



UTILITY STANDARDS

(Water, Wastewater, Irrigation)

VOLUME 3 OF 4: TECHNICAL SPECIFICATIONS – DIVISIONS 02-17

ADOPTED AUGUST 17, 2022

**CITY OF CAPE CORAL
1015 Cultural Park Boulevard
Cape Coral, FL 33990**

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SECTION 02100

SITE PREPARATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The work of this Section includes measures required during the Contractor's initial mobilization onto the Site to protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process; clearing, grubbing and stripping; and regrading of certain areas to receive embankment fill. Contractors shall fully comply with the requirements of Ch. 556, F.S. including but not limited to notifying utility owners and providing the required information through the Sunshine One Call of Florida, Inc. (811) System, not less than two full business days in advance of beginning any construction.

1.2 SITE INSPECTION

- A. Prior to moving onto the Site, the Contractor shall inspect the Site conditions and the City's property and right-of-way lines.
- B. The Contractor's attention is directed to any Soil Erosion and Sediment Control Ordinances in force. The Contractor shall comply with all applicable sections of these ordinances and NPDES requirements.

1.3 PRE-CONSTRUCTION VIDEO

- A. A pre-construction video is required for all projects conducted by the City of Cape Coral, and any work within City owned right of ways and/or City owned property, public utility easements, or other areas that may be required by the City of Cape Coral. Prior to any work being performed, the Contractor shall prepare a preconstruction video in accordance with Section 01380.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PRIMARY SITE ACCESS

- A. The Contractor shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.
- B. Utility Interference: Where existing utilities interfere with the WORK, notify the utility owner and the City before proceeding per Section 01530 Protection of Existing Facilities.

3.2 CLEARING AND GRUBBING

- A. Except as otherwise directed the Contractor shall cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits of the construction.
- B. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas needed to construct buildings, structures