor shall furnish a water meter or other approved device for measuring the rate of flow at no additional cost to the Owner.

1. At a point not more than 2.0 feet downstream from the beginning of the new main, the entering water shall be dosed with a 1.0 percent chlorine solution, fed at a constant rate, such that the water will have a free chlorine residual of not less than 25 mg/L at the end of a 24-hour holding period.

2. To assure that this concentration is provided, the Contractor shall provide testing services to measure the chlorine concentration at regular intervals, in accordance with the procedures described in the current edition of "Standard Methods For the Examination of Water or Wastewater", or AWWA Manual M12. Approved standard chlorine test kits may be used.

3. The following table gives the amount of chlorine required for each 100-feet of pipeline of various diameters. Solutions of 1-percent may be prepared using sodium hypochlorite or calcium hypochlorite. (Note: Calcium hypochlorite requires one pound of $CaCl_2$ to 8 gallons of water to provide the required chlorine concentration.)

CHLORINE REQUIRED TO PRODUCE 25 mg/l CONCENTRATION IN 100-FT. OF PIPE BY DIAMETER		
PIPE DIAMETER (INCHES)	100% CHLORINE (lbs./100 Feet Pipe)	1.0% CHLORINE (lbs. NaOCl / Gal. water)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60
24	0.411	4.90

4. During the application of chlorine, valves shall be positioned and operated so that the strong chlorine solution in the main being treated will not flow into connecting water mains that are in active service.

5. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water.

   The chlorinated water shall be retained in the main for not less than 24 hours, during which time all valves, hydrants and appurtenances in the treated section shall be operated to insure complete disinfection.

   At the end of the 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

6. Hypochlorite solutions shall be applied to the water main using a gasoline powered or electrically powered chemical-feed pump designed for feeding chlorine solutions at a controlled rate of flow. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the pressures created by the pumps.

All connections shall be checked for tightness before solution is applied to the main.

H. FINAL FLUSHING

After the 24-hour retention period, the heavily chlorinated water shall be flushed from the main until the chlorine residual measurements show that the concentration in the water leaving the main is at least 3.0 mg/L, but not less than 0.5 mg/L.

I. DISPOSING OF CHLORINATED WATER

The environment to which the chlorinated water is to be discharged shall be inspected and approved by Reedy Creek Environmental Permitting and Engineering and the Owner's Representative prior to discharge of chlorinated effluent. If there is any question that the chlorinated discharge will cause damage to the environment, then a dechlorinating agent shall be applied to the water to be wasted to neutralize the chlorine residual remaining in the water.

1. Chlorinated water shall not be discharged into surface waters, including lakes, ponds, reservoirs, canals or streams.

2. The chlorine residual of water being disposed of shall be neutralized by treating with one of the chemicals listed in the following table:

POUNDS OF CHEMICALS REQUIRED TO REDUCE AND NEUTRALIZE VARIED RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER. *				
RESIDUAL CHLORINE (mg/L)	SULFUR DIOXIDE (SO_2)	SODIUM BIOSULFATE ($NaHSO_3$)	SODIUM SULFITE (Na_2SO_3)	SODIUM THIOSULFATE ($Na_2SO3\text{-}5H_2O$)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

* With the exception of chlorine residual, in mg/L, or P.P.M., all amounts shown above are in pounds.

J. BACTERIOLOGICAL TESTING

STANDARD CONDITIONS:

After final flushing and before the water main is placed in service, samples shall be collected from the end of the line and shall be tested for bacteriological quality in accordance with "Standard Methods For the Examination of Water and Wastewater", and shall show the absence of coliform organisms. A standard plate count shall be required.

1. Sampling:

   At least two samples shall be collected from the new main and two from each branch, in addition to the sampling points stipulated in the FDEP permit. In the case of extremely long mains (not greater than 1000 linear feet), it is required that samples be collected along the length of the line as well as at its end. The total number of samples and the locations of sampling points shall be as directed by the Owner's Representative and all regulatory agencies.

2. Special Conditions:

   If, during construction, trench water has entered the main, or if in the opinion of the Owner's Representative, excessive quantities of dirt and debris have entered the main, bacteriological samples shall be taken at intervals of not more than 200 feet and shall be identified by station or location. Samples shall be taken of water that has been standing in the main for at least 16 hours after final flushing has been completed.

3. Sampling Procedures:

   Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by "Standard Methods for the Examination of Water and Wastewater". Hoses and fire hydrants shall not be allowed in the collection of bacteriological samples. Approved sampling points shall be corporation cocks with gooseneck assemblies and terminal blow-off/sampling tap only.

K. RECHLORINATION

1. Should the initial disinfection fail to produce satisfactory bacteriological samples, the main shall be rechlorinated by the continuous feed method until satisfactory results are obtained.

2. Should positive bacteriological samples continue to be recorded, the situation shall be evaluated by the Owner's Representative to determine corrective action, and daily samples recorded.

3. All retesting shall be at the expense of the Contractor.

L. Prior to placing the water system in service, the water system shall be cleared for use, in writing, by the Florida Department of Environmental Protection and the Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include, but not be limited to all labor, equipment, tools, materials and all incidentals required for the construction, installation, testing and disinfection of a potable water distribution system, including all appurtenances as shown on the plans and as specified herein.

B. The work shall include but not be limited to, ductile iron pipe, PVC pipe, valves, air release and vacuum relief valves, ductile iron fittings, strainers, tapping sleeves, tapping saddles, cast iron and plastic valve boxes, backflow preventers, master meters, fire hydrants, valve vaults and boxes, all restrained joints and concrete thrust blocking as required for all types of piping, all excavation, sheeting, shoring and bracing, dewatering, jacking and boring, where required, slope protection, backfilling, grading and drainage, concrete work, rip-rap, compaction, grass restoration, pavement restoration where required and all other work necessary to complete the construction, installation, flushing, testing and disinfection of the potable water distribution system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID standard specifications which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall prevail.

1. Submittals	Section 01330
2. Testing Laboratory Services	Section 01410
3. Excavating and Backfilling for Utilities	Section 02320
4. Boring & Jacking	Section 02445
5. Hydraulic Directional Drilling	Section 02448
6. Underground utilities marking	Section 02505

1.02 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Environmental Protection.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900 or C905.

1.03 QUALITY ASSURANCE

A. TECHNICAL GUIDANCE

1. Handbook of Ductile Iron Pipe, latest edition, DIPRA

2. Recommended Standards for Water Works (Ten-State Standards), latest edition

3. Florida Department of Environmental Protection, FAC 62-555.

4. Handbook of PVC Pipe Design & Construction, latest edition, Uni-Bell Plastic Pipe Association.

5. Manual M23: PVC Pipe - Design & Installation, AWWA

B. REFERENCE STANDARDS

This specification references the following standards which form a part of this specification to the extent specified herein. The latest edition of each standard shall apply. In any case of conflict, the most restrictive standard shall prevail.

1. AWWA C104/ANSI A21.4 Cement-Mortar Lining For Ductile Iron Pipe and Fittings For Water.

2. AWWA C105/ANSI A21.5, Polyethylene Encasement For Ductile Iron Piping For Water and Other Liquids.

3. AWWA C110/ANSI A21.10 Ductile Iron Fittings, 3 in. through 48 in., for Water and other liquids

4. AWWA C111/ANSI A21.11 Rubber Gasket Joints For Ductile Iron Pipe and Fittings.

5. AWWA C115/ANSI A21.15, Flanged Ductile Iron Pipe

6. AWWA C151/ANSI 21.51 Ductile Iron Pipe.

7. AWWA C153/ANSI A21.53 Compact Ductile Iron Fittings.

8. AWWA C500, Gate Valves For Water and Sewage Systems.

9. AWWA C503, Wet-Barrel Fire Hydrants.

10. AWWA C504, Rubber-Seated Butterfly Valves.

11. AWWA C509, Resilient Seated Gate Valves For Water and Sewerage Systems.

12. AWWA C600, Installation of Ductile Iron Water Mains and Appurtenances.

13. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe & Fittings for Water

14. AWWA C651, Disinfecting Water Mains.

15. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch, for Water Distribution.

16. AWWA C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 Inch through 36 Inch

17. ASTM C478, Precast Concrete Valve Boxes and Vaults.

18. ASTM C150, Concrete, Type II.

19. ASTM D1784, Rigid Polyvinyl Chloride PVC Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

20. ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe.

21. ASTM D3139, Joints For Plastic Pressure Pipes Using Flexible Elastomeric Seals.

22. ASTM F477, Elastomeric Seals For Joining Plastic Pipes.

C. INSPECTION AND CERTIFICATION OF PIPE AND FITTINGS

1. All pipe fittings and appurtenances to be installed under this Specification may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturers' cooperation shall be required in these inspections.

2. The Contractor shall obtain from the pipe manufacturer a certificate of inspection stating that the pipe and fittings supplied for this Project has been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall be borne by the Contractor. Letters of certification shall be furnished for all inspections and tests prior to the installation of the pipe, fittings and appurtenances.

D. INSPECTION UPON DELIVERY

1. All pipe fittings and appurtenances shall be subject to visual inspection by a representative of the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit shall be rejected and shall be immediately removed from the job site.

2. The Owner's Representative may perform or cause to be performed all tests as specified in the applicable AWWA Standards, to ensure conformance with the standard. In the case of failure of the pipe or appurtenances to comply with such standards, the responsibility for replacement of the defective materials becomes that of the manufacturer or the Contractor.

3. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

E. INSPECTION OF PRECAST CONCRETE PRODUCTS

1. The quality of all materials, the process of manufacture and the finished precast concrete sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the precast products have been delivered.

   Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection at any time after delivery, due to failure to meet any of the specification requirements.

2. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site within 24 hours. Sections which have been damaged after delivery will be rejected and replaced at the Contractor's expense.

3. At the time of inspection, the precast sections will be carefully examined to assure compliance with ASTM C478, these specifications and the manufacturer's approved shop drawings.

4. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all precast sections shall be dense and close textured.

5. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound

and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.05 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of pipelines incorporating products and materials similar to those specified herein.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES), also known as the Owner's Representative, and the Reedy Creek Improvement District (RCID), also known as the Owner.

1.06 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01300, Submittals.

B. PRODUCT DATA

1. The data to be submitted shall include, but not be limited to:

a. Ductile iron pipe and fittings.

b. Polyvinyl chloride (PVC) pressure pipe.

c. Fusible C-900 PVC

d. High density polyethylene pipe

e. Elastomeric seals for ductile iron and PVC pipe joints.

f. Resilient seated gate valves.

g. Tapping valves.

h. Resilient seated butterfly valves.

i. Air release and vacuum relief valves.

j. Tapping saddles and tapping sleeves.

k. Cast iron and plastic valve boxes.

l. Precast concrete valve vaults.

m. Valve operators.

n. Mechanical joint retainer glands.

o. Corrosion protection materials.

p. Underground marking and identification tapes.

q. Underground tracer wire and appurtenances.

r. Fire hydrants and fittings.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile iron pipe (DIP) for potable water service shall conform to AWWA C151.

1. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi

2. Pipe shall be Pressure Class 200, minimum.

3. Ductile iron pipe for potable water main service shall have a cement mortar lining and a bituminous seal coat in accordance with AWWA C104 and a minimum 1.0 mil bituminous coating on the pipe exterior in accordance with AWWA C151.

4. Ductile iron pipe shall be supplied in lengths not in excess of a nominal twenty (20) feet and, unless otherwise specified, shall have rubber-gasket joints conforming to AWWA C111.

5. Single gasket push-on joints shall normally be used where joint restraint is not required.

6. Where joint restraint is required, restrained joints shall: be "T-R Flex" joints as manufactured by U.S. Pipe, "Flex-Ring" and "Lok-Ring" joints as manufactured by American Ductile Iron Pipe, or approved equal.

   Joint restraint other than at fittings may also be accomplished with American "Fast Grip" or U.S. Pipe "Field Lok" gaskets, or approved equal.

   Restrained joints at fittings shall utilize mechanical joints with a restraining gland. Restraining glands shall be EBAA Iron Series 1100 or 3000, Stargrip Series 3000, Series 3000OS or Series 3100P or approved equals.

7. High strength, low alloy steel T-bolts and nuts for mechanical joint shall conform to AWWA C110, Appendix, and AWWA C111. Threads shall conform to ANSI B.1.

8. Where called for on the plans, polyethylene encasement for ductile iron pipe shall conform to AWWA C105.

9. Acceptable manufacturers:

   American, U.S. Pipe, Griffin Pipe or approved equal.

B. Ductile iron fittings for potable water distribution shall conform to AWWA C110 or C153. Minimum pressure rating shall be 250 psi.

1. Rubber gasket joints shall be mechanical joint in accordance with AWWA C111.

2. Fittings shall be lined and coated according to section 2.01 A.3 above.

3. All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline.

4. Only those fittings that are of domestic (United States) manufacture will be acceptable.

5. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's identification, country of manufacture, and number of degrees or fraction of the circle. The letters "D.I." or the word "Ductile" shall also be cast on the outside of the body.

6. Fusion bonded epoxy coated ductile iron fittings as manufactured by "One-Bolt, Inc." are acceptable, provided they meet ASTM A 536 grade 65-45-12 and are installed in strict accord with the manufacturer's instructions.

C. Flanged ductile iron pipe and fittings with threaded flanges where called for on the plans, shall conform to AWWA C115. Flanges shall be furnished flat faced and drilled to 125 pound template in accordance with ANSI B16.1 full faced gaskets.

D. Polyvinyl chloride (PVC) pressure pipe for potable water service, in sizes 4-inch through 12-inch shall conform to AWWA C900. For sizes 16" through 36", PVC pipe shall conform to AWWA C905

1. Laying lengths shall be 20 feet +/- 1 inch for all sizes.

2. PVC pipe shall exceed pressure Class 200 for all pipe. Use DR 14 for sizes 12" and under with cast iron outside dimensions. PVC pipe for sizes larger than 16" shall be DR18, with cast iron outside dimensions.

3. PVC pipe joints shall have an integral wall-thickened bell end with gasket seal conforming to ASTM D3139. (Solvent weld joints will not be permitted.)

4. PVC pipe for potable water service shall be blue or white pigmented.

5. Fittings for use with AWWA C900/905 pipe shall be ductile iron conforming to section 2.01.B above.

6. Where joint restraint is required, restraining glands may be utilized. Restraining glands shall be specifically designed for use with C900 PVC pipe and shall be EBAA Iron "2000PV" or "3000" Series, Romac "GripRing", Sigma "PV-LOK", Tyler "MJR", Stargrip Series 4000 and Series 4100P or approved equals.

7. All PVC pipe shall be identified on the exterior of the pipe with the following information:

   a. Nominal pipe size and O.D. base: (e.g. 6-inch C.I.)

   b. Material code designation number: (PVC 1120)

   c. Dimension ratio (DR) number

   d. Pressure classification

   e. AWWA designation: C900 or C905

   f. Pipe manufacturer's name and production code.

   g. Date and shift of manufacture

   h. All PVC pipe shall bear the NSF mark indicating its approval for potable water.

8. Acceptable manufacturers:

   Johns Manville, Certainteed, H&W, Clow, or approved equal.

E. PVC pipe smaller than 4-inch in size shall conform to ASTM D2241, SDR21, with I.P.S. dimensions, and manufactured from PVC 1120 resin. Appropriate requirements of paragraph 2.01.D above shall apply. Schedule 40 PVC shall not be allowed, unless specifically required by the Owner's Representative.

F. RESILIENT SEATED GATE VALVES 2" and larger, for potable water service shall conform to, or exceed all applicable requirements of AWWA C509/515.

1. All resilient seated gate valves shall have non-rising stems for counter clockwise operation and a 2-inch square operating nut.

2. Each valve shall have the manufacturer's name, pressure rating, the year of manufacture, and an arrow to indicate the direction of opening cast into the valve body.

3. The interior of the valve body and bonnet shall have a factory applied 2-part thermo-setting epoxy resin lining equal to Endurall 3300.

4. Each valve shall be hydrostatically tested to a pressure equal to twice the specified working pressure prior to shipment from the factory. The manufacturer shall certify each valve.

5. Acceptable manufacturers:
   Clow, American Flow Control, Mueller, Crane, M & H, Kennedy, Keystone, U.S. Pipe, or approved equal.

G. RUBBER SEATED BUTTERFLY VALVES are not acceptable unless specifically required by the Owner and Engineer of Record and identified as such on the contract documents. Butterfly valves so identified for potable water service shall conform to, or exceed, all applicable requirements of AWWA C-504.

1. Butterfly valves shall be of the tight closing, rubber seat type with recess-mounted BUNA-N or equal seats securely fastened to the valve body, or attached to the valve disc.

2. The valve disc shall rotate a full 90-degrees from the full open position to the tight shut position. Butterfly valves shall meet the full structural requirements of the applicable sections of AWWA C-504, latest edition.

3. Butterfly valve bodies shall be constructed of cast iron conforming to ASTM A126, Class B (or ASTM A48, Class 40), or ductile iron conforming to ASTM A536, Grade 65-45-12.

4. Buried valves shall have integrally cast mechanical joint ends. All valves for above ground service shall be flanged. Flange drilling shall be in accordance with ANSI B16.1, Class 125.

5. Two trunions for shaft bearings shall be integral with each valve body. Valve body thickness shall be in strict accordance with the applicable provisions of AWWA C-504.

6. Valve discs shall be constructed of NI-RESIST, Type 1, or of ductile iron conforming to ASTM A536, Grade 65-45-12, with stainless steel seating edges. All disc seating edges shall be smooth and polished.

7. Valve shafts shall be of the "stub-shaft" type or a one piece shaft extending full size through the disc bearings and into the operating mechanism. Valve shafts shall be constructed of stainless steel conforming to ASTM A276, Type 304 minimum. Shafts shall be high tensile steel with stainless steel shaft journals, Teflon bushings and shaft seals.

8. Valve seats shall be of a natural rubber or a synthetic type rubber compound similar to BUNA-N. Seats shall be molded in, vulcanized and bonded simultaneously into the valve body and seat. The bond shall be capable of withstanding a test pull of not less than 75 pounds without failure in accordance with ASTM D429, Method B.

9. Valve seats that are attached to the valve disc shall be held in place by a stainless steel retaining ring conforming to ASTM A 296, Grade CF8.

Cap screws extending through the rubber seat and the seat retaining ring must be provided for adjustment of the rubber seat. The mating valve body seat shall be constructed of Type 304 stainless steel.

10. Valves shall be equipped with corrosion resistant, self-lubricated sleeve type bearings. The bearing shall be such that the bearing load will not exceed the published design load for the bearing material.

11. Valve operators for manual operation shall be of the worm gear type and shall be fully enclosed.

    Valves furnished for underground service shall be fully gasketed and grease packed.

    Valves located above ground shall be equipped with handwheel operators and shall have a suitable indicator arrow to show the valve position from full open to fully closed.

12. All valves for underground service, designated to be furnished with above ground operators, shall be equipped with handwheel operators on extended bonnets. The operating shaft for buried valves shall be such that the handwheel shall set not less than 3-feet above finished grade. All other underground butterfly valves shall be furnished with a 2-inch square AWWA operating nut with valve box and cover. All valves buried deeper than 30" shall have cast iron valve extensions.

13. Handwheel operators shall be capable of withstanding a pull of 200 pounds when operator components are positioned at the extreme operator positions without sustaining damage. Valves with operating nuts shall be capable of withstanding an input torque of 300 ft.-lbs. without sustaining damage.

14. Acceptable manufacturers:

    Clow, American Flow Control, Mueller, M & H, Kennedy, Keystone, U.S. Pipe, Centerline, Henry Pratt, or approved equal.

H. AIR RELEASE AND/OR VACUUM RELIEF VALVES for potable water service shall be installed as shown on the plans. The valves shall be constructed with a cast iron body, cover and baffle, stainless steel float, BUNA-N or viton seat and stainless steel trim. All fittings shall be threaded.

1. Air Release Valves shall be APCO 200 Series; Val-Matic Model 15, 22 or 25; Vent-O-Mat Series RBX, H-Tec Model 985 or approved equal.

2. Air and Vacuum Valves shall be APCO 140 or 150 Series; Val-Matic Series 100; Vent-O-Mat Series RBX, H-Tec Models 992 thru 997 or approved equal.

3. Combination Air Valves shall be APCO 140C or 1800 Series; Val-Matic Series 200; Vent-O-Mat Series RBX, H-Tec or approved equal.

   Note: APCO Series 140 or 150 or approved equivalent air and vacuum valves are still acceptable.

I. CORPORATION STOPS. The use of corporation stops for water service connections will not be allowed.

J. SERVICE SADDLES OR TAPPING SLEEVES shall be used for all potable water service taps.

1. Size-on-size taps using tapping saddles or sleeves will not be permitted.

   Where size-on-size outlets are required, a tee shall be installed in lieu of a tapping saddle or sleeve. Tapping saddles and tapping sleeves will only be permitted on lines that are at least one nominal pipe size or diameter larger than the proposed tap.

2. For taps 2 inches to 2-1/2 inches on mains 4 inches or larger, use a double strap service saddle. Saddle body shall be bronze or fusion-coated ductile iron with BUNA-N gasket. Straps shall be bronze or stainless steel. Taps smaller than 2 inch diameter will not be allowed. If a smaller line is preferred, tap the carrier pipe with a 2 inch tap and provide reducers or bushings after the tap to the desired diameter.

   Acceptable manufacturers and models:

   Smith-Blair No. 323 or 317, JCM 406, Ford FC202, Mueller BR2B or approved equal.

3. Tapping sleeves shall be used for taps 4 inches and larger. Tapping sleeves shall be fabricated of stainless steel, fusion-bonded epoxy coated ductile iron, or fusion-bonded epoxy coated steel and designed for a test pressure of at least 200 psi. The outlet of the tapping sleeve may be either extruded or welded to the tapping sleeve.

   The flange shall conform to AWWA C-207, Class D, ANSI 150 lb. drilling. Bolt holes shall straddle the pipe centerline.

   The sleeve shall be equipped with a 3/4 inch NPT test plug with a standard square head. The gasket shall be of 360-degree design, and manufactured of gridded virgin GPR compounded for water service and complying with ASTM D-2000-80M 4AA607. An 18-10 stainless steel armor shall be vulcanized to the gasket, to bridge the gap between the securing lugs.

   All bolts and nuts shall be stainless steel with 5/8 inch NC threads. Bolt threads shall be fluorocarbon coated to prevent galling. Nylatron G.S. washers shall be provided for lubrication.

   Approved manufacturers and models:

   Smith-Blair Models 622, 662 or 663; JCM Models 422 or 432; Ford style FAST or FTSC; Mueller H304 or approved equal.

K. TAPPING VALVES

1. Valves for use with tapping sleeves shall meet or exceed all provisions of AWWA C509.

2. Valves for use with tapping sleeves shall be resilient seated wedge gate type and shall be designed for use with tapping equipment. The valves shall have non-rising stems and shall have an alignment ring to prevent misalignment with the tapping sleeves.

3. The valves shall close clockwise (right) and open counter clockwise (left), and shall be equipped with a standard 2-inch square operating nut. Valve outlets shall have a flanged mechanical joint.

4. Acceptable manufacturers:

   Clow, Mueller, American Flow Control, U.S. Pipe, Dresser Industries.

L. FIRE HYDRANTS: Wet barrel fire hydrants shall meet or exceed all provisions of AWWA C503 and shall be Clow/Rich No. 92, 3-way "Slimline-Low Silhouette with No. 30C break-away riser. Dry barrel fire hydrants shall meet or exceed AWWA C502, UL246, and FM 1510 and shall be American-Darling B-84-B with breakable cast iron flange or Mueller Super Centurion-200 or 250. Weep holes on the dry barrel type hydrants are not required or allowed. All hydrants shall be equipped with two, 2.5" hose connections and one 4.5" pumper connection, complete with all caps and chains. Threads for hose and pumper connections shall be in conformance with the requirements of the RCID Fire Department. Hydrants shall be furnished with the manufacturer's standard prime finish and with an affidavit stating that the hydrant and all material meets the applicable AWWA requirements as stated above, and that all test requirements specified herein have been met.

1. The hydrant shall be furnished with the manufacturer's standard prime finish.

2. The manufacturer shall furnish an affidavit stating that the fire hydrant and all material used in the construction of the hydrant, are in conformance with the applicable requirements of AWWA Standard C-503 and this specification, and that all tests specified therein have been performed and that all test requirements have been met.

3. Acceptable Manufacturer: Clow Corporation, Valve Division Corona, California or American Flow Control, a division of American Cast Iron Pipe Co., Birmingham, Alabama or Mueller Co. Substitutes will not be accepted.

M. FLANGED COUPLING ADAPTERS. Flanged coupling adapters for ductile iron pipe shall be Smith-Blair Model 912, JCM Model 301, Dresser Model 127, or approved equal.

N. VALVE BOXES. Valve boxes for potable water service shall be adjustable, cast iron or heavy wall high density polyethylene (HDPE) suitably sized for the size and depth of the buried valve. HDPE boxes shall have all exterior components joined with stainless steel screws and be equipped with a telescoping, plated, square steel tube stem assembly that allows for variable height adjustment. The stem assemble shall be torque tested to 1000 ft-pounds. All valve boxes shall be designed for traffic bearing H-20 wheel loading with round cast iron lids marked

"WATER". Valve boxes shall be Tyler Model 6850/6860, U.S. Foundry Model 7500, American Flow Control's Trench Adapter or approved equal.

2.02 PRECAST CONCRETE PRODUCTS

A. Precast concrete valve vaults and air release valve manholes shall be in accordance with ASTM C478.

1. Concrete for the construction of manhole sections and valve vaults shall be Class A concrete with a compressive strength of 4000 psi at 28-days and shall conform to ASTM C150, Type II cement.

2. Valve vaults and manholes shall be precast units with integral base slab and wall sections. Poured in place base slabs shall not be approved.

3. Precast sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of three (3) days after having been painted. Precast sections shall not be shipped for a minimum of seven (7) days after removal from the forms.

4. The interior and mating surfaces of all precast concrete products shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 mils. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 mils. The coatings shall be applied by the precast manufacturer in strict accordance with the paint manufacturer's recommendations.

   Acceptable coating: Koppers 300M, Devtar 5A by ICI Devoe or approved equal.

5. The date of manufacture of the precast sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Fed. Spec. SS-S-210A and AASHTO M198.

7. Rubber ring joint seals for precast sections shall not be permitted.

8. Shallow valve vaults, where the depth of cover is less than four (4) feet, shall be capable of supporting the overburden plus a live load equivalent to AASHTO H-20 loading.

9. Valve vault base sections shall not be less than eight (8) inches thick and shall be reinforced with number five (5) bars at nine (9) inches on centers, each way and shall have number four (4) bars around each pipe.

10. All precast concrete products shall be wet cast. Dry casting, or low slump concrete will not be acceptable.

11. All precast concrete products shall have proper lifting loops in the base slabs, (minimum of three (3)). Penetrating lifting holes will not be acceptable in any structure.

    Where non-penetrating lifting holes are approved, their use will not be permitted within eight (8) inches of any joint or pipe penetration.

12. Precast concrete grade rings for manhole adjustment shall conform to ASTM C478. Grade rings shall be a minimum of two (2) inches thick and a maximum of five (5) inches thick and shall be reinforced with six (6) gauge or thicker reinforcing wire.

13. Acceptable Manufacturers:

    Hanson Precast, Inc., Green Cove Springs, FL
    Atlantic Concrete Products, Inc., Sarasota, FL
    Mack Concrete Products, Inc., Astatula, FL
    Southern Precast, Inc., Alachua, FL
    Old Castle Precast, Orlando, Fl.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless indicated otherwise on the drawings or as specified herein, the minimum cover for potable water mains shall not be less than thirty-six (36) inches.

B. Unless indicated otherwise on the drawings, separation requirements between potable water lines and other FDEP regulated utilities shall be in accord with Chapter 62-555 FAC, which requires a minimum of 12" of vertical separation and 36" of horizontal separation. Preferred vertical separation is greater than 18 inches and preferred horizontal separation is greater then 10 feet.

C. Potable water mains shall be laid in the dry. All work occurring at trench depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

   1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

   2. The groundwater level shall be lowered only to sufficient depth to assure that trench bottom soils will not be saturated or develop quick conditions.

   3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

5. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

D. Potable water mains and appurtenances shall be constructed using the materials indicated on the drawings and as specified herein. Substitutions shall not be made without the express approval of the Owner's Representative.

E. The Contractor shall not cover lines until they have been inspected and approved.

F. Conflict encasement shall be in accordance with the applicable standard.

3.02 HANDLING AND STORAGE OF PIPE FITTINGS AND APPURTENANCES

A. All pipe, fittings and appurtenances shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage.

1. Pipe, fittings and appurtenances shall not be dropped, rolled or skidded into or against pipe, fittings or other construction products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and appurtenances shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table.

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e.) bell, plain end; bell, plain end, etc. No less than two rows of timbers shall be placed between tiers. Chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between pipes in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis.

1. Gaskets for mechanical joint and push-on joint ductile iron pipe and fittings shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Mechanical joint bolts and locking segments for push-on joints shall be handled and stored in such a manner that will insure proper use in respect to pipe types and sizes.

3.03 LAYING POTABLE WATER MAINS

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. Potable water mains shall be laid in accordance with the details shown in the plans and as specified herein.

1. The trench bottom shall be graded to the proposed elevation of the pipeline and the bottom shaped to fit the lower quadrant of the pipe. Holes shall be excavated at each bell so the pipe will be uniformly supported along the entire length of the barrel only.

2. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative.

3. Any pipe having a defective joint, bell or spigot shall be rejected, removed from the work site and replaced with a sound unit.

4. All pipe shall be installed to the homing mark on the spigot. On field cut pipe, the Contractor shall provide a homing mark on the spigot end in strict accordance with the manufacturer's recommendations.

5. All pipe shall be retained in position so as to maintain alignment and joint closure until sufficient haunching and backfill has been placed to adequately hold the pipe in place.

6. Foreign materials shall be prevented from entering the pipe while pipe is being placed in the trench. No debris, tools, articles of clothing or other materials shall be placed in the pipe at any time.

7. At all times when pipe laying is not in progress for ten (10) minutes or more the open ends of the pipe shall be closed by a watertight plug to ensure that absolute cleanliness is maintained inside the pipe at all times. Plugs shall be one-piece plastic with gasket as manufactured by Taylor Made Plastics, Inc., Sarasota, FL, or approved equal.

3.04 JOINTING POTABLE WATER MAINS

A. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative. Joints shall be in strict accordance with AWWA C600.

B. The Contractor shall take all reasonable precautions to provide assurance that the interior of the pipe and the jointing seal shall be free from sand, dirt, trash or other foreign material before installation in the line. Any pipe or fitting that has been installed containing dirt or other detrital material shall be removed, cleaned and relaid. Extreme care shall be taken to keep the bells of the pipe free from sand, dirt or rocks so that the joint may be properly assembled without over stressing the bells.

C. All pipe shall be installed to the homing mark on the spigot. When field cutting of pipe is required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe, cut ends of pipe to be used with push-on bell shall be beveled to conform to the manufacturers spigot end. Care shall be taken to prevent damage to linings.

D. Deflection at pipe joints shall not exceed one half (1/2) the maximum pipe deflection recommended by the pipe manufacturer. If at any time joint deflections exceed the manufacturer's maximum recommended pipe deflections, an appropriate fitting shall be used.

3.05 PIPE JOINT RESTRAINTS AND THRUST BLOCKING

A MECHANICALLY RESTRAINED JOINTS

Mechanical pipe restraining mechanisms for push-on or mechanical joints will be used unless concrete blocking is specifically indicated on the plans, or as directed by the Owner's Representative.

Restraining glands, tie rods, clamps or other components of dissimilar metals shall be protected against corrosion by the application of a suitable coating at the direction of the Owner's Representative.

B. THRUST BLOCKING

Thrust blocking will not be allowed unless the job conditions dictate that conventional methods of mechanically restraining the pipe are not practical.

Where concrete thrust blocks are required due to the nature of the construction, vertical and horizontal reaction blocking shall be concrete having a compressive strength of not less than 2000 psi at 28 days. Thrust blocking shall be placed between undisturbed soil and the fitting to be restrained. The bearing area of the thrust blocking shall be adequate to prevent movement of the fittings and shall be of the size, weight and dimensions shown on the plans or as directed by the Owner's Representative.

Prior to placing concrete for thrust blocking all pipe joints, glands, flanges, bolts and other appurtenances shall be protected by 15 lb. roofing felt or other approved material. Plastic sheeting or other similar material shall not be used. Wood side forms shall be used when placing concrete for thrust blocking as shown in the applicable detail at the end of this section.

The blocking shall be located so as to contain the resultant force in such a way that the pipe and fittings will be accessible for repair. The blocking shall be sized to include soil conditions, pipe type and fittings, pressure conditions, cover, compaction, and all other variables that could affect the size of the thrust block and restraint required. An appropriate factor of safety shall be applied to all thrust block sizing calculations.

C. RESTRAINT/CONCRETE THRUST BLOCK DESIGN

Mechanical restraints or concrete thrust blocking shall be sized for the working pressure plus surge allowance, or a test pressure of 200 psi, whichever is greater. Adequate factors of safety shall be employed.

D. FUSIBLE PIPING JOINT RESTRAINT

Fusion joining of PVC and HDPE piping materials may be used in lieu of conventional joint restraint where hydraulic directional drilling is required or selected or where special construction conditions may dictate this method of joint restraint. Butt fusion with standard heat fusion equipment shall be used and the fused joint shall have at least 96% of the tensile and burst strength of the pipe material. Pipe ends to be fused shall be machined flush and aligned with each other. Heat fusion shall be accomplished by standard heat fusion equipment in strict accord with the requirements of the pipe manufacturer. Fusible PVC C-900 pipe shall meet ASTM cell classification 12454B.

3.06 PIPELINE IDENTIFICATION

A. PIPE DETECTING WIRE FOR NON-METALLIC PIPE

See Section 02505.

B. PIPE IDENTIFICATION

1. Plastic pipe (PVC and HDPE) shall be pigmented in a “safety” blue color. The entire pipe shall be pigmented or “safety” blue strips on the longitudinal axis of the pipe shall be pigmented. Each stripe shall be at least 2 inches in width. Pipelines smaller than 24 inch outside diameter shall have at least two stripes at the 12 and 6 o’clock positions. Pipelines 24 inch and larger in diameter shall have three stripes at the 12, 4 and 8 o’clock positions.

2. Non-metallic pipe not meeting the above requirements shall, upon approval by the Owner’s Representative, have adhesive marking tapes applied in accordance with Section 02505.

3. Metallic pipe (ductile iron or steel) can be painted with a safety blue stripe to designate potable water in lieu of the marking tape. Stripes shall be painted in

2 inch minimum widths at the same locations as required for plastic pipe. Paint shall be an acrylic aliphatic urethane, Devthane #378 or approved equal. Dry film thickness shall be greater then 2 mils. Paint shall be applied at least 24 hours prior to placement of the piping materials in the trench, to allow adequate time for drying.

C. UNDERGROUND WARNING TAPE

See Section 02505.

D. VALVE BOX I.D. TAG

1. All valve boxes shall have concrete collars and I.D. tags, per the standard detail on the drawings.

3.07 CONNECTIONS FROM NEW TO EXISTING WATER MAINS

A. No connections will be allowed from new to existing potable water mains without written approval from the Owner's Representative, and cleared for use by FDEP (if an FDEP permit to construct was necessary)..

1. Approval will be made only after a request form for alteration or connection has been submitted with approved plans.

2. The use of fire hydrants by other than authorized persons is prohibited. The Owner's Representative may permit the use of water from a fire hydrant for construction or other purposes provided the applicant shall properly meet the conditions as described in Section 1500 of these Specifications and as shown in the appropriate standard. The installation shall be under the supervision of the Owner's Representative.

3. Valves shall not be operated by any person other than Reedy Creek Energy Services Water Department personnel.

3.08 FLUSHING

A. Foreign material left in the pipelines during installation often result in valve and fire hydrant seat leakage during hydrostatic pressure testing. The Contractor shall make every effort to insure that lines are kept clean during installation.

B. Thorough flushing is required prior to hydrostatic pressure testing; flushing shall be accomplished by partially opening valves and fire hydrants several times under actual line pressures with pipeline velocities of not less than 3.0 feet per second in the largest line size to be flushed.

The pipelines shall be flushed full bore and shall not be less than three (3) times the total volume of the section being tested. Lines shall be flushed with only potable water.

3.09 PRESSURE AND LEAKAGE TESTING

A. Hydrostatic pressure and leakage testing of water mains shall be performed in accordance with Section 4 of AWWA C600 except as modified below. All testing shall be made using only potable water. Air testing shall not be permitted.

1. The Contractor shall furnish all gauges, meters, pressure pumps, and all other equipment required to pressure test the main at no additional cost to the Owner.

2. The Contractor shall submit his plan for testing the system to the Owner's Representative for review not less than ten (10) working days prior to starting the test.

3. The pipelines shall be tested in such sections as may be directed by the Owner's Representative or by installing temporary plugs as required. Pressure tests will not be allowed against closed valves unless approved by the Owner's Representative. In no case shall the test section exceed one thousand (1000) linear feet unless approved by the Owner's Representative.

4. All sections which fail to meet the tests shall be repaired and the leakage eliminated, regardless of the total leakage as shown by the test.

5. All lines which fail to meet the tests shall be repaired and retested as necessary until the test requirements are complied with, at no additional cost to the Owner. All defective materials, pipes, valves and appurtenances shall be removed and replaced at the contractor's expense.

6. The Contractor shall provide accurate means for measuring the water required to maintain the test pressure. The quantity of water required to maintain the test pressure shall be the measure of the leakage.

B. The required pressure for the field hydrostatic pressure test shall be two (2) times the working pressure at the point of testing, but in no case shall the test be less than 200 psi, with no pressure loss.

1. The Contractor shall provide all temporary plugs and blocking necessary to maintain the required test pressure. Corporation cocks, service saddles, pipe risers and angle globe valves shall be provided at each dead-end in order to bleed air from the main. The cost of these items shall be included as part of the testing.

2. The duration of the pressure test shall be a minimum of four (4) hours. The costs of all required items shall be included as part of the testing.

C. TEST PRESSURE RESTRICTIONS

1. Test pressures shall not exceed the pipe or thrust-restraint design.

2. No test pressure variations for the duration of the test shall be allowed.

D. PRESSURIZATION OF THE LINES

1. Each section of the pipe shall be slowly filled with water and pressurized to the specified test pressure based on the elevation of the lowest point of the line or section under test, and corrected to the elevation of the test gauge by means of a force pump connected to the pipe in a manner satisfactory to the Owner's Representative..

2. In no case shall a line be tested while connected to an existing water main.

E. AIR REMOVAL BEFORE TESTING

1. Prior to applying the specified test pressure, all air shall be expelled from the pipe, valves and hydrants.

2. If permanent air relief valves or air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that all air can be expelled as the line is filled with water. After all air has been expelled from the line, the corporation cocks shall be closed and the test pressure applied.

3. After the main has been tested and accepted, the corporation cocks shall be removed and plugged.

F. EXAMINATION UNDER PRESSURE

All exposed pipe, fittings, valves, hydrants, joints, etc. shall be carefully examined during the test. Defective or damaged pipe, fittings, valves or other appurtenances that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory to the Owner's Representative.

G. ACCEPTANCE OF THE INSTALLATION

Final acceptance shall be determined on the basis of zero pressure drop. If the test of any section of pipe discloses leakage, the Contractor, at his own expense, shall locate and make all repairs necessary until all leakage is eliminated

3.10 DISINFECTION OF POTABLE WATER PIPELINES

A. Prior to placing the water system in service, all potable water pipelines shall be chlorinated in accordance with AWWA C-651, "AWWA Standard For Disinfecting Water Mains" and the requirements of Chapter 62-555 FAC.

B. The Contractor shall notify the Owner's Representative not less than five (5) working days prior to commencement of disinfection of the lines and shall present his plan for chlorination to the Owner's Representative for approval.

C. The location of the sampling points and chlorination points shall be determined by the Owner's Representative and shall include all locations referenced in the

required permits. All taps for chlorination and sampling shall be uncovered and backfilled by the Contractor at no additional expense to the Owner.

D. All line disinfection must be witnessed by the Owner's Representative. Owner's Representative will take bacteriological samples and have them tested.

E. After the line has been tested and accepted, the corporation cocks shall be removed and plugged, or left in place at the discretion of the Owner's Representative. The Contractor shall repair any damage to pipe exterior coating prior to acceptance.

F. General procedure for disinfection of potable water systems.

1. Prevent contaminating materials from entering the water main during construction, repair or storage.

2. Remove by flushing any detritus that may have entered the water main during construction.

3. Chlorinate any residual contamination that may remain in the lines, through a tap at one end of the line.

4. Flush chlorinated water from the main after the required minimum detention time of 24 hours.

5. Determine the bacteriological quality of the water by laboratory examination in accordance with "Standard Methods For the Examination of Water or Wastewater" or AWWA Manual M12.

6. Satisfactory bacteriological test results shall be required before any potable water system is placed into service.

7. No new potable water piping shall be placed into active service until the line(s) have been cleared for use by the Florida Department of Environmental Protection.

G. FILLING AND CONTACT

When installation has been completed, and flushed clean, the main shall be filled with water from the existing water distribution system or other approved source of supply and shall be made to flow at a constant measured velocity no greater than 1.0 foot per second into the newly laid water main. The Contractor shall furnish a water meter or other approved device for measuring the rate of flow at no additional cost to the Owner.

1. At a point not more than 2.0 feet downstream from the beginning of the new main, the entering water shall be dosed with a 1.0 percent chlorine solution, fed at a constant rate, such that the water will have a free chlorine residual of not less than 25 mg/L at the end of a 24-hour holding period.

2. To assure that this concentration is provided, the Contractor shall provide testing services to measure the chlorine concentration at regular intervals,

in accordance with the procedures described in the current edition of "Standard Methods For the Examination of Water or Wastewater", or AWWA Manual M12. Approved standard chlorine test kits may be used.

3. The following table gives the amount of chlorine required for each 100-feet of pipeline of various diameters. Solutions of 1-percent may be prepared using sodium hypochlorite or calcium hypochlorite. (Note: Calcium hypochlorite requires one pound of $CaCl_2$ to 8 gallons of water to provide the required chlorine concentration.)

CHLORINE REQUIRED TO PRODUCE 25 mg/l CONCENTRATION IN 100-FT. OF PIPE BY DIAMETER		
PIPE DIAMETER (INCHES)	100% CHLORINE (lbs./100 Feet Pipe)	1.0% CHLORINE (lbs. NaOCl / Gal. water)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60
24	0.411	4.90

4. During the application of chlorine, valves shall be positioned and operated so that the strong chlorine solution in the main being treated will not flow into connecting water mains that are in active service.

5. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water.

   The chlorinated water shall be retained in the main for not less than 24 hours, during which time all valves, hydrants and appurtenances in the treated section shall be operated to insure complete disinfection.

   At the end of the 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

6. Hypochlorite solutions shall be applied to the water main using a gasoline powered or electrically powered chemical-feed pump designed for feeding chlorine solutions at a controlled rate of flow. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the pressures created by the pumps. All connections shall be checked for tightness before solution is applied to the main.

H. FINAL FLUSHING

After the 24-hour retention period, the heavily chlorinated water shall be flushed from the main until the chlorine residual measurements show that the concentration in the water leaving the main is at least 3.0 mg/L, but not less than 0.5 mg/L.

I. DISPOSING OF CHLORINATED WATER

The environment to which the chlorinated water is to be discharged shall be inspected and approved by Reedy Creek Environmental Permitting and Engineering and the Owner's Representative prior to discharge of chlorinated effluent. If there is any question that the chlorinated discharge will cause damage to the environment, then a dechlorinating agent shall be applied to the water to be wasted to neutralize the chlorine residual remaining in the water.

1. Chlorinated water shall not be discharged into surface waters, including lakes, ponds, reservoirs, canals or streams.

2. The chlorine residual of water being disposed of shall be neutralized by treating with one of the chemicals listed in the following table:

POUNDS OF CHEMICALS REQUIRED TO REDUCE AND NEUTRALIZE VARIED RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER. *				
RESIDUAL CHLORINE (mg/L)	SULFUR DIOXIDE (SO_2)	SODIUM BIOSULFATE ($NaHSO_3$)	SODIUM SULFITE (Na_2SO_3)	SODIUM THIOSULFATE (Na_2SO3-$5H_2O$)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

* With the exception of chlorine residual, in mg/L, or P.P.M., all amounts shown above are in pounds.

J. BACTERIOLOGICAL TESTING

STANDARD CONDITIONS:

After final flushing and before the water main is placed in service, samples shall be collected from the end of the line and shall be tested for bacteriological quality in accordance with "Standard Methods For the Examination of Water and Wastewater", and shall show the absence of coliform organisms. A standard plate count shall be required.

1. Sampling:

   At least two samples shall be collected from the new main and two from each branch, in addition to the sampling points stipulated in the FDEP permit. In the case of extremely long mains (not greater than 1000 linear feet), it is required that samples be collected along the length of the line as well as at its end. The total number of samples and the locations of sampling points shall be as directed by the Owner's Representative and all regulatory agencies.

2. Special Conditions:

   If, during construction, trench water has entered the main, or if in the opinion of the Owner's Representative, excessive quantities of dirt and debris have entered the main, bacteriological samples shall be taken at intervals of not more than 200 feet and shall be identified by station or location. Samples shall be taken of water that has been standing in the main for at least 16 hours after final flushing has been completed.

3. Sampling Procedures:

   Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by "Standard Methods for the Examination of Water and Wastewater". Hoses and fire hydrants shall not be allowed in the collection of bacteriological samples. Approved sampling points shall be corporation cocks with gooseneck assemblies and terminal blow-off/sampling tap only.

K. RECHLORINATION

1. Should the initial disinfection fail to produce satisfactory bacteriological samples, the main shall be rechlorinated by the continuous feed method until satisfactory results are obtained.

2. Should positive bacteriological samples continue to be recorded, the situation shall be evaluated by the Owner's Representative to determine corrective action, and daily samples recorded.

3. All retesting shall be at the expense of the Contractor.

L. Prior to placing the water system in service, the water system shall be cleared for use, in writing, by the Florida Department of Environmental Protection and the Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include, but not be limited to all labor, equipment, tools, materials and all incidentals required for the construction, installation, and testing of a reclaimed water distribution system, including all appurtenances as shown on the plans and as specified herein.

B. The work shall include but not be limited to, ductile iron pipe, PVC pipe, valves, air release and vacuum relief valves, ductile iron fittings, strainers, tapping sleeves, tapping saddles, cast iron and plastic valve boxes, backflow preventers, master meters, fire hydrants, valve vaults and boxes, all restrained joints and concrete thrust blocking as required for all types of piping, all excavation, sheeting, shoring and bracing, dewatering, jacking and boring, where required, slope protection, backfilling, grading and drainage, concrete work, rip-rap, compaction, grass restoration, pavement restoration where required and all other work necessary to complete the construction, installation, flushing, testing and disinfection (when required) of the reclaimed water distribution system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID standard specifications which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall prevail.

1. Submittals	Section 01330
2. Testing Laboratory Services	Section 01410
3. Excavating and Backfilling for Utilities	Section 02320
4. Boring & Jacking	Section 02445
5. Hydraulic Directional Drilling	Section 02448
6. Underground Utilities Marking	Section 02505

1.02 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Regulation.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900.

1.03 QUALITY ASSURANCE

A. TECHNICAL GUIDANCE

1. Handbook of Ductile Iron Pipe, latest edition, DIPRA

2. Recommended Standards for Water Works (Ten-State Standards), latest edition

3. Florida Department of Environmental Protection, FAC 62-610.

4. Handbook of PVC Pipe Design & Construction, latest edition, Uni-Bell Plastic Pipe Association.

5. Manual M23: PVC Pipe - Design & Installation, AWWA

B. REFERENCE STANDARDS

This specification references the following standards which form a part of this specification to the extent specified herein. The latest edition of each standard shall apply. In any case of conflict, the most restrictive standard shall prevail.

1. AWWA C104/ANSI A21.4 Cement-Mortar Lining For Ductile Iron Pipe and Fittings For Water.

2. AWWA C105/ANSI A21.5, Polyethylene Encasement For Ductile Iron Piping For Water and Other Liquids.

3. AWWA C110/ANSI A21.10 Ductile Iron Fittings, 3 in. through 48 in., for Water and other liquids

4. AWWA C111/ANSI A21.11 Rubber Gasket Joints For Ductile Iron Pipe and Fittings.

5. AWWA C115/ANSI A21.15, Flanged Ductile Iron Pipe

6. AWWA C151/ANSI 21.51 Ductile Iron Pipe.

7. AWWA C153/ANSI A21.53 Compact Ductile Iron Fittings.

8. AWWA C500, Gate Valves For Water and Sewage Systems.

9. AWWA C503, Wet-Barrel Fire Hydrants.

10. AWWA C504, Rubber-Seated Butterfly Valves.

11. AWWA C509, Resilient Seated Gate Valves For Water and Sewerage Systems.

12. AWWA C600, Installation of Ductile Iron Water Mains and Appurtenances.

13. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe & Fittings for Water

14. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch

15. AWWA C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 Inch Through 36 Inch

16. ASTM C478, Precast Concrete Valve Boxes and Vaults.

17. ASTM C150, Concrete, Type II.
18. ASTM D1784, Rigid Polyvinyl Chloride PVC Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

19. ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe.

20. ASTM D3139, Joints For Plastic Pressure Pipes Using Flexible Elastomeric Seals.
21. ASTM F477, Elastomeric Seals For Joining Plastic Pipes.

C. INSPECTION AND CERTIFICATION OF PIPE AND FITTINGS

1. All pipe fittings and appurtenances to be installed under this Specification may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturers' cooperation shall be required in these inspections.

2. The Contractor shall obtain from the pipe manufacturer a certificate of inspection stating that the pipe and fittings supplied for this Project has been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall be borne by the Contractor. Letters of certification shall be furnished for all inspections and tests prior to the installation of the pipe, fittings and appurtenances.

D. INSPECTION UPON DELIVERY

1. All pipe fittings and appurtenances shall be subject to visual inspection by a representative of the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit shall be rejected and shall be immediately removed from the job site.

2. The Owner's Representative may perform or cause to be performed all tests as specified in the applicable AWWA Standards, to ensure conformance with the standard. In the case of failure of the pipe or appurtenances to comply with such standards, the responsibility for replacement of the defective materials becomes that of the manufacturer or the Contractor.

3. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

E. INSPECTION OF PRECAST CONCRETE PRODUCTS

1. The quality of all materials, the process of manufacture and the finished precast concrete sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the precast products have been delivered.

   Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection at any time after delivery, due to failure to meet any of the specification requirements.

2. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site within 24 hours. Sections which have been damaged after delivery will be rejected and replaced at the Contractor's expense.

3. At the time of inspection, the precast sections will be carefully examined to assure compliance with ASTM C478, these specifications and the manufacturer's approved shop drawings.

4. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all precast sections shall be dense and close textured.

5. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.05 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of pipelines incorporating products and materials similar to those specified herein.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES) and the Reedy Creek Improvement District (RCID).

1.06 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01330, Submittals.

B. PRODUCT DATA

1. The data to be submitted shall include, but not be limited to:

a. Ductile iron pipe and fittings.

b. Polyvinyl chloride (PVC) pressure pipe.

c. Fusible C-900 PVC

d. High density polyethylene pipe

e. Elastomeric seals for ductile iron and PVC pipe joints.

f. Resilient seated gate valves.

g. Tapping valves.

h. Resilient seated butterfly valves.

i. Air release and vacuum relief valves.

j. Tapping saddles and tapping sleeves.

k. Cast iron and plastic valve boxes.

l. Precast concrete valve vaults.

m. Valve operators.

n. Mechanical joint retainer glands.

o. Corrosion protection materials.

p. Underground marking and identification tapes.

q. Underground tracer wire and appurtenances.

r. Fire hydrants and fittings.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile iron pipe (DIP) for reclaimed water service shall conform to AWWA C151.

1. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi

2. Pipe shall be Pressure Class 200, minimum.

3. Ductile iron pipe for reclaimed water main service shall have a cement mortar lining and a bituminous seal coat in accordance with AWWA C104 and a minimum 1.0 mil bituminous coating on the pipe exterior in accordance with AWWA C151.

4. Ductile iron pipe shall be supplied in lengths not in excess of a nominal twenty (20) feet and, unless otherwise specified, shall have rubber-gasket joints conforming to AWWA C111.

5. Single gasket push-on joints shall normally be used where joint restraint is not required.

6. Where joint restraint is required, restrained joints shall: be "T-R Flex" joints as manufactured by U.S. Pipe, "Flex-Ring" and "Lok-Ring" joints as manufactured by American Ductile Iron Pipe, or approved equal.

   Joint restraint other than at fittings may also be accomplished with American "Fast Grip" or U.S. Pipe "Field Lok" gaskets, or approved equal.

   Restrained joints at fittings shall utilize mechanical joints with a restraining gland. Restraining glands shall be EBAA Iron Series "1100" or "3000", Stargrip Series 3000, Series 3000 OS or Series 3100P, or approved equal.

7. High strength, low alloy steel T-bolts and nuts for mechanical joint shall conform to AWWA C110, Appendix, and AWWA C111. Threads shall conform to ANSI B.1.

8. Where called for on the plans, polyethylene encasement for ductile iron pipe shall conform to AWWA C105.

9. Acceptable manufacturers:
   American, U.S. Pipe, Griffin Pipe or approved equal

B. Ductile iron fittings for reclaimed water distribution shall conform to AWWA C110 or C153. Minimum pressure rating shall be 250 psi.

1. Rubber gasket joints shall be mechanical joint in accordance with AWWA C111.

2. Fittings shall be lined and coated according to section 2.01 A.3 above.

3. All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline.

4. Only those fittings that are of domestic (United States) manufacture will be acceptable.

5. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's identification, country of manufacture, and number of degrees or fraction of the circle. The letters "D.I." or the word "Ductile" shall also be cast on the outside of the body.

6. Fusion bonded epoxy coated ductile iron fittings as manufactured by "One Bolt, Inc." are acceptable, provided they meet ASTM A 536 grade 65-45-12 and are installed in strict accordance with the manufacturer's instructions.

C. Flanged ductile iron pipe and fittings with threaded flanges where called for on the plans, shall conform to AWWA C115. Flanges shall be furnished flat faced and drilled to 125 pound template in accordance with ANSI B16.1 full faced gaskets.

D. Polyvinyl chloride (PVC) pressure pipe for reclaimed water service, in sizes 4-inch through 12-inch shall conform to AWWA C900. PVC pipe for sizes 16" through 30" shall conform to AWWA C905.

1. Laying lengths shall be 20 feet +/- 1 inch for all sizes.

2. PVC pipe shall exceed pressure Class 200 for all pipe. Use DR14 for sizes 12" and under with cast iron outside dimensions.PVC pipe for sizes larger than 16" shall be DR18, with outside cast iron dimensions

3. PVC pipe joints shall have an integral wall-thickened bell end with gasket seal conforming to ASTM D3139. (Solvent weld joints will not be permitted.)

4. PVC pipe for reclaimed water service shall be purple pigmented.

5. Fittings for use with AWWA C900 pipe shall be ductile iron conforming to section 2.01.B above.

6. Where joint restraint is required, restraining glands may be utilized. Restraining glands shall be specifically designed for use with C900 PVC pipe and shall be EBAA Iron "2000PV" or "3000" Series, Romac "GripRing", Sigma "PV-LOK", Tyler "MJR", Stargrip Series 4000 and Series 4200P or approved equal.

7. All PVC pipe shall be identified on the exterior of the pipe with the following information:

   a. Nominal pipe size and O.D. base: (e.g. 6-inch C.I.)

   b. Material code designation number: (PVC 1120)

   c. Dimension ratio (DR) number

   d. Pressure classification

   e. AWWA designation: C900

   f. Pipe manufacturer's name and production code.

   g. Date and shift of manufacture.

8. Acceptable manufacturers:

   Johns Manville, Certainteed, H&W, Clow, or approved equal.

E. PVC pipe smaller than 4-inch in size shall conform to ASTM D2241, SDR21, with I.P.S. dimensions, and manufactured from PVC 1120 resin. Appropriate requirements of paragraph 2.01.D above shall apply. Schedule 40 PVC shall not be allowed, unless specifically required by the Owner's Representative.

F. RESILIENT SEATED GATE VALVES 3" and larger, for reclaimed water service shall conform to, or exceed all applicable requirements of AWWA C509/515.

1. All resilient seated gate valves shall have non-rising stems for counter clockwise operation and a 2-inch square operating nut.

2. Each valve shall have the manufacturer's name, pressure rating, the year of manufacture, and an arrow to indicate the direction of opening cast into the valve body.

3. The interior of the valve body and bonnet shall have a factory applied 2-part thermo setting epoxy resin lining equal to Endurall 3300.

4. Each valve shall be hydrostatically tested to a pressure equal to twice the specified working pressure prior to shipment from the factory. The manufacturer shall certify each valve.

5. Acceptable manufacturers:
   Clow, American Flow Control, Mueller, Crane, M & H, Kennedy, Keystone, U.S. Pipe, or approved equal.

G. RUBBER SEATED BUTTERFLY VALVES are not acceptable unless specifically required by the Owner and Engineer of Record and identified as such on the contract documents. Butterfly valves so identified for reclaimed water service shall conform to, or exceed, all applicable requirements of AWWA C-504.

1. Butterfly valves shall be of the tight closing, rubber seat type with recess-mounted BUNA-N or equal seats securely fastened to the valve body, or attached to the valve disc.

2. The valve disc shall rotate a full 90-degrees from the full open position to the tight shut position. Butterfly valves shall meet the full structural requirements of the applicable sections of AWWA C-504, latest edition.

3. Butterfly valve bodies shall be constructed of cast iron conforming to ASTM A126, Class B (or ASTM A48, Class 40), or ductile iron conforming to ASTM A536, Grade 65-45-12.

4. Buried valves shall have integrally cast mechanical joint ends. All valves for above ground service shall be flanged. Flange drilling shall be in accordance with ANSI B16.1, Class 125.

5. Two trunions for shaft bearings shall be integral with each valve body. Valve body thickness shall be in strict accordance with the applicable provisions of AWWA C-504.

6. Valve discs shall be constructed of NI-RESIST, Type 1, or of ductile iron conforming to ASTM A536, Grade 65-45-12, with stainless steel seating edges. All disc seating edges shall be smooth and polished.

7. Valve shafts shall be of the "stub-shaft" type or a one piece shaft extending full size through the disc bearings and into the operating mechanism. Valve shafts shall be constructed of stainless steel conforming to ASTM A276, Type 304 minimum. Shafts shall be high tensile steel with stainless steel shaft journals, Teflon bushings and shaft seals.

8. Valve seats shall be of a natural rubber or a synthetic type rubber compound similar to BUNA-N. Seats shall be molded in, vulcanized and bonded simultaneously into the valve body and seat. The bond shall be capable of withstanding a test pull of not less than 75 pounds without failure in accordance with ASTM D429, Method B.

9. Valve seats that are attached to the valve disc shall be held in place by a stainless steel retaining ring conforming to ASTM A 296, Grade CF8. Cap screws extending through the rubber seat and the seat retaining ring must be provided for adjustment of the rubber seat. The mating valve body seat shall be constructed of Type 304 stainless steel.

10. Valves shall be equipped with corrosion resistant, self-lubricated sleeve type bearings. The bearing shall be such that the bearing load will not exceed the published design load for the bearing material.

11. Valve operators for manual operation shall be of the worm gear type and shall be fully enclosed.

    Valves furnished for underground service shall be fully gasketed and grease packed.

    Valves located above ground shall be equipped with handwheel operators and shall have a suitable indicator arrow to show the valve position from full open to fully closed.

12. All valves for underground service, designated to be furnished with above ground operators, shall be equipped with handwheel operators on extended bonnets. The operating shaft for buried valves shall be such that the handwheel shall set not less than 3-feet above finished grade. All other underground butterfly valves shall be furnished with a 2-inch square AWWA operating nut with valve box and cover. All valves buried deeper than 30" shall have cast iron valve extensions.

13. Handwheel operators shall be capable of withstanding a pull of 200 pounds when operator components are positioned at the extreme operator positions without sustaining damage. Valves with operating nuts shall be capable of withstanding an input torque of 300 ft.-lbs. without sustaining damage.

14. Acceptable manufacturers:
    Clow, American Flow Control, Mueller, M & H, Kennedy, Keystone, U.S. Pipe, Centerline, Henry Pratt, or approved equal.

H. AIR RELEASE AND/OR VACUUM RELIEF VALVES for reclaimed water service shall be installed as shown on the plans. The valves shall be constructed with a cast iron body, cover and baffle, stainless steel float, BUNA-N or viton seat and stainless steel trim. All fittings shall be threaded.

1. Air Release Valves shall be APCO 200 Series; Val-Matic Model 15, 22 or 25; Vent-O-Mat Series RBX, H-Tec Model 985 or approved equal.

2. Air and Vacuum Valves shall be APCO 140 or 150 Series; Val-Matic Series 100; Vent-O-Mat Series RBX, H-Tec Models 992 thru 997 or approved equal.

3. Combination Air Valves shall be APCO 140C or 1800 Series; Val-Matic Series 200; Vent-O-Mat Series RBX, H-Tec or approved equal.

   Note: APCO Series 140 or 150 or approved equivalent air and vacuum valves are still acceptable.

I. CORPORATION STOPS. The use of corporation stops for reclaimed water service connections will not be allowed.

J. SERVICE SADDLES OR TAPPING SLEEVES shall be used for all reclaimed water service taps.

1. Size-on-size taps using tapping saddles or sleeves will not be permitted.

   Where size-on-size outlets are required, a tee shall be installed in lieu of a tapping saddle or sleeve. Tapping saddles and tapping sleeves will only be permitted on lines that are at least one nominal pipe size or diameter larger than the proposed tap.

2. For taps 2 inch to 2-½ inch on mains 4 inches or larger, use a double strap service saddle. Saddle body shall be bronze or fusion-coated ductile iron with BUNA-N gasket. Straps shall be bronze or stainless steel. Taps smaller than 2 inch diameter will not be allowed. If a smaller line is preferred, tap the carrier pipe with a 2 inch tap and provide reducers or bushings after the tap to the desired diameter.

   Acceptable manufacturers and models:

   Smith-Blair No. 323 or 317, JCM 406, Ford FC202, Mueller BR2B or approved equal.

3. Tapping sleeves shall be used for taps 4 inches and larger. Tapping sleeves shall be fabricated of stainless steel, fusion-bonded epoxy coated ductile iron, or fusion-bonded epoxy coated steel and designed for a test pressure of at least 200 psi. The outlet of the tapping sleeve may be either extruded or welded to the tapping sleeve.

   The flange shall conform to AWWA C-207, Class D, ANSI 150 lb. drilling. Bolt holes shall straddle the pipe centerline.

   The sleeve shall be equipped with a 3/4 inch NPT test plug with a standard square head. The gasket shall be of 360-degree design, and manufactured of gridded virgin GPR compounded for water service and complying with ASTM D-2000-80M 4AA607. An 18-10 stainless steel armor shall be vulcanized to the gasket, to bridge the gap between the securing lugs.

   All bolts and nuts shall be stainless steel with 5/8 inch NC threads. Bolt threads shall be fluorocarbon coated to prevent galling. Nylatron G.S. washers shall be provided for lubrication.

   Approved manufacturers and models:

   Smith-Blair Models 622, 662 or 663; JCM Models 422 or 432; Ford style FAST or FTSC; Mueller H304 or approved equal.

K. TAPPING VALVES

1. Valves for use with tapping sleeves shall meet or exceed all provisions of AWWA C509/515.

2. Valves for use with tapping sleeves shall be resilient seated wedge gate type and shall be designed for use with tapping equipment. The valves shall have non-rising stems and shall have an alignment ring to prevent misalignment with the tapping sleeves.

3. The valves shall close clockwise (right) and open counter clockwise (left), and shall be equipped with a standard 2-inch square operating nut. Valve outlets shall have a flanged mechanical joint.

4. Acceptable manufacturers:
   Clow, Mueller, American, U.S. Pipe, Dresser Industries.

L. FIRE HYDRANTS: Wet barrel fire hydrants shall meet or exceed all provisions of AWWA C503. Hydrants shall be Clow/Rich No 92, 3-way "Slimline-Low Silhouette" with No. 30C break-away riser. Dry barrel hydrants shall meet or exceed AWWA C502, UL246, and FM 1510 and shall be American Darling B-84-B with breakable cast iron flange or Mueller Super Centurion 200 or 250. Weep holes on the dry barrel type hydrants are not required or allowed. The hydrant shall have two, 2-1/2 inch hose connections and one 4-1/2 inch pumper connection, complete with all caps and chains. Threads for hose and pumper connections shall be in conformance with the requirements of the RCID Fire Department.

1. The hydrant shall be furnished with the manufacturer's standard prime finish.

2. The manufacturer shall furnish an affidavit stating that the fire hydrant and all material used in the construction of the hydrant, are in conformance with the applicable requirements of AWWA Standard C-503 and this specification, and that all tests specified therein have been performed and that all test requirements have been met.

3. Acceptable Manufacturer: Clow Corporation, Valve Division Corona, California, or American Flow Control a division of American Cast Iron Pipe Co, Birmingham, Alabama or Mueller Co. Substitutes will not be accepted.

M. FLANGED COUPLING ADAPTERS. Flanged coupling adapters for ductile iron pipe shall be Smith-Blair Model 912, JCM Model 301, Dresser Model 127, or approved equal.

N. VALVE BOXES. Valve boxes for reclaimed water service shall be adjustable, cast iron or heavy wall high density polyethylene (HDPE) suitably sized for the size and depth of the buried valve. HDPE boxes shall have all exterior components joined with stainless steel screws and be equipped with a telescoping, plated, square steel tube stem assembly that allows for variable height adjustment. The stem assemble shall be torque tested to 1000 ft-pounds. All valve boxes shall be designed for traffic bearing H-20 wheel loading with square cast iron lids marked “RECLAIMED”. Valve boxes shall be Tyler Model 6850/6860, U.S. Foundry Model 7500, American Flow Control’s Trench Adapter or approved equal.

2.02 PRECAST CONCRETE PRODUCTS

A. Precast concrete valve vaults and air release valve manholes shall be in accordance with ASTM C478.

1. Concrete for the construction of manhole sections and valve vaults shall be Class A concrete with a compressive strength of 4000 psi at 28-days and shall conform to ASTM C150, Type II cement.

2. Valve vaults and manholes shall be precast units with integral base slab and wall sections. Poured in place base slabs shall not be approved.

3. Precast sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of three (3) days after having been painted. Precast sections shall not be shipped for a minimum of seven (7) days after removal from the forms.

4. The interior and mating surfaces of all precast concrete products shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 mils. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 mils. The coatings shall be applied by the precast manufacturer in strict accordance with the paint manufacturer's recommendations.

   Acceptable coating: Koppers 300M or Devtar 5A by ICI Devoe.

5. The date of manufacture of the precast sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Fed. Spec. SS-S-210A and AASHTO M198.

7. Rubber ring joint seals for precast sections shall not be permitted.

8. Shallow valve vaults, where the depth of cover is less than four (4) feet, shall be capable of supporting the overburden plus a live load equivalent to AASHTO H-20 loading.

9. Valve vault base sections shall not be less than eight (8) inches thick and shall be reinforced with number five (5) bars at nine (9) inches on centers, each way and shall have number four (4) bars around each pipe.

10. All precast concrete products shall be wet cast. Dry casting, or low slump concrete will not be acceptable.

11. All precast concrete products shall have proper lifting loops in the base slabs, (minimum of three (3)). Penetrating lifting holes will not be acceptable in any structure.

    Where non-penetrating lifting holes are approved, their use will not be permitted within eight (8) inches of any joint or pipe penetration.

12. Precast concrete grade rings for manhole adjustment shall conform to ASTM C478. Grade rings shall be a minimum of two (2) inches thick and a maximum of five (5) inches thick and shall be reinforced with six (6) gauge or thicker reinforcing wire.

13. Acceptable Manufacturers:

    Hanson Precast, Inc., Green Cove Springs, FL
    Atlantic Concrete Products, Inc., Sarasota, FL
    Mack Concrete Products, Inc., Astatula, FL
    Southern Precast, Inc., Alachua, FL
    Old Castle Precast, Orlando, Fla.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless indicated otherwise on the drawings or as specified herein, the minimum cover for reclaimed water mains shall not be less than thirty-six (36) inches.

B. Unless indicated otherwise on the drawings, separation requirements between reclaimed water lines and other FDEP regulated utilities shall be in accord with Chapter 62-555 FAC, which requires a minimum of 12" of vertical separation and 36" of horizontal separation. Preferred vertical separation is greater than18 inches and preferred horizontal separation is greater than 10 feet.

C. Reclaimed water mains shall be laid in the dry. All work occurring at trench depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

2. The groundwater level shall be lowered only to sufficient depth to assure that trench bottom soils will not be saturated or develop quick conditions.

3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

5. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

D. Reclaimed water mains and appurtenances shall be constructed using the materials indicated on the drawings and as specified herein. Substitutions shall not be made without the express approval of the Owner's Representative.

E. The Contractor shall not cover lies until they have been inspected and approved.

F. Conflict encasement shall be in accordance with the applicable standard.

3.02 HANDLING AND STORAGE OF PIPE FITTINGS AND APPURTENANCES

A. All pipe, fittings and appurtenances shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage.

1. Pipe, fittings and appurtenances shall not be dropped, rolled or skidded into or against pipe, fittings or other construction products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and appurtenances shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table.

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e...) bell, plain end; bell, plain end, etc. No less than two rows of timbers shall be placed between tiers. Chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between pipes in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis.

1. Gaskets for mechanical joint and push-on joint ductile iron pipe and fittings shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Mechanical joint bolts and locking segments for push-on joints shall be handled and stored in such a manner that will insure proper use in respect to pipe types and sizes.

3.03 LAYING RECLAIMED WATER MAINS

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. Reclaimed water mains shall be laid in accordance with the details shown in the plans, and as specified herein.

1. The trench bottom shall be graded to the proposed elevation of the pipeline and the bottom shaped to fit the lower quadrant of the pipe. Holes shall be excavated at each bell so the pipe will be uniformly supported along the entire length of the barrel only.

2. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative.

3. Any pipe having a defective joint, bell or spigot shall be rejected, removed from the work site and replaced with a sound unit.

4. All pipe shall be installed to the homing mark on the spigot. On field cut pipe, the Contractor shall provide a homing mark on the spigot end in strict accordance with the manufacturer's recommendations.

5. All pipe shall be retained in position so as to maintain alignment and joint closure until sufficient haunching and backfill has been placed to adequately hold the pipe in place.

6. Foreign materials shall be prevented from entering the pipe while pipe is being placed in the trench. No debris, tools, articles of clothing or other materials shall be placed in the pipe at any time.

7. At all times when pipe laying is not in progress for ten (10) minutes or more the open ends of the pipe shall be closed by a watertight plug to ensure that absolute cleanliness is maintained inside the pipe at all times. Plugs shall be one-piece plastic with gasket as manufactured by Taylor Made Plastics, Inc., Sarasota, FL, or approved equal.

3.04 JOINTING RECLAIMED WATER MAINS

A. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative. Joints shall be in strict accordance with AWWA C600.

B. The Contractor shall take all reasonable precautions to provide assurance that the interior of the pipe and the jointing seal shall be free from sand, dirt, trash or other foreign material before installation in the line. Any pipe or fitting that has been installed containing dirt or other detrital material shall be removed, cleaned and re-laid. Extreme care shall be taken to keep the bells of the pipe free from sand, dirt or rocks so that the joint may be properly assembled without over stressing the bells.

C. All pipe shall be installed to the homing mark on the spigot. When field cutting of pipe is required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe, cut ends of pipe to be used with push-on bell shall be beveled to conform to the manufacturers spigot end. Care shall be taken to prevent damage to linings.

D. Deflection at pipe joints shall not exceed one half (1/2) the maximum pipe deflection recommended by the pipe manufacturer. If at any time joint deflections exceed the manufacturer's maximum recommended pipe deflections, an appropriate fitting shall be used.

3.05 PIPE JOINT RESTRAINTS AND THRUST BLOCKING

A MECHANICALLY RESTRAINED JOINTS

Mechanical pipe restraining mechanisms for push-on or mechanical joints will be used unless concrete blocking is specifically indicated on the plans, or as directed by the Owner’s Representative.

Restraining glands, tie rods, clamps or other components of dissimilar metals shall be protected against corrosion by the application of a suitable coating at the direction of the Owner’s Representative.

B. THRUST BLOCKING

Thrust blocking will not be allowed unless the job conditions dictate that conventional methods of mechanically restraining the pipe are not practical.

Where concrete thrust blocks are required due to the nature of the construction, vertical and horizontal reaction blocking shall be concrete having a compressive strength of not less than 2000 psi at 28 days. Thrust blocking shall be placed between undisturbed soil and the fitting to be restrained. The bearing area of the thrust blocking shall be adequate to prevent movement of the fittings and shall be of the size, weight and dimensions shown on the plans or as directed by the Owner’s Representative.

Prior to placing concrete for thrust blocking all pipe joints, glands, flanges, bolts and other appurtenances shall be protected by 15 lb. roofing felt or other approved material. Plastic sheeting or other similar material shall not be used. Wood side forms shall be used when placing concrete for thrust blocking as shown in the applicable detail at the end of this section.

The blocking shall be located so as to contain the resultant force in such a way that the pipe and fittings will be accessible for repair. The blocking shall be sized to include soil conditions, pipe type and fittings, pressure conditions, cover, compaction, and all other variables that could affect the size of the thrust block and restraint required. An appropriate safety factor shall be applied to all thrust block sizing calculations.

C. RESTRAINT/CONCRETE THRUST BLOCK DESIGN

Mechanical restraints or concrete thrust blocking shall be sized for the working pressure plus surge allowance, or a test pressure of 200 psi, whichever is greater. Adequate factors of safety shall be employed.

D. FUSIBLE PIPING JOINT RESTRAINT

Fusion joining of PVC and HDPE piping materials may be used in lieu of conventional joint restraint where hydraulic directional drilling is required or selected or where special construction conditions may dictate this method of joint restraint. Butt fusion with standard heat fusion equipment shall be used and the fused joint shall have at least 96% of the tensile and burst strength of the pipe material. Pipe ends to be fused shall be machined flush and aligned with each other. Heat fusion shall be accomplished by standard heat fusion equipment in strict accord with the requirements of the pipe manufacturer. Fusible PVC C-900 pipe shall meet ASTM cell classification 12454B.

3.06 PIPELINE IDENTIFICATION

A. PIPE DETECTING WIRE FOR NON-METALLIC PIPE

See Section 02505

B. PIPE IDENTIFICATION

1. Plastic pipe (PVC and HDPE) shall be pigmented in a purple color matching Pantone 522C. The entire pipe shall be pigmented or purple strips on the longitudinal axis of the pipe shall be pigmented. Each stripe shall be at least 2" in width. Pipelines smaller than 24 inches outside diameter shall have at least two stripes at the 12 and 6 o'clock positions. Pipelines 24" and larger in diameter shall have three stripes at the 12, 4 and 8 o'clock positions.

2. Non-metallic pipe not meeting the above requirements shall, upon approval by the Owner's Representative, have adhesive marking tapes applied in accordance with Section 02505.

3. Metallic pipe (ductile iron or steel) can be painted with a safety purple stripe to designate reclaimed water in lieu of the marking tape. Stripes shall be painted in 2" minimum widths at the same locations as required for plastic pipe. Paint shall be an acrylic aliphatic urethane, Devthane #378 or approved equal. Use a safety purple color or color similar to Pantone 522C; dry film thickness shall be greater then 2 mils. Paint shall be applied at least 24 hours prior to placement of the piping materials in the trench, to allow adequate time for drying.

C. VALVE BOX I.D. TAG

1. All valve boxes shall have concrete collars and I.D. tags, per the standard detail on the drawings.

3.07 CONNECTIONS FROM NEW TO EXISTING RECLAIMED WATER MAINS

A. No connections will be allowed from new to existing reclaimed water mains without written approval from the Owner's Representative, and cleared for use by FDEP (if an FDEP permit to construct was necessary).

1. Approval will be made only after a request form for alteration or connection has been submitted with approved plans.

2. Valves shall not be operated by any person other than Reedy Creek Energy Services Water Department personnel.

3.08 FLUSHING

A. Foreign material left in the pipelines during installation often result in valve and fire hydrant seat leakage during hydrostatic pressure testing. The Contractor shall make every effort to insure that lines are kept clean during installation.

B. Thorough flushing is required prior to hydrostatic pressure testing; flushing shall be accomplished by partially opening valves and fire hydrants several times under actual line pressures with pipeline velocities of not less than 3.0 feet per second in the largest line size to be flushed.

The pipelines shall be flushed full bore and shall not be less than three (3) times the total volume of the section being tested.

3.09 PRESSURE AND LEAKAGE TESTING

A. Hydrostatic pressure and leakage testing of water mains shall be performed in accordance with Section 4 of AWWA C600 except as modified below. All testing shall be made using potable or reclaimed water. Air testing shall not be permitted.

1. The Contractor shall furnish all gauges, meters, pressure pumps, and all other equipment required to pressure test the main at no additional cost to the Owner.

2. The Contractor shall submit his plan for testing the system to the Owner's Representative for review not less than ten (10) working days prior to starting the test.

3. The pipelines shall be tested in such sections as may be directed by the Owner's Representative or by installing temporary plugs as required. Pressure tests will not be allowed against closed valves unless approved by the Owner's Representative. In no case shall the test section exceed one thousand (1000) linear feet unless approved by the Owner's Representative.

4. All sections which fail to meet the tests shall be repaired and the leakage eliminated, regardless of the total leakage as shown by the test.

5. All lines which fail to meet the tests shall be repaired and retested as necessary until the test requirements are complied with, at no additional cost to the Owner. All defective materials, pipes, valves and appurtenances shall be removed and replaced at the contractor's expense.

6. The Contractor shall provide accurate means for measuring the water required to maintain the test pressure. The quantity of water required to maintain the test pressure shall be the measure of the leakage.

B. The required pressure for the field hydrostatic pressure test shall be two (2) times the working pressure at the point of testing, but in no case shall the test be less than 200 psi, with no pressure loss.

1. The Contractor shall provide all temporary plugs and blocking necessary to maintain the required test pressure. Corporation cocks, service saddles, pipe risers and angle globe valves shall be provided at each dead-end in order to bleed air from the main. The cost of these items shall be included as part of the testing.

2. The duration of the pressure test shall be a minimum of four (4) hours. The costs of all required items shall be included as part of the testing.

C. TEST PRESSURE RESTRICTIONS

1. Test pressures shall not exceed the pipe or thrust-restraint design.

2. No test pressure variations for the duration of the test shall be allowed.

D. PRESSURIZATION OF THE LINES

1. Each section of the pipe shall be slowly filled with potable or reclaimed water and pressurized to the specified test pressure based on the elevation of the lowest point of the line or section under test, and corrected to the elevation of the test gauge by means of a force pump connected to the pipe in a manner satisfactory to the Owner's Representative.

2. In no case shall a line be tested while connected to an existing reclaimed water main.

E. AIR REMOVAL BEFORE TESTING

1. Prior to applying the specified test pressure, all air shall be expelled from the pipe, valves and hydrants.

2. If permanent air relief valves or air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that all air can be expelled as the line is filled with water. After all air has been expelled from the line, the corporation cocks shall be closed and the test pressure applied.

3. After the main has been tested and accepted, the corporation cocks shall be removed and plugged.

F. EXAMINATION UNDER PRESSURE

All exposed pipe, fittings, valves, hydrants, joints, etc. shall be carefully examined during the test. Defective or damaged pipe, fittings, valves or other appurtenances that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory to the Owner's Representative.

G. ACCEPTANCE OF THE INSTALLATION

Final acceptance shall be determined on the basis of zero pressure drop. If the test of any section of pipe discloses leakage, the Contractor, at his own expense, shall locate and make all repairs necessary until all leakage is eliminated

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include, but not be limited to the construction and installation of a gravity sanitary sewerage collection system, including all labor, equipment, materials and all incidentals required to install manholes, gravity sewer mains, service laterals, and testing, including all appurtenances as shown on the plans and as specified herein.

B. The work shall include, but not be limited to polyvinyl chloride (PVC) pipe and fittings, ductile iron pipe, precast concrete manholes, sheeting, bracing, excavation, backfilling, dewatering where required, grading and drainage, slope protection, concrete work, Rip-Rap, compaction, grass restoration, pavement restoration where required, and all other work incidental to the project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID standard specifications which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall prevail.

1. Submittals	Section 01330
2. Testing Laboratory Services	Section 01410
3. Excavating and Backfilling for Utilities	Section 02320
4. Boring & Jacking	Section 02445
5. Hydraulic Directional Drilling	Section 02448
6. Underground Utilities Marking	Section 02505

1.03 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Environmental Protection.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900.

1.04 QUALITY ASSURANCE

A. TECHNICAL GUIDANCE

1. Design and Construction of Sanitary and Storm Sewerage, W. E. F. Manual of Practice No. 9.

2. Handbook of Ductile Iron Pipe, latest Edition (DIPRA)

3. Recommended Standards For Sewage Works, (Ten State Standards), latest edition.

4. Florida Department of Environmental Protection, F.A.C.62-604.

B. REFERENCE STANDARDS

This specification references the following Documents which forms a part of this Standard to the extent specified herein. In any case of conflict, the most restrictive standard shall prevail.

1. ASTM D746 (ANSI/AWWA C151/21.51) Ductile Iron Pipe.

2. ASTM D3034 Polyvinyl Chloride (PVC) Sewer Pipe.

3. ASTM D3139 Joint Seals for Polyvinyl Chloride Sewer Pipe.

4. ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipes.

5. AWWA C601 Lubricant For Pipe Joint Seals.

6. ASTM C94 Concrete, Type II.

7. ASTM C478 Precast Concrete Manhole Bases, Risers, Cones and Grade Rings.

8. ASTM C923 Watertight Resilient Connectors for Manhole to Pipe Seal.

9. ASTM A48 Cast Iron Manhole Frames and Covers.

10. ASTM F794 PVC Profile Gravity Sewer Pipe and Fittings.

11. ASTM F949 PVC Corrugated Sewer Pipe and Fittings.

C. INSPECTION AND CERTIFICATION OF PIPE AND FITTINGS:

1. All pipe, fittings and appurtenances to be installed under this specification may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturer's cooperation shall be required in these inspections.

2. The Contractor shall obtain a certificate of inspection from the pipe manufacturer stating that the pipe and fittings supplied for this project has been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall borne by the Contractor. Letters of certification shall be furnished to the Owner's Representative for all inspections and tests, prior to installation of the pipe.

D. INSPECTION UPON DELIVERY

1 All pipe and appurtenances shall be subjected to visual inspection by the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit or handling shall be rejected and shall be immediately removed from the job site.

2. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

E. INSPECTION OF CONCRETE PRODUCTS

1. The quality of all materials, the process of manufacture and the finished manhole sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the manholes have been delivered.

   Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection by the Owner's Representative at any time after delivery, due to failure to meet any of the specification requirements.

2. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site at once. Sections

which have been damaged after delivery will be rejected and replaced at the contractor's expense.

3. At the time of inspection, the manhole sections will be carefully examined by the Contractor and the Owner's Representative to assure compliance with ASTM Designation C478, these specifications and the manufacturer's approved shop drawings. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all manhole sections shall be dense and close textured.

4. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.05 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of pipelines incorporating products and materials similar to those specified herein.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES) and the Reedy Creek Improvement District (RCID).

1.06 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the general requirements of Section 01330, Submittals.

B. PRODUCT DATA

1. The data to be submitted shall include, but not be limited to:

a. Polyvinyl Chloride (PVC) Pipe (ASTM 3034)

b. Ductile Iron Pipe AWWA/ANSI C151/A21-51

c. Precast Concrete Manhole Sections (ASTM C478)

d. Concrete Mix (ASTM C150, Type II Cement)

e. Concrete Coatings

f. Manhole Joint Sealant

g. Manhole Reinforcement

h. Resilient Manhole Connectors (ASTM C928)

i. Manhole Frames and Covers

j. Manhole Adjustment Rings

k. Couplings between dissimilar piping materials

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Polyvinyl chloride (PVC) pipe and fittings for gravity sanitary sewer mains, laterals and stubs shall conform to ASTM 3034, SDR35, or ASTM F949 for corrugated sewer pipe.

1. PVC pipe shall be manufactured from approved, Type 1, Grade 1, PVC 12454-C conforming to ASTM D1784 and shall meet all requirements of ASTM D2122 and ASTM D2412.

2. PVC pipe shall have integral wall thickened bells or extruded couplings with gasket seals. Solvent weld joints will not be permitted.

3. PVC pipe joints shall be rubber gasket push-on joints.

4. Polyvinyl Chloride (PVC) pipe shall not be used for sanitary sewer mains larger than 15 inches in diameter.

5. Joint seals in PVC pipe and fittings shall comply with ASTM D3212 and ASTM F477.

6. PVC pipe supplied shall be UL/FM approved.

7. PVC pipe for gravity sewer collection service shall be green pigmented.

8. All PVC fittings for gravity sanitary sewer service shall conform to the same specification as the pipeline in which they are to be installed.

9. PVC pipe shall be identified on the exterior of the pipe with the following information:

a. Nominal pipe size and o.d. base.

b. Material code designation number (12454C).

c. Dimension ratio number (SDR 35).

d. Pipe Stiffness Designation (PS46).

e. ANSI/ASTM Designation (D3034), or ASTM F949.

f. Pipe manufacturer's name and production code.

Acceptable manufacturers:
Clow, H AND W, Certainteed, Johns Manville, Contech Construction Products.

B. Ductile Iron Pipe (DIP) and fittings for gravity sanitary sewer mains, laterals and stubs shall conform to ANSI/AWWA C151/A21.51.

1. Ductile Iron Pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi

2. The pipe thickness shall be in accordance with table 50.12, ANSI/AWWA C150/A21.50 and shall be thickness Class 50 or Pressure Class 200, minimum.

3. Ductile Iron Pipe and fittings for sanitary service shall be lined with 40 mil thick ceramic epoxy lining. The ceramic epoxy lining shall consist of a two component amine cured Novalac epoxy of at least 87% solids and 20% by volume ceramic quartz pigment. The ceramic epoxy lining shall have a permeability rating of zero permeance when a film of at least 40 mils is tested in accordance with ASTM D1653-79 or a permeability rating of 0.0 perms when measured using ASTM E66-96 Method a, with a duration of 42 days.

Pipe and lining shall be tested for holidays according to National Association of Corrosion Engineers (NACE) Standard Recommended Practice as outlined in RP 0274.

One holiday per pipe length may be repaired in the field. Pipe with more than one holiday will be rejected.

4. Ductile Iron Pipe shall be supplied in lengths not in excess of a nominal twenty (20) feet, and shall be single gasket, push-on joints with locking segments conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C111/A21.11.

5. Polyethylene Encasement, where required, shall be in accordance with ANSI/AWWA C105/21.51. Polyethylene tubing shall conform to the requirements of ASTM 1248.

6. Acceptable manufacturers:

   U.S. Pipe, American, Griffin Pipe or approved equal.

2.02 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast manhole base sections, barrel sections eccentric or concentric cone sections and grade rings shall be in accordance with ASTM C478.

1. Manholes shall be precast units with integral slab and lower ring. Poured in place base slab with precast ring wall shall not be approved, except at junctions with existing sanitary sewers, where saddle or "doghouse" style manholes are specified, or at the direction of the Owner's Representative.

2. Concrete for the construction of manhole sections shall be class A concrete with a compressive strength of 4,000 psi at 28 days and shall conform to ASTM C150, Type II cement.

3. Manhole sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of three (3) days after having been painted. Manhole sections shall not be shipped for a minimum of seven (7) days after removal from the forms.

4. The interior and mating surfaces shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 Mils. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 Mils.

   The coatings shall be applied by the precast manufacturer in strict accordance with the paint manufacturer's recommendations.

   Acceptable coatings:
   Koppers 300M, Devtar 5A or approved equal.

5. The date of manufacture of the manhole sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast manhole sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Federal Specification SS-S-210A and AASHTO M198. Rubber ring manhole joint seals shall not be permitted.

7. Precast manhole bases with invert channels cast or formed directly into standard precast concrete manhole bases shall be used except at junctions with existing sewer mains.

   The bench shall be formed smooth and brush finished and shall slope smoothly and evenly downward at a minimum slope of three quarters (3/4) inch per foot from the manhole wall to the flow channel. The size and shape of the flow channel shall conform to the lower eight tenths (0.8) diameter of the inlets and outlets.

   When flow line directional changes occur exceeding forty five (45) degrees an additional flow line drop of one tenth (0.1) foot across manholes shall be provided.

   The precast manhole base units shall be of the Moore Base design or Tru-Contour design.

   Acceptable manufacturers:
   Hanson Precast, Inc., Green Cove Springs, Florida
   Atlantic Concrete Products, Inc., Sarasota, Florida
   Mack Concrete Products, Inc., Astatula, Florida
   Southern Pre-Cast, Inc., Alachua, Florida.
   Old Castle Precast, Orlando, Florida

8. Where a lined manhole base unit is required, the base liner shall be rigid, mechanically bonded, non-structural, complying with the appropriate ASTM fitting standard for the pipes to be connected. Base liner shall be by GU-Manhole Liners, Ltd., or approved equal.

   a. The depth of the main through channel shall be equal or greater than the diameter of the main pipe run. The depth of each lateral channel shall be equal to or greater that the diameter of the lateral pipe.

      Channel slopes shall be the minimum, consistent with providing for a self cleansing velocity at half bore flow conditions and exceeding the sum of hydraulic losses due to entrance, exit and friction.

   b. The benching part of the base liner shall be impressed with an effective anti-skid pattern.

   c. The geometry of each socket on the base liner shall meet the current fitting standard for the pipe to be connected as follows:

For Ductile Iron Pipe:	AWWA C151
For PVC Pipe:	ASTM F789 and ASTM D3034
For Ribbed Pipes:	ASTM F794

d. Gaskets for joining pipes to the manhole base liner shall be as approved by the pipe manufacturer, shall conform to the current ASTM C443 or ASTM 923 standard, and shall be installed according to the manufacturer's instructions.

Gaskets used between the concrete portion of the manhole sections (base, risers, cones, and adjustment rings) shall comply with ASTM C990, or ASTM C443, and shall be installed according to the manufacturer's instructions.

e. Where groundwater pressures are deemed excessive, a sealing compound shall be applied to the outside area around each bell of the base liner. The sealant shall be applied in one coat extending from the bell opening for a continuous three inch wide band around the entire bell. Apply the sealant between fifteen minutes and three hours before pouring the concrete around the base liner.

The sealant shall be Tapecoat Mastik Compound, as supplied by The Tapecoat Co., or approved equal. The sealant is to be applied in accordance with manufacturer's recommendations.

f. Material properties shall be the same as for manhole liners (see paragraph 2.02.B)

9. Precast manholes sections shall have a wall thickness of not less than five (5) inches.

10. All precast concrete products shall be wet cast. Dry casting, or low slump concrete will not be acceptable.

11. All precast concrete manhole bases shall have proper lifting loops in the base slabs (minimum of three (3)).

12. Penetrating lifting holes will not be acceptable in any structure. Where non-penetrating lifting holes are approved, their use will not be permitted within eight (8) inches of any joint or pipe penetration.

13. Where pipes enter or exit manholes a neoprene rubber resilient connector shall be used to provide a watertight connection for the pipe penetration into the manhole. Watertight resilient manhole connectors shall conform to ASTM C923.

The resilient connector shall be Kor-N-Seal molded neoprene boot as manufactured by National Pollution Control Systems, Inc. of Nashua, New Hampshire or A-Lok resilient pipe connector as manufactured by A-Lok Products, Inc. of Tullytown, Pennsylvania, Star Seal, as manufactured by Hail Mary Rubber Co., or approved equal.

Resilient pipe connectors shall be supplied and installed by the manufacturer of the precast products.

14. Precast concrete grade rings for manhole adjustment shall conform to ASTM C478. Grade rings shall be a minimum of two (2) inches thick and a maximum of five (5) inches thick and shall be reinforced with six (6) gauge or thicker reinforcing wire. The use of brick for manhole adjustment shall not be approved.

15. Drop manholes shall be provided, where pipes enter the manhole at an elevation twenty four (24) inches or more above the invert of the receiving manhole. Drop manholes shall be in accordance with the applicable RCID standard detail.

16. All pipe penetrations into manhole walls shall be precast or corebored by mechanical means. The use of concrete chisels or hand tools shall not be allowed.

17. The use of cast-in ladder rungs or other means of aiding egress and access shall not be allowed on the walls of the manholes. Manhole walls shall be smooth and free of cast-in obstructions.

B. Where a manhole liner is required, the liner shall be rigid, mechanically bonded to the manhole, non-structural, and corrosion resistant

1. The minimum thickness of the liner shall be 3/16 inches (5.0 mm).

2. All pre-formed liner units shall be proportioned for compatibility with the specified precast concrete units including, base liners, GU riser liners and cone liners. The terminal edges of the liners shall extend no less than 3/4 of an inch into the joint.

3. The liner shall be constructed from fiberglass reinforced polyurethane meeting the following composition requirements, and incorporating an area and point bonding system:

- Minimum length of fibers: 0.625 inches.
- Glass content between 12% and 15% by weight.
- Fiberglass weight between 400 and 425 lineal yards per pound.
- Fiberglass type to be E GLASS.

4. There shall be no surface degradation of the liner when tested according to ASTM D1308 using the following reagents at 16 hour exposure.

Nitric acid	69%
Hydrochloric Acid	38%
Acetic Acid	60%
Ammonia	28%
Sodium Hydroxide	5.25%
Sulfuric Acid	50%

5. There shall be no evidence of chemical attack on the material when tested according to ASTM D2152.

6. Bonding aggregate shall be pre-washed, kiln dried, fractured 3/8 inch gravel having a well graded particle size distribution complying with the table below, with minimum size = 3/16 inch and maximum size = 3/8 inch. Rate of application is 3.5 lb/square foot. Aggregate is to be applied uniformly with sufficient exposed surface area to ensure a complete and homogeneous bonding with the fiberglass reinforced polyurethane, as well as with the concrete during the precast process.

   Particle size distribution (ASTM E-11)

Sieve No.	% Passing
0.375	100
0.25	100
4	98-100
6	50-80
8	5-15
16	0-2

7. Bonding wire shall be grade 1006 10 gauge cold drawn wire having a tensile strength of 75,000 psi, formed into coils of 2 inch diameter. The steel shall comply with ASTM A510 and ASTM A853.

8. Caulking to be applied to the inside of the manhole riser joints shall meet the following:

   - no reaction with FRP
   - insoluble in water
   - has good term adhesion and cohesion
   - does not crack, shrink, or unstick
   - remains stable in a wastewater collection environment
   - does not stain

   Caulking shall be Paraseal Caulking Compound, as supplied by Savalite Corp., or approved equal. Caulking shall be applied as recommended by the manufacturer.

9. When placing concrete to a manhole liner component, the concrete shall be vibrated to ensure complete bonding with the bonding aggregate of the liner and the exclusion of voids in the concrete and between the concrete and liner. The liner shall be adequately supported during placement and curing of the concrete to ensure no deformation of any part of the liner.

10. The design and placement of the concrete mix shall provide for adequate strength and density. The concrete shall be watertight and free from voids, honeycombing, cracks, spalls and all other structural defects.

11. Precast concrete composite manhole components shall comply with ASTM C478, as modified by this specification.

2.03 MANHOLE FRAME, COVER AND ADJUSTMENT RINGS

A. Ductile iron castings for manhole frames and covers shall be manufactured from ductile iron in accord with ISO 1083-87.

1. Castings for manhole frames and covers shall be in conformance with the applicable detail at the end of this section.

2. Lifting, or pick holes shall be non-penetrating.

3. Frames and covers shall be traffic bearing and shall be capable of supporting AASHTO H-20 loadings and a test load of at least 80,000 pounds.

4. Frames shall be circular and shall incorporate a 360˚, mechanically attached elastomer seating gasket for infiltration control and traffic shock. Covers shall be hinged and incorporate a 90˚ blocking system to prevent accidental closure. Hinge boxes shall be self-cleaning, and the covers shall have a locking capability.

5. The minimum clear opening shall be thirty (30) inches.

6. The cover shall be hinged to the frame, matched to the frame for size and fit and have a one quarter (1/4) inch high square block tread with the RCID utility mark centered on the cover. The utility shall be indicated with a one and one half (1-1/2) inch, by one (1) inch, by one quarter (1/4) inch letter (“S” for Sewer) located at the six o'clock position on the cover as shown on the drawings. The manhole frame and cover shall be Pamrex 32 or approved equal.

7. Where replacement manhole frames and covers are required for 24 inch or 28 inch nominal openings, use the Pamrex 24 or Pamrex 28 frame and cover, unless directed otherwise by the Owner’s Representative.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless indicated otherwise on the drawings or as specified herein, the minimum cover for sanitary sewer pipes shall not be less than thirty-six (36) inches.

B. Unless indicated otherwise on the drawings, separation requirements between sanitary sewer lines and other FDEP regulated utilities shall be in accord with Chapter 62-555 FAC, which requires a minimum of 12 inch of vertical separation

and 36 inches of horizontal separation. Preferred vertical separation is greater than18 inches and preferred horizontal separation is greater than 10 feet.

C. Sanitary Sewer lines shall be laid in the dry. All work occurring at trench depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

2. The groundwater level shall be lowered only to sufficient depth to assure that trench bottom soils will not be saturated or develop quick conditions.

3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

5. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

D. Sanitary Sewer lines and appurtenances shall be constructed using the materials indicated on the drawings and as specified herein. Substitutions shall not be made without the express approval of the Owner's Representative.

E. The Contractor shall not cover lies until they have been inspected and approved.

F. Conflict encasement shall be in accordance with the applicable standard.

3.02 SETTING MANHOLES

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. The precast manhole base section shall be carefully placed on the prepared foundation so as to be fully and uniformly supported in true alignment, making certain that all entering pipes can be inserted on the proper line and grade.

1. Precast manhole units shall be handled by lifting rings only.

2. The first precast section shall be placed and adjusted to true grade and alignment; all inlet pipes shall be properly installed so as to form an integral watertight unit. The sections shall be uniformly supported by the base structure, and shall not bear directly on any of the entering pipes.

3. Precast manholes shall be placed and aligned to provide vertical alignment with not greater than one eighth (1/8) inch maximum tolerance for six (6)

feet of depth. The completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

C. The manhole frame and cover shall be fully bedded in mortar, with precast concrete grade rings or high density polyethylene (HDPE) grade rings placed between the manhole cone and the manhole frame.

1. Precast concrete grade rings shall conform to the specification for precast concrete manhole sections as designated in ASTM C478.

2. Precast concrete grade rings shall have a minimum depth of two (2) inches and a maximum depth of five (5) inches.

3. Precast concrete and HDPE grade rings shall not be used for more than nineteen (19) inches of vertical adjustment.

4. The use of brick for manhole adjustment will not be permitted.

3.03 HANDLING AND STORAGE OF PIPE, CONCRETE PRODUCTS AND APPURTENANCES

A. All pipe, pipe fittings, manhole sections, grade rings and cast iron rings and covers shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage. Precast concrete manholes and manhole sections shall be handled with lift rings only. Under no circumstances shall pipe, fittings or concrete products be dropped, or moved in such a manner that would cause damage to the products.

1. Pipe, fittings and concrete products shall not be rolled or skidded into or against pipe or concrete products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or other construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings, manholes etc. shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table:

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e.) bell, plain end; bell, plain end etc. no less than two rows of timbers shall be placed between tiers, chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis

1. Gaskets for mechanical joint and push-on joint ductile iron pipe shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Push-on joint locking segments shall be handled and stored in such a manner that will ensure proper use in respect to pipe types and sizes.

3.04 LAYING GRAVITY SEWER LINES

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. Gravity sanitary sewer lines shall be laid in accordance with the details shown on the plans and as specified herein, and shall be in compliance with all applicable portions of ASTM D2321.

1. The trench bottom shall be graded to the proposed elevation of the pipe line and the bottom shaped to fit the lower quadrant of the pipe. Holes shall be excavated at each bell so that the pipe will be uniformly supported along the entire length of the barrel only.

2. All sanitary sewer lines shall be laid using a laser for setting line and grade. The Contractor shall be responsible for all control for the project. The line and grade shall be constantly checked for conformance to the approved design on a joint by joint basis.

3. In the event a pipe segment deviates from the approved design, either in line or grade, the work shall immediately be stopped and the defect shall be remedied before proceeding with new work.

4. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner's Representative. Any pipe having a defective joint, bell or spigot shall be rejected, removed from the site and replaced with a sound unit.

5. Pipe laying in the finished trench shall commence at the lowest point or from a point designated by the Owner's Representative, and shall be laid upgrade from the point of connection with all bell ends forward.

6. All pipe shall be installed to the homing mark on the spigot. On field cut pipe, the Contractor shall provide a homing mark on the spigot end in strict accordance with the manufacturer's recommendations.

7. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient haunching and backfill is in place to adequately hold the pipe in place.

8. Foreign materials shall be prevented from entering the pipe while pipe is being placed in the trench. No debris, tools, articles of clothing or other materials shall be placed in the pipe at any time.

9. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to the correct line and grade. The pipe shall be properly bedded and secured in place with haunching to the springline of the pipe.

10. At all times when pipe laying is not in progress for ten (10) minutes or more the open ends of the pipe shall be closed by a watertight plug to ensure that absolute cleanliness is maintained inside the pipe at all times. Plugs shall be one-piece plastic with gasket as manufactured by Taylor Made Plastics, Inc., Sarasota, FL, or approved equal.

3.05 JOINTING SANITARY SEWER PIPES

A. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner.

B. The Contractor shall take all reasonable precautions to provide assurance that the interior of the pipe and the jointing seal shall be free from sand, dirt, trash or other foreign material before installation in the line. Any pipe or fitting that has been installed, containing dirt or other detrital material in it shall be removed, cleaned and relaid. Extreme care shall be taken to keep the bells of the pipe free from sand, dirt or rocks so that the joint may be properly assembled without over stressing the bells.

C. Where dissimilar pipe materials are joined together at locations other than manholes, at the site of a repair or where new construction meets existing, use a coupling of the appropriate diameter for the pipeline sizes to be joined. Couplings shall be Hymax 2000 and shall be installed per the manufacturer's instructions, including the stab depth and bolt torque requirements. In the event the Hymax coupling will not fit the pipelines, use Fernco RC series repair couplings as appropriate for the pipeline diameter and material types encountered.

3.06 LATERAL SEWER LINES

A. Unless otherwise specified by the Owner's Representative, lateral sewers and fittings shall be a minimum of four (4) inches in diameter and shall be less than one hundred (100) feet in length from the main to a point not more than five (5) feet from the proposed building line, as shown on the plans.

1. Service laterals shall be constructed perpendicular to the sewer main, unless otherwise indicated, on a straight line and a constant grade of not less than one (1) percent, and not greater than one hundred (100) percent, (i.e. forty five (45) degrees from horizontal). Terminal inverts of service laterals shall not be less than three (3) feet in depth.

2. Laterals shall be connected directly to manholes unless approved otherwise by the Owner's Representative. When connecting to the manhole, core bore the manhole wall for the lateral penetration and use a Link-Seal or equal device to seal the annulus.

3. When installing service laterals from existing sewer mains not having wyes or tees, the Contractor shall install tapping sleeves. The opening into the sewer main shall be cut using a power driven cutter or saw of the type recommended by the pipe manufacturer. Tapping sleeves shall be installed using an epoxy type jointing compound provided by the manufacturer.

4. Service laterals shall be sealed with approved plugs or caps prior to beginning infiltration/exfiltration tests. Six (6) inches of crusher-run gravel or bedding rock shall be placed in front of the plugs or caps and over the top of the last six (6) feet of pipe laid.

5. Clean-outs shall be provided in each service lateral, at all wyes and tees and at all changes in direction as shown on the sewer detail sheet. Clean-outs shall be the same diameter as the service lateral.

6. The end of unconnected or temporary service laterals shall be marked with a 4" x 4" x 4'-0" pressure treated stake extending two (2) feet above grade at the terminal end of the lateral.

3.07 PIPELINE IDENTIFICATION

A. PIPE DETECTING WIRE FOR NON-METALLIC PIPE

Pipe detecting wire for non-metallic pipe shall not be required for gravity sanitary sewers.

B. PIPE IDENTIFICATION

1. Plastic pipe (PVC and HDPE) shall be pigmented in a light green color. The entire pipe shall be pigmented or light green strips on the longitudinal axis of the pipe shall be pigmented. Each stripe shall be at least 2inches in width.

Pipelines smaller than 24 inch in outside diameter shall have at least two stripes at the 12 and 6 o'clock positions. Pipelines 24 inch and larger in diameter shall have three stripes at the 12, 4 and 8 o'clock positions.

2. Non-metallic pipe not meeting the above requirements shall, upon approval by the Owner or Owner's Representative, have adhesive marking tapes applied in accordance with Section 02505.

3. Metallic pipe (ductile iron or steel) can be painted with a light green stripe to designate sanitary sewer in lieu of the marking tape. Stripes shall be painted in 2 inch minimum widths at the same locations as required for plastic pipe. Paint shall be an acrylic aliphatic urethane, Devthane #378 or approved equal. Dry film thickness shall be greater then 2 mils. Paint shall be applied at least 24 hours prior to placement of the piping materials in the trench, to allow adequate time for drying.

3.08 RECORD DRAWINGS

A. The Contractor shall maintain records of service lateral locations and upon completion of the work shall furnish a copy of record, or "As-Built Plans" to the Owner's Representative. The record shall include:

1. Coordinates of wye branch and end of sewer connection referenced to the next downstream manhole of each run.

2. Offset of the end of the service lateral, referenced from the centerline of the sewer main.

3. Depth of the terminal end of the service lateral.

4. Distance from the end of service lateral to the nearest building corner or known permanent marker.

5. All references shall be clearly indicated on the record prints.

3.09 INSPECTION AND TESTING

A. ALIGNMENT AND DEFLECTION

The Contractor shall thoroughly flush and clean the sewer system prior to lamping. Lines shall be lamped between manholes and other structures for alignment, deflection and obstructions. The results of the lamping may require further inspection by television camera as determined by the Owner's Representative. Should it be necessary to reinspect the lines by t.v. camera, the additional test shall be performed at the Contractor's expense.

B. LEAKAGE TESTS

Leakage tests by exfiltration and/or infiltration, as described shall be performed on all sewer lines in the system. The Owner's Representative shall have the option of determining which test shall be employed.

1. The maximum allowable infiltration/ exfiltration shall be 100 gallons per day/per inch of pipe diameter/per mile of pipeline, except that an allowance of an additional 10 percent of gallonage will be accepted for each additional 2-feet of head over a basic 2-feet minimum internal pressure head.

2. An exfiltration test shall be conducted only if the groundwater table within the test section is below the pipeline invert elevation. Testing of a section of sewer main for exfiltration shall be performed as follows:

    a. Plug the upstream invert of the upstream manhole of the test section, and the upstream invert of the downstream manhole of the test section.

    b. The test section shall be filled with water to a depth of 3 to 4 feet above the plugged invert of the upstream manhole of the test section.

    c. After filling the test section with water to the mark, using a water meter, measure the quantity of water which is required to maintain the water level to the mark. The exfiltration is the measured rate at which the water level drops over a given period of time expressed as g.p.d./inch of diameter/per mile of pipe.

3. The duration of the test shall not be less than 2 hours. Infiltration tests shall be conducted under the supervision of the Owner's Representative.

4. The pipeline shall be tested for infiltration only after the backfill has been placed, and after the release of groundwater subsequent to the Contractor's dewatering operations, and at such time as the static water level has completely returned to the normal groundwater elevation.

5. The test for infiltration shall be performed as follows:

    a. The test for infiltration shall start at the farthest downstream test section and shall commence upstream, section by section until the entire sewer line has been tested.

    b. Place a water tight plug in the upstream invert of the upstream manhole of the test section.

    c. Allow 30 minutes for the upstream flow to clear the section under test.

d. The flow (infiltration) shall be determined by using a direct reading v-notch weir, suitably sized for the size of the sewer main under test.

Direct reading v-notch weirs as manufactured by N.B. Products Company, 35 Beulah Road, New Britan, Pennsylvania, or approved equal shall be used.

6. If upon inspection of the completed sewer or any part thereof, shows any manholes, pipes or joints which allow the infiltration of water in a noticeable stream or jet, the defective work or material shall be repaired or replaced as directed by the Owner's Representative at the Contractor's expense.

7. All leaks shall be repaired regardless of the amount of leakage.

8. All water used in testing and flushing the sewer system shall be at the expense of the Contractor.

9. Air testing shall not be allowed.

C. CLEANING THE LINES

1. At the conclusion of the work, the Contractor shall thoroughly clean all pipe by flushing with water or other means to remove all sand, dirt, stones, wood or other material which may have entered the system during the construction period.

Debris cleaned from the lines shall be removed from the lowest outlet. Debris and water from flushing shall not be introduced into the existing sewage collection system.

Following the final cleaning and flushing, if the obstruction still remains the Contractor shall remove the obstructions by whatever means are available at no additional cost to the Owner.

2. Following the final cleaning and flushing of the sewer lines the Owner's Representative will perform the final inspection of the system for leaks. If defective pipes or joints are found, the Contractor shall make all necessary repairs and/or replacements at no additional cost to the Owner.

3. Upon completion of the work, the sewer system or selected sections therein shall be subject to a final test and inspection at the option of the Owner's Representative.

4. Additional test if required, shall be as specified herein and shall meet all requirements including but not limited to line, grade, cleanliness, infiltration, exfiltration and workmanship.

D. FINAL TESTING INSPECTION AND ACCEPTANCE

1. Deflection testing will be performed on all thermo-plastic, flexible pipe at the direction of the Owner's Representative. Pipe deflection shall not exceed 5 percent of the inside diameter of the pipe.

   Test equipment and test supervision shall be provided at the contractor's expense. Deflection testing shall be performed using a mandrel having a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.

2. Internal inspection of sewer mains shall be accomplished by the use of a self-contained television system. These facilities shall be provided by the Contractor and scheduled through the Owners Representative.

3. Television inspection of sewers located within street right-of-ways, paved areas or areas subject to frequent vehicular traffic, when required by the Owner, shall be inspected with the television system on two occasions:

   a. The first inspection shall be performed immediately following the installation and compaction of the stabilized subgrade.

   b. The second inspection shall be performed following completion of compaction of the base course of the roadway.

   c. If a third inspection is required because of deficiencies that needed correction, the inspection shall be at the Contractor's expense.

4. Non-paved areas, not subject to vehicular traffic, shall be inspected on one occasion. Should it be necessary to re-inspect because of deficiencies that needed correction, the second inspection shall be at the Contractor's expense.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include, but not be limited to all labor, equipment, tools, materials and all incidentals required for the construction, installation, and testing of a sanitary sewer force main, including all appurtenances as shown on the plans and as specified herein.

B. The work shall include but not be limited to, ductile iron pipe, PVC pipe, valves, air release and vacuum relief valves, ductile iron fittings, tapping sleeves, tapping saddles, cast iron and plastic valve boxes, valve vaults and boxes, all restrained joints and concrete thrust blocking as required for all types of piping, all excavation, sheeting, shoring and bracing, dewatering, jacking and boring, where required, slope protection, backfilling, grading and drainage, concrete work, rip-rap, compaction, grass restoration, pavement restoration where required and all other work necessary to complete the construction, installation, flushing and testing of the sanitary sewer force main.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. This specification references the following RCID standard specifications which form a part of this specification to the extent specified herein. In any case of conflict, the most restrictive specification shall prevail.

1. Submittals	Section 01330
2. Testing Laboratory Services	Section 01410
3. Excavating and Backfilling for Utilities	Section 02320
4. Boring & Jacking	Section 02445
5. Hydraulic Directional Drilling	Section 02448
6. Underground Utilities Marking	Section 02505

1.02 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Regulation.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900.

1.03 QUALITY ASSURANCE

A. TECHNICAL GUIDANCE

1. Handbook of Ductile Iron Pipe, latest edition, DIPRA

2. Recommended Standards for Sewage Works (Ten-State Standards), latest edition

3. Florida Department of Environmental Protection, FAC 62-604.

4. Handbook of PVC Pipe Design & Construction, latest edition, Uni-Bell Plastic Pipe Association.

5. Manual M23: PVC Pipe - Design & Installation, AWWA

B. REFERENCE STANDARDS

This specification references the following standards which form a part of this specification to the extent specified herein. The latest edition of each standard shall apply. In any case of conflict, the most restrictive standard shall prevail.

1. AWWA C104/ANSI A21.4 Cement-Mortar Lining For Ductile Iron Pipe and Fittings.

2. AWWA C105/ANSI A21.5, Polyethylene Encasement For Ductile Iron Piping For Water and Other Liquids.

3. AWWA C110/ANSI A21.10 Ductile Iron Fittings, 3 in. through 48 in., for Water and other liquids

4. AWWA C111/ANSI A21.11 Rubber Gasket Joints For Ductile Iron Pipe and Fittings.

5. AWWA C115/ANSI A21.15, Flanged Ductile Iron Pipe

6. AWWA C151/ANSI 21.51 Ductile Iron Pipe.

7. AWWA C153/ANSI A21.53 Compact Ductile Iron Fittings.

8. AWWA C600, Installation of Ductile Iron Water Mains and Appurtenances.

9. AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe & Fittings for Water

10. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch.

11. AWWA C905, Polyvinyl Chloride (PVC) Water Transmission Pipe, nominal Diameters 14 Inch through 36 Inch.

12. ASTM C478, Precast Concrete Valve Boxes and Vaults.

13. ASTM C150, Concrete, Type II.

14. ASTM D1784, Rigid Polyvinyl Chloride PVC Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

15. ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe.

16. ASTM D3139, Joints For Plastic Pressure Pipes Using Flexible Elastomeric Seals.

17. ASTM F477, Elastomeric Seals For Joining Plastic Pipes.

C. INSPECTION AND CERTIFICATION OF PIPE AND FITTINGS

1. All pipe fittings and appurtenances to be installed under this Specification may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturers' cooperation shall be required in these inspections.

2. The Contractor shall obtain from the pipe manufacturer a certificate of inspection stating that the pipe and fittings supplied for this Project has been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall be borne by the Contractor. Letters of certification shall be furnished for all inspections and tests prior to the installation of the pipe, fittings and appurtenances.

D. INSPECTION UPON DELIVERY

1. All pipe fittings and appurtenances shall be subject to visual inspection by the Owner's Representative at the point of delivery and again just before being lowered into the trench. All materials found to be defective due to manufacture, or damaged in transit shall be rejected and shall be immediately removed from the job site.

2. The Owner's Representative may perform or cause to be performed all tests as specified in the applicable AWWA Standards, to ensure conformance with the standard. In the case of failure of the pipe or appurtenances to comply with such standards, the responsibility for replacement of the defective materials becomes that of the manufacturer or the Contractor.

3. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe and/or fittings of inferior quality.

E. INSPECTION OF PRECAST CONCRETE PRODUCTS

1. The quality of all materials, the process of manufacture and the finished precast concrete sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the precast products have been delivered.

   Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection at any time after delivery, due to failure to meet any of the specification requirements.

2. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site within 24 hours. Sections which have been damaged after delivery will be rejected and replaced at the Contractor's expense.

3. At the time of inspection, the precast sections will be carefully examined to assure compliance with ASTM C478, these specifications and the manufacturer's approved shop drawings.

4. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all precast sections shall be dense and close textured.

5. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.05 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of pipelines incorporating products and materials similar to those specified herein.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES) and the Reedy Creek Improvement District (RCID).

1.06 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01300, Submittals.

B. PRODUCT DATA

1. The data to be submitted shall include, but not be limited to:

a. Ductile iron pipe and fittings.

b. Polyvinyl chloride (PVC) pressure pipe.

c. Fusible C-900 PVC

d. High Density Polyethylene pipe

e. Elastomeric seals for ductile iron and PVC pipe joints.

f. Plug valves.

g. Tapping valves.

h. Air release and vacuum relief valves.

i. Tapping tees and tapping sleeves.

j. Cast iron and plastic valve boxes.

k. Precast concrete valve vaults.

l. Valve operators.

m. Mechanical joint retainer glands.

n. Corrosion protection materials.

o. Underground marking and identification tapes.

p. Underground tracer wire and appurtenances.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile iron pipe (DIP) for sanitary sewer force mains shall conform to AWWA C151.

1. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi

2. Pipe shall be Pressure Class 150, minimum.

3. Ductile iron pipe for sanitary sewer force mains shall have a minimum 1.0 mil bituminous coating on the pipe exterior in accordance with AWWA C151.

4. Ductile iron pipe for sanitary sewer force mains shall be lined with 40 mil thick ceramic epoxy lining. The ceramic epoxy lining shall consist of a two component amine cured Novalac epoxy of at least 87% solids and 20% by volume ceramic quartz pigment. The ceramic epoxy lining shall have a permeability rating of zero permeance when a film at least 40 mils is tested in accordance with ASTM D1653-79 or a permeability rating of 0.0 perms when measured using ASTM E66-96 Method a. with a duration of 42 days.

   Pipe and linings shall be tested for holidays according to National Association of Corrosion Engineers (NACE) Standard Recommended Practice as outlined in RP 0274.

   One holiday per pipe length may be repaired in the field. Pipe with more than one holiday will be rejected.

5. Ductile iron pipe shall be supplied in lengths not in excess of a nominal twenty (20) feet and, unless otherwise specified, shall have rubber-gasket joints conforming to AWWA C111.

6. Single gasket push-on joints shall normally be used where joint restraint is not required.

7. Where joint restraint is required, restrained joints shall: be "T-R Flex" joints as manufactured by U.S. Pipe, "Flex-Ring" and "Lok-Ring" joints as manufactured by American Ductile Iron Pipe, or approved equal.

   Joint restraint other than at fittings may be accomplished with American "Fast Grip" or U.S. Pipe "Field Lok" gaskets, or approved equal.

   Restrained joints at fittings shall utilize mechanical joints with a restraining gland. Restraining glands shall be EBAA Iron Series "1100" or "3000", Stargrip Series 3000, Series 300OS or Series 3100P or approved equal.

8. High strength, low alloy steel T-bolts and nuts for mechanical joint shall conform to AWWA C110, Appendix, and AWWA C111. Threads shall conform to ANSI B.1.

9. Where called for on the plans, polyethylene encasement for ductile iron pipe shall conform to AWWA C105.

10. Acceptable manufacturers:
    American, U.S. Pipe, Griffin Pipe or approved equal.

B. Ductile iron fittings for sanitary sewer force mains shall conform to AWWA C110 or C153. Minimum pressure rating shall be 250 psi.

1. Rubber gasket joints shall be mechanical joint in accordance with AWWA C111.

2. Fittings shall be lined and coated according to section 2.01 A.3 above.

3. All fittings shall be cast and machined allowing the bolt holes to straddle the vertical centerline.

4. Only those fittings that are of domestic (United States) manufacture will be acceptable.

5. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's identification, country of manufacture, and number of degrees or fraction of the circle. The letters "D.I." or the word "Ductile" shall also be cast on the outside of the body.

6. Fusion bonded epoxy coated ductile iron fittings as manufactured by "One Bolt, Inc. " are acceptable, provided they meet ASTM A 536 grade 65-45-12 and are installed in strict accord with the manufacturer's instructions.

C. Flanged ductile iron pipe and fittings with threaded flanges where called for on the plans, shall conform to AWWA C115. Flanges shall be furnished flat faced and drilled to 125 pound template in accordance with ANSI B16.1 full faced gaskets.

D. Polyvinyl chloride (PVC) pressure pipe for sanitary sewer force mains, in sizes 4-inch through 12-inch shall conform to AWWA C900.,

1. Laying lengths shall be 20 feet +/- 1 inch for all sizes.

2. PVC pipe shall be at least pressure Class 150 (DR 18) with cast iron outside dimensions.

3. PVC pipe joints shall have an integral wall-thickened bell end with gasket seal conforming to ASTM D3139. (Solvent weld joints will not be permitted.)

4. PVC pipe for sanitary sewer force mains shall be green or brown pigmented.

5. Fittings for use with AWWA C900 pipe shall be ductile iron conforming to section 2.01.B above.

6. Where joint restraint is required, restraining glands may be utilized. Restraining glands shall be specifically designed for use with C900 PVC pipe and shall be EBAA Iron "2000PV" or “3000” Series, Romac “GripRing”, Sigma “PV-LOK”, Tyler “MJR”, Stargrip Series 4000 and Series 4100P or approved equals.

7. All PVC pipe shall be identified on the exterior of the pipe with the following information:

   a. Nominal pipe size and O.D. base: (e.g. 6-inch C.I.)

   b. Material code designation number: (PVC 1120)

   c. Dimension ratio (DR) number (DR18)

   d. AWWA pressure classification

   e. AWWA designation: C900

   f. Pipe manufacturer's name and production code.

   g. Date and shift of manufacture

8. Acceptable manufacturers:

   Johns Manville, Certainteed, H&W, Clow, or approved equal.

E. Polyvinyl chloride (PVC) pressure pipe for sanitary sewer force mains, in sizes 16-inch through 36-inch shall conform to AWWA C905.

1. Laying lengths shall be 20 feet +/- 1 inch for all sizes.

2. PVC pipe shall be Class 150 (DR 25) with cast iron outside dimensions.

3. PVC pipe joints shall have an integral wall-thickened bell end with gasket seal conforming to ASTM D3139. (Solvent weld joints will not be permitted.)

4. PVC pipe for sanitary sewer force mains shall be green or brown pigmented.

5. Fittings for use with AWWA C905 pipe shall be ductile iron conforming to section 2.01.B above.

6. Where joint restraint is required, restraining glands may be utilized. Restraining glands shall be specifically designed for use with C900 PVC pipe and shall be EBAA Iron "2000PV" or "3000" Series, Romac "GripRing", Sigma "PV-LOK", Tyler "MJR", Stargrip Series 4000 and Series 4100P or approved equals.

7. All PVC pipe shall be identified on the exterior of the pipe with the following information:

   a. Nominal pipe size and O.D. base: (e.g. 6-inch C.I.)

   b. Material code designation number: (PVC 1120)

   c. Dimension ratio (DR) number (DR25)

   d. AWWA pressure classification

   e. AWWA designation: C905

   f. Pipe manufacturer's name and production code.

   g. Date and shift of manufacture

8. Acceptable manufacturers:
   Johns Manville, Certainteed, H&W, Clow, or approved equal.

F. PLUG VALVES shall be semi-steel body, non-lubricated, eccentric type, with resilient-faced plugs, bi-directional and capable of drip-tight shut-off at the rated pressure if applied at either port. Operation of all valves 4 inches or larger shall be by gear actuators furnished by the valve manufacturer. Gear actuators for buried or submerged installations shall have sealed enclosures. Equip valves with 2" square actuation nuts. Port opening for plug valves 16" or larger shall be 90% of pipe area. Port opening for plug valves smaller than 16" shall be 100% of pipe area.

Acceptable manufacturers:
Henry Pratt, Homestead, Clow, American, Mueller, M & H, Kennedy, DeZurik, Keystone, U.S. Pipe, Centerline, or approved equal.

G. AIR RELEASE AND/OR VACUUM RELIEF VALVES for sanitary sewer force mains shall be installed as shown on the plans. The valves shall be constructed with a cast iron body, cover and baffle, stainless steel float, BUNA-N or viton seat and stainless steel trim. All fittings shall be threaded.

1. Air Release Valves shall be APCO 400 SARV Series; Val-Matic Model 48BW or 49BW; Vent-O-Mat Series RGX, H-Tec Model #985 or approved equal.

2. Air and Vacuum Valves shall be APCO 400 SAVV Series; Val-Matic Series 300; Vent-O-Mat Series RGX, H-Tec Models 992 thru 997 or approved equal.

3. Combination Air Valves shall be APCO 440 SCAV Series; Val-Matic 48/300 or 49/300 Series; Vent-O-Mat Series RGX, H-Tec or approved equal.

H. SERVICE SADDLES OR TAPPING SLEEVES shall be used for all taps on sanitary sewer force mains.

1. Size-on-size taps using tapping saddles or sleeves will not be permitted.

   Where size-on-size outlets are required, a tee shall be installed in lieu of a tapping saddle or sleeve. Tapping saddles and tapping sleeves will only be permitted on lines that are at least one nominal pipe size or diameter larger than the proposed tap.

2. For taps 2 inches to 2-½ inches on mains 4 inches or larger, use a double strap service saddle. Saddle body shall be bronze or fusion-coated ductile iron with BUNA-N gasket. Straps shall be bronze or stainless steel. Taps smaller than 2 inch diameter will not be allowed. If a smaller line size is preferred, tap the carrier pipe with a 2 inch tap and provide reducers or bushings after the tap to the desired diameter.

   Acceptable manufacturers and models:

   Smith-Blair No. 323 or 317, JCM 406, Ford FC202, Mueller BR2B or approved equal.

3. Tapping sleeves shall be used for taps 4 inches and larger. Tapping sleeves shall be fabricated of stainless steel, fusion-bonded epoxy coated ductile iron, or fusion-bonded epoxy coated steel and designed for a test pressure of at least 200 psi. The outlet of the tapping sleeve may be either extruded or welded to the tapping sleeve.

   The flange shall conform to AWWA C-207, Class D, ANSI 150 lb. drilling. Bolt holes shall straddle the pipe centerline.

   The sleeve shall be equipped with a 3/4 inch NPT test plug with a standard square head. The gasket shall be of 360-degree design, and manufactured of gridded virgin GPR compounded for water service and complying with

ASTM D-2000-80M 4AA607. An 18-10 stainless steel armor shall be vulcanized to the gasket, to bridge the gap between the securing lugs.

All bolts and nuts shall be stainless steel with 5/8 inch NC threads. Bolt threads shall be fluorocarbon coated to prevent galling. Nylatron G.S. washers shall be provided for lubrication.

Approved manufacturers and models:

Smith-Blair Models 622, 662 or 663; JCM Models 422 or 432; Ford style FAST or FTSC; Mueller H304 or approved equal.

I. TAPPING VALVES

1. Valves for use with tapping sleeves shall meet or exceed all provisions of AWWA C509/515.

2. Valves for use with tapping sleeves shall be resilient seated wedge gate type and shall be designed for use with tapping equipment. The valves shall have non-rising stems and shall have an alignment ring to prevent misalignment with the tapping sleeves.

3. The valves shall close clockwise (right) and open counter clockwise (left), and shall be equipped with a standard 2-inch square operating nut. Valve outlets shall have a flanged mechanical joint.

4. Acceptable manufacturers:

   Clow, Mueller, American Flow Control, U.S. Pipe, Dresser Industries.

J. FLANGED COUPLING ADAPTERS. Flanged coupling adapters for ductile iron pipe shall be Smith-Blair Model 912, JCM Model 301, Dresser Model 127, or approved equal.

K. VALVE BOXES. Valve boxes for force main service shall be adjustable, cast iron or heavy wall high density polyethylene (HDPE) suitably sized for the size and depth of the buried valve. HDPE boxes shall have all exterior components joined with stainless steel screws and be equipped with a telescoping, plated, square steel tube stem assembly that allows for variable height adjustment. The stem assemble shall be torque tested to 1000 ft-pounds. All valve boxes shall be designed for traffic bearing H-20 wheel loading with round cast iron lids marked "WATER". Valve boxes shall be Tyler Model 6850/6860, U.S. Foundry Model 7500, American Flow Control's Trench Adapter or approved equal.

2.02 PRECAST CONCRETE PRODUCTS

A. Precast concrete valve vaults and air relief manholes shall be in accordance with ASTM C478.

1. Concrete for the construction of manhole sections and valve vaults shall be Class A concrete with a compressive strength of 4000 psi at 28-days and shall conform to ASTM C150, Type II cement.

2. Valve vaults and manholes shall be precast units with integral base slab and wall sections. Poured in place base slabs shall not be approved.

3. Precast sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of three (3) days after having been painted. Precast sections shall not be shipped for a minimum of seven (7) days after removal from the forms.

4. The interior and mating surfaces of all precast concrete products shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 mils. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 mils. The coatings shall be applied by the precast manufacturer in strict accordance with the paint manufacturer's recommendations.

   Acceptable coating: Koppers 300M, or Devtar 5A by ICI Devoe or approved equal.

5. The date of manufacture of the precast sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Fed. Spec. SS-S-210A and AASHTO M198.

7. Rubber ring joint seals for precast sections shall not be permitted.

8. Shallow valve vaults, where the depth of cover is less than four (4) feet, shall be capable of supporting the overburden plus a live load equivalent to AASHTO H-20 loading.

9. Valve vault base sections shall not be less than eight (8) inches thick and shall be reinforced with number five (5) bars at nine (9) inches on centers, each way and shall have number four (4) bars around each pipe.

10. All precast concrete products shall be wet cast. Dry casting, or low slump concrete will not be acceptable.

11. All precast concrete products shall have proper lifting loops in the base slabs, (minimum of three (3)). Penetrating lifting holes will not be acceptable in any structure.

    Where non-penetrating lifting holes are approved, their use will not be permitted within eight (8) inches of any joint or pipe penetration.

12. Precast concrete grade rings for manhole adjustment shall conform to ASTM C478. Grade rings shall be a minimum of two (2) inches thick and a maximum of five (5) inches thick and shall be reinforced with six (6) gauge or thicker reinforcing wire.

13. Acceptable Manufacturers:

    Hanson Precast, Inc., Green Cove Springs, FL
    Atlantic Concrete Products, Inc., Sarasota, FL
    Mack Concrete Products, Inc., Astatula, FL
    Southern Precast, Inc., Alachua, FL
    Old Castle Precast, Orlando, FL.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless indicated otherwise on the drawings or as specified herein, the minimum cover for sanitary sewer force mains shall not be less than thirty-six (36) inches.

B. Unless indicated otherwise on the drawings, separation requirements between force mains and other FDEP regulated utilities shall be in accord with Chapters 62-555 and 62-604 FAC, which requires a minimum vertical separation of 12" and a minimum horizontal separation of 36". Preferred horizontal separation is greater than10 feet and preferred vertical separation is greater than 18 inches.

C. Sanitary sewer force mains shall be laid in the dry. All work occurring at trench depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

2. The groundwater level shall be lowered only to sufficient depth to assure that trench bottom soils will not be saturated or develop quick conditions.

3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering will require monitoring of both the quantity and quality of the discharge, and discharge to surface waters cannot exceed a turbidity level of 29 NTU over background.

5. Consult with and obtain Owner's approval of dewatering means and methods prior to commencement of the work.

D. Sanitary sewer force mains and appurtenances shall be constructed using the materials indicated on the drawings and as specified herein. Substitutions shall not be made without the express approval of the Owner's Representative.

E. The Contractor shall not cover lies until they have been inspected and approved.

F. Conflict encasement shall be in accordance with the applicable standard.

3.02 HANDLING AND STORAGE OF PIPE FITTINGS AND APPURTENANCES

A. All pipe, fittings and appurtenances shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage.

1. Pipe, fittings and appurtenances shall not be dropped, rolled or skidded into or against pipe, fittings or other construction products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and appurtenances shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table.

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e.) bell, plain end; bell, plain end, etc. No less than two rows of timbers shall be placed between tiers. Chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between pipe in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis.

1. Gaskets for mechanical joint and push-on joint ductile iron pipe and fittings shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Mechanical joint bolts and locking segments for push-on joints shall be handled and stored in such a manner that will insure proper use in respect to pipe types and sizes.

3.03 LAYING SANITARY SEWER FORCE MAINS

A. Refer to Section 02320, Excavating and Backfilling for Utilities.

B. Sanitary sewer force mains shall be laid in accordance with the details shown in the plans, and as specified herein.

1. The trench bottom shall be graded to the proposed elevation of the pipeline and the bottom shaped to fit the lower quadrant of the pipe. Holes shall be excavated at each bell so the pipe will be uniformly supported along the entire length of the barrel only.

2. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer’s specifications and instructions for the type of pipe used and the applicable standards of the Owner.

3. Any pipe having a defective joint, bell or spigot shall be rejected, removed from the work site and replaced with a sound unit.

4. All pipe shall be installed to the homing mark on the spigot. On field cut pipe, the Contractor shall provide a homing mark on the spigot end in strict accordance with the manufacturer's recommendations.

5. All pipe shall be retained in position so as to maintain alignment and joint closure until sufficient haunching and backfill has been placed to adequately hold the pipe in place.

6. Foreign materials shall be prevented from entering the pipe while pipe is being placed in the trench. No debris, tools, articles of clothing or other materials shall be placed in the pipe at any time.

7. At all times when pipe laying is not in progress for ten (10) minutes or more the open ends of the pipe shall be closed by a watertight plug to ensure that absolute cleanliness is maintained inside the pipe at all times. Plugs shall be one-piece plastic with gasket as manufactured by Taylor Made Plastics, Inc., Sarasota, FL, or approved equal.

3.04 JOINTING SANITARY SEWER FORCE MAINS

A. Pipe installation and jointing shall be in strict accordance with the pipe manufacturer's specifications and instructions for the type of pipe used and the applicable standards of the Owner. Joints shall be in strict accordance with AWWA C600.

B. The Contractor shall take all reasonable precautions to provide assurance that the interior of the pipe and the jointing seal shall be free from sand, dirt, trash or other foreign material before installation in the line. Any pipe or fitting that has been installed containing dirt or other detritus shall be removed, cleaned and re-laid. Extreme care shall be taken to keep the bells of the pipe free from sand, dirt or rocks so that the joint may be properly assembled without over stressing the bells.

C. All pipe shall be installed to the homing mark on the spigot. When field cutting of pipe is required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe, cut ends of pipe to be used with push-on bell shall be beveled to conform to the manufacturers spigot end. Care shall be taken to prevent damage to linings.

D. Deflection at pipe joints shall not exceed one half (1/2) the maximum pipe deflection recommended by the pipe manufacturer. If at any time joint deflections exceed the manufacturer's maximum recommended pipe deflections, an appropriate fitting shall be used.

3.05 PIPE JOINT RESTRAINTS AND THRUST BLOCKING

A MECHANICALLY RESTRAINED JOINTS

Mechanical pipe restraining mechanisms for push-on or mechanical joints will be used unless concrete blocking is specifically indicated on the plans, or as directed by the Owner’s Representative.

Restraining glands, tie rods, clamps or other components of dissimilar metals shall be protected against corrosion by the application of a suitable coating at the direction of the Owner’s Representative.

B. THRUST BLOCKING

Thrust blocking will not be allowed unless the job conditions dictate that conventional methods of mechanically restraining the pipe are not practical.

Where concrete thrust blocks are required due to the nature of the construction, vertical and horizontal reaction blocking shall be concrete having a compressive strength of not less than 2000 psi at 28 days. Thrust blocking shall be placed between undisturbed soil and the fitting to be restrained. The bearing area of the thrust blocking shall be adequate to prevent movement of the fittings and shall be of the size, weight and dimensions shown on the plans or as directed by the Owner’s Representative.

Prior to placing concrete for thrust blocking all pipe joints, glands, flanges, bolts and other appurtenances shall be protected by 15 lb. roofing felt or other approved material. Plastic sheeting or other similar material shall not be used. Wood side forms shall be used when placing concrete for thrust blocking as shown in the applicable detail at the end of this section.

The blocking shall be located so as to contain the resultant force in such a way that the pipe and fittings will be accessible for repair. The blocking shall be sized to include soil conditions, pipe type and fittings, pressure conditions, cover, compaction and all other variables that could affect the size of the thrust block and restraint required. An appropriate safety factor shall be applied to all thrust block sizing calculations.

C. RESTRAINT/CONCRETE THRUST BLOCK DESIGN

Mechanical restraints or concrete thrust blocking shall be sized for the working pressure plus surge allowance, or a test pressure of 200 psi, whichever is greater. Adequate factors of safety shall be employed.

D. FUSIBLE PIPING JOINT RESTRAINT

Fusion joining of PVC and HDPE piping materials may be used in lieu of conventional joint restraint where hydraulic directional drilling is required or selected or where special construction conditions may dictate this method of joint restraint. Butt fusion with standard heat fusion equipment shall be used and the fused joint shall have at least 96% of the tensile and burst strength of the pipe material. Pipe ends to be fused shall be machined flush and aligned with each other. Heat fusion shall be accomplished by standard heat fusion equipment in strict accord with the requirements of the pipe manufacturer. Fusible PVC C-900 pipe shall meet ASTM cell classification 12454B.

3.06 PIPELINE IDENTIFICATION

A. PIPE DETECTING WIRE FOR NON-METALLIC PIPE

See Section 02505.

B. PIPE IDENTIFICATION

1. Plastic pipe (PVC and HDPE) shall be pigmented in a light green color. The entire pipe shall be pigmented or light green strips on the longitudinal axis of the pipe shall be pigmented. Each stripe shall be at least 2 inches in width. Pipelines smaller than 24 inch outside diameter shall have at least two stripes at the 12 and 6 o'clock positions. Pipelines 24 inch and larger in diameter shall have three stripes at the 12, 4 and 8 o'clock positions.

2. Non-metallic pipe not meeting the above requirements shall, upon approval by the Owner's Representative, have adhesive marking tapes applied in accordance with Section 02505.

3. Metallic pipe (ductile iron or steel) can be painted with a light green stripe to designate force main in lieu of the marking tape. Stripes shall be painted in 2 inch minimum widths at the same locations as required for

plastic pipe. Paint shall be an acrylic aliphatic urethane, Devthane #378 or approved equal. Dry film thickness shall be greater then 2 mils. Paint shall be applied at least 24 hours prior to placement of the piping materials in the trench, to allow adequate time for drying.

C. VALVE BOX I.D. TAG

1. All valve boxes shall have concrete collars and I.D. tags, per the standard detail on the drawings.

3.07 CONNECTIONS FROM NEW TO EXISTING WATER MAINS

A. No connections will be allowed from new to existing sanitary sewer force mains without written approval from the Owner's Representative, and cleared for use by FDEP (if an FDEP permit to construct was necessary).

1. Approval will be made only after a request form for alteration or connection has been submitted with approved plans.

2. Valves shall not be operated by any person other than Reedy Creek Energy Services Water Department personnel.

3.08 FLUSHING

A. Foreign material left in the pipelines during installation often result in valve and fire hydrant seat leakage during hydrostatic pressure testing. The Contractor shall make every effort to insure that lines are kept clean during installation.

B. Thorough flushing is required prior to hydrostatic pressure testing; flushing shall be accomplished by the introduction of clean water (potable water or reclaimed water) to achieve pipeline velocities of not less than 3.0 feet per second in the largest line size to be flushed. An air gap or similar approved backflow prevention device shall be used between the force main and water supply source.

The pipelines shall be flushed full bore and shall not be less than three (3) times the total volume of the section being tested.

3.09 PRESSURE AND LEAKAGE TESTING

A. Hydrostatic pressure and leakage testing of sanitary sewer force mains shall be performed in accordance with Section 4 of AWWA C600 except as modified below. All testing shall be made using clean water (either reclaimed water or potable water). Air testing shall not be permitted.

1. The Contractor shall furnish all gauges, meters, pressure pumps, and all other equipment required to pressure test the main at no additional cost to the Owner.

2. The Contractor shall submit his plan for testing the system to the Owner's Representative for review not less than ten (10) working days prior to starting the test.

3. The pipelines shall be tested in such sections as may be directed by the Owner's Representative or by installing temporary plugs as required. Pressure tests will not be allowed against closed valves, unless approved otherwise by the Owner's Representative. In no case shall the test section exceed one thousand (1000) linear feet unless approved by the Owner's Representative.

4. All sections which fail to meet the tests shall be repaired and the leakage eliminated, regardless of the total leakage as shown by the test.

5. All lines which fail to meet the tests shall be repaired and retested as necessary until the test requirements are complied with, at no additional cost to the Owner. All defective materials, pipes, valves and appurtenances shall be removed and replaced at the contractor's expense.

6. The Contractor shall provide accurate means for measuring the water required to maintain the test pressure. The quantity of water required to maintain the test pressure shall be the measure of the leakage.

B. The required pressure for the field hydrostatic pressure test shall be two (2) times the working pressure at the point of testing, but in no case shall the test be less than 150 psi, with no pressure loss.

1. The Contractor shall provide all temporary plugs and blocking necessary to maintain the required test pressure. Corporation cocks, service saddles, pipe risers and angle globe valves shall be provided at each dead-end in order to bleed air from the main. The cost of these items shall be included as part of the testing.

2. The duration of the pressure test shall be a minimum of four (4) hours. The costs of all required items shall be included as part of the testing.

C. TEST PRESSURE RESTRICTIONS

1. Test pressures shall not exceed the pipe or thrust-restraint design.

2. No test pressure variations for the duration of the test shall be allowed.

D. PRESSURIZATION OF THE LINES

1. Each section of the pipe shall be slowly filled with water and pressurized to the specified test pressure based on the elevation of the lowest point of the line or section under test, and corrected to the elevation of the test gauge by means of a force pump connected to the pipe in a manner satisfactory to the Owner's Representative.

2. In no case shall a line be tested while connected to an existing sanitary force main.

E. AIR REMOVAL BEFORE TESTING

1. Prior to applying the specified test pressure, all air shall be expelled from the pipe, valves and hydrants.

2. If permanent air relief valves or air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that all air can be expelled as the line is filled with water. After all air has been expelled from the line, the corporation cocks shall be closed and the test pressure applied.

3. After the main has been tested and accepted, the corporation cocks shall be removed and plugged.

F. EXAMINATION UNDER PRESSURE

All exposed pipe, fittings, valves, hydrants, joints, etc. shall be carefully examined during the test. Defective or damaged pipe, fittings, valves or other appurtenances that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory to the Owner's Representative.

G. ACCEPTANCE OF THE INSTALLATION

Final acceptance shall be determined on the basis of zero pressure drop. If the test of any section of pipe discloses leakage, the Contractor, at his own expense, shall locate and make all repairs necessary until all leakage is eliminated

END OF SECTION

This specification applies only to modular lift stations having not more than three (3) submersible pumps and a capacity of not more than one thousand (1,000) gpm design capacity. Lift stations having a larger capacity, (greater than 1,000 gallons per minute) shall be custom designed, under the direction and approval of Reedy Creek Energy Services.

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work under this section shall govern the construction, installation, testing and start-up of a wet pit submersible sanitary sewerage lift station, complete with all appurtenances in accordance with the drawings and as specified herein.

B. The work shall include but not be limited to all materials, labor, equipment, tools, transportation, pipe, fittings, precast concrete or cast-in-place wet wells and valve pits as required, covers hatches, rail mounted submersible sewerage pumps, base ells, stainless steel guide rails, valves, electrical controls and service, flow meters (where required), pump hoists (where required), emergency electrical generators (where required), , lights, telemetry systems and all accessories, services and incidentals as specified herein or as required for the construction, installation and testing of a complete system.

C. The work shall also include, all erosion control, all dewatering, sheeting, shoring and bracing, all excavation, trenching, backfill and compaction. All concrete work, waterproofing, grading, drainage, slope protection, where required, site restoration, seeding, sodding and mulching and all other work incidental to the project.

1.02 DEFINITIONS

A. Under this subsection the following definitions shall apply:

1. DUCTILE IRON PIPE: Cast ferritic material in which a major part of the carbon content occurs as free carbon in nodules or spheroidal form, and meeting the requirement of ASTM D746.

2. DUCTILE IRON PUSH-ON JOINT: The push-on joint as described in AWWA C151 and the single rubber gasket joint as described in AWWA C111.

3. FDEP: The Florida Department of Environmental Protection.

4. FLANGED JOINT: Bolted and gasketed joint as described in AWWA C115 and ANSI/ASME B16.1.

5. MECHANICAL JOINT: Bolted and gasketed joint as described in AWWA C111

6. POLYVINYL CHLORIDE PIPE: Thermoplastic compounds prepared by combining PVC resins with modifiers, stabilizers, lubricants and pigments to obtain the properties required to meet the dimensional and stability requirements of AWWA C900.

1.03 EXPERIENCE

A. The Contractor shall be a firm with not less than five (5) years of successful experience in the installation and construction of sanitary lift stations incorporating products and materials similar to those specified for this project.

1. The Contractor shall take field measurements prior to installation and fabrication.

2. The Contractor shall comply with all relevant requirements of regulatory agencies having jurisdiction over the project.

3. The Contractor shall comply with the requirements of Reedy Creek Energy Services (RCES) also known as the Owner's Representative, the Reedy Creek Improvement District (RCID) also known as the Owner.

1.04 QUALITY ASSURANCE

A. Unit Integrity: To assure unit integrity, the pumps, motors, control panel, access cover, guide rail assemblies, and other auxiliary equipment and materials specified in this Section shall be furnished and coordinated by the pump manufacturer/supplier who shall assume full responsibility for the satisfactory operation of the entire pumping system.

B. The pump manufacturer shall have a factory authorized service facility within a 200 mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of all necessary spare parts for each model of pump furnished under this contract. Service facility shall be capable of in-shop motor rewinds. No part of a pump being repaired shall leave the State of Florida for repair. The service facility shall also be capable of providing a 48-hour turn-around time on any pumps brought in for repair. The warranty center shall maintain an inventory of original factory replacement parts, including, but not limited to seals, bearings, O-rings, stators, impellers and wear rings. The service facility shall be an established entity prior to delivery of equipment for this project, completely equipped with loaner pumps, spare parts and crane-equipped truck.

C. The pump manufacturer shall have a guaranteed parts stock program, at a distribution center within a 350-mile radius of the jobsite. The guaranteed stock shall include at least three (3) sets of spare parts, as listed below, for each pump model and size supplied under this contract. As part of the bid, the Contractor shall furnish a notarized statement that the parts are in stock and available for inspection by the Owner.

1. Upper & lower seals

2. Wear rings

3. Motor cable

4. Cable entry washer/grommet

5. All o-rings

6. Inspection plugs and washers

7. Impeller bolts and keys

8. Upper & lower bearings

D. The control system shall have an established record of successful performance for similar service.

1. The control system shall be supplied by the pump equipment supplier and shall be manufactured by a UL or equivalent listed shop. Evidence of UL or equivalent listing shall be provided or the control system shall carry a serialized UL listing number certifying that the system is manufactured to UL standard 508 or equal, industrial control system.

2. Deletion of specific items or parts from the control system does not relieve the system manufacturer of supplying a total system designed for the specific application.

3. The control system shall be guaranteed for a period of five years from the date of shipment for the factory.

E. TECHNICAL GUIDANCE

1. Water Environment Federation Manual of Standard Practice No. FD-4

2. Handbook of Ductile Iron Pipe, latest Edition, (DIPRA)

3. Recommended Standards for Sewage Works (Ten State Standards), Chapter 20.

4. Florida Department of Environmental Protection, FAC 62-604.

F. REFERENCE STANDARDS

This specification references the following standards which form a part of this specification to the extent specified herein. The latest edition of each standard shall apply. In any case of conflict, the most restrictive specification shall prevail.

1. ASTM D746 AWWA C151/ANSI21.51 Ductile Iron Pipe.

2. ASTM D1785 and ASTM D2464 Schedule 80 Polyvinyl Chloride Pressure Pipe.

3. ASTM A53, ASTM A106 and ASTM A120 Schedule 40 Galvanized Pipe.

4. ASTM A197 and ANSI B16.3 Galvanized Malleable Iron Pipe Fittings.

5. Type 304 Alloy, Schedule 40 Stainless Steel Pipe.

6. ASTM C94 Concrete Type II.

G. INSPECTION AND CERTIFICATION OF PIPE, FITTINGS AND EQUIPMENT

1. All pipe, fittings, pumps and appurtenances to be installed, may be inspected and tested for compliance with these specifications at the manufacturer's facility by an independent testing laboratory selected by the Contractor. The manufacturers' cooperation shall be required in these inspections.

2. The Contractor shall obtain from the manufacturers, certificates of inspection stating that the pipe, fittings, pumps and related equipment supplied have been inspected and tested at the point of origin, and that they meet or exceed the requirements set forth in these specifications.

3. The costs of the inspections and tests shall be borne by the Contractor. Letters of certification shall be furnished to the Owner's Representative for all inspections and tests prior to the installation of the pipe, fittings, pumps and appurtenances.

H. INSPECTION UPON DELIVERY

1. All pipe, fittings, pumps and appurtenances shall be subjected to visual inspection by a representative of the Owner's Representative at the point of delivery and again just before being installed. All materials found to be defective due to manufacture, or damaged in transit shall be rejected, and shall be immediately removed from the job site.

2. The entire product of any manufacturer may be rejected when, in the opinion of the Owner's Representative, the methods of manufacture fail to secure uniform results, or where the materials are such as to produce pipe, fittings, appurtenances and equipment of inferior quality.

1.05 WARRANTY

The pump manufacturer shall warrant the pumps being supplied against defects in workmanship and materials for a period of not less than five (5) years or 10,000 hours of operation (whichever occurs last) under normal use, operation and service. The manufacturer shall replace specific parts listed below which fail under normal use as a result of factory manufacturing defects. Replacement value

will be on a progressive schedule of cost for a period of five (5) years. Parts included are: mechanical seals, rotor, stator, impeller, pump housing, wear rings or cutter disc, and ball bearings. The warranty shall be in published form and apply to all similar units. The manufacturer's warranty shall be submitted with the product specification and drawing submittals.

1.06 INSPECTION OF PRECAST CONCRETE PRODUCTS

A. The quality of all materials, the process of manufacture and the finished precast concrete sections shall be subject to inspection and approval by the Owner's Representative. Such inspection may be made at the place of manufacture and/or at the site after the precast products have been delivered.

Even though sample sections may have been approved and accepted as satisfactory at the manufacturer's yard, the finished sections shall be subject to rejection at any time after delivery, due to failure to meet any of the specification requirements.

B. Sections rejected after delivery to the job site shall be marked for identification and shall be removed from the job site at once. Sections which have been damaged after delivery will be rejected and replaced at the Contractor's expense.

C. At the time of inspection, the precast sections will be carefully examined to assure compliance with ASTM C478, these specifications and the manufacturer's approved shop drawings.

D. All sections shall be examined for general appearance, dimensions, scratch strength, laitance, honeycombs, blisters, cracks, roughness, soundness, etc. The surface of all precast sections shall be dense and close textured.

E. Imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong, sound and permanent repairs can result. All repairs shall be carefully inspected before final approval.

1.07 REQUIREMENTS

A. Sanitary lift stations shall be constructed in the dry. All work occurring at depths below groundwater level shall be dewatered and maintained in a dry condition continuously while work is taking place at those elevations.

1. Dewatering methods shall be at the Contractor's option, subject to the approval of the Owner's Representative.

2. The groundwater level shall be lowered only to sufficient depth to assure that excavation and trench bottom soils will not be saturated or develop quick conditions.

3. Disposal of dewatering water shall conform to the requirements of RCID and its General Permit.

4. Generally, dewatering water will require monitoring of both the quantity and quality of the discharge, and the discharge to surface waters cannot exceed a turbidity level of 29 NTUs over background.

5. Consult with and obtain owner's approval of dewatering means and methods prior to commencement of the work.

B. Sanitary lift stations and appurtenances shall be constructed, using the materials and equipment indicated on the drawings and as specified herein, substitutions shall not be made without the expressed approval of the Owner's Representative.

C. Where lift station piping is to extend into or through walls or structures, Link-seal type penetration seals shall be provided at the wall face. Openings into existing structures shall be made with a core-boring machine.

1.08 SUBMITTALS

A. PROCEDURES

1. Submit product data, shop drawings, samples, testing laboratory reports, etc. in a timely manner and in accordance with the requirements of Section 01330, Submittals.

B. PRODUCT DATA

1 The data to be submitted shall include, but not be limited to:

a. Ductile iron pipe and fittings.

b. Schedule 40, Type 304 stainless steel pipe.

c. Polyvinyl chloride (PVC) pressure pipe.

d. Threaded ductile iron pipe flanges.

e. Full faced rubber gaskets for flanged pipe and fittings.

f. Bubbler liquid level controls and sensors.

g. Liquid level float switches.

h. Pressure transducer type liquid level controls and sensors

i. Access hatches.

j. Pump hoists and monorail systems.

k. Plug valves.

l. Air release and vacuum relief valves.

m. Precast concrete wet wells and valve vaults.

n. Valve operators.

o. Submersible pumps.

p. Pump bases.

q. Auxiliary generators, including fuel tank and piping.

r. Flow meters

s. Electrical controls.

t. Corrosion protection materials.

u. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations

v. A complete total bill of materials of all equipment.

w. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, seals, etc. on the list. List bearings by the bearing manufacture's numbers only.

C. SUBMERSIBLE PUMP DATA: Specific data on the characteristics and performance of each pump to be submitted shall include the following:

1. Guaranteed performance curves, based on actual shop test of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, submergence and horsepower. Curves shall be submitted on 8-1/2 inch by 11 inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at Shut-Off Head to Pump Capacity at minimum specified TDH. Catalog cuts showing a family of curves will not be acceptable.

2. Complete motor data, including, but no limited to: type of enclosure design, rated horsepower, rated voltage, FLA, starting current, LRA, LRKVA, NEMA Code letter, rpm, input power in kW at nameplate rating, starting calculations, cable size, efficiency at 50%, 75%, & 100% load, and power factor at 50%, 75%, & 100% load.

D. CONTROL SYSTEM: Specific data on the control system to be submitted shall include the following:

1. Drawings showing the layout of the control panels and, where applicable, instrumentation panel. The layout shall show front and side elevations and shall indicate every device mounted on the inner or exterior door and subpanel with complete identification.

2. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, starters and related systems.

E. In the event that the equipment proposed does not conform with all of the detailed requirements of the Specifications, describe completely all non-conforming aspects. Failure to describe any and all deviations from the Specifications will be cause for rejection and/or disqualification.

F. Deliver a certified statement of agreement to the above listed conditions of warranty for equipment and materials to be supplied an installed under this Specification.

1.09 OPERATING INSTRUCTIONS

A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for equipment furnished and installed on this project and shall include all cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided to instruct representatives of the Owner on proper operation and maintenance.

C. The cost of training programs to be conducted with the manufacturer's personnel shall be included in the contract price. The training shall be directly related to the system being supplied.

D. The manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The manufacturer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to the Owner.

1.10 SPARE PARTS

A. The manufacturer shall furnish a complete list of recommended spare parts necessary for the first five (5) years of operation of each pumping system (including the control system).

1.11 PATENTS AND LICENSES

A. The manufacturer shall be responsible for all patents or licenses that exist because of the equipment that may be provided.

B. The manufacturer shall assume all costs of patent fees or licenses for the for the use of any equipment or process, structural feature or arrangement of any of the component parts furnished hereinunder, and the price bid shall be deemed to include payment of all such patent fees, licenses or other costs equipment or process, and shall safeguard and save harmless the Owner and his representatives from all damages, judgments, claims and expenses arising from licensing fees, or claimed infringement of any letters, patent or patent rights, or fees pertaining thereto.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile iron pipe and fittings shall conform to AWWA C151/ANSIA21.51 and shall have a minimum tensile strength of 60,000 PSI with a minimum yield strength of 42,000 PSI

1. Pipe thickness shall be in accordance with AWWA C110/ Pressure Class 150 minimum.

2. Ductile iron pipe shall have a minimum 1.0 mil bituminous coating on the pipe exterior in accordance with AWWA C151.

3. Ductile Iron Pipe and fittings for shall be lined with 40 mil thick ceramic epoxy lining. The ceramic epoxy lining shall consist of a two component amine cured Novalac epoxy of at least 87% solids and 20% by volume ceramic quartz pigment. The ceramic epoxy lining shall have a permeability rating of zero permeance when a film of at least 40 mils is tested in accordance with ASTM D1653-79 or a permeability rating of 0.0 perms when measured using ASTM E66-96 Method a, with a duration of 42 days.

   Pipe and lining shall be tested for holidays according to National Association of Corrosion Engineers (NACE) Standard Recommended Practice as outlined in RP 0274.

   One holiday per pipe length may be repaired in the field. Pipe with more than one holiday will be rejected.

4. All lift station piping and above ground piping shall be flanged joint in accordance with AWWA C115/ANSIA21.15 and shall be supplied in lengths not to exceed a nominal twenty (20) feet.

5. Pipe flanges and flanged ductile iron fittings shall be threaded, Class 250 in accordance with AWWA C115/ANSIA21.15 and ANSI/ASME B16.1.

6. Gaskets for flanged pipe and fittings shall be full faced neoprene, 1/16 inch thick.

Acceptable manufacturers:
U.S. Pipe, American Pipe, Clow, Griffin Pipe or approved equivalent.

B. Polyvinyl chloride (PVC) pipe for lift station service shall be PVC Type I, cell classification 12454-B.

1. Polyvinyl chloride (PVC) pipe and fittings shall be Schedule Eighty (80) with threaded joints conforming to ASTM D1785 and ASTM D2464. (One (1) to two (2) inches in diameter only.)

2. All PVC fittings shall be of the same manufacture as the pipe.

C. Galvanized steel pipe shall be Schedule Forty (40) and shall conform to ASTM A53, ASTM A106 or ASTM A120.

1. Galvanized pipe fittings shall be 150 lb. galvanized malleable iron, threaded and banded in conformance with ASTM A197 and ANSI B16.3, for three (3) inch and smaller.

D. PLUG VALVES shall be semi-steel body, non-lubricated, eccentric type, with resilient-faced plugs, bi-directional and capable of drip-tight shut-off at the rated pressure if applied at either port. Operation of all valves 4 inches or larger shall be by gear actuators furnished by the valve manufacturer. Gear actuators for buried or submerged installations shall have sealed enclosures. Equip valves with 2" square actuation nuts. Port opening for plug valves 16" or larger shall be 90% of pipe area. Port opening for plug valves smaller than 16" shall be 100% of pipe area.

Acceptable manufacturers:
Henry Pratt, Homestead, Clow, American, Mueller, M & H, Kennedy, Keystone, U.S. Pipe, Centerline, or approved equal.

E. Horizontal swing check valves shall conform to AWWA C508. Valve bodies and flanges shall be high strength cast iron in accordance with ANSI B16.1/125 lbs.

1. All working parts shall be removable through the top of the valve. A one quarter (1/4) inch tapped boss with plug shall be provided on the top flange of each valve. The valve shall be furnished with outside weight and lever.

2. Resilient seated check valves for applications on lines 8", 6" and 4" diameter shall be manufactured from ductile iron meeting ASTM A-536 65-45-12, with a pressure rating of 250 psig. Valves shall have a ductile iron disc fully encapsulated with Buna N rubber, with a disc travel of not more than 35 degrees and maintain a water tight seal at backpressures of 5 psig or greater. Valve bodies shall be fully coated with a minimum of 10

mils of fusion bonded epoxy on all internal and external ferrous surfaces. Encapsulated discs shall be reversible and maintain a watertight seal on either face. Valves shall be suitable for buried service, with standard flanged mating surfaces and free of internal and external moving parts with the exception of the reversible disc.

Acceptable Manufacturers:
American Flow Control, Mueller or approved equal.

F. Pressure gages shall be Red Valve Model 2608 or approved equal, oil filled with isolation diaphragm or Ronning-Petter Ful-Stream pressure sensor with PVC end connectors or approved equal.

G. Backflow preventer shall be reduced pressure principle conforming to AWWA C506 and shall be listed in the "RCID Policies and Procedures for Metering, Cross Connections, Backflow Prevention and Reclaimed Water", latest edition. The valves shall conform to the following.

1. End detail - screwed. ANSI B16.15.

2. Maximum working pressure - 150 PSI

3. Hydrostatic pressure test - 300 PSI

4. Temperature range - up to 110° F.

5. Fluid - water.

6. Materials - Bronze, ASTM B-61, 303 stainless steel.

H. Air release and vacuum relief valves (where indicated) shall be installed as shown on the plans. The valves shall be constructed with a cast iron body, cover and baffle, stainless steel float, bronze water diffuser, BUNA-N or viton seat and stainless steel trim.

1. Valves shall be provided with a vacuum check to prevent air from re-entering the line. All fittings shall be threaded.

2. Air release valves shall be Model 400 as manufactured by APCO Valve and Primer Corporation, Schaumburg, Illinois or Vent-O-Mat Series RGX.

2.02 PRECAST CONCRETE PRODUCTS

A. Precast concrete wet well sections and valve vaults shall be in accordance with ASTM C478.

1. Concrete for the construction of wet well sections and valve vaults shall be Class A concrete with a compressive strength of 4000 PSI at 28-days and shall conform to ASTM C94, Type II cement.

2. Precast sections shall be cured by an approved method for a minimum of four (4) days prior to painting and shall not be shipped for a minimum of seven (7) days after removal from the forms.

3. The interior and mating surfaces of all precast concrete products shall have a protective coal tar epoxy coating having a minimum dry thickness of 16 mils.

4. The exterior surfaces shall have a protective coal tar epoxy coating with a minimum dry thickness of 9 mils. The coatings shall be applied by the manufacturer in strict accordance with the paint manufacturer's recommendations.

   Acceptable coating:
   Koppers 300M, Devtar 5A by ICI Devoe or approved equal.

5. The date of manufacture of the precast sections and the name or trademark of the manufacturer shall be clearly marked or impressed on the exterior of each precast section when the form is removed, and on the interior after the section has been painted.

6. Precast sections shall be cast with tongue and groove joints, sealed with "Ramnek" (TM) sealant as manufactured by the T.K. Snyder Company of Houston, Texas or approved equal. Joint sealant shall meet or exceed all requirements of Fed. Spec. SS-S-210A and AASHTO M198.

7. Rubber ring joint seals for precast sections shall not be permitted.

B. Wet well and valve vault base sections shall be monolithic and shall not be less than eight (8) inches thick, and shall be reinforced with number five (5) bars at nine (9) inches on centers, each way and shall have number four (4) bars around each pipe opening as shown in the applicable detail at the end of this section.

1. All precast concrete products shall have proper lifting loops in the base slabs, or interior (minimum of four (4)). Penetrating lifting holes will not be acceptable in any structure.

2. Where pipes enter or exit lift stations or valve vaults, a neoprene resilient connector shall be used to provide a watertight connection for the pipe penetration into the wet well or valve box. The resilient connector shall be link-seal as manufactured by Thunderline Corp. or approved equal.

2.03 ACCESS HATCHES

A. Access hatches shall be fabricated from one quarter (1/4) inch aluminum diamond floor plate and reinforced for 300 pound load with a maximum deflection of 1/150th of the span. Hatches shall be single or double leaf construction in the minimum sizes shown in the drawings. The pump manufacturer shall coordinate the wet well hatch size with the pumps being furnished while the valve vault cover shall be double leaf with a minimum of 48’ x 48” clear opening.

Reinforcing shall have positive seating on the frame. Channel frame shall be 1/4" aluminum with full anchor flange around the perimeter.

1. The hatch shall be provided with stainless steel hinges which are removable for maintenance after the hatch has been cast in place.

2. Hatch gutters shall drain to the interior of the wet well and valve box.

3. Hatches shall be equipped with stainless steel hold open arms to hold the cover at ninety (90) degrees, stainless steel safety chains, cast aluminum drop handles, watertight slam-locks operated by a removable tee handle from the outside, stainless steel torsion bars for ease of opening and padlock hasps.

Acceptable manufacturer:
U.S. Foundry, Halliday, Bilco or approved equal.

B. Access hatches in vehicular traffic areas shall be rated for H20 wheel loads as defined by the AASHTO. Hatch covers shall be of aluminum cover plate with stainless steel hardware and may use galvanized steel for reinforcing. Acceptable manufacturers: U.S. Foundry, Bilco or approved equal.

2.04 SUBMERSIBLE PUMPS AND ACCESSORIES

A. The Contractor shall furnish and install all pumps, fittings and related equipment in accordance with the drawings and as specified herein.

1. The pumping units required under this Specification shall be complete including pumps, motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs and adjustments.

2. All metal components within the wet well, with the exception of the pumps, motors, station piping and related appurtenances, shall be 304 or 316 stainless steel.

3. Each foundation plate for each pump shall be designed and accurately anchored into position. All necessary foundation bolts, plates, nuts and washers shall be furnished by the manufacturer for installation by the Contractor.

4. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and all other pertinent data shall be permanently attached to each pump and/or motor.

5. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump.

6. The pump manufacturer shall factory test all pumps prior to shipment in accordance with the standards of the Hydraulic Institute. For all pumps, flow, TDH, and input kW shall be tested and recorded for at least five points on the pump performance curve, including shut-off head. Certified copies of the test reports shall be furnished to the Owner for approval prior to shipment.

B. PUMPS

The Contractor shall furnish and install the required number of submersible sewage pumps, of the required size and capacity, as referenced in the drawings.

1. Each pump shall be capable of handling raw, unscreened sewage. The overall pump design shall combine high efficiency, low required NPSH, large sphere passage and the ability to handle high solids concentrations efficiently. The impeller/casing design shall result in a passage free of surfaces to which solid or fibrous materials can adhere.

2. The design shall be such that the pumps will be automatically connected to the piping system when lowered on to the discharge fitting. Pumps shall be easily removed for service or inspection, not requiring the removal of nuts, bolts or other fasteners, or the need for personnel to enter the wet well.

3. Each pump shall be equipped with a 300 series stainless steel lifting bail with an opening of at least eight inches in diameter and a series 300 stainless steel cable or chain of adequate strength (rated for at least 4 times the weight of the pump/motor and coupling) and length to permit the raising and lowering of the pump for maintenance and inspection.

4. The stator casing, oil casing and impeller shall be constructed of gray cast iron with all parts coming into contact with raw sewage protected by a coat of PVC epoxy primer with a compatible epoxy finish coat.

5. All external bolts and nuts shall be 300 series stainless steel. A replaceable wear ring shall be installed at the pump inlet on all closed impellers to provide protection for the impeller against wear. Pumps 12 HP and less may be fitted with an adjustable spiral bottom plate and open impeller requiring no wear rings. The impeller shall be of a non-clog design and shall be capable of passing minimum 3-inch solids, heavy sludge, fibrous materials and shall be constructed with long throughways with no acute turns. Impellors shall be statically and dynamically balanced after assembly to the rotor. Impellor vanes shall be smooth, finished throughout and free of sharp edges. The impellor shall be attached to the shaft in a manner that will preclude it from unscrewing or loosening by torque from either forward or reverse rotation of the pump.

6. The pump casing shall have a machined connection system that will attach to the ASTM A48 Class 35B cast iron discharge connection. The sliding

guide bracket may be an integral part of the pump unit or a separate bolted to the pump discharge via a standard ASA bolt pattern. Sealing of the guide bracket to the discharge base shall not require movement of the pump, hydraulic pressure, or machined faces. The discharge connection shall be bolted to the floor of the sump with 316 stainless steel anchor bolts and so designed as to receive the pump connection without the need of any bolts or nuts. No portion of the pump shall bear directly on the floor of the sump.

7. The sealing of the sump unit to the discharge connection shall be accomplished by a downward motion of the pump, with the entire weight of the pump guided by not less than two (2), Type 304, Schedule 40 stainless steel guide rails, effecting a seal by the weight of the pump pressing against the face of the flange of the discharge connection. Buna-N seals shall be used, or approved equal. No portion of the pump shall bear against the floor of the sump. Intermediate supports of 304 stainless steel for the guide rails shall be provided every 10 feet.

8. Each pump shall be provided with a tandem double mechanical seal composed of two separate lapped face seals. The lower seal shall consist of one stationary and one rotating silicon carbide or tungsten carbide ring, and the upper shall consist of one stationary carbon ring and one rotating alloy steel ring. Each seal shall be held in contact by a separate spring. The seals shall require neither maintenance nor adjustment and shall be easily replaceable. Conventional double mechanical seals with single or double springs between the rotating faces, requiring constant differential pressure to effect sealing will not be considered equal to the tandem seal specified and required.

9. The pump shall be fitted with an oil chamber in which the shaft mechanical seals operate. The chamber shall be fitted with a drain and inspection plug easily accessible from the outside of the pump.

10. The pump motor shall be NEMA Design B with a minimum 1.10 service factor based upon the nameplate horsepower rating. De-rating the motors to achieve the specified services is not acceptable. Motors shall be rated at 155 degrees C for continuous operation in a totally, partially or non-submerged condition. Motors shall be non-overloading and capable of 15 starts per hour minimum or unlimited starts per hour if variable frequency drive driven. The motor windings shall be provided with minimum two over-temperature sensors set at 140 degrees C, one in each phase, all wired in series. The sensors shall be self-resetting and wired into the pump controls in a manner that will shut the pump down if the sensor opens.

11. Unless otherwise noted or shown on the drawings, motors shall be rated at 460 volts, three phase, and shall be Explosion Proof rated for Class 1, Division 1 environments.

12. The pump motor shall have cooling characteristics suitable to permit continuous operation, in a totally, partially or non-submerged condition

under full load without damage for extended periods. The pump motor shall be non-overloading at any point on the pump operating curve.

13. The pump/motor shaft shall be constructed of either 1045 carbon steel completely isolated with a 316 stainless steel shaft sleeve or 420/421 stainless steel and shall be keyed to accept the impeller. The impeller shall be secured to the shaft by a stainless steel locking bolt or nut. When operating the pump design point, the shaft shall have a maximum deflection of 0.2 mm at the lower seal face and a maximum deflection of 0.45 mm at the wear ring area.

14. The motor shaft shall rotate on permanently lubricated ball bearings properly sized to withstand the axial and radial forces induced by the impeller. The ABFMA minimum B-10 bearing life shall be at least 50,000 hours.

15. Pumps shall be provided with a cable entry design that shall preclude specific torque requirements to insure a watertight and submersible seal. Sealing of the power cable entrance into the terminal chamber shall be by one of the following systems:

    a. Cable terminal box on side of motor housing, with cable entry sealed to insure that no entry of moisture is possible into the high-voltage motor/terminal area even if the cable is damaged or severed below water level.

    b. A compressed grommet seal on the cable's outer jacket only, with a sealed terminal board between the cable entry and motor housing as a secondary seal against leakage through a damaged cable jacket. A moisture detector shall be provided in the sealed junction chamber area to signal and shut down the pump motor before shorting and motor damage can occur.

16. Guide Rails:

    a. Guide rails for submersible pumps shall be a double rail 316 stainless steel pipe type rail supported by 316 SS brackets spaced at intervals of no greater than 10 feet apart. At least one intermediate bracket shall be provided in addition to the upper guide rail bracket for all lift stations greater than 10 feet in wetwell depth. Upper guide rail brackets shall be mounted in to opening of the access hatch to facilitate pump removal.

    b. Single type guide rails or T-type rails shall not normally be accepted and shall be approved only upon written authorization by RCID or its authorized representative.

C. FLOAT/CABLE HANGER:

A 300 series stainless steel cable holder with a minimum of six hooks of sufficient length and strength to provide support for each separate cable shall be furnished. Sharp corners and edges shall be ground smooth to prevent abrasion and cutting of the electrical cable and insulation. The cable holder shall be of sufficient length and strength to provide support for each separate cable, except that the pump power and lift cables may use the same hook position, provided the cables do not foul one. The float/cable hanger shall be easily accessed from the hatch opening.

D. CABLE:

1. Pump motor cable shall be of the SO/SOW type suitable for submersible pump applications with the rating permanently embossed on the cable. Pumps shall be supplied with power and sensor conductors encapsulated in a single cable, where practical. Cable length shall be sufficient to reach the control panel without the need for junction boxes or splices. Cable sizing shall conform to NEC requirements for the full load current of the pump motor. Cables shall consist of a P-MSHA approved type SPC insulated cable with a double-jacketed protection system. The cables shall have a neoprene outside and synthetic rubber inside, and shall exceed industry standards for oil, gas and sewage resistance. Individual conductors shall be type RUW. Stainless steel strain relief cord grips shall be provided for each pump cable.

2. The power cable(s) from each pump shall be pulled to the control panel through a minimum of a 2" diameter conduit. If the pump is fitted with more than one power cable, the conduit diameter shall be increased accordingly. Only one set of pump power cables shall be pulled per conduit. All float switches shall be pulled through a separate 2" diameter conduit.

E. FLOAT SWITCHES:

Float switches shall be UL listed non-floating displacement type with sealed mercury switches in a chemical resistant polypropylene casing. Sufficient cable shall be provided to reach the control panel without the need for splices or junction boxes in addition to providing ample cable for height adjustments. Float switches shall be Roto-Floats as manufactured by Anchor Scientific.

F. PRESSURE TRANSDUCER:

Where specified, pressure transducers may be used to replace float switches or bubbler systems for level sensing and control in the wetwell. Sensors shall consist of a pressure sensing element encased in a watertight case with a 316 SS, FM-approved explosion-resistant body. Transducers shall be supplied with 40 ft. of shielded and vented cable, capable of withstanding a 200 pound tensile loading, and allowing the transducer to be suspended by its own cable. The device shall operate with a 10-30VDC power supply and provide a standard 4-20 ma DC

output. Unit shall be capable of operating in a temperature range of -20˚ F to +190˚F and have a static accuracy of 0.25% FSO BFSL. Pressure ranges for the transducer shall be as specified on the construction documents. The pressure transducer shall be the Birdcage Submersible Pressure Sensor by Blue Ribbon Corp., Winter Park, Florida or approved equal.

F. PHASE MONITORS:

Pump station shall be equipped with a combination voltage and power phase monitor as manufactured by Diversified Electronics.

G. ACCEPTABLE MANUFACTURER:

The electric motor driven, totally submersible sewage pumps shall be manufactured by ABS Pumps Inc., Flygt Corporation, Inc. or Wilo/EMU. Substitutes will not be accepted.

The pump vendor/supplier shall be responsible for furnishing a complete and integrated pumping system for the lift station, including but not limited to: pumps, motors, guide rails, level controls, guide rail brackets, pump bases/elbows and mounting plates, lifting cables, power and control cables, control panel and all interior hardware and enclosure, and all appurtenances interior to the wetwell to ensure a complete and functional system.

2.05 PUMP CONTROL SYSTEM

A. SYSTEM DESCRIPTION

1. A control panel shall be supplied containing all the electrical and mechanical equipment necessary to provide for the operation of the pumps. The panel shall operate from float switches and provide for redundant operation in the case of the "off" float switch failure.

   The pump control system shall operate as a regulator system, providing hard wired logic for sequential operation of the pumps and alarm system. All power through the panel into the wet well shall be twenty four (24) volt except for power to the pump motors, which shall be 460 volts, 60 Hertz, 3 phase.

2. The control panel will operate the electrical pumps at the power characteristics specified.

3. The control function provides for the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, additional pumps will automatically start and pump the station to the "off" elevation as shown on the plans. In the event the flow exceeds the capacity of the pumps, a high level audible alarm and light will be excited to indicate alarm conditions. A reset function shall lock out the audible alarm; however, the alarm light shall release only with the correction of the high level condition.

4. In the event of a loss of power, phase reversal of the incoming power lines, loss of phase or phase balance the pumps shall shut down to provide protection from single phasing. The phase monitor shall reset automatically upon removal of the stated conditions.

5. The control panel shall contain a combination circuit breaker and overloads for each pump, providing overload protection, short circuit protection, reset and disconnect for all phases; across-the-line magnetic starters; hand-off-automatic pump selector switches; phase monitor; overload relay for each pump which shall be pre-calibrated to match the pump motor characteristics, and factory sealed to insure that the trip setting is tamper proof; 120 VAC panel pilot circuitry; a 24 volt control circuit transformer with disconnect circuit breaker and overload protection for external pilot circuitry shall be included with an automatic electric alternator providing alternating operation of the pumps under normal operation or multiple pumps simultaneously under high-water conditions. Additional equipment shall be: flashing alarm light, auxiliary contacts for external alarms; terminal board for the connection of line, pump and liquid level sensors; liquid level sensors; ground fault receptacle; running time meters for each pump; lightning arrestor, power monitor and motor insulation detector.

B. MECHANICAL CONSTRUCTION AND MATERIALS

1. The control enclosure shall be a NEMA 3R enclosure manufactured from 14 gauge minimum 304 stainless steel material with a drip shield welded to the top to prevent intrusion of dripping water. The door shall be gasketed with a rubber composition material around the perimeter and shall be installed with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees. A padlock hasp shall be provided. Enclosure shall be pedestal mounted.

2. A 460 Volt generator receptacle (Hubbell #460R7W or approved equal) shall be installed on the side of the enclosure that will match the existing units utilized by the end user.

3. A polished aluminum inner dead front door shall be mounted on a continuous aluminum aircraft type hinge and shall contain cutouts for the protrusion of the control breakers and provide protection of personnel form internal live voltages. All control switches, pilot indicator lights, elapsed time meters, duplex receptacle and other operational devices shall be mounted on the external surface of the dead front. The dead front door shall open a minimum of 150 degrees to allow for access to the equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity. A locking feature shall be provided to hold the inner door open.

4. The back plate shall be manufactured from 12 gauge sheet steel and be finished with a primer coat and two (2) coats of baked-on white enamel.

All hardware shall be mounted using machine thread screws. Sheet metal screws shall not be acceptable.

5. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved white letters with a black background. Embossed tape similar to dymo tape is not acceptable. Control panel shall also be provided with a master nameplate located on the exterior door (wording and color to be supplied by the Owner).

6. Three (3) Crouse-Hinds type "CGB" cable connectors shall be provided to terminate the motor and float cables in the control panel. The connectors shall be suitable for a 2" conduit with a neoprene bushing suitable for the cables supplied.

7. The control diagrams and overload tables shall be laminated to the inside of the exterior door. Print storage pockets shall be provided on the inside of each panel. Pockets shall be of sufficient size as required to hold all prints necessary to service the panel. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

8. Provide an industrial corrosion inhibitor emitter that shall protect internal components of control panel from corrosion for up to one year. One spare emitter shall be provided for each panel.

C. EQUIPMENT

1. The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at 90 degrees "C". Conductor terminations shall be as recommended by the device manufacturer.

2. The control system shall contain a main circuit breaker [MCB] interlocked with the emergency circuit breaker [ECB], motor breakers [MB], control circuit breaker [CCB], duplex receptacle breaker [DRB] and any other devices as shown on the drawings.

3. The main and emergency circuit breaker shall be interlocked utilizing a "walking beam" device that is UL listed for the application. Mechanical devices that are not UL listed shall not be used.

4. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protector similar and equal to Square "D" type "FAL". Each breaker shall be sized to adequately meet the operating conditions of the load and have a minimum interrupting capacity of 10,000 amps at 230 VAC and 14,000 amps at 480 volts.

   a. Breakers shall be indicating type, providing "ON-OFF-TRIPPED" positions of the handle. They shall be quick make-quick break on

manual and automatic operation and have inverse time characteristics.

b. Breakers shall be designed so that tripping of one pole automatically trips all poles.

c. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

d. A motor circuit protector (MCP) shall be provided for each pump motor. MCPs shall be "MAG GARD" as manufactured by Square D, or equal.

5. Motor starters shall be open frame, across the line, NEMA-rated, Class 8536 as manufactured by Square D, with individual overload protection in each phase. Motor starter contacts and coil shall be replaceable from the front of the starter without removal of the starter from its mounted position. Overload heaters shall be block type, utilizing melting alloy spindles, sized for the full load amperage of the load. Adjustable overloads, definite purpose contactors, fractional size starters and horsepower rated contractors or relays shall not be used.

6. A lightning-transit protector with tell-tale operational indicators on each phase shall be provided. Indicators shall indicate loss of protection for that phase. The device shall be a solid state device with a response time of less the 5 nano-seconds with a withstanding surge capacity of 6500 amperes. Units shall be instant recovery, long life and have no holdover currents.

7. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 hertz, single phase current shall be mounted inside the panel. Receptacle to have a breaker that is on a separate circuit independent of all other loads.

8. The control panel shall include an adjustable time delay relay to prevent multiple pumps from starting simultaneously. Relays shall be Paragon Electric Company, Series JW, or equal.

9. Duplex alternators shall be STA-CON Model No. 008-1 20-1 3SP, or equal.

10. Each pump shall be provided with an automatic motor insulation monitoring device. The unit shall be a completely enclosed, solid state, electronic module designed to automatically monitor the motor winding insulation resistance. Each monitoring device shall be provided with a reset button, emergency bypass switch, power-on indicator and low meg light. Each unit shall be provided with two output circuits, one rate at 3 amps for the motor starter circuit and one rated at 1 amp for connection to alarm devices. The unit shall be designed to operate on a 120 volt power assembly.

11. WIRING

a. Tagging: All control panel wiring shall be numbered at both ends with typewritten heat shrinkable wire markers. Adhesive or taped on tags will not be acceptable. Tagging scheme shall identify the designated component tag and terminal destination.

b. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, type MTW thermoplastic insulation. Internal wiring for DC signal wiring shall be twisted pairs no smaller than No. 18 AWG, and be separated at least 6" from any power wiring. AC power wiring shall be 12 AWG. No. 16 AWG wiring shall be used for interconnecting relay coils, contacts, indicator lights, etc. within the panels.

c. Wiring shall not be spliced or tapped except at device terminals or terminal blocks. Control and signal wiring shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the longitudinal axis of the wire and the bend area shall be protected with a sleeve. All wires to internal components shall be connected to the "inside" of the field interface terminal strip. All wires to external components shall be connected to the "outside" of the field interface strip. no more than two wires shall be connected to any one terminal point.

d. Color Coding:

- Power Wiring: Phase A shall be black with brown phasing tape, Phase B shall be black with orange tape, and Phase C shall be black with yellow tape.

- Internally powered AC Control Wiring: Control panel wiring associated with control circuits that are de-energized when the main panel disconnect is opened shall be color coded "red".

- Externally powered AC Control Wiring: Control panel wiring associated with control circuits that remain "hot' when the main panel disconnect is opened shall be color coded "yellow".

- All yellow wiring leaving panels shall be brought to an isolated set of terminal blocks.

- Low voltage DC wiring: Blue (B+): Blue with tracer (B-)

- Intrinsically safe wiring: Light blue

- DC Control Wiring: Orange

- Neutral: White
- Ground: Green
- All foreign voltage control wiring shall be yellow.

12. Phase monitors shall be Diversified Electronics Model No. SUA-440-ASA with relay socket, for 480 volts, three phase, or equal.

13. Pump mode selector switches shall be Hand-Off-Auto type to permit override of automatic level control and manual actuation or shutdown of a pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown. Switched shall be NEMA 4X providing three switch positions, each of which shall be clearly labeled according to function.

14. Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (800H) modules, as manufactured by Allen-Bradley, or equal. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

15. A six digit, non-reset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenths of hours". The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal, or equal.

16. Fuses shall be wired such that the alarm circuitry of the station is unaffected should a fuse blow. The intention is to have the high well, power failure and other alarm features of the station remain functional and intact if the fuse protection features of the panel are initiated.

D. DETAILED OPERATION

1. A 24 volt intrinsically safe AC power system shall be provided for the float or pressure transducer control system. The system shall provide for the automatic control and alternation of the pumps to maintain a pumped down condition of the wet well. Levels shall be sensed by float switches or the pressure transducer adjusted to the level shown on the plans.

2. Each pump shall be controlled by the pressure transducer or a float switch and when tilted shall turn the pump on. The pump(s) shall remain "on" until a common "off" level is reached.

3. At the conclusion of each pump cycle, an alternator shall switch the pumps on the next cycle to equalize run time on the pumps.

4. In the event the "Off" float switch fails, the system shall sense the failure and switch the "Off" level to the second float switch. The system shall provide indication for the switches and indicate a failure of the "Off" unit.

5. Control system contingent on the "Off" float switch supplying control power to the other units is not acceptable.

E. EQUIPMENT LIST

The control system shall include, but not be limited to the following equipment. The list is to determine the required devices for the proper operation of the system.

- Motor breakers main circuit breaker
- Control circuit breaker
- Transducer readout (if specified)
- Motor starters
- Surge protection
- Duplex ground-fault receptacle breaker
- Phase monitor
- Alternator
- Duplex ground-fault receptacle
- Relays
- Fuses
- HOA Switches [NEMA 4]
- Generator receptacle
- Run lights
- Float pilot lights
- Elapsed time meters
- 24 VAC XFRMR
- 480/120 VAC XFRMR
- MS overloads
- Alarm light
- Alarm horn
- Flasher
- Terminal strips
- MCB/ECB interlock
- Alarm silence

G. ACCEPTABLE MANUFACTURER:

The control panels shall be manufactured by STA-CON, Orlando, FL; Quality Controls, Orlando, FL; or Electric Specialty, Orlando, FL. Substitutes will not be accepted.

PART 3 - EXECUTION

3.01 HANDLING AND STORAGE OF PIPE FITTINGS AND APPURTENANCES

A. All pipe, fittings and appurtenances shall be loaded and unloaded by lifting with hoists or skidding in order to avoid shock or damage.

1. Pipe, fittings and appurtenances shall not be dropped, rolled or skidded into or against pipe, fittings or other construction products on the ground.

2. Slings, hooks, pipe tongs and other lifting devices shall be padded and used in such a manner as to prevent damage to pipe or construction products.

3. Stored materials shall be kept safe from damage. The interior of all pipe, fittings and appurtenances shall be kept free from dirt, oil, grease and foreign matter at all times.

B. Pipe shall not be stacked higher than the limits shown in the following table.

MAXIMUM STACKING HEIGHTS FOR PIPE

Nominal Pipe Size (Inches)	6	8	10	12	14	16	18	20	24	30	36	42
Number of Tiers	13	11	10	9	8	7	6	6	5	4	4	3

The bottom tier shall be kept off of the ground on timbers. Pipe in tiers shall be alternated, (i.e., bell, plain end; bell, plain end, etc.). No less than two rows of timbers shall be placed between tiers. Chocks shall be affixed to each, in order to prevent movement. The timbers shall be large enough to prevent contact between pipes in adjacent tiers.

C. The Contractor shall cover stored PVC pipe to prevent exposure to ultraviolet radiation.

D. Pipe gaskets shall be used in the work on a first-in, first-out basis.

1. Gaskets for mechanical joint and push-on joint ductile iron pipe and fittings shall be stored in a cool, dry location, out of direct sunlight.

2. Gaskets shall be stored in such a manner so as to prevent coming into contact with petroleum products.

E. Mechanical joint bolts and locking segments for push-on joints shall be handled and stored in such a manner that will insure proper use in respect to pipe types and sizes.

3.02 EXCAVATION AND TRENCH CONSTRUCTION

A. Trenching, excavation and shoring shall be in accordance with Section 02320.

3.03 SETTING WET WELLS AND VALVE VAULTS

A. All wet wells and valve vaults shall be in accordance with the plans or the standard detail drawing at the end of this section.

1. Wet wells and valve vaults shall be precast concrete units and shall be in accordance with ASTM C478.

2. Wet wells and valve vaults shall be precast units with integral base slab and wall sections. Poured in place base slabs shall not be approved. Wet wells and valve vaults shall conform to Subsection 2.02 of this specification and the applicable standard detail at the end of this section.

3. Valve vault bases shall be sloped to a floor drain and the drain shall be equipped with a p-trap and sloped to the wetwell, unless shown otherwise on the drawings.

B. The soil foundation beneath the precast unit shall be stabilized and compacted to ninety-eight (98) percent of the maximum density as determined by ASTM D1557 and ASTM D1556.

1. The precast wet wells and valve vaults shall be carefully placed on the prepared foundation so as to be fully and uniformly supported in true alignment, making certain that the pipe can pass through on the designed line and grade.

2. The first precast section shall be placed and adjusted to true grade and alignment. All inlet pipes shall be properly installed so as to form an integral watertight unit. The sections shall be uniformly supported by the base structure, and shall not bear directly on any of the entering or exiting pipes.

3. Precast units shall be handled by lifting rings only.

4. Precast wet wells and valve vaults shall be placed and aligned to provide vertical alignment with not more than one eighth (1/8) inch maximum tolerance for five (5) feet of depth. The completed unit shall be watertight, rigid, true to dimensions and alignment.

3.04 TESTING

A. Refer to Section 01410, Testing Laboratory Services.

B. FACTORY PERFORMANCE TESTS:

The pump manufacturer shall provide factory performance tests in accordance with the Hydraulic Institute Standards, latest edition. Certified performance curves shall be submitted for capacity, power requirements and pump efficiency at specified minimum operating head, shut off head and at least three other points.

C. FIELD TESTING:

1. Field testing shall be provided by the Contractor with the representative of the pump manufacturer present, and witnessed by the Owner's Representative.

a. A three-point pump performance test shall be performed, measuring the amperage draw, voltage, discharge pressure and the rate of flow.

b. The rate of flow and head shall be within 10 percent and 5 percent, respectively, above the approved curve for acceptance.

c. The test results shall be provided to the Owner's Representative prior to the final inspection of the system.

2. Upon completion of each station, the PUMP MANUFACTURER shall inspect the installation and submit a certificate stating that the installation of the equipment is satisfactory, and that the equipment is ready for operation.

3. After all pumps have been completely installed, the Contractor, along with the PUMP SUPPLIER shall conduct, in the presence of the Owner's Representative, such tests as are necessary to indicate that the pump station conforms to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests. As a minimum, the test shall include satisfactory demonstration of the level control system (high, low and alarm level), pump alteration system, alarms, pump operation and valve functioning.

3.05 START-UP ND FINAL INSPECTION

A. The contractor shall schedule with the Owner's Representative for start-up and final inspection at the completion of the work.

B. Prior to the final test, the contractor shall flush all influent lines to the station and then shall remove all debris and sediment that has accumulated in the station bottom.

C. The Final Acceptance Test shall demonstrate that all items of these specifications have been met by the equipment as installed and shall include, but be limited to, the following items:

1. That the quick release lift out feature functions properly and allows the pumps to be easily raised and lowered.

2. That all units have been properly installed and are in correct alignment.

3. That the units operate without overheating or overloading any parts without objectionable vibration.

4. That there are no mechanical defects in any of the parts.

5. That the pumps can deliver the specified pressure and quantity of raw, unscreened sewage.

6. That the pump sensors and controls perform satisfactorily as to control sequence; i.e. correct start and stop elevations, and proper alarm level functions.

D. If the pump performance does not meet the Specifications, corrective measures shall be taken or the pumps shall be removed and replaced with pumps which satisfy the conditions specified. A 24-hour operating period of the pumps will be required before acceptance. If a pumping station cannot be put into regular

service because of the lack of wastewater or discharge force mains, the station shall be "exercised" at a minimum of two times a month by the Contractor.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site concrete work, including subgrade preparation, formwork, reinforcing steel, concrete, and accessory materials for:

1. Pavement, curbs, and gutters.
2. Walkways and steps.
3. Retaining walls, catch basins, manholes, valve and sump pits, and similar structures.
4. Footings for fence posts, and similar work of other trades.
5. Dumpster and compactor equipment pads.
6. Thrust blocks for pressure piping systems.
7. Mechanical and electrical equipment pads.
8. Ductbanks.
9. Other site concrete work as indicated on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grading: Section 02310.

B. Asphalt concrete paving: Section 02745.

C. Precast concrete and other use concrete specified as part of Divisions 2, 15 and 16.

1.03 DEFINITIONS

A. Slip resistance: Slip index of not less than 0.5 when tested dry and wet (with an unbroken film of pure water) in accord with ASTM F609 using a Neolite test pad.

1.04 QUALITY ASSURANCE

A. Tests and inspections:

1. Testing laboratory services: Refer to Section 01455.
2. Soil bearing and compaction:
   a. Test methods:
      (1) Maximum dry density of backfill materials shall be determined by ASTM D1557, Procedure A.
      (2) Field density tests shall be determined by ASTM D1556, ASTM D2922, or ASTM D2937.
   b. Required tests:
      (1) Backfill material: Determine suitability of backfill material not previously evaluated.
      (2) Maximum density tests: Determine optimum moisture content and maximum dry density of backfill materials placed and compacted.

(3) Field density tests: Determine in-place density of backfill materials placed and compacted. one test for every 1000 cu. yd. of material placed and one test for each 1 ft. vertical lift.

(4) Other tests as may be required by Owner.

c. Required inspections:

(1) Excavation inspection: Detailed inspection of exposed excavations prior to placing backfill material.

(2) Placement and compaction inspection: Continuous inspection and monitoring.

3. Concrete: In accord with -FDOT Section 346-5 and as specified herein.

a. Portland cement: Furnish cement mill test reports and manufacturer's certification that cement complies with specification requirements.

b. Required tests:

(1) Aggregate:

(a) Hardrock aggregate: Test in accord with ASTM C33.

(b) Limerock aggregate: Test for conformance to local acceptable standards and specified requirements.

(c) Do not deliver aggregates to site or ready-mix plant until pit source has been approved, and plant, capacity, and ability to produce a uniform and continuous product has been verified.

(d) Take samples from aggregate stockpiles assigned to project.

(2) Slump tests: Make one slump test in accord with ASTM C143 for each set of test cylinders: Make additional tests as may be ordered by Owner.

(a) Make and keep an accurate record of all tests.

(b) Maximum slumps: As specified hereinafter.

(3) Test cylinders: Take one sample of four cylinders from each day's placement of 100 cu. yd. or fractional part thereof of each mix design in accord with ASTM C172. Take samples at evenly spaced intervals as concrete is deposited in forms. Mark cylinders with date, sample number, and location in structure from which sample was taken. Do not take more than one sample of four cylinders from any location or batch of concrete.

(a) Make and store cylinders in accord with ASTM C31.

(b) Curing: At the end of 24 hours, take cylinders to laboratory and store under moist curing conditions at approximately 70°F until tested.

(c) Testing:

(i) Test cylinders in accord with ASTM C39. Test one cylinder at age of 7 days for information and two cylinders at 28 days for acceptance. Maintain one cylinder in reserve.

(ii) Seven-day strength: Not less than 60% of specified ultimate 28-day strength.

(d) Mix adjustment: Should test results indicate concrete strength below specified 7-day or 28-day minimum requirements, decrease water/cement ratio and adjust mix proportions as necessary to achieve specified minimum strengths.

(e) Concrete failures:

(i) Should test results indicate that concrete strength requirements for any portion of work does not conform to 28-day minimum requirements, secure core or prism specimens of hardened concrete and test in accord with ACI 301 and ASTM C42.

(ii) Laboratory shall secure and test specimens under Owner's direction.

c. Ready-mix plant inspections:

(1) Testing laboratory shall provide and maintain continuous inspection at plant to check sieve analysis for quality and moisture content of aggregates, check mix with design mixes, check cement being used with test reports, check loading of mixer trucks, and certify quantities of materials loaded in each mixer truck.

(2) Certification: Provide batch tickets signed by dispatcher and testing laboratory inspector at ready-mix plant. Each batch ticket shall state batch quantities of cement, water, fine aggregates, coarse aggregates, and admixture contained in each truck load.

(3) Deliver to Owner's representative on job site a properly signed ticket with each load of ready-mix concrete.

4. Reinforcing steel:

a. Quality control of identifiable steel:

(1) Submit to laboratory copies of mill certificates for all types, sizes, and heats of reinforcing steel intended for use in the work. Include the following information:

(a) Source of steel.

(b) Description.

(c) Heat number.

(d) Yield point.

(e) Ultimate tensile strength.

(f) Elongation percentage in 8 in. length.

(g) Bend test results.

(h) Chemical analysis, including carbon equivalent (CE) of ASTM A615 bars to be welded.

(2) All costs in connection with tests and inspections of identifiable steel will be paid by Owner.

b. Quality control of unidentifiable steel:

(1) When steel cannot be identified, testing laboratory shall make one series of tensile tests and one series of bend tests in accord with ASTM A370 or ASTM A615, for each 5 tons or fractional part thereof of each size and kind of reinforcing steel. Make tests using a minimum of two separate samples. Test full sections of bars as rolled.

(2) All costs in connection with tests and inspections of unidentifiable steel will be paid by Contracto.

c. Field quality control for welding:

(1) Inspection and tests of welds shall be made by testing laboratory for reinforcing bar welds, as follows:

(a) Certification of welders engaged in electric-arc welding of reinforcing.

(b) Inspection of reinforcing bar welds.

(c) X-ray test of one of the first arc-welds made by each welder; full penetration splice welds.

(d) Two tensile tests of sample welds of the largest size bar for each type of welding.

(2) Owner will pay all costs in connection with tests and inspections for welding of reinforcing steel splices when such welding is indicated on Drawings.

(3) All costs in connection with tests and inspections for welding of reinforcing steel splices not indicated on Drawings will be paid by Contractor.

5. Payment:

a. Owner will pay all costs for all tests and inspections except retests and reinspections required because of failures.

b. All costs incurred for retests and reinspections required because of failure of original tests will be paid by Contractor.

B. Reference specifications and standards:

1. ACI: 301 Specifications for Structural Concrete for Buildings.
2. ACI: 305 Hot Weather Concreting.
3. ACI: 306 Cold Weather Concreting.
4. ASTM: A370 Mechanical Testing of Steel Products.
5. ASTM: A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
6. ASTM: C31 Making and Curing Concrete Test Specimens in the Field.
7. ASTM: C33 Concrete Aggregates.
8. ASTM: C39 Compressive Strength of Cylindrical Concrete Specimens.
9. ASTM: C42 Drilled Cores and Sawed Beams of Concrete, Obtaining and Testing.
10. ASTM: C143 Slump of Hydraulic Cement Concrete.
11. ASTM: C172 Sampling Freshly Mixed Concrete.
12. ASTM: C1107 Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
13. ASTM: D1556 Density of Soil in Place by the Sand-Cone Method.
14. ASTM: D1557 Moisture-Density Relations of Soils Using 10 lb. Rammer and 18 in. Drop.
15. ASTM: D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
16. ASTM: D2937 Density of Soil In-Place by the Drive-Cylinder Method.
17. ASTM: E1155 Determining Floor Flatness and Levelness Using the *F*-Number System
18. ASTM: F609 Using a Horizontal Pull Slipmeter (HPS).
19. FDOT: Standard Specifications for Road and Bridge Construction.

20. SSPWC: Standard Specifications for Public Works Construction ("Green Book").

1.05 SUBMITTALS

A. Procedure: In accord with Section 01330.

B. Shop drawings: Plans, elevations, sections, and details, including layout of components and accessories. Indicate dimensions, clearances required, utility service requirements, materials, and finishes.

C. Manufacturer's detailed technical materials data, including technical bulletins, drawings, guides, and manuals, as applicable to the work of this Project, for the following:

1. Admixtures.
2. Curing materials.
3. Joint materials.
4. Waterstops.
5. Metallic aggregate topping.
6. Nonshrink grout, including test data.

D. Certifications:

1. Cement mill test reports and certification.
2. Admixture certification, including chloride ion content.
3. Ready-mix batch plant tickets.
4. Reinforcing steel mill certifications.
5. Reinforcing steel welder's certifications.

E. Concrete mix designs: Submit, for approval, certified concrete mix designs for initial and any subsequent changes in mix designs.

1.06 PROJECT CONDITIONS

A. Existing conditions:

1. Do not conceal or cover any work until required tests and inspections have been performed and accepted.
2. Do not fabricate items which require fitting to other building elements or into building spaces, until dimensions have been verified at the site.

B. Environmental requirements: Unless otherwise recommended by product or system manufacturer or reference specifications or standards, conform to the following:

1. Do not place concrete when the ambient temperature is 35°F or lower or is expected to go below that temperature within 24 hours.
2. Do not place concrete during rain that will cause surface damage to concrete.
3. Hot weather concreting procedures: In accord with ACI 305.
4. Cold weather concreting procedures: In accord with ACI 306.

C. Traffic control:

1. Maintain vehicular and pedestrian traffic control during concrete operations.

2. Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety, and to cause the least interruption of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete: In accord with FDOT Section 346, Portland Cement Concrete, type as indicated on Drawings.

1. Cement: Conform to*n* FDOT Section 921.
2. Admixtures: Conform to FDOT Sections 346-2.5 and 924.
3. Fine aggregates: Conform to FDOT Section 902.
4. Coarse aggregates: Conform to FDOT Sections 346-2.4 and 901.
5. Design slumps and mix proportioning: FDOT Section 346-3.1 and 346-4.1, except as follows.
   a. Conform to approved design mix.
   b. Provide concrete which will develop the following minimum 28-day ultimate compressive strengths.
      (1) Retaining walls and similar structural uses: 4000 psi.
      (2) All other uses: 3000 psi.

B. Formwork: Wood or equivalent metal, conforming to FDOT Section 400-5.3.

C. Reinforcement: Conform to FDOT Section 931.

D. Curing materials: Liquid or equivalent sheet membrane, conforming to FDOT Section 925, except as specified herein.

E. Joint materials:

1. Construction joints: Preformed galvanized steel sheet or resawn wood.
2. Expansion joints: Premolded resilient filler, conforming to FDOT Section 932, except as specified herein.

F. Waterstops: Unless otherwise indicated on Drawings, provide extruded dumbbell type, spliced by thermal butt fusion.

G. Borrow material (for fill): Nonexpansive, predominantly granular material:

1. Particles less than 2 in. in any dimension;
2. Free of organic and inorganic debris;
3. Not more than 12% by weight passing the No. 200 sieve.
4. Acceptable to a geotechnical engineer retained by Owner.

H. Non-shrink grout: Prepackaged, nonshrink, nonmetallic, natural aggregate grout conforming to ASTM C1107, with minimum 28-day compressive strength of 5000 psi.

1. Hi-Flow or NS Grout by Euclid Chemical Company.
2. Five Star Grout by Five Star Products.
3. Master Flo 713 or 928 by Master Builders, Inc..

I. Integral mineral coloring pigments: Provide pure synthetic or natural mineral oxide colors as selected by Owner.

1. Chromix by L.M. Scofield Co., Longwood, FL, Los Angeles, CA.
2. Davis Colors, Beltsville, MD, Los Angeles, CA.
3. Lambco Colors by Lambert Corp. of Florida, Orlando, FL.
4. Landers-Segal Color Co., Inc., Passaic, NJ.
5. Solomon Colors, Springfield, IL.

J. Extra heavy-duty, high slump, metallic-aggregate topping:

1. Super Euco-Top by Euclid Chemical Company.
2. Mastertop 300 Anvil-Top by Master Builders.

K. Miscellaneous materials: As required to complete the Work.

2.02 INTEGRALLY COLORED CONCRETE

A. Provide integral color concrete for concrete pavements and other concrete work indicated on Drawings to be colored.

B. Consolidate color admixture in accord with manufacturer's instructions, using pigment proportions as required to match Owner-approved samples.

PART 3 - EXECUTION

3.01 PREPARATION

A. Compact top 6 in. subgrade to 95% of the Modified Proctor maximum dry density.

B. Do not allow traffic over prepared subgrade.

C. Uniformly moisten subgrade at time concrete is placed. Uniformly apply water immediately prior to concrete placement.

D. Accurately trim to required elevations, allowing for full thickness concrete.

3.02 WALKS AND SLABS

A. Construct in accord with FDOT Section 522, except finishing and curing of integral color concrete shall be as follows.

1. Finishing:

a. Tamp freshly placed concrete with approved metal grid tampers not less than 12 in. x 12 in. in size so as to bring fines to top, then rod to uniform surfaces at required levels.

(1) Float and trowel finish as soon as surface becomes workable.

(2) Provide slopes as indicated on Drawings, or as directed by Owner.

b. During finishing maintain adequate surface moisture and reduce plastic shrinkage as recommended by integral color manufacturer.

(1) Immediately after fresh concrete has been brought to a flat surface, a shiny film of moisture on top surface shall not be permitted to evaporate or as soon as the shiny surface disappears, it shall be restored and maintained until troweling.

(2) Maintain surface moisture film as specifically recommended by integral color manufacturer applying evaporation retarder/finishing aids, frequent, light, fine spray applications of water rather than excessive wetting. Adjust extent of water spray in accord with temperature, humidity, and wind conditions.

c. Work concrete flatwork to achieve the following tolerances when measured in accord with ASTM E1155.

(1) Trowel finished surfaces: F_F25/F_L20 with minimum F_F20/F_L15.

(2) Float and broom finished surfaces: F_F20/F_L17 with minimum F_F15/F_L10.

d. Surface finish textures:

(1) Provide float, trowel, brush/broom, and/or abrasive-blasted surface textures to match Owner-approved sample panels.

(2) Perform slip resistance testing to ensure that slip resistance of exposed concrete walking surface finishes is maintained. Follow testing procedures required for slip resistance testing of mock-up sample panels.

2. Curing: Cure, harden, and seal colored concrete flat slabs with compound(s) recommended by manufacturer of integral color concrete pigments. Curing, hardening, and sealing compound(s) shall not discolor, lighten, darken, stain, or impart other unsightly characteristics to colored concrete and shall be compatible with Owner's maintenance sealer.

B. Dumpster and compactor equipment pads and similar heavy-duty use areas indicated on Drawings: Apply bonding agent as recommended by topping manufacturer. Mix and apply extra heavy-duty, metallic-aggregate topping in accord with manufacturer's recommendations; unless indicated otherwise, provide minimum 1 in. topping thickness.

3.03 CURBS AND GUTTERS

A. Construct concrete curbs, gutters, and other similar structures in accord with FDOT Section 520, except finishing and curing of integral color concrete shall be as specified herein for walks and slabs.

3.04 SITE STRUCTURES

A. Construct catch basins, manhole bases, junction boxes, inlets, and other similar structures to conform to requirements of FDOT Section 425, Inlets, Manholes and Junction Boxes. Construct thrust blocks, ductbanks, and other similar concrete structures in accord with requirements of FDOT Section 400, Concrete Structures.

1. Formwork: Conform to FDOT Section 400-5.

2. Placing reinforcing steel: Conform to FDOT Section 415.

3. Placing concrete: Conform to FDOT Section 400-7.

4. Consolidating (mechanically vibrating) concrete: Conform to FDOT Section 400-7.11.

5. Waterstops:

a. Install accurately in the formwork. Securely fasten in place as recommended by manufacturer to prevent displacement during concrete placement.

b. Use full manufactured length to avoid joints as much as possible.

c. Thermally weld all joints and intersections in accord with manufacturer's instructions. Joints shall develop 85% (minimum) of tensile strength of section.

6. Construction joints: Unless indicated otherwise on Drawings, keyed type, conforming to FDOT Section 400-9 and as specified herein.

7. Expansion joints: Unless indicated otherwise on Drawings, premolded resilient filler, conforming to FDOT Section 400-10.

8. Form removal: Conform to FDOT Section 400-14.

9. Finishing: Conform to FDOT Section 400-15.

10. Curing: Conform to FDOT Section 400-16.

B. Additionally construct thrust blocks, ductbanks, and similar concrete structures related to other Divisions of work, in accord with requirements specified in applicable Sections and as indicated on Drawings.

3.05 JOINTS

A. Construction (pour) joints:

1. Place construction joints at all breaks in concrete placement lasting more than 1 hour and at color changes.

2. Unless otherwise indicated on Drawings, key construction joints for slabs 6 in. or more in thickness, except at expansion joints.

B. Expansion joints: Construct expansion joints with preformed resilient filler compatible with joint sealant materials, including joint backing, specified in Section 07920.

C. Control joints:

1. Place control joints in all exterior flat concrete work, and other locations as indicated on Drawings.

2. Where control joints are not indicated on Drawings, verify specific types and layout with Owner prior to placing concrete. Size and shape of layout is dependent on specific areas, but do not space control joints farther apart than 10 ft. o.c. in a square pattern (e.g., if a concrete walk is 4 ft. wide, control joint should occur at equal spacing of approximately 4 ft. o.c. along length).

3. Control joints may be one of two types, as indicated on Drawings: Saw-cut or hand-tooled.

a. Saw-cut:

(1) Use at slabs on grade only. Make saw-cuts 1/8 in. wide. Do not cut through steel bar reinforcing. Depth of all saw-cuts shall not be less than 1/4 of slab thickness.

(2) Verify hardness condition of concrete before commencing saw-cutting to ensure that saw will not fret, ravel, or spall edges of cuts nor dislodge aggregate. Use saw-cutting equipment appropriate for the hardness condition of concrete

b. Hand tooled: Make control joints with a "V" shaped jointing tool with rounded edges and a 3/4 in. deep keel.

c. Whether saw-cut or hand-tooled, accurately lay out areas and make control joints straight and true, with clearly defined angles.

4. Construction (pour) joints may be substituted for control joints where specifically approved by Owner.

3.07 PROTECTION OF COMPLETED WORK

A. During curing period, protect concrete from damaging mechanical disturbances, water flow, loading shock, and vibration.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Asphalt concrete paving.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cutting & Patching: Section 01732

B. Site Demolition: Section 02220.

C. Grading: Section 02310.

D. Excavating and Backfilling for Utilities: Section 02320.

1.03 QUALITY ASSURANCE

A. Tests and inspections:

1. Procedure: In accord with Section 01455.

2. Required tests:

a. Compaction:

(1) Limerock base: Perform field density tests in accord with ASTM D1557 (AASHTO T180).

(2) Special aggregate base ("Dura-Rock"): Perform field density tests in accord with ASTM D558 (AASHTO T134).

(3) Asphalt concrete surface course: Perform field density tests in accord with FDOT Section 330-10.3.

b. Water flood tests of finished paving: In addition to tests and requirements of FDOT Section 330-12 conduct a water flood test of areas as directed by Owner.

3. Required inspections:

a. Base:

(1) Verify that base meets or exceeds specified base course.

(2) Visually observe uniformity and moisture condition of base material as it is delivered to project site.

(3) Observe and monitor placement and construction of base material to ensure that work meets or exceeds specified requirements.

(4) Make random depth checks before and after final compaction to assure minimum compacted thickness is obtained.

b. Special aggregate base ("Dura-Rock"):

(1) Continuously monitor batching and mixing operations at the batch plant.

(2) Provide written reports to Owner listing the following:

(a) Gradation of sand, weight, and proportion to limerock.

(b) Limerock weight and proportion to sand.

(c) Cement weight and proportion to sand and limerock.

(d) Water, in gallons, and proportion to dry materials.

(3) Perform inspections not less than once each day for duration of special aggregate base ("Dura-Rock") batching and mixing operations.

(4) Perform a detailed inspection of the completed special aggregate base ("Dura-Rock") at the age of 7 days to ensure sufficient hardness to withstand anticipated traffic without marring and distortion.

B. Reference specifications and standards:

1. ASTM: C136 Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM: C150 Portland Cement.
3. ASTM: D558 Moisture-Density Relations of Soil-Cement Mixtures.
4. ASTM: D977 Emulsified Asphalt.
5. ASTM: D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft^3).
6. ASTM: D2026 Cutback Asphalt (Slow-Curing Type).
7. ASTM: D2028 Cutback Asphalt (Rapid-Curing Type).
8. ASTM: D3320 Emulsified Coal-Tar Pitch (Mineral Colloid Type).
9. FDOT: Standard Specifications for Road and Bridge Construction.

1.04 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Product data: Manufacturer's detailed technical materials and application data, including technical bulletins, guides, and manuals for seal coat materials.

C. Certificates/certifications: Supplier's certification that materials conform to Specifications requirements.

1. Typeof asphalt concrete mixtures in accord with FDOT Section 331.
2. Sieve analysis of asphalt concrete aggregates in accord with ASTM C136.

1.05 PROJECT CONDITIONS

A. Existing conditions: Do not conceal or cover any work until required tests or inspections have been performed and accepted.

B. Environmental requirements: Unless recommended otherwise by material or product manufacturer conform to the following.

1. Apply or install products or systems only when ambient temperatures are above 50°F and rising.
2. Place base course when ambient temperature is above 40°F.

C. Protection: Protect completed installation from damage of subsequent construction activities. Immediately remove all foreign matter that accumulates on exposed surfaces in accord with fabricator or manufacturer's recommendations.

1. Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.

2. Provide flagmen, barricades, warning signs, and warning lights for movement of traffic and safety, and to cause the least interruption of work.

D. Sequencing and scheduling:

1. Coordinate and sequence the application or installation of work of this Section with adjacent or integral materials, products, and work specified in other Sections. Such work includes, but is not limited to, the following:

a. Concrete curbs and gutters.

b. Concrete paving.

c. Utility services.

d. Demolition of existing asphalt concrete.

e. Cold mill existing asphalt concrete paving.

2. Order specified materials, products, and similar items with extended "long lead" (ordering) times, sufficiently in advance of scheduled application, or installation dates to not delay the scheduled progress of the Work. Such items include but are not limited to the following:

a. Items of rare ("short") supply.

b. Items not of standard stock.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stabilizing materials: Conform to FDOT Section 914, Type B or C at Contractor's option.

B. Limerock: Conform to FDOT Section 911, and classified as Ocala Formation (no substitution).

C. Asphalt concrete: Conform to FDOT Section 331, Type S-I or S-III, unless indicated otherwise on Drawings.

D. Prime coat: Cutback asphalt, rapid curing, Grade RC-70, conforming to FDOT Section 916-3 (AASHTO M81/ASTM D2028).

E. Tack coat: Anionic asphalt emulsion, slow-setting, Grade SS-1H, FDOT Section 916-4 (AASHTO M140/ASTM D977).

F. Seal/slurry coat:

1. New paving: Coal-tar emulsion conforming to ASTM D3320[blend of emulsified asphalt and coal-tar emulsion (not less than 10%)].

2. Existing paving: Plant-blended asphalt emulsion and mineral aggregate mixture, conforming to SSPWC Section 203-9.

G. Special aggregate base ("Dura-Rock"):

1. Limerock: Conform to FDOT Section 911, and classified as Ocala Formation.

2. Sand: Conform to the following gradation.

Sieve	Percentage Passing
No. 10	92 - 100
No. 20	62 - 80

No. 40	38 - 58
No. 60	17 - 35
No. 100	0 - 19
No. 200	0 - 8

3. Cement: ASTM C150, Type I Portland cement.
4. Water: Potable.

2.02 MIXES

A. Asphalt concrete: Plant mix in accord with FDOT Sections 320, 330-1, 330-2, 330-3, 330-4, 330-5, and 330-6.

B. Special aggregate base ("Dura-Rock"):

1. Blend as follows:
   a. Limerock: 40%.
   b. Sand: 60%.
   c. Cement: 4% by weight of aggregate.
   d. Water: 9%-13% by dry mixture weight of aggregate and cement.
2. Batching and mixing:
   a. Batch and mix all "Dura-Rock" at a commercial batching plant.
   b. Do not batch and mix materials in field.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Proof-roll subgrade using heavy, rubber-tired rollers to locate unstable areas or areas requiring additional compaction.

B. Compact unstable areas or areas requiring additional compaction in accord with FDOT Section 120-9.4].

3.03 APPLICATION/INSTALLATION/PERFORMANCE

A. Stabilization of subgrade:

1. Stabilize subgrade in accord with FDOT Section 160, to depths and bearing values indicated on Drawings. Compact in excess of 98% of Modified Proctor maximum dry density in accord with ASTM D1557 (AASHTO T180).
2. Materials for stabilized subgrade beneath the "Dura-Rock" base shall be mixed outside the placement area.

B. Limerock base course: Transport, spread, shape, compact, and finish limerock base material in accord with FDOT Section 200, to minimum compacted thickness as indicated on Drawings. Compact in excess of 98% of Modified Proctor maximum dry density in accord with ASTM D1557 (AASHTO T180).

C. Special aggregate base course ("Dura-Rock"):

1. Transport from batch plant, spread, shape, compact, and finish special aggregate base ("Dura-Rock") material in a single layer to minimum compacted thickness as indicated on Drawings. Compact in excess of 98% of maximum dry density in accord with ASTM D558 (AASHTO T134).

2. Do not allow more than 4 hours to elapse between batching and final compaction. Do not allow materials to remain undisturbed for more than 2 hours without being worked.

3. Wet surface with potable water as necessary during final rolling to prevent excessive surface moisture loss.

D. Asphalt concrete:

1. Prime coat: After base course has been placed to required grades and approved, apply prime coat in accord with FDOT Section 300-6.

2. Tack coat: When new asphalt is to be placed against existing or new concrete or asphalt surfaces, such as curbs, gutters, walls, structures, or other paving, apply tack coat in accord with FDOT Section 300-7.

3. Asphalt concrete: Provide transportation, placing, and compacting of asphalt concrete, preparation of application surfaces, joints, tolerances, and protection of finished asphalt in accord with FDOT Section 330.

3.04 FIELD QUALITY CONTROL

A. Mixes: Do not deliver batches of base or asphalt concrete materials to job site which do not conform to specified requirements.

B. Flood test: All finished asphalt concrete paving surfaces that retains standing water when flood tested shall be deemed defective.

C. Physical defects: Any portion of asphalt concrete paving that exhibits creeping, shoving, cracking, raveling, softening, or other similar defects during warranty period shall be deemed defective.

D. Removal and replacement of defective asphalt concrete paving:

1. Remove and replace defective areas, including base and subgrade, as directed by Owner.

2. Cut away, remove, and fill patch area with fresh, hot asphalt concrete.

a. As a minimum, remove defective areas for full depth of asphalt concrete surfacing course.

b. Cut sides perpendicular and parallel to direction of traffic with edges vertical.

c. Apply tack coat to exposed asphalt concrete surfaces before placing new asphalt concrete mixture.

d. Compact by rolling to specified surface density and smoothness.

3.05 ADJUST AND CLEAN

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials.

B. Protection: After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than as permitted by FDOT Section 330-13.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Batching, delivering and placement of all concrete for pavement.

B. Installation, finishing, texturing, curing, sealing and protection of all Area Development concrete paving including, but not necessarily limited to, all Area Development curbs, ramps, and steps.

C. Work shall include all required sub-grade preparation, formwork, steel reinforcement and other accessory materials as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grading: Section 02310.

B. Concrete Forms and Accessories: Section 03100.

C. Concrete Reinforcement: Section 03200.

D. Cast-In-Place Concrete: Section 03300.

1.03 QUALITY ASSURANCE

A. Reference specifications and standards:

1. ACI 117: Tolerances for Concrete Construction and Materials.
2. ACI 302: Recommended Practices for Concrete Floor and Slab Construction.
3. ACI 304: Recommended Practices for Measuring, Mixing, and Transporting Concrete.
4. ACI 305: Hot Weather Concreting
5. ACI 306: Cold Weather Concreting
6. ACI 308: Standard Practices for Curing Concrete
7. ACI 347: Guide to Formwork for Concrete
8. ASTM: C31 Making and Curing Concrete Test Specimens
9. ASTM: C33 Concrete Aggregates
10. ASTM: C39 Compressive Strength of Cylindrical Concrete Specimens
11. ASTM: C94 Ready-Mixed Concrete
12. ASTM: C150 Portland Cement
13. ASTM: C171 Sheet Materials for Curing Concrete
14. ASTM: C172 Sampling Ready Mixed Concrete
15. ASTM: C309 Liquid Membrane-Forming Compounds for Curing Concrete
16. ASTM: C494 Chemical Admixtures for Concrete
17. ASTM: C979 Pigments for Integrally Colored Concrete

B. Tests and inspections:

1. Procedure: In accordance with Section 01455.

2. Owner shall pay costs for all required tests and inspections, except re-tests and re-inspections required due to failures.

    a. Costs incurred for re-tests and re-inspections will be paid by the Owner and then charged to the Contractor by way of Change Order deduction from the Contract.

3. Certified testing laboratory shall perform and keep accurate records of the following tests and inspections:

    a. Portland cement: Furnish mill test reports and manufacturer's certification that cement complies with required Specifications.

    b. Fly ash: Sample and test each load of fly ash for loss on ignition before it is delivered to the batch plant.

    c. Hardrock aggregate:

        (1) Test aggregate to ensure there are no alkali reactive problems.

        (2) Provide samples of aggregates from stockpiles assigned to project.

        (3) Do not deliver any aggregate to the site or batch plant until source has been approved and capacity and ability to provide a uniform product, for the duration of the project, has been verified.

4. Test cylinders:

    a. Take one sample of 4 cylinders from each day's placement in accord with ASTM C172. Take samples at evenly spaced intervals as concrete is placed in forms.

    b. Mark each cylinder with date, sample number, mix design number, and location.

    c. Store cylinders at testing laboratory under moist curing conditions at approx. 70°F until testing.

    d. Test cylinders in accord with ASTM C39. Test one (1) cylinder at 7 days for information and two (2) cylinders at 28 days for acceptance. Should test results indicate that concrete strength does not conform to specified minimum requirements, the installed concrete will be deemed deficient and may be rejected at the Owner's discretion.

5. Slump tests:

    a. Make (1) slump test of each set of test cylinder in accord with ASTM C143. Make any additional or more frequent tests as may be requested by the Owner.

    b. Retain a record of all slump tests indicating the test results, date, mix design number and location of pour.

6. Batch tickets:

    a. Provide to Owner batch tickets, with each concrete load, signed by the ready-mix plant dispatcher. Each ticket shall state time, quantity of cement, water and aggregates in load, mix design number, and admixtures.

    b. List integral color additives on batch ticket by designating both the manufacturer and the product name and number. (i.e. Scofield Chromix #C-21, Adobe Tan)

    c. Concrete deliveries that do not have batch tickets with required information will be deemed deficient and may be rejected at the Owner's discretion.

7. Pour Card:

    a. Provide a Pour Card, to be signed by Owner, verifying Owner's visual approval of sub-base, formwork, reinforcement, and coordination with other trades where required. A signed and approved pour card shall be acquired by Contractor for elements of the concrete pour at least 24 hrs. prior to installation of concrete.

C. Workman qualifications:

1. Installation to be performed by workmen with not less than 3 years experience, and foremen with not less than 5 years experience in properly executing all concrete finishes specified on Drawings and/or contained within Owner-furnished samples for this Project.

    a. A foreman or supervisor shall be present during all phases of installation and finishing.

    b. Where specific licensed patterns are required, the stamped or patterned concrete finish shall be performed by a contractor that is licensed, tooled and trained by the stamp pattern vendor.

D. Environmental conditions:

1. Do not place concrete when ambient temperature is 35°F or lower or is expected to go below that temperature within 24 hours of the placement. Follow cold weather procedures in accord with ACI 306.

2. Do not place concrete during rain unless proper protection has been provided to assure no damage results to concrete finish.

3. Follow hot weather procedures in accord with ACI 305 and ASTM C94. During hot weather, when air temperature is 90° F. or greater, mixing and delivery time shall be reduced to a maximum of 60 minutes. Any concrete deliveries made past these times shall be rejected.

E. Site conditions:

1. Do not conceal any work until all required tests and inspections have been performed and accepted.

2. Maintain vehicular and pedestrian traffic during all concrete operations. Do not limit access to other site work.

3. Provide flagmen, barricades, warning signs and lights for movement of traffic as needed.

4. Provide protection of all new concrete from any and all pedestrian and vehicular traffic.

1.04 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Product data: Manufacturer's product literature showing technical data and application instructions for all products intended for use in the work. Include MSDS sheets for all color pigments, stains, sealers and admixtures.

C. Mix Design: For Owner's approval, provide concrete suppliers formulations for concrete mix, certified by an independent technical agency and stamped by a licensed engineer. Provide required quantities of materials expressed in per cubic yard of concrete.

1. Statement of mix design shall include:

    a. Name and address of batch plant supplying concrete

    b. Owner and project address concrete is being supplied to

    c. Date of report

    d. Mix design number

e. Type, size and quantity of course and fine aggregates

f. Type, brand and quantity of cement

g. Water/Cement Ratio

h. PSI strength at 28 days

i. Method of testing used

j. Type, quantity and manufacturer of admixtures

k. Name, number, quantity and manufacturer of integral color additive

D. Shop Drawings: Provide scaled drawings of all paving areas indicating proposed locations for all joint types and pattern of concrete placement. Drawings shall also indicate Contractor's proposed sequence for installation of work. Drawings to be approved by Owner prior to the commencement of work.

E. Mock-up samples:

1. Pre Mock-up conference:

a. At least two (2) weeks prior to the scheduled commencement of preparing the mock-up samples, the Contractor shall schedule a 'Pre-Mock-up Conference' with the Owner to review specific paving requirements. Contractor shall include the foreman or supervisor of concrete finishers intended for the work. Record discussions of conference including all decisions, directions, and agreements (or disagreements) reached. Furnish copies of record to parties in attendance.

b. Review methods and procedures related to construction and finishing of samples including, but not limited to the following;

(1) Proposed location, of suitable size, to execute and store samples.

(2) Required materials, tools, and procedures.

(3) Availability of materials and construction schedule.

(4) Required inspections and approvals.

2. Sample panels:

a. Provide, for Owner's approval, a 4ft. x 8ft. sample panel of 3-1/2 in. minimum thickness, cast and finished for each concrete paving type specified on Drawings (except those with metallic aggregate toppings). Requirement of samples for other structures such as curbs, walls or pilasters will be determined during the pre-Mock-up Conference.

b. Construct each sample using products, materials, and methods identical to those to be used in the project finish work. Concrete used for each sample shall be of the same Owner-approved mix design including source, admixtures, and batching procedures to be used in the finished work.

(1) Finishers and foreman that execute the approved mock-ups shall be the same workmen who execute the final finished work.

(2) Include in each sample all joint types, which will occur in the finish work.

(3) Include in the finishing of any formed surfaces, patching and repairing of major and minor defects.

(4) Include in each sample all specific aggregate types and sizes that may be specified on the drawings or present within the Owner's approved sample.

(5) Cure, harden and seal all mock-ups with materials and methods specified for the finished work.

c. Cast samples at a location approved by the Owner.

d. Approved 'Sample Panels' will be used to judge final acceptance of the finished work. If requested by Owner, Contractor will be responsible to relocate samples adjacent to the final work for reference. For this purpose, samples shall be constructed in a manner that will allow them to be moved without damage.

e. Obtain Owner's approval of each mock-up prior to commencement of final work. If first samples are not approved, prepare additional mock-ups until approval is obtained.

f. Contractor shall be responsible for the care and protection of approved samples. Lost or damaged samples shall be re-cast at Contractor's expense. Replacement sample shall be completed to match all original requirements and approvals

g. Final demolition and removal of mock-ups and sample panels from the project site will be the responsibility of Contractor, when directed to do so by Owner.

1.05 PRE-INSTALLATION CONFERENCE

A. At least two (2) weeks prior to the scheduled commencement of installing finish work, the Contractor shall arrange a 'Pre-job Conference' with Owner. This meeting shall include all parties responsible for installation, finishing, scheduling and testing of the work performed under this Section. Record discussions of conference including all decisions, directions and agreements (or disagreements) reached. Furnish copies of record to parties in attendance.

B. Review methods and procedures related to the work of this Section, including, but not necessarily limited to the following:

1. Products and system requirements.
2. Review of required submittals.
3. Review of required details and finishes.
4. Schedule and sequencing of work.
5. Coordination with other trades and existing site conditions.
6. Forecasted weather and procedures for coping with unfavorable conditions.
7. Required inspections, reviews and procedures for approvals.

PART 2 - PRODUCTS

2.01 FORMWORK

A. Wood, plywood, metal-framed plywood or other panel-type material to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius of 100 ft. or less.

2.02 REINFORCEMNENT

A. Rebar: Deformed, new billet steel bar, Grade 60, in accord with ASTM A615. Provide bar size and spacing as required as indicated on Drawings. Refer to Section 03300 for additional Specifications and requirements.

B. Wire mesh:

1. Welded wire fabric with fiber yield strength (Fy) of 65,000 psi, in accordance with ASTM A185. Wire size and spacing to be as indicated on Drawings.

2. Provide wire mesh in flat sheets only. Rolled mesh is not acceptable. Lap adjoining panels at least 1 full mesh spacing and tie splices with 16 gauge wire at 12 in. o.c. Offset joints of adjacent panels to prevent continuous laps.

C. Supports:

1. For all slabs on grade, provide pre-cast, 3000 psi concrete 'dobies' with integral wire ties. Supports to be of a size adequate to hold reinforcement mat centered in the slab. Spacing shall be as required to hold all reinforcement in-place at required offsets during concrete pour.

2. For all concrete that the formed surfaces will be exposed to view, reinforcement shall be supported and tied in-place to provide adequate coverage and eliminate any exposure of supports.

3. Do not use brick, wood or other non-specified materials to support reinforcements in place.

D. Slip dowels: Smooth, square metal plates cut from hot rolled plate steel in accord with ASTM A36. Installed with pre-fabricated, two-piece plastic, installation sleeves as manufactured and supplied by 'Diamond Dowel Systems', PNA, Inc. Tel: (800) 542-0214. Size as required, by manufacturer, based on thickness of concrete slab.

E. Load plate baskets: Fully assembled Load Plate Baskets as manufactured and supplied by PNA, Inc. Tel: (800) 542-0214. Provide Load Plates and basket assemblies in the sizes required by manufacturer, based on thickness of concrete slab.

2.03 READY MIX CONCRETE

A. Materials: To ensure consistency of color and finish, maintain a single source and supplier of cement and aggregates throughout the duration of the project for each paving type.

1. Portland cement: In accord with ASTM C150, Type I or II. Type III and V cement is not acceptable for Area Development concrete paving unless otherwise approved or directed by Owner. Store in suitable silos that protect the material from dampness and contamination.

2. Fly ash: In accord with ASTM C168, Class F, with low carbon content and low loss on ignition of 3% or less.

3. Fine aggregate: In accord with ASTM C33, consisting of washed natural sand of hard, strong and durable particles which do not contain more than1% by weight of deleterious substances such as clay, shale, schist, mica or any soft and flaky particles.

4. Coarse aggregate: In accord with ASTM C33, consisting of washed natural, hard, fine grained stone not to exceed 35% of crushed rock over 1/2 inch in size and which does not contain in excess of 5% by weight of flat, chip-like, thin, elongated, friable pieces or more than 1% by weight of shale or cherty material.

5. Water: Clean, potable water conforming to ASTM C94, free from all deleterious amounts of acids, alkalis, salts and organic materials.

B. Batching:

1. Proportioning, mixing and transportation of concrete shall conform to ASTM C94.

2. Concrete shall be delivered and discharged from the truck within 1-1/2 hours after the introduction of water to the cement and aggregate mix or within 300 revolutions of the drum. Any concrete that is delivered after this time shall be rejected.

3. Use only mix designs previously approved by Owner.
4. Provide minimum 3000 PSI concrete for all portions of flat-work not otherwise indicted on Drawings.
5. Batch concrete with 1-1/2 gallons of design water withheld for addition at the site to maximize slump control. Mix for at least five minutes at rated mixing speed after the last water is added to the drum. Make slump tests before and after any water additions for each load and when mix, during discharge, exhibits significant change in consistency.
6. Water to cement ratio shall not exceed **0.50.**
7. Design slumps:
    a. Slabs on grade to 8 in. thick: 4 in. ± 1 in.
    b. Slabs greater than 8 in. thick: 4-1/2 in. ± 1 in.
    c. Walls and curbs: 4-1/2 in. ± 1 in.

C. Admixtures:

1. Provide approved water reducers, super-plasticizers, retarders or bonding agent admixtures as conditions require. Any selected admixtures shall not reduce the specified concrete strength and wearability or negatively affect concrete color or finish.
2. Do not use admixtures which cause excessive shrinkage (10% or greater) or cause corrosion of embedded steel.
3. Do not use admixtures which contain calcium chloride, triethanolamine or thiocyanates with chloride ions in excess of 0.05%.
4. Approved admixture manufacturers:
    a. Applied Concrete Technology.
    b. Euclid Chemical Co.
    c. Master Builders, Inc.
    d. Sika Chemical Co.
    e. W.R. Grace & Co.

C. Synthetic fibers: Synthetic fibers conforming to ASTM C1116, Type III.

1. Nylon: Filamentized 100% virgin nylon fibers;
    a. Nylon 6 as manufactured. by Nycon, Inc., 101 Cross street, Westerly, R.I., (800) 456-9266
2. Polypropylene: Fibrillated virgin polypropylene fibers, 3/4 inch long;
    a. Fiberstand 100, by Euclid Chemical,
    b. Grace Fiber, by W.R. Grace
    c. Fibermesh, by Fibermesh, Inc.

D. Integral color additives: Provide integral color concrete for areas as indicated on Drawings.

1. Synthetic mineral oxide pigments conforming to ASTM C979.
2. Provide specific colors and manufacturer of pigments as indicated on Drawings.
3. Proportion of admixture in concrete mix is to be determined by the manufacturer to provide full color or to match Owner's samples.
4. Mix and consolidate color admixtures in accord with manufacturer's instructions.

5. In the event that a specific color manufacturer has not been specified, use one the following Owner-approved sources:
    a. Chromix, by L.M. Scofield Co., Los Angeles, CA. Tel: (800) 800-9900
    b. Davis Colors, by Davis Colors, Los Angeles, CA. Tel: (800) 356-4848
    c. Solomon Colors, by Solomon Grind-Chem, Springfield, IL. Tel: (800) 846-2599
    d. Bayferrox, by Bayer, Pittsburg, PA. Tel: (800) 662-2927

2.04 HARDENERS AND TOPPINGS

A. Colored hardeners: Provide topically applied colors to concrete for all areas indicated as such on the Drawings.
    1. Cementitious powder of high color opacity and surface hardening characteristics, conforming to ASTM C979, for topical application on freshly placed concrete.
    2. Provide specific colors and manufacturer of color hardeners as indicated on the Drawings.
    3. In the event that a specific manufacturer has not been specified, use the following Owner-approved source;
        a. Lithochrome, by L.M. Scofield Co., Los Angeles, CA. Tel: (800) 800-9900
        b. Emerchrome, by L.M. Scofield Co., Los Angeles, CA. Tel: (800) 800-9900
        c. Brickform Color Hardener, by Rafco, Rancho Cucamonga, CA. Tel: (800) 483-9628

B. Colored aggregate toppings: Provide special topically applied aggregates to concrete for all areas indicated as such on the Drawings.
    1. Surface broadcast material containing specific combinations of specially ground and graded colored stones, glass and aggregates for topical application and imbedment on freshly placed concrete.
    2. Provide specific mixes and manufacturer as indicated on the Drawings and Owner furnished samples when provided.
    3. In the event that a specific manufacturer has not been specified, use one of the following Owner approved sources:
        a. Lithotex, by L.M. Scofield Co., Los Angeles, CA. Tel: (800) 800-9900
        b. Lithocrete, by Shaw & Sons, Costa Mesa, CA. Tel: (949) 642-0660

C. Heavy-duty metallic aggregate toppings:
    1. Anvil-Top 300, by Master Builders.
    2. Super Euco-Top, by Euclid Chemical Co.

D. Slip-resistant abrasive topping:
    1. Aluminum oxide or a blend with not less than 58% aluminum oxide and approximately 14/36 mesh grading:
        a. A-H Emery Emerundum, by AntiHydro International Inc.
        b. Lithochrome Abrasive, by L.M. Scofield Co.
        c. Aluminum Oxide Surface Treatment, by The Burke Company.
        d. Frictex H, by Sonneborn Building Products.

2.05 CHEMICAL STAINS

A. Water-based acid solutions with metallic salts, containing no pigments or resins. Provide chemical stains in all colors and quantities as indicated on Drawings or to match the Owner's-furnished samples.

B. Chemical stains shall be applied with brushes, sponges and hand-pump sprayers as needed to attain the desired effects.

C. In the event that no specific stain manufacturer has been specified, use one of the following Owner-approved sources:

1. Lithochrome Chemstain, by L.M. Scofield, Co., Los Angeles, CA. Tel: (800) 800-9900

2. Brickform Blush-Tone, by Rafco, Rancho Cucamonga, CA. Tel: (800) 483-9628

2.06 CURING COMPOUNDS

A. Provide approved liquid, membrane-forming, curing and evaporation reducer (resin- based dissipating type) as required to facilitate proper curing and hardening of finished concrete surfaces.

B. Curing compound shall not discolor or stain the color of the concrete and shall be compatible for use with the specified concrete sealer.

2.07 CURING COVERS AND PROTECTION PAPER

A. Provide curing blankets and protection paper over finished concrete as required. If not specified otherwise, select from the following Owner approved products:

1. Hydracure Covers, as manufactured by PNA Technologies. Tel: (800) 542-0241.

2. Seekure 892, non-staining, reinforced and laminated protection paper, by Fortifiber Corporation.

3. Orange Label Sisalkraft, reinforced and laminated protection paper, by Fortifiber Corporation.

2.08 SEALERS

A. Apply sealers to all concrete paving as indicated on Drawings. If no specific product has been called for on the drawings, the contractor shall provide a sealer from the following approved list of materials and manufacturers:

1. Low-sheen, penetrating type:

a. Protecrete 'Repeller', by Applied Concrete Technology, Inc. Tel: (800) 228-6694.

b. Protecrete 'Densifier-Plus', by Applied Concrete Technology, Inc. Tel: (800) 228-6694.

c. 'Replo', by L. M. Scofield Company. Tel: (800) 800-9900

2. Glossy, non-penetrating type:

a. 'Cementone', by L. M. Scofield Company. Tel: (800) 800-9900

b. Brickform 'Satinseal', by Rafco Products. Tel: (800) 483-9628

c. Brickform 'Masterseal', by Rafco Products. Tel: (800) 483-9628

2.09 JOINT FILLERS

A. Pre-molded asphalt impregnated type, conforming to ASTM D1751. 3/8 inch or 1/2 inch thick as indicated on Drawings or otherwise specified by Owner.

1. Tamms Industries
2 W.R. Meadows Co.

PART 3 - EXECUTION

3.01 SUBGRADE AND COMPACTION

A. Insure sub-grade soil is compacted to required specifications and set to proper grades.

B. Sub-grade is to be free of all soft, compressible or expansive soils. Remove any exposed rocks and all loose soil or debris.

C. Concrete shall not be placed if sub-grade is overly saturated. If sub-grade is dry it should be lightly moistened with an even spray, just prior to placing concrete, to control any initial rapid loss of moisture from the slab.

3.02 FORMWORK

A. Set forms to meet alignment, shape, dimensions and grades as shown on the drawings.

B. Straight lines shall be set true, plumb and with limited deviation. Radiuses shall be formed concentric and smoothly transition to all adjoining straight segments.

C. Forms shall be smooth, clean lumber, free of visual defects and any latent cement. Depth of all forms shall be equal to the depth of the concrete.

D. Forms shall be of sufficient thickness to ensure they will not deform when loaded. Bender board or thin back-cut boards may be used for curves and radiuses with sufficient bracing.

E. Hold forms rigidly in-place with sufficient amount of stakes, clamps, spreaders and braces to ensure formwork will not move when loaded.

3.03 FINISHING AND TEXTURING

A. Concrete should be placed no faster than it can be properly finished with due regard to weather, concrete temperature and the size and abilities of the finishing crew.

1. Concrete is to be placed in forms no later than 1-1/2 hours after water was first added to the batch. During hot weather, 90° F. or greater, placement time shall be reduced to a maximum of 1 hour. Any concrete placement made past these durations may be rejected at no additional costs to Owner.

B. Placement and finishing:

1. Concrete should be placed continuously and in one direction within the formwork.

2. Screed or strike-off surface to provide slab at required grades.

3. Prior to the accumulation of any bleed water, bullfloat or darby to level and smooth the surface.

4. After all bleed water has been evaporated, tool all required joints and edges, hand float and finish as needed.

5. Finish concrete surface to achieve the following tolerances when measured in accord with ASTM E1155.

a. Trowel finished surfaces: F_F25/F_L20 (F_L17 for elevated slabs).

b. Float and broom finished surfaces: F_F20/F_L17.

C. Surface finishes and textures: provide all finishes and textures as noted on drawings and paving schedule or match approved Owner's samples when available. In the event Owner has not provided a sample for a specified finish, the following descriptions have been provided for reference:

1. Steel or smooth trowel finish: a smooth, hard and dense surface, free of all marks from trowels, groovers and edgers. To be performed only after the concrete has been floated and when no water can be brought up to the surface from the troweling process. Surface to receive subsequent passes until the trowel makes a ringing sound as it moves over the surface.

2. Smooth float or 'sweat' finish: a relatively even and smooth finish that still contains enough texture to provide good slip resistance. Produced with a wood or metal float leaving a fine texture with a consistent circular trowel pattern. See drawings or take Owner's art direction for desired pattern.

3. Sponge float finish: a slightly rougher finish than the smooth float, achieved by final troweling with a sponge or rubber faced float leaving a pronounced radial trowel pattern. See drawings or take Owner's art direction for desired pattern.

4. Broom finish: brush or broom finish is achieved by drawing a clean stiff-bristle broom across the still-plastic surface to create uniform striations. Direction of broom pattern is to be alternated between each adjoining panel. However, the pattern may be otherwise directed by Owner.

   (a). Light broom: executed with a medium to stiff poly-bristle push broom.

   (b). Medium broom: executed with medium to stiff palmyra bristle push broom.

   (c). Heavy broom: executed with a stiff palmyra bristle or steel wire push broom

5. Acid washed finish: surface layer of mortar is removed by applying a diluted solution of acid over the hardened concrete. Contractor must take all necessary precautions to protect any and all surrounding materials and finishes from effects of the acid solution, including control and proper removal of all water used to remove the acid and cement from the concrete.

6. Salt finish: #2 size rock salt crystals are scattered across the still-plastic concrete at a rate of 1 pound per each 10 sq. Ft. Of surface and tamped into the surface with a wood darby. Salt crystals to be dissolved and removed by water-washing after concrete has had sufficient time to cure and not be damaged by the washing process.

7. Exposed aggregate finish:

   (a). Water-wash: surface layer of mortar is removed with a light, controlled spray of water and scrubbed with a stiff brush to expose aggregate fines in concrete.

8. Retardant and brush: surface layer of mortar is removed by applying a retardant to the finished concrete, to increase the setting time of the mortar paste, and then removing it by water-wash and brushing to expose aggregate to desired finish.

9. Seeded-aggregate finish: an exposed aggregate finish, achieved by surface applying a decorative aggregate. Aggregate is to be uniform in size and thoroughly washed prior to installation. Evenly distribute aggregate across the surface and tamp into the concrete with a hand float or darby. Apply immediately after the concrete has been bull-floated and tamp until completely embedded in concrete surface. Expose aggregate by simultaneous brushing and washing after concrete has sufficiently hardened or with retardant finish process.

10. Brush-blast finish: a scour cleaning that lightly textures the surface. Abrasive or sand-blast to sufficiently remove surface sheen without any reveal of aggregate.

11. Sand-blast finish:

   (a). Sand-or abrasive blasted to remove cement-sand matrix to expose aggregate face until aggregate is in uniform relief.

(1) Light: removes mortar to leave only exposure of fine aggregate. Maximum reveal of 1/16 inch and uniform in color.

(2) Medium: maximum reveal of 1/4 inch and uniform in color.

(3) Heavy: rugged and uneven appearance leaving approx. 80% of surface as course aggregate. Maximum reveal of 1/3 diameter of coarse aggregate; 3/8 to 1/2 inch reveal.

b. Perform abrasive- and sand-blasting on concrete surfaces at the same time intervals after concrete placement used to produce sample panels.

c. Surface textures shall match Owner-approved sample panels as applicable.

d. Sandblasting shall be performed by a qualified technician using only equipment that is of sufficient size and capacity for the work.

e. Contractor shall be responsible for protection of all adjacent work, control of airborne material and removal of all debris from the blasting process.

D. Stamped and patterned concrete:

1. Provide patterns, and textures as indicated on drawings and match Owner's approved samples. Install by a contractor licensed to use specific stamps or texture mats when required by particular tool vendor or licensee specified on the drawings.

2. Release agent for textured patterns: colored bond-breaking powder, L.M. Scofield lithochrome antiquing release. Provide with secondary color to complement integral color. Colors to be selected by Owner.

3. Placement:

a. Prepare concrete mix and place in accord with all specifications herein.

b. After final floating, apply colored release agent and imprint pattern or texture in surface in accord with pattern manufacturer's recommendations or to match approved samples.

c. Poorly registered patterns or finishes with 'flat-spots' that are void of the required texture will be considered deficient.

E. Colored aggregate toppings:

1. Provide seeded aggregates, and textures as indicated on drawings and match Owner's approved samples. Install by a contractor licensed to use specific aggregate toppings when required by manufacturer of product specified for use.

2. Placement:

a. Surface broadcast materials at rates and coverage required per the manufacturer's recommendations and to match Owner's samples.

b. Apply material when concrete slab has set to a point that seeded aggregate will not sink into concrete and prior to the concrete surface becoming too stiff to work the aggregates into the surface.

c. Material shall be applied by hand and dropped vertically at a 90 deg. Angle to the surface from a distance of 18 to 24 inches.

d. Float the seeded materials after each application. Trowel the finish surface after the final application to flat, dense and uniform finish.

F. Heavy-duty metallic aggregate topping:

1. Apply at dumpster and compactor pads and other areas indicated on drawings requiring a high-strength, impact-resistant wearing surface.

   a. Apply bonding agent over hardened concrete sub-slabs as recommended by topping manufacturer.

   b. Mix and apply topping in accord with manufacturer's recommendations. Unless indicated otherwise on drawings, provide minimum 1 in. Topping thickness.

   c. Provide hard, steel trowel finish in order to obtain maximum surface density and cure as recommended by topping manufacturer.

3.04 JOINTING

A. Place joints in concrete work and other locations as indicated on drawings and as directed in the field by Owner.

B. Verify specific types and layout of all joints with the Owner prior to placing concrete. Although layout depends on specific shape and size of areas, do not space control joints more than 10 ft. On center in a square pattern.

Example: if a concrete walk is 4 ft. Wide, control joints should occur at equal spacing of approximately 4 ft. On center along length.

C. Accurately lay out areas and make joints straight and true, with clearly defined angles, unless directed otherwise by Owner.

D. Provide isolation joints, with expansion material and joint sealing compound, at all vertical surfaces and adjoining construction to the full depth of the slab.

E. Saw-cut joints:

1. Make saw-cut control joints in concrete no later than 12 hours after finishing or as soon as concrete is strong enough to not be damaged by the blade or weight of the machine.

2. Carefully check condition of concrete before commencing saw-cutting to ensure that the saw will not fret, ravel, spawl edges of cuts or dislodge aggregate. Use saw-cutting equipment appropriate for hardness condition of the concrete. Depth of saw-cuts shall be no less than 1/4 of the installed slab thickness. Do not cut through steel bar reinforcing. Saw-cuts to be 1/8 in. Wide unless otherwise noted on drawings.

F. Hand-tooled joints:

1. Make all hand-tooled control joints with a brass v-shaped grooving tool with 1/4 in. Rounded edges and a keel with 1-1/2 in. depth.

G. Expansion joints (isolation joints):

1. Provide foam or rigid joint filler material as required to the full depth of slab.

2. Unless otherwise directed by Owner, provide a 1/4 in. Radius, tooled edge, for all expansion joints and paving edges to reduce spalling.

3. Install foam backer rod and finish with joint sealing compound in accord with construction details and as specified in section 07920. Note: plastic ‘zip’ type joint strips will not be allowed for the installation of any expansion or isolation joints.

3.05 CURING AND SEALING

A. All concrete shall be properly cured with approved methods and materials as specified.

1. Commence curing of concrete immediately after finishing is completed. Do not permit any traffic, debris or material storage on surface during curing**.**

2. Alternating wet and dry surface conditions during curing is not permitted.

B. Seal all concrete flatwork immediately after the concrete has been properly cured with specified sealers.

1. When approved by Owner, remove protection paper and thoroughly clean the concrete surface, removing all loose release agents by power-washing if necessary.

2. Apply specified sealers in accord with manufacturer's directions.

3. Protect concrete from any and all pedestrian and vehicular traffic until sealer has thoroughly dried.

4. Re-install protection paper or other Owner-approved materials to protect finished concrete from damage.

C. Standard gray concrete:

1. Cure standard gray curbs and flat work by either curing with liquid applied curing compound and protection paper or water-curing methods as follows:

a. Protection paper method:

(1) Immediately after finishing concrete, apply curing compound and cover with curing and protection paper. Lap joints in paper a minimum of 6 in. And seal with pressure-sensitive (masking) tape. Seal perimeter edges and penetrations of paper to slab to prevent escape of moisture.

(2) Provide two separate and overlapping applications of curing compound at opposing right angles.

(3) Maintain protection paper in-place for a minimum of 14 days.

b. Water-curing method:

(1) Maintain concrete surfaces continuously wet for 14 days by either ponding with water, using a constructed dam around the perimeter or by applying a continuous fine spray.

D. Colored concrete:

1. Cure and harden, colored concrete slabs by covering with curing blankets and maintaining a thoroughly wet condition between the concrete and cover for no less than 14 days.

a. Curing blankets are to be kept flat and unwrinkled against the concrete surface.

2. Where wet cure method is not compatible with the specified concrete finish. Cure concrete, with compound recommended by manufacturer of the integral color concrete pigments. Curing compound(s) shall not discolor, lighten, darken, stain, or impart other unsightly characteristics to colored concrete and shall be compatible with Owner's maintenance sealer.

a. After application of curing agent, cover with approved protection paper. Lap joints in paper a minimum of 6 in. And seal with pressure-sensitive, water-proof tape.

b. Protection paper is to be kept flat and unwrinkled against the concrete surface.

c. Maintain protection paper in place for no less than 14 days.

E. Stamped concrete slabs:

1. Cure and harden stamped and textured concrete slabs by leaving release agent in-place and covering with approved curing paper.

   a. Immediately after finishing concrete, leave release agent in-place and cover with curing and protection paper. Lap joints in paper a minimum of 6 inches. And seal with pressure-sensitive (masking) tape. Seal perimeter edges and penetrations of paper to slab to prevent escape of moisture.

   b. Maintain a thoroughly and continuously wet moisture condition between slab and curing paper for no less than 14 days

   c. Leave curing and protection paper in place until its removal is approved by the Owner

3.06 CEMENT TOPPINGS

A. Where indicated on Drawings or specified otherwise, finish required concrete floors and slabs with applied cement topping as follows:

1. Sand-blast existing slabs to expose aggregate firmly embedded in concrete matrix.

2. Remove from concrete base all standing water and clean off all latent cement.

3. Immediately before placing topping, thoroughly scrub into sub-slab surface, with a stiff bristle broom, a bonding grout composed of 1 part neat Portland cement, 1-1/2 parts sand, bonding admixture, and water. Place topping mix thereon within 1 hour.

4. For topping thickness of 2 in. and less, use a 4000 psi. topping mix made with 3/8 in. maximum size aggregate.

5. Finish topping as specified.

3.07 STEPS AND LANDINGS

A. Finishing: Compact concrete into place. When concrete has set enough for vertical surfaces to stand alone and support workmen (if necessary), remove formwork and finish surfaces as specified on Drawings.

B. Non-slip finish: When specified, float or lightly trowel-in slip-resistant abrasive aggregate at the rate of not less than 25 lb. per 100 sq. ft. in top surface of treads and landings. Finish smooth, ensuring that slip resistance is maintained.

C. Safety stair nosing: Unless indicated otherwise on Drawings, provide four (4) tooled safety grooves, 1/2 in. width by 1/4 in. depth, spaced 3/4 in. apart, stopping 3 in. from each end.

D. Stair nosing: When indicated on the Drawings, install cast-in-place type stair nosing.

E. Curing: Cure stair treads and landings as specified for paving types.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Brick paving.

B. Interlocking concrete paving.

C. Cement treated base.

D. Gravel sumps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Compacted subgrade: Section 02310.

B. Concrete curbs (edge restraints) and paving: Division 3.

1.03 DEFINITIONS

A. Slip resistance: Slip index of not less than 0.5 when tested dry and wet (with an unbroken film of pure water) in accord with ASTM F1679, using a neolite test pad and in accord with ASTM F1677.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Submit proof of the following.

1. Manufacturer shall have a minimum of 5 years successful experience in the manufacture of pavers.

2. Manufacturer shall have sufficient production capacity and established quality control procedures to produce, transport, and deliver the required pavers of die quality specified, without causing delay to the work.

3. Manufacturer shall have suitably experienced personnel and a management capability sufficient to produce pavers as indicated on the Drawings and specified herein.

4. Provide Certification meeting ICPI program.

B. Installer qualification: Submit proof of the following.

1. Minimum of 5 years successful experience in the installation of pavers, similar to the pavers required for this project.

2. Suitably experienced personnel and a management capability sufficient to execute the work indicated on the Drawings and specified herein.

3. Supervisor shall have a minimum of 5 years experience in the installation of paver systems similar in nature to this project. Ensure that the supervisor is on site for the entire duration of the project.

C. Reference specifications and standards:

1. ASTM: C33 Concrete Aggregates.

2. ASTM: C67 Sampling and Testing Brick and Structural Clay Tile.

3. ASTM: C150 Portland Cement.

4. ASTM: C595 Blended Hydraulic Cements.

5. ASTM: C936 Solid Interlocking Concrete Paving Units.

6. ASTM: D558 Moisture-Density Relations of Soil-Cement Mixtures.

7. ASTM: D1633 Compressive Strength of Molded Soil-Cement Cylinders.
8. ASTM: F1677 Using a Portable Inclineable Articulated Strut Slip Tester (PIAST).
9. ASTM: F1679 Using a Variable Incidence Tribometer.
10. ASTM: D2940 Graded Aggregate Material for Bases of Subbases for Highways or Airports.
11. CALTRANS Standard Specification.

D. Allowable tolerances: 1/8 in. in 10 ft. from indicated planes.

1.05 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Shop drawings: Submit paving patterns for approval by Owner.

C. Samples: Each type of paving unit specified, showing range and variation in color.

D. Certificates: Manufacturer's compliance certification.

E. Test reports: Coefficient of friction test reports to Owner.

F. Environmental data: The joint sand stabilizer manufacturer shall provide documentation to demonstrate that the product complies with relevant local environmental and hazardous materials legislation.

G. Method statement:

1. Provide a method statement for approval by to Owner prior to installation.
2. The method statement shall indicate the proposed starting points, direction of operations and progress of work, the dimensional controls to be used and the personnel and equipment to be kept on site at all times.
3. In particular it shall set out control procedures to ensure uniform use of the colors.

H. Pre-mock-up conference:

1. At least 2 weeks prior to scheduled commencement of each mock-up, arrange a meeting at project site.
    a. Meeting shall be attended by applicators, erectors, installers of respective work contained in mock-up
    b. Meeting shall also be attended by applicators, erectors, and installers of related work including substrates to receive mock-up, other work in and around mock-up or which must precede or follow construction of mock-up
    c. Meeting shall also be attended by product/system manufacturer's representatives, Owner, and other representatives directly concerned with performance of products, materials, and methods contained in the mock-up.
    d. Record discussions of conference and decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending.
2. Review methods and procedures related to construction of mock-up, including but not necessarily limited to the following:
    a. Inspect representative areas of substrates to receive mock-up. Discuss condition of substrate and related work.
    b. Review product or system requirements (Drawings, Specifications and other Contract Documents). Resolve conflicts.

c. Review required submittals, both completed and yet to be completed.

d. Review and finalize construction schedule related to the work contained in the mock-up and verify availability of materials, applicator's/erector's/installer's personnel, equipment, and facilities needed to avoid delays.

e. Review required inspection, testing, certifying, and materials usage accounting procedures.

f. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including use of temporary enclosures (if not a mandatory requirement).

I. Site mock-ups:

1. Provide for approval, a job site prepared finished sample panel for each type paving finish. It is intended that the mock-up will show the transitions between the various paving types.

   a. Construct mock-up using products, materials, and methods identical to those to be utilized in Project work.

   b. Workmen who construct approved mock-ups shall be the same workmen who shall construct or supervise construction of the final finished work, unless otherwise approved by Owner.

2. The size of each sample shall be representative of the type finish being demonstrated, but not less than 4 ft. x 4 ft. in size.

   a. Construct samples on grade at locations as directed by Owner.

   b. Include in each panel, all joint types which will occur in each type finish work.

3. Owner will assist in the preparation of samples by providing certain samples, photographs, instructions, and field direction. Contractor to match owner sample for aggregate size, and demonstrate that the supplied paving can receive engraving that matches the owners sample.

4. Obtain Owner's approval of completed mock-up. If initial mock-up is not adequate, satisfactory, or approved by Owner, subsequently prepare additional mock-up(s) or modify initial mock-up until Owner gives approval.

5. Test site mock-up for slip resistance.

   a. Notify Owner, if mock-up does not meet definition for slip resistance.

   b. Provide Owner with recommendation for modifications to mock-up to provide slip resistance.

6. Approved site mock-ups will be used to judge final finish work.

7. If first samples are not approved, prepare additional samples until Owner gives approval.

8. Owner-approved in-place samples may remain as part of the completed finish work if all conditions have been met and Owner is in agreement.

9. Approved sample panels which are not incorporated into the finish work shall be protected in-place during the course of work until their removal is authorized by Owner. When authorized by Owner, break-up and remove the panels from the project site and return the subgrade to design conditions.

1.06 PRODUCT HANDLING

A. Procedures: In accord with Section 01660.

B. Packaging: Pavers shall be packaged on pallets in such a way as minimize damage during transportation, delivery, storage and handling.

C. Rate of supply: Deliver pavers to the construction site in such quantities and at such times as will assure the continuity of the installation.

D. Storage: Place packaged pavers on firm, level, and smooth surfaces and at least 6 in. above the ground. Place stored pallets so that identification marks are visible.

E. Damaged pavers: No paver, or part thereof, used in the permanent work shall exhibit obvious signs of damage on the top surface, including but not limited to chipping, cracking and staining. Such damage shall be grounds for rejection.

F. Bedding sand:

1. Deliver and stockpile bedding sand in such a way as to minimize contamination and segregation. Stockpiles are to be located on firm, level, and smooth surfaces that do not channel water into the sand.

2. Cover with waterproof covering to prevent exposure to rainfall or removal by wind. Secure in place.

G. Jointing sand:

1, Deliver jointing sand in bags and store in such a way as to minimize contamination.

2. Cover with waterproof covering to prevent exposure to rainfall or removal by wind. Secure in place.

H. Joint sand stabilizer: Deliver and store in accord with the manufacturers instructions and maintain a temperature range of 50°F to 105°F .

1.07 PROJECT CONDITIONS

A. Coordination: Coordinate work in this Section with that affecting or affected by other trades to ensure the smooth progression of the work.

B. Utilities: Underground utilities shall be completed prior to start of the work specified by this Section.

1.08 MAINTENANCE MATERIALS

A. Procedures: In accord with Section 01330.

B. Furnish additional 2% of quantity of pavers for Owner's future replacement and maintenance use, in sealed boxes.

C. Furnish sufficient quantities of grout materials, in unopened bags, of colors and types installed in the work. Quantities of each color and type shall be in direct proportion to quantities of paving furnished.

D. Deliver all maintenance materials to Owner's warehouse as directed.

PART 2 - PRODUCTS

2.01 BRICK PAVERS

A. General:

1. Brick pavers shall match the existing brick pavers at Disneyland and as specified herein.

2. Brick pavers are indicated on Drawings as Type P-701.

B. Physical requirements:

1. The average compressive strength of the test samples shall not be less than 10,000 psi with no individual brick paver less than 8,800 psi.
2. The average modulus of rupture of the test samples shall not be less than 1,500 psi with no individual brick paver less than 1,275 psi.
3. The average water absorption of the test samples shall not be greater than 7%.

C. Acceptable Manufacturer: Pine Hall Brick P.O. Box 11044, 2701Shorefair Drive, Winston-Salem, NC, 27116-1044 Tel: (336) 721-7500.

D. Dimensions and permissible variations:

1. The brick pavers shall be solid units without core holes or other perforations.
2. The brick pavers shall be manufactured such that the module size from center of joint to center of joint shall have a nominal length of 8 in. and a nominal width of 4 in.
3. The thickness of the brick paver shall be as indicated on the Drawings and shall be a nominal thickness of 2-1/4 in.
4. Brick pavers shall be provided with chamfers along their length that shall be 1/8 in. x 1/8 in. beveled. The ends shall be square and shall not exhibit deformation as a result of the chamfering process.
5. No brick paver shall depart from the specified size by more than the following limits:
   a. Length: +/- 3/32 in.
   b. Width: +/- 1/16 in.
   c. Thickness: +/- 1/16 in.
6. The dimensions of all brick pavers when measured from face to face shall not differ from the nominal sizes such that the overall measurements of 24 brick pavers laid in contact, in a straight line, in identical orientation, falls outside the following limits:
   a. Length: 191-1/4 in. to 192-3/4 in.
   b. Width: 95-3/4 in. to 97 in
7. The concave or convex warpage of exposed surfaces or edges shall not exceed 1/16 in. in 6 in. when measured in accord with ASTM C67.
8. The out of square measurement of the brick pavers shall not exceed l/16 in. on any corner.

E. Visual inspection:

1. The brick pavers shall be free of chips that extend more than 1/4 in. in from the edge. The cumulative length of chips on a single edge shall not exceed 5% of the length of that edge.
2. All brick pavers shall be free from defects that would interfere with the proper placing of the brick pavers or impair the strength or performance thereof.
3. The color range of the brick pavers shall be submitted to and approved by the Owner.

F. Records: The manufacturer shall maintain a production record showing batch numbers and date of manufacture. The product shall be marked with the batch number on the packaging for identification.

2.02 INTERLOCKING CONCRETE PAVERS

A. General:

1. Interlocking concrete pavers for bands are 10 in. x 10 in. square x 2-1/4 in. thickness and are indicated on Drawings as Type P-702.

2. Interlocking concrete pavers for infill are 10 in. hexagonal x 2-1/4 in. thickness and are indicated on Drawings as Type P-703.

3. Interlocking concrete pavers for herringbone are 4 in. x 8 in. x 2-1/4 in. thickness and indicated on Drawings as Type P-704.

B. Physical requirements:

1. Interlocking concrete pavers in accord with ASTM C936 (8,000 psi compressive strength, less than 5% absorption).

C. Acceptable Manufacturer:

1. Creative Brick & Concrete (Gift Bricks Inc.), 9512 Washington Avenue, Racine, WI 53406, Tel.: (414) 886-0727, Attn: Dave Hess.

2. Wausaw Tile, 1150 E. Lincoln, Banning, Ca 92220 Tel: (909) 849-5695, Attn: Francis Hamele.

D. Permissible variations:

1. No interlocking concrete paver shall depart from the specified size by more than the following limits:

a. Length: +/- 3/32 in.

b. Width: +/- 1/16 in.

c. Thickness: +/- 1/16 in.

2. The concave or convex warpage of exposed surfaces or edges shall not exceed 1/16 in. in 6 in. when measured in accord with ASTM C67.

3. The out of square measurement of the interlocking concrete pavers shall not exceed l/16 in. on any corner.

E. Visual inspection:

1. The interlocking concrete pavers shall be free of chips that extend more than 1/4 in. in from the edge. The cumulative length of chips on a single edge shall not exceed 5% of the length of that edge.

2. All interlocking concrete pavers shall be free from defects that would interfere with the proper placing of the interlocking concrete pavers or impair the strength or performance thereof.

3. The color range of the interlocking concrete pavers shall be a submitted and approved by the Owner.

F. Records: The manufacturer shall maintain a production record showing batch numbers and date of manufacture. The product shall be marked with the batch number on the packaging for identification.

2.03 BEDDING SAND

A. Materials: The bedding sand shall be in accord with the requirements of ASTM C33 except for the grading requirements. The sand shall be clean, naturally occurring silica sand with sub-angular particles. Manufactured sand shall not be used. The sand shall contain no more than 10% acid soluble material. It shall be delivered to the site in a moist condition.

B. Graduation: The sand gradation shall be in accord with the following grading requirements such that it shall not vary from the high limit on one sieve to the low limit on the next sieve or vice versa.

Sieve size weight	Percentage passing by weight
3/8 in.	100
3/16 in.	95 - 100
No.8	80 - 100

No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	0 - 10
No. 200	0 - 0.5

C. Mineralogy: The sand supplier shall provide mineralogical details of the proposed sand by way of petrographic analysis or equal.

2.04 JOINT FILLING SAND

A. Materials: Joint filling sand shall be in accord with the requirements for bedding sand specified in this Section except that the sand shall be dry and shall be in accord with the following grading requirements:

Sieve size weight	Percentage passing by weight
No.8	100
No. 16	60 - 90
No. 30	30 - 60
No. 50	0 - 5
No. 70	0 - 1
No. 100	0 - 0.5

2.05 JOINT SAND STABILIZER

A. Manufacturers: The joint sand stabilizing material shall be one of the following.

1. Surebond SB- 1300 as manufactured by Surebond Inc., 500 E. Remington Road, Schaumburg, IL, 60173 Tel. (847) 843-1818)
2. Sandstable as manufactured by Sandstable Limited, I Queen Square, Bristol, BSlv 4JQ, United Kingdom, Tel. 44 117 929 9125

2.06 CEMENT TREATED BASE

A General: Cement treated base shall consist of aggregate, cement and water uniformly mixed in a central plant, transported to the project, spread, compacted, shaped, finished and cured in accord with this Section.

B. Materials:

1. Cement in accord with the latest specifications for Portland cement, ASTM C150 (Type I) or Portland-Pozzolan-ASTMC595 (Type IP).
2. Water shall be free from substances deleterious to the hardening of the cement treated base.
3. Aggregate shall be in accord with ASTM D2940 and may be any granular material or combinations of aggregates that will, when mixed with adequate amounts of cement and water, produce specified compressive strength. The maximum size of aggregate shall pass a 2 in. sieve.

C. Mix design: Provide a laboratory mix design conforming to unconfined compression test strength of not less than 750 psi at 7 days in accord with the ASTM D1633 Method “A." The preceding test shall utilize the moisture-density relation as determined by ASTM D558.

D. Equipment: Cement treated base may be constructed with any combination of machines or equipment that will produce the results in accord with this Section.

2.07 GRAVEL FOR SUMP

A. Gravel shall be in accord with CALTRANS Standard Specification Section 68, Class 2, permeable material.

2.08 FILTER GEOTEXTILE

A. Manufacturer: The woven geotextile fabric shall be MIRAFI 700X manufactured by TCMiraDRI, 3500-T Parkway Lane, Suite 500, Norcross, GA, 30092, Tel: (770) 729-1004, or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work.

1. Inspect edge restraints to ensure that they meet the grade, alignment, verticality and continuity requirements for proper installation prior to commencing paver insta1lation. Notify the general contractor, in writing, of any deficiencies if and when they occur, and discontinue paving these areas until they are rectified.

2. Inspect the substrate to ensure that it meets the grade requirements for proper installation and that the area is free from soft or yielding places and debris or obstructions prior to commencing paver installation. Notify the contractor, in writing, of any deviation in the underlying surface levels greater that +1/8 in. to -1/4 in. or other deficiencies if and when they occur, and discontinue paving these areas until they are rectified.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Lay out work accurately to line and plane.

3.03 INSTALLATION OF CEMENT TREATED BASE

A. Before other construction operations are begun, the area to be paved shall be graded and shaped as required to receive the cement treated base in accord with the grades, lines, thicknesses and typical cross-section indicated on the Drawings

1. The subgrade shall be firm and able to support without displacement of the construction equipment and the compaction hereafter specified.

2. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

B. The aggregate, cement and water shall be mixed in a pug mill as approved by Owner.

1. The plant shall be equipped with feeding and metering devices that will add the aggregate, cement and water into the mixer in the required quantities to produce a mixture that will meet or exceed the mix design criteria as stated above.

2. The aggregate and the cement shall be mixed sufficiently to prevent cement balls from forming when the mix water is added.

3. The mixing time shall be sufficient to assure an intimate, uniform mixture of aggregate, cement and water.

4. The percentage of moisture in the aggregate, at the time of cement application shall be the amount that assures a uniform and intimate mixture of aggregate and cement during mixing operations. It shall not exceed the specified moisture content required for adequate compaction.

5. Free access to the plant shall be provided to Owner.

6. The mixture shall be hauled to the paving areas in trucks having beds cleaned of deleterious material.

C. The mixture shall be placed on a moistened subgrade in a uniform layer by any approved method of spreading that will deposit the required quantity per lineal foot, without segregation, to produce a uniformly compacted base in accord with the grade and cross-section.

1. Not more than 30 minutes shall elapse between placement of cement treated base in adjacent lanes at any location except at longitudinal and transverse construction joints.

2. No cement treated base mixture shall be placed when the sub-grade is frozen or when the air temperature is less than 40°F in the shade.

3. Owner may allow placement when the temperature is 35°F and clearly rising.

4. Compaction shall start as soon as possible after spreading.

5. The elapsed time between the addition of water to the cement treated base mixture and the start of compaction shall not exceed 60 minutes under normal conditions. Owner may alter this time if environmental conditions, such as temperature, humidity or wind conditions would justify such a change.

D. At the start of compaction, the percentage of moisture in the mixture shall not be more than 1 percentage point below or 2 percentage points above the specified optimum moisture content, and shall be less than that compaction and finishing.

1. The specified optimum moisture content and density shall be determined in the field by a Moisture-Density Test ASTM D558, on representative samples of cement treated base moisture obtained from the area prior to compaction.

2. Prior to compaction, the mixture shall then be compacted uniformly to the specified density.

3. During compaction operations, initial shaping may be required to obtain uniform compaction and required grade and cross-section.

E. When initial compaction is completed, the surface of the cement treated base shall be shaped to the required lines, grades and cross-section.

1. The moisture content of the surface material shall be maintained at not less than its specified optimum moisture content during finishing operations.

2. If any reshaping of the surface is necessary, it shall be lightly scarified to remove any compaction planes, scales or smooth surfaces left by equipment.

3. Final compaction shall then be continued until uniform and adequate density is obtained.

4. Cement treated base shall be uniformly compacted to the minimum of 95% of maximum density in accord with ASTM D1633.

5. Compaction and finishing shall be done in such a manner as to produce, in not longer than 2 hours, a smooth, dense surface free of compaction planes, cracks, ridges, or loose material.

F. Finished portions of cement treated base that are traveled on by equipment used in construction of an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging completed work.

1. Cement treated base shall be protected against freezing for 7 days after its construction and until it has hardened.

2. Owner must approve and curing must be performed in accord with manufacturer's recommendations.

G. Construction Joints:

1. At the end of each day's construction a transverse construction joint shall be formed by cutting back in to the completed work to form a full depth vertical face free of loose or shattered material.

2. The section may be opened to all traffic provided that the cement treated base has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

H. The contractor shall be required within the limits of his contract to maintain the cement treated base in good condition until all the work has been completed and accepted.

1. Maintenance shall include immediate repairs of any defects that may occur.

2. This work shall be done by the contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact.

3. Faulty work shall be corrected.

4. Any low areas shall be remedied by replacing the material for the full depth of treatment rather than by adding a thin layer of cement treated base to the completed work.

I. Cement treated base shall be in accord with the lines, grades, thicknesses and typical cross-section indicated on the Drawings. The finished surface of the cement treated base to receive the bedding sand shall be uniform and even and shall not deviate by more than +0 and -1/2 in. over a 10 ft. straightedge when measure in any direction.

J. Cement treated base shall continue a minimum of 2 ft. under adjacent paving at a 4 in. minimum depth as indicated on Drawings. Coordinate installation of adjacent paving to ensure that this continuation is provided.

3.04 GRAVEL SUMPS

A. Drill sumps to depth, diameter and at locations indicated on Drawings.

B. Dispose of soil removed from sumps in a legal manner.

C. Fill sumps with gravel.

D. Cover sumps with filter geotextile fabric as indicated on Drawings and fasten in a manner that will retain filter fabric in place during installation of bedding course sand.

3.05 INSTALLATION OF PAVERS

A. Bedding course sand:

1. Bedding sand shall be spread over the areas to be constructed to create an uncompacted loose surface onto which the pavers shall be placed.

a. The laying course shall be such that after compaction it forms a uniform layer nominally 1 in. thick.

b. Upon completion of the work, the final surface of the pavers shall be 1/8 in. above adjacent finishes at the low edge and flush with adjacent finishes at the high edge.

2. Bedding sand shall be laid to a tolerance +/- 3/16 in. to allow for the correct surcharge. Where distances between screed rails exceed 12 ft. intervals, an intermediate rail shall be set to line and level.

3. The screeded bedding sand shall not be subjected to any traffic by either mechanical or pedestrian use.

4. Sufficient sand shall be placed to ensure that no delay occurs in paver laying.

   a. The sand shall be kept moist as necessary by lightly misting with water so as not to disturb the screeded surface.

   b. Bedding sand that has been screeded but not covered with pavers at the end of each days work shall be taken up and re-screeded prior to re-commencement.

5. The voids left after the removal of screed rails shall be filled with loose sand as the laying of pavers proceeds.

6. A 20 ft. x 20 ft. test area shall be laid prior to screeding sand to determine the correct amount of surcharge required to obtain the correct final grade. If this area complies with the specification it may be incorporated as part of the final work.

7. Spreading of the laying course sand shall stop when weather conditions are unsuitable. If inclement weather causes deterioration of the laying course sand it shall be lifted and stored to one side to drain before it is reused.

B. Pavers:

1. Use pavers from a minimum of 3 packs of each color paver being laid at any one face. Pavers shall be laid hand tight in accord with the pattern as indicated on the Drawings.

2. Pavers shall be laid in a random layout to distribute variation in color. All areas shall comprise an equal proportion of each color.

3. Full pavers shall be laid first. Cut pavers shall then be laid to fill the edges between the laying pattern and the edge restraint or adjacent paving.

4. All cut pavers shall be cut using an appropriate dry-cut laser-welded masonry saw and in such a manner that no segment is smaller than 1/4 of a full paver.

   a. The cut faces shall be vertical.

   b. Where necessary to maintain joint width requirements at edge restraints, the cuts shall be curved.

5. Before compaction, the alignment of the pavers shall be adjusted to form concentric joints. The minimum joint width shall be 1/16 in. and the maximum width shall be 3/16 in.

6. If weather conditions are such that the performance of the pavement may be compromised, laying operations shall be discontinued and all laid pavers shall be aligned and compacted prior to suspension of the work.

7. On recommencement of laying operations, the edge 2 courses of existing paving shall be lifted and the sand rescreeded before further pavers are laid.

C. Compaction:

1. At the end of each day, after the pavers have been aligned, and cut pavers incorporated at edge restraints, dry joint sand shall be brushed over the surface so that it penetrates the joints. Surplus sand shall be brushed off.
2. The pavement shall be compacted using a low amplitude plate compactor with a plate area of not less than 2-1/2 sq. ft. transmitting an effective force of not less than 11 psi at a frequency of 80 - 100 Hz.
    a. Take necessary precautions to prevent damage to the pavers.
    b. Compaction shall continue until the finished surface is within the specified tolerance.
    c. No compaction shall be permitted within 4 ft. of an unrestrained edge.
3. After vibration of the pavers to finished elevations, dry jointing sand shall be brushed over the surface and the pavement shall be re-compacted until all joints are completely filled with sand.
    a. Great care shall be taken to ensure that the joints are filled; sand shall be constantly brushed over the surface and the pavement recompacted as necessary.
    b. Surplus jointing sand shall be maintained on the surface until application of the joint sand stabilizer.
4. On completion of vibration, before and after joint filling, surface tolerances shall be within 3/16 in. under a 10 ft. straight edge and +1/4 in. to -1/8 in. from finished elevation.
    a. The pavers shall be 1/8 in. above edge restraints and there shall not be a difference in elevation between adjacent units of greater than 1/8 in.
    b. Elevations shall be such that no water stands on the surface.

D. Jointing sand stabilizer:

1. On completion of the entire pavement installation the surface shall be further compacted using an 8-10 ton pneumatic tired roller having tire pressures of 90 psi.
    a. Rolling shall be continued for a minimum of 2 days.
    b. At the completion of rolling jointing sand shall be brushed off the surface so that the sand level is at the bottom of the chamfers.
2. The surface shall be made clean and free form oil, laitence, dust and any loose material prior to the application of joint sand stabilizer. The surface and joint sand shall be dry for the full depth prior to commencing work.
3. The joint sand stabilizer shall be applied evenly at the appropriate coverage as follows:
    a. Surebond shall be applied from a low pressure regulated backpack sprayer at a coverage rate of 150 sq. ft./gallon. Work the material into the untreated joints using 3/4 in. nap rollers, ensuring that all joints are adequately flooded and that no surplus material is left on the surface. This work to be in accord with the manufacturer's recommendations.
    b. Sandstable shall be applied from a watering can at a coverage rate of 80 sq. ft./gallon. Work the material into the untreated joints using squeegees, ensuring that no surplus material is left on the surface, in accord with the manufacturer’s recommendations.
4. The area treated with sand stabilizer shall be protected from rain or moisture.
5. No traffic shall be allowed onto the area treated with sand stabilizer for 24 hours after completing application of the stabilizer.

6. Work shall cease if inclement weather (rain or strong wind) will affect the stabilizing operation and shall not recommence until the joint sand has dried sufficiently to allow penetration of the sealant.

E. Ensure that slip resistance of paving is maintained.

3.06 FIELD QUALITY CONTROL

A. Water/flood test: After installation of paving is complete, perform flood testing of entire paving surface for surface ponding of or standing water. Paving surfaces may be tested sequentially in sections, starting from the high point of any contiguous areas.

1. Provide barriers as necessary to contain water and protect adjacent areas from water damage.

2. Ensure that area drains and drainage piping systems are unplugged, open and completely functional/operational.

3. In the presence of the Owner, thoroughly flood all portions of area to be flood-tested, with sufficient quantity of water to permit any "low" spots to fully accumulate water. Permit water to freely surface drain, but do not delay marking/recording procedure nor permit water to penetrate or drain into underlying substrates.

4. Immediately mark or otherwise record specific areas where water stands or ponds; methods used to mark/record "low" areas shall not permanently mar, physically alter, nor otherwise leave any evidence of same on finished paving surfaces. Correct or remedy paving installation (including removal/reinstallation of pavers, cement-treated base course, bedding sand course, and subgrade) to the extent necessary to eliminate standing or ponding water on the finished paving surface; unless otherwise directed by Owner, corrective/remedial work shall be performed in accord with Specifications requirements.

5. Retest corrected/remedied areas for standing or ponding water and recorrect until finished paving surface is free of any standing or ponding water.

6. Perform corrective/remedial work, tests, and retesting without additional cost nor schedule impacts to the Owner.

3.07 PROTECTION AND CLEAN UP

A. Protection:

1. Protect work from damage, discoloration, deterioration and theft until Substantial Completion.

2. All vehicles and equipment operating on the completed pavers before and after application of the joint sand stabilizer shall be maintained in a clean condition, so that oil, tar, rubber or other matter is not deposited on the surface of the pavers or adjacent paving and features.

B. Clean up:

1. All material generated by construction work in this Section shall be removed at the end of each section of the work and the site shall be left in a clean and safe condition.

2. After completion of any repair work, clean all exposed surfaces with clean water and stiff brushes until all stains and dirt are removed. Use cleaning solutions only that are recommended by the paver and stabilizer manufacturers and do not use wire brushes.

3.08 MAINTENANCE

A. Repairs:

1. Repair or replace any damaged work to original specified condition prior to handover.

2. Where lateral displacement of the pavers has occurred adjacent to edge restraints, the cut pavers shall be replaced with new pavers of the correct size to comply with the specified joint widths and the surface shall be re-stabilized.

B. Maintenance: Return to the site 3 months after completion to rectify any problems in the completed work caused by failure in any respect to adequately align the pavers, compact the bedding sand or fill the joints.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Chain link fences and gates.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Concrete for post footings: Sections 02705, 03300, and 03301.

B. Grounding of chain link fences and gates: Section 16450.

1.03 QUALITY ASSURANCE

A. Reference specifications and standards:

1. ASTM: A121 Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM: A392 Zinc-Coated Steel Chain-Link Fence Fabric.
3. ASTM: A569 Steel, Carbon, Hot-Rolled Sheet Strip, Commercial Quality.
4. ASTM: A641 Zinc-Coated (Galvanized) Carbon Steel Wire.
5. ASTM: A653 Steel Sheet, Zinc-Coated (Galvanized) and Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM: A780 Repair of Damaged Hot-Dip Galvanized Coatings.
7. ASTM: A824 Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence.
8. ASTM: F567 Installation of Chain-Link Fence.
9. ASTM: F626 Fence Fittings.
10. ASTM: F669 Strength Requirements of Metal Post and Rails for Industrial Chain Link Fence.
11. ASTM: F900 Industrial and Commercial Swing Gates.
12. ASTM: F1083 Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
13. ASTM: F1184 Industrial and Commercial Horizontal Slide Gates.
14. ASTM: F1234 Protective Coatings on Steel Framework for Fences.

1.04 SUBMITTALS

A. Procedure: In accord with Section 01330.

B. Shop drawings: Plans, elevations, sections, and details, including fully dimensioned actual layout of components and accessories. Indicate dimensions, clearances required, materials, finishes, and anchorage to or in supporting construction.

C. Product data: Manufacturer's detailed technical materials, fabrication, and installation data, including technical bulletins, drawings, guides, and manuals, as applicable to the work of this Project.

1.05 PROJECT CONDITIONS

A. Protection: Protect completed installation from damage of subsequent construction activities. Immediately remove any foreign matter that accumulates on exposed, finished surfaces in accord with manufacturer's recommendations.

B. Sequencing and scheduling:

1. Coordinate and sequence erection or installation of work of this Section with adjacent or integral materials, products, and work specified in other Sections.

2. Order specified materials, products, and similar items with extended "long lead" (ordering) times, sufficiently in advance of scheduled installation, or erection dates to permit any required shop or field alteration, modification, or finishing and to not delay the scheduled progress of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fence fabric:

1. ASTM A392, Class 1, 11 gauge wire, woven into approximately 2 inch mesh, and provided with hot-dip galvanized finish before or after weaving; completely free of barbs, icicles, or other projections which might be hazardous.

2. Knuckle top and bottom selvage.

B. Framework: Steel pipe conforming to strength requirements of ASTM F669, Group 1A or 1C.

1. Group 1A: Conforming to ASTM F1083 (replaces ASTM A120), Schedule 40, electric welded seamless pipe with external and internal hot-dip zinc coating of 1.8 oz. per sq. ft. (minimum average).

2. Group 1C: Manufactured from steel sheet or strip conforming to ASTM A653, Grade 50, Class 1 or 2 (ASTM A446, Grade D) or ASTM A569 with minimum yield strength of 50,000 psi, cold-rolled and electrically-welded, with external and internal protective coatings conforming to ASTM F1234 as follows:

a. External: Type A (1.8 oz. per sq. ft., minimum average, hot-dip zinc coating), or Type B (0.9 oz. per sq. ft., minimum zinc coating with chromate conversion coating and minimum 0.3 mils acrylic/polymer coating.

b. Internal: Type B (0.9 oz. per sq. ft. minimum, zinc coating with chromate conversion coating or Type D (zinc-rich organic coating with minimum 90% zinc powder).

3. Pipe size and weight as follows:

			Minimum Weight Per Foot	
Item	Nominal Pipe Size	Outside Diameter	Group 1A	Group 1C
Top rail, brace rails and transom rails	1-1/4	1.660 in.	2.27 lb.	1.82 lb.
Gate frames:				
Up to 6 ft. high	1-1/2	1.900 in.	2.72 lb.	2.28 lb.
More than 6 ft. high	2	2.375 in.	3.65 lb.	3.12 lb.
Line posts:				
Up to 6 ft. high	2	2.375 in.	3.65 lb.	3.12 lb.

Item	Nominal Pipe Size	Outside Diameter	Minimum Weight Per Foot	
			Group 1A	Group 1C
More than 6 ft. high	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
Terminal, corner, angle, and pull posts:				
Up to 6 ft. high	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
More than 6 ft. high	3	3.500 in.	7.58 lb.	5.71 lb.
Swing gate posts:				
Up to 6 ft. wide	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
Up to 12 ft. wide	3-1/2	4.000 in.	9.11 lb.	6.56 lb.
Up to 18 ft. wide	6	6.625 in.	18.97 lb.	-----
Up to 24 ft. wide	8	8.625 in.	28.55 lb.	-----
Slide gate posts (cantilever):				
Up to 12 ft. wide	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
More than 12 ft. wide	3-1/2	4.000 in.	9.11 lb.	6.56 lb.

C. Fittings: In accord with ASTM F626.

1. Post caps: Type designed to fit snugly over post tops, with minimum projection of 1-1/2 inch below tops, and made with malleable iron or pressed steel. Provide line post caps of such design as will allow top rail to pass through same. Provide curved top caps for all other posts.
2. Expansion sleeve couplings: Top rails - pressed steel or round steel tubing, 6 inch long, fitted with raised center, and sized to fit tightly inside or outside of rail.
3. Rail ends: Top rails and brace rails - malleable iron or pressed steel, with holes to receive 5/16 inch bolts for all fastenings.
4. Tension bands, brace rail end bands, and truss rod brackets: Mild steel flats, not less than 1/8 inch x 1 inch, and tension bands for gates not less than 1/8 inch x 3/4 inch Provide 5/16 inch bolts for all fastenings.
5. Tension bars: Mild steel flats, not less than 3/16 inch x 3/4 inch.
6. Tension wire: ASTM A824, Type II, Class 2, 7 gauge marcelled or 6 gauge plain steel wire, galvanized. Provide at bottom of fence fabric.
7. Turnbuckles: Eye and eye type, drop forged steel, right and left hand threads on 5/16 inch diameter screws, with 4-1/2 inch take-up.
8. Truss rods: Minimum 5/16 inch diameter steel rod.
9. Tie wire and clips: Soft annealed galvanized steel wire. Provide 9 gauge wire for fastening fabric to posts, and 14 or 9 gauge wire for fastening fabric on top rails, bottom rails, intermediate rails, and brace rails. Provide 9 gauge wire clip (hog rings) for fastening fabric to bottom tension wire.

10. Angle extension-arm brackets: Standard formed pressed steel, or cast iron, with slots for installing three strands of barbed wire.

11. Hardware:

    a. Provide hinges, bolts, cane bolts (with steel pipe sleeve and precast concrete collar where applicable), fork latches, keepers, and other operating hardware of manufacturer's standard as approved by Owner.

    b. Latches for double drive gates shall be of a yoke type assembly with a plunger bar, Page Industrial latch type 75 or Owner approved equivalent, arranged to engage a 1-1/2 inch pipe center stop, anchored in concrete.

    c. Latches for walk gates shall have a gravity type mechanism, Page Industrial latch type 75 or Owner approved equivalent, which shall automatically engage a pin in the gate frame.

    d. Latches shall be secured to the gate frame so they are non-removable after installation and shall have provisions for padlocking.

    e. Gate keepers shall consist of a mechanical device, which shall automatically engage the free end of the gate when in the full open position.

12. Finish: Hot-dip galvanize all metal after fabrication with a minimum of 1.2 oz. per sq. ft. (except tie wire and clips) and 0.8 oz. per sq. ft. (tie wire and clips) of zinc coating, except bolts and nuts may be cadmium-plated.

D. Concrete and grout materials: In accord with Sections 02705, 03300, and 03301.

E. Barbed wire: Two-strand, galvanized, 12-1/2 gauge line wire with 14 gauge, four-point round barbs spaced approximately 5 in. on center in accord with ASTM A121, Chain Link Fence Grade (Class 3 zinc coating).

F. Barbed tape (at fences minimum 8 foot height): Manufactured from Type 430 stainless steel strip, minimum 0.025 inch thick, with needle sharp, razor-edge barbs at 4 inches on center, cold-clenched around a 0.098 inch minimum stainless steel wire core. Coil size and type (helical, concertina, single, double) shall be as selected by Owner. Provide manufacturer's standard stainless steel clips and tie wire.

G. Galvanizing repair compound: In accord with ASTM A780.

H. Visual screening (when indicated on the drawings): Closed mesh (approximately 90% obscure) green polypropylene shade cloth/privacy screening.

I. Isolation tape: Polymer alloy film with elastomeric coating, 30 mils thick, specifically designed for corrosion and electrolytic protection of embedded metals, Tapecoat H30 by The Tapecoat Company, Evanston, IL, Tel: (708) 866-8500, 3602 Corrosion Inhibiting Tapewrap by Rust-Oleum Corp., Vernon Hills, IL, Tel: (708) 367-7700, or Owner-approved equivalent.

2.02 FABRICATION - WELDING

A. Gate frames: Miter and continuously weld at corners and intersections of intermediate brace rails.

B. Posts: Continuously weld angle top posts at angle/vertical intersections and at continuous top rail connections.

C. Continuously weld, without voids, around entire part interface, at other conditions.

D. Welds exhibiting uniformity and soundness may remain as drawn. All other welds shall be ground smooth.

E. Hot-dip galvanize welded assemblies after completion of fabrication.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: In accord with ASTM F567.

B. Preparation:

1. Measure and lay out complete fence line.

2. Locate and mark position of posts.

C. Posts:

1. Excavated footing sizes:

a. Diameter:

(1) Line, corner, end, and pull posts: Not less than four times greatest cross-section of post. Increase footing diameter, in poor or unstable soil conditions, to support posts without deflection from imposed loads

(2) Gate posts: Diameter to support posts without deflection from imposed loads, but not less than that specified for line, corner, end and pull posts.

b. Hole depths:

(1) Line, corner, end, and pull posts: Not less than 39 inches with post embedded 36 inches for fence heights less than 8 feet. Increase post depth and post length 3 inches for every 1 foot of fence height greater than 8 feet

(2) Gate posts: Depth to support posts without deflection from imposed loads, but not less than that specified for line, corner, end and pull posts.

2. Core-drilled or sleeved concrete curbs, walls:

a. Diameter: Not less than 1/2 inch more than the greatest cross-section of post.

b. Depth and post length: Not less than three times the greatest cross-section of post.

3. Prime post surfaces as recommended by isolation tape manufacturer and spiral-wrap isolation tape with overlaps completely covering surface to be embedded.

4. Setting:

a. Install angle or corner posts at each change in direction of 15° or more; change in grade of 5% or more, and at beginning and end of curved sections. Install terminal posts at ends. Install gate posts at both sides of gates.

b. Space line posts equally between gate, terminal, angle, and corner posts, but not more than 10 feet on center. In curved sections, with radius of 50 feet or less, space posts at 5 feet - 6 inches on center. Set top of post eye level with top of fabric.

5. Concrete for excavated footings: Fill post hole with concrete to 2 inches above grade, crown top to slope away from post at rate of 1/4 inch per foot for complete drainage. Trowel entire surface uniformly smooth.

6. Grout for core-drilled or sleeved concrete curbs, walls: Fill approximately 1/2 of void with grout, then immediately force post into bottom of void. Additionally fill annular space between post and core or sleeve, solid with grout, crowning top to slope away from post at rate of 1/4 inch per foot for complete drainage. Trowel entire surface uniformly smooth.

D. Framework:

1. Top rails: Install top rail at all fabric. Pass rail through post caps, and secure with rail end fittings and bands.
2. Brace rails: Provide one horizontal brace rail in each panel adjacent to gate, terminal, and corner posts. Set rail at mid-height, and rigidly secure to posts with rail-end fittings and bands.
    a. Provide brace rail in all panels of curved fencing.
    b. Provide transom rail at top of each pedestrian gate when fence fabric is higher than 7 ft.
3. Bottom tension wire: Install at bottom of all fabric. Provide with turnbuckle for each 150 feet, or fraction thereof. Attach to posts and turnbuckles in positive manner to prevent loss of tension.

E. Fabric: Stretch tightly. Secure with full height (of fabric) tension bands at gate, terminal angle and corner posts. Attach tension bars to posts with bolted tension bands spaced at 15 inches on center maximum.
1. Fasten to line posts with tie wires spaced at 15 inches on center maximum. Hook wire at both ends. Do not use hooked ties with links.
2. Fasten to top rails, bottom rails, intermediate rails, and brace rails with two full turns of 14 gauge wire, or one turn with 9 gauge wire at 24 inches on center maximum. Hook ends of tie wire.
3. Fasten to bottom tension wire with wire clips (hog rings) at 18 inches on center maximum.

F. Barbed wire and brackets:
1. Bolt extension-arm brackets to post caps with 5/16 inch bolts.
2. Provide three parallel strands of barbed wire on extension-arm brackets. Stretch wire taut, and wire to brackets with two turns of 14 gauge tie wire.

G. Barbed tape: Secure loops of barbed tape to barbed wire strands atop fence, at even spacing (as recommended by manufacturer, but not to exceed 12 inches) with stainless steel tie wires (two per loops) on adjacent barbed wire strands. For concertina type, clip adjacent coils together with stainless steel clips (minimum three per coil) equally spaced as recommended by manufacturer.

H. Gates:
1. Swing gates: In accord with ASTM F900.
    a. Provide gates of sizes indicated on Drawings, made with galvanized round pipe frame, securely braced internally, and filled with fence fabric. Provide heavy-duty ball and socket offset type hinges which will allow gate to be in line with fence when closed, and fold back 180° to lie flat against fence when open. Provide single gates with galvanized steel flat plate stop welded to gate frame. Provide galvanized steel plate backing for mounting and securing specialty hardware and other similar items on gates. Equip each gate with a heavy-duty center locking device with provision for a padlock.
    b. Unless specifically required otherwise for specialty hardware items, provide clearances as follows: 1 inch at hinge side; 1-1/2 inch at latch side; 1 inch at head (when transom rail is used); 1-1/2 inch at bottom. In sloping areas, conform bottom gate rails to grade.
2. Slide gates: In accord with ASTM F1184. Provide gates of sizes indicated on Drawings, made with galvanized, round tubular pipe frame securely braced internally, and filled with fence fabric. Provide heavy-duty, sealed-bearing roller assemblies, which will allow gates to overlap gate openings when closed and completely unobstruct gate opening (between gate posts) when open. Equip gates with locking device with provision for a padlock.
3. Latch and lock assemblies: Secure assemblies to gate posts by hammered pins or bolts.
4. Latches, stops, roller assemblies, and other gate accessories shall be steel or malleable iron with galvanized coating as specified for fence framework.

I. Visual screening:

1. Fabricate in sections with minimal, horizontal seams, in longest lengths possible and practical with hemmed edges and non-corrosive grommets (at not greater than 24 inches on center); provide additional grommets (in reinforced seams) at intermediate locations coincident with horizontal brace rails, at fence heights greater than 10 feet. All horizontal seaming shall be identical, consistently located on all sections, and wherever practical, coincident with framework members.

2. Secure to fencing fabric at grommet locations only using tie wires or clips as specified for fencing fabric attachment and/or polyester/polypropylene cording. Method of attachment must be adjustable at all times. Visual screening shall be taut and flat and exhibit even tension throughout; ripples, and similar visually unacceptable appearances are not permitted at any time.

3.02 ADJUST AND CLEAN

A. Adjust tension wires and truss rods for rigid installation.

B. Tighten fasteners, and accessories.

C. Adjust hardware for ease of operation.

D. Remove excess and waste materials from job site.

3.03 TOUCH-UP

A. Galvanizing: Touch up field cuts, holes, abrasions and welds (including welds at grounding conductor connections) with field-applied zinc coating touch-up material in accord with ASTM A780 (including annexes). Apply in accord with manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Labor, materials, weeding, plant materials, soil additives, soil preparation, planting, services, and facilities required for landscaping work as indicated on Drawings and specified, complete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Site Clearing: Section 02230

B. Grading: Section 02310.

C. Erosion and Sedimentation control**:** Section 02370.

D. Seeding & Strawing: Section 02922

E. Sodding: Section 02924

1.03 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Submit manufacturer's data sheets on all products.

1.04 PROJECT CONDITIONS

A. Protect and maintain all existing plant materials indicated. This includes maintaining all protective barriers in place unless directed otherwise by Owner. Vehicles and equipment shall not be parked, serviced, or operated within drip line of existing trees or within newly planted areas. Personnel not required for installation work shall be barred from the planted area.

B. Sequencing: Do not commence planting until site grading, soil import, and preparation has been completed and approved by Owner. Ensure all drainage swales and flow lines have been established and accepted prior to planting.

C. Contractor's duties:

1. Schedule item delivery date with supplier in accord with construction schedule. Materials damaged during shipment or found unacceptable or unhealthy shall be rejected. Contractor shall be responsible to receive, off-load, and maintain plant materials prior to installation.

2. Designate place of delivery for all items with Owner approval.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All plant materials shall be subject to inspection and approval by Owner.

B. Topsoil shall be fertile, friable, natural surface soil obtained from well-drained areas possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass or other vegetation. Topsoil shall be free of material that might be harmful to plant growth and shall not hinder planting or maintenance operations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Ensure that final grades to ±0.10 feet have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, and other preparatory needs. Be responsible to see that finish grading of all planting areas is as indicated on the plans and as directed by Owner.

3.02 PREPARATION

A. Weed control:

1. Before and during preliminary and finish grading, dig out all weeds and grasses by roots and dispose of off-site. Prior to planting, eliminate any weeds present in delivered plant stock. Grasses not of perennial type, except for Torpedo Grass and Nut Grass, less than 2-1/2 inches high and not bearing seeds, may be turned under. Perennial weeds and grasses to be removed include, but are not limited to, the following:

    a. Nut Grass.

    b. St. Augustine.

    c. Puncture Vine.

    d. Morning Glory.

    e. Dog Fennel.

    f. Torpedo Grass.

    g. Common Bermuda Grass.

    h. Kikuyu grass.

        (1) Remove other noxious or invasive weeds.

2. Site shall be maintained weed-free throughout planting operations and until final acceptance by Owner.

3. All soil areas to be turf grass, except Bahia grass, shall be fumigated with Basamid or Owner-approved equivalent prior to planting.

B. Soil preparation (pretillage) for all planted areas:

1. Areas to be planted that are densely compacted, 85% to 90%, shall be cross-ripped to 12 inches depth. Areas over 90% compacted shall be cross-ripped to 24 inches depth, and all unacceptable materials removed.

2. Soil for planting shall be free of rocks over 1/2 inch in dia., and free of foreign debris, refuse, plants or roots, clods, weeds, sticks, solvents, petroleum products, concrete, base rock, or other deleterious or undesirable and unwanted materials. Soil shall be free of soil-borne diseases and capable of sustaining healthy plant life. Materials not meeting such requirements shall be removed, including all temporary road bases or pavement already in place.

3. In area which will receive import soil, scarify the existing soil 4 inches deep if the soil has been compacted prior to backfilling.

4. Topsoil previously removed and stockpiled may be used in the work. If the quantity of excavated topsoil is inadequate, additional topsoil shall be furnished and installed.

5. All areas to receive topsoil shall be shaped to receive a minimum of 3 inches of topsoil.

6. The topsoil shall be uniformly distributed and evenly spread to an average thickness of 3 inches.
    a. The spreading shall be performed in such a manner that planting can proceed with little additional soil preparation or tillage.
    b. The area shall be left smooth and suitable for lawns.
7. The topsoil surface shall be made smooth and uniform. Irregularities in the surface from topsoiling or other operations shall be corrected so as to prevent the formation of depressions where water will stand.
8. Topsoil shall not be hauled and placed when wet or when the subgrade is excessively wet, extremely dry or in a condition otherwise detrimental to the proposed planting or to proper grading.
9. Topsoil shall not be compacted.
10. Where any portion of the surface becomes gullied or otherwise damaged, the affected area shall be repaired to establish the condition and grade prior to topsoiling and then shall be re-topsoiled.
11. After smooth grading, the topsoil surface shall be cleared of stones or other objects that might be a hindrance to planting or maintenance operations.
12. Topsoil or other material that has been brought upon the surface of paved areas shall be removed daily.

C. Landscape erosion control:
1. Provide and maintain temporary erosion control for planted areas. Do not block irrigation coverage with silt fences.
2. Provide sand bags, sod, and/or erosion control silt fence at drainage swales until planting is established and soil has been stabilized. See Section 02370 for additional requirements.
3. Install Bahia sod on slopes and swales for erosion as indicated on Drawings.
4. Repair all scars caused by erosion, as approved by Owner.

D. Final grades:
1. Minor grading modifications may be required to establish final grades.
2. Finish grading shall ensure proper drainage of site as determined by the grading plans and Owner.
3. Areas shall be graded such that final grades will be 2 inches below adjacent paved areas, sidewalks, valve boxes, headers, clean-outs, drains, manholes, and similar conditions, unless otherwise indicated on Drawings.
4. Surface drainage shall be away from building foundations at 1/4 inch per foot to aid in water runoff.
5. Remove or redistribute excess soil before application of fertilizer. Make allowances when establishing finish grades for earth excavation from planting pits and mulch.
6. Trenches: If sprinkler system has been installed after grading and fertilizing has been completed, retill trench backfill and fertilize to depth specified for area, to conform to specified requirements.
7. Eliminate all erosion scars after each erosion event and prior to commencing maintenance period, unless directed otherwise by Owner.

3.03 CLEAN-UP

A. Pick up all trash resulting from this work no less frequently than each Friday, or as directed by Owner, before leaving site, once a week, and/or the last working day of each week. All trash shall be removed completely from site. After planting operations have been completed, remove trash, excess soil, empty plant containers, and rubbish from property. Scars, ruts, and other marks in ground caused by this work shall be repaired and ground left neat and orderly throughout.

B. Leave site area broom-clean and wash down all paved areas within Contract area, leaving premises in a clean condition. All walks shall be left in a clean and safe condition.

C. Completed work shall be maintained and protected from damage including providing and maintaining of temporary barriers.

D. Dispose of unacceptable or excess soil at an off-site location approved by Owner.

3.04 FIELD QUALITY CONTROL

A. Inspections described herein will be made by Owner as work progresses.

B. Inspections will be made on an ongoing basis and at the following parts of the work:

1. Finish grading and soil preparation.
2. Upon completion of finish grading and soil preparation.
3. Planting areas prior to seeding.
4. Completion of work and substantial completion (or partial substantial completion) letter issued by Owner.
5. Final inspection.

3.05 PROTECTION

A. Continuously protect all planted areas, plant materials, and supports until final acceptance of work.

B. Protect work completed by other trades from damage.

3.06 FINAL ACCEPTANCE OF INSTALLATION

A. Maintain all planted areas free of debris and insects. Mow, cultivate, weed and water all areas until final acceptance of work zone is approved by Owner. All punch list items shall be completed and all irrigation operational prior to Owner's acceptance of project installation.

B. Prior to final approval of work, do the following:

1. Re-sod or re-seed areas where necessary to obtain full and even coverage.
2. Remove all debris resulting from work of this Section.
3. Regrade, lightly compact, and replant around sprinkler heads where necessary to maintain proper vertical positioning in relation to established grade.
4. Fill all depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage, compact lightly, and replant filled areas in accord with Drawing requirements.

C. Acceptability of work for start of maintenance and completion of the work for substantial (or partial substantial) completion issued by Owner shall include, but shall not be limited to:

1. Punch list items complete and approved by Owner.
2. Final grades approved in accord with Drawings and Specifications.

3. Site weed-free in accord with approved weed control plan.
4. Grasses installed in accord with Drawings and Specifications.
5. All materials fertilized and soil amendments complete and in place.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Establish a stand of grass on slopes and other areas indicated on Drawings for seeding and strawing. The work includes seeding, fertilizing, and strawing as required. Maintain the seeded areas until a dense, mature stand of grass has been established.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grading: Section 02310.

B. Plantings: Section 02900

1.03 QUALITY ASSURANCE

A. All seeds and seed mixtures shall be free of noxious weed seeds as determined by the Florida Department of Agriculture.

1. All seeds and seed mixtures shall not contain any weed seeds in excess of 0.50%.

2. Grass seed which has become wet, moldy or otherwise damaged in transit or storage shall not be acceptable

2. Hay that is fresh and excessively brittle or that is in such an advanced stage of decomposition as to smother or retard the growth of grass will not be acceptable.

1.04 SUBMITTALS

A. Procedures: Submit in accord with Section 01330.

B. Submit supplier's certifications that materials meet standards indicated.

1.05 PRODUCT HANDLING

A. Grass seed and fertilizer shall be delivered in sealed containers or bags, each labeled in accordance with the applicable federal and state regulations and bearing the name, trade name or trademark and certification of the producer and the complete analysis of the seed.

1.06 TESTS AND INSPECTIONS

A. Fertilizer and seed:

1. Owner may take samples of fertilizer and seed as they are delivered to the site for inspection and sampling.

2. Fertilize and seed which do not meet Specification requirements will be rejected.

B. Seeded areas:

1. Inspect jointly with Owner 6 weeks after completion of seeding.

2. Reseed any bare spots over 1 square yard in area or other unsatisfactory growth, in accord with Specifications requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Summer mix: (May 1 to September 30).

1. Seed -

a. Scarified Argentine Bahia grass certified 80% pure, 80% germination and hulled Bermuda grass certified 90% pure, 80% germination.

b. Mix at a ratio of 10 lb. hulled Bermuda grass to 90 lb. scarified Argentine Bahia grass +150 lb. brown head mullet.

2. Fertilizer: 16-4-8 ratio of nitrogen, phosphorous, and potash.

a. Nitrogen: Minimum 50% of nitrogen shall be from a natural organic source such as tankage or sludge.

b. Potash: Derived from both muriate and sulphate.

c. Minor elements: Two units of magnesium, 0.25 units of manganese and one unit of chelated iron.

3. Hay: Agricultural quality from fields where seed crop is desired free of noxious weed seed.

a. Baled Pangola.

b. Any of the Bahia's.

B. Winter mix: (September 30 to May 1).

1. Seed - formula rate per acre: 100 lb. Argentine Bahia grass certified 80% pure and 80% germination. 10 lb. hulled Bermuda grass certified 90% pure and 80% germination. 200 lbs. rye per acre.

2. Fertilizer: N.P.K. 16-18-10 of nitrogen, phosphorous and potash.

a. Nitrogen: Derived from nitrate nitrogen 6.40 and 9.60 ammonical nitrogen.

b. Minor elements: Two units of magnesium, derived from SUL-PO-MAG. N.P.K. derived from base mixtures of NANO3 + D.A.P. + K20.

(1) Make formulation from granular materials.

3. Hay: Agricultural quality from fields where seed crop is desired free of noxious weed seed.

a. Baled Pangola.

b. Any of the Bahia's.

PART 3 - EXECUTION

3.01 SEEDBED PREPARATION

1. The seedbed shall be loose and porous at the time of seeding.

2. When necessary, the seedbed shall be loosened to a depth of at least 3 inches by harrowing or other suitable means and the surfaces smooth graded and cleared of objectionable material as specified.

3.02 SUMMER MIX INSTALLATION (MAY 1 TO SEPTEMBER 30)

A. Fertilizer: Uniformly distribute at a rate of 500 lb. per acre at time of seeding. Forumulation shall be such as to provide not less than 80 lb. each of nitrogen, phosphorous, and potash per acre.

B. Seed: Uniformly distribute with calibrated equipment at a rate of 250 lb. formula mix per acre.

C. Hay: Apply at a rate of 200 bales per acre to provide uniform coverage of approximately 2 inches depth.

D. Thoroughly incorporate seed and fertilizer into the soil, in one operation, to a minimum depth of 1-1/2 inches

E. Within 24 hr. after seeding, compact all seeded areas with a roller capable of producing 90 lb. of compaction weight per sq. inch

3.03 WINTER MIX INSTALLATION (SEPTEMBER 30 TO MAY 1)

A. Fertilizer: Uniformly distribute at a rate of 600 lb. per acre at time of seeding.

B. Seed: Uniformly distribute with calibrated equipment at formula rate per acre.

C. Hay: Apply at the rate of 200 bales per acre to provide uniform coverage of approximately 2 inches

D. Thoroughly incorporate seed and fertilizer into the soil in one operation, to a minimum depth of 1-1/2 inches

E. Within 24 hours after seeding, compact all seeded areas with a roller capable of producing 90 pounds of compaction weight per square inch

3.04 HAY APPLICATION

A. Hay shall be spread not more then 48 hours after the completion of seeding operations.

B. Hay application shall be started at the windward side of relatively flat areas and at the upper part of slopes and shall continue uniformly until the area is completely covered.

C. Hay shall be anchored in place by a Coulter disc hay-anchoring machine or other suitable equipment that will secure the hay firmly in the ground to form a soil-binding hay and prevent the loss or bunching of the hay by the wind.

D. The number of passes over the hay needed to secure it firmly to the soil shall in no case exceed 3.

3.05 GRASS ESTABLISHMENT

A. Seeded areas shall be protected against traffic or other use by erecting barricades around each area immediately after seeding is completed and by placing warning signs of an approved type on each seeded area.

B. The period of grass establishment shall begin immediately after the completion of haying in an area and shall continue for a period of 2 months after the completion of seeding on the entire project unless the desired grass cover is established in a shorter period of time and a shortening of the grass establishment period is authorized.

C. Watering shall be done in a manner to prevent the displacement of seed and hay and to prevent puddling and water erosion.

D. Immediately after the completion of hay application in an area, the area shall be moistened to a depth of 3 inches or more.

E. After the initial watering, the seeded areas shall be watered as required to maintain the soil in a moist condition for the entire grass establishment period.

F. Weeds or other undesirable vegetation that threaten to smother the grass shall be uprooted and removed from the area.

G. After grass growth reaches approximately 2 inches, bare areas shall be reseeded.

H. Reseeding shall be with the grass seed specified and shall be sown at the rate specified and in a manner that will cause a minimum of disturbance to the existing stand of grass and hay.

I. In areas where hay has been distributed sufficiently to nullify its purpose, new hay shall be added and anchored as specified.

J. Acceptance Provisions

1. Completed grass areas shall have been recently mowed and be covered with a uniform stand of the specified grass, be free of rank growths of weeds or other undesirable vegetation and be free of irregular surface changes and other depressions where water will accumulate.

2. Scattered bare spots not larger than 6 inches in any dimension shall be allowed, up to a maximum of 3 percent of any grass area.

3. The condition of grass areas at the time of inspection shall be noted and a determination shall be made whether the grass establishment period shall be extended for any area.

4. If, before completion and acceptance of the entire work, portions of the surface become gullied or otherwise damaged following seeding or the grass seedings have been destroyed, the affected area shall be repaired to reestablish the condition and grade of the soil prior to seeding and then shall be reseeded, remulched and the grass established as specified.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Permanent sodding at locations indicated on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grading: Section 02310.

B. Plantings: Section 02900

1.03 SUBMITTALS

A. Procedures: In accord with Section 01330.

B. Description of type grass and location from which harvested, for approval by Owner.

1.04 PRODUCT HANDLING

A. Dumping sod from vehicles will not be permitted.

B. If stacked during transit or storage, the sod shall be placed with all roots facing the bottom of the pallet.

C. During delivery and while in stacks, sod shall be kept moist and cool and protected from sun and air.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sod:

1. Sod shall be well-matted with root growth.
2. Unless otherwise directed by Owner, sod grass shall match the grass type adjacent to which it will be planted.
3. Purchase in mature state from local suppliers.
4. Number 1 quality, fresh, premium from certified seed. The turf shall be sufficiently dense so that no surface media is visible when mowed to a height of 1-1/2 inches. Maximum mowing height shall be 2-1/2 inches. At the time of sale, the turf shall contain no more than 1% undesirable grasses and not more than two weeds per 500 square feet. The thickness of the media portion of the sod shall not exceed 1/2 inch.

    a. Sod shall not be acceptable if it contains any of the following weeds: Bermuda grass, quack grass, Johnson grass, poison ivy, nutsedge, nimbleill, thistle, bindwind, bent grass, wild garlic, frond ivy, perennial sorrel, Brome grass, or Kikuyu grass.

    b. The soil media shall be friable and well-drained. Standard size sections of sod shall be strong enough that they can be picked up and handled without damage.

PART 3 - EXECUTION

3.01 HARVESTING

A. Use approved sod cutters for cutting and removing sod. Exercise care to retain native soil intact.

B. Cut sod to a thickness sufficient to secure a dense stand of live grass.

C. Sod shall not contain noxious weeds in excess of 0.50%.

3.02 SOIL PREPARATION

A. Remove rocks, weeds, and debris from area to be sodded. Work-up soil to a depth of 6 inches and break up all clods to less than 1 inch in size. Soil prep all areas as described elsewhere in Specifications.

B. Carefully smooth surface areas to be sodded. Roll areas to expose soil depressions or surface irregularities. Regrade as required to obtain optimum conditions.

3.03 PLANTING

A. At time of planting, sod shall be live, fresh, and uninjured, with native soil mat adhering firmly to root structure.

B. Pre-irrigate soil to wet it to a depth of 2 inches. Soil should be damp, but not muddy.

C. Plant sod within 24 hours after it has been delivered to site. Do not leave it exposed to direct sun any longer than is necessary.

D. Lay first strip of sod slabs along a straight line (use a string in irregular areas). Use a 2 x 4 laid on its side as a "kicker" to butt against sod strips and force them into place. Butt joints tightly, do not overlap edges. On second strip, stagger joints (much as in laying bricks). Use a sharp knife to cut sod to fit curves, edges, and sprinkler heads. Do not use sod strips less than 10 inches wide.

E. Do not lay entire lawn area before watering. When a conveniently large area has been sodded, water lightly to prevent drying out. Continue to lay sod, and to water, until installation has been completed.

F. After laying of sod has been completed, roll lightly with lawn roller filled with water to eliminate irregularities and to form good contact between sod and soil. Avoid very heavy rollers or excessive initial watering to avoid roller marks.

G. Thoroughly water complete lawn surface. Soil should be moistened at least 2 inches deep. Repeat sprinkling at regular intervals to keep sod moist 2 inches deep at all times. After sod is established, decrease watering frequency and increase amount of water per application as needed. Do not allow water to pond. Avoid excessive watering. Soil shall be moist but not saturated. Monitor irrigation as required.

H. Replace all dead or dying sod with equivalent quality material as directed by Owner.

I. Minimize traffic over sod areas during its growth establishment (90 days).

J. Sod areas on which an acceptable stand of grass is not present shall be re-sodded.

1. An acceptable stand is living grass from at least 90 percent of the sod placed according to this Specification.

2. Areas on which there is not an acceptable stand of grass shall continue to be replanted throughout the maintenance period until an acceptable stand of grass is present.

END OF SECTION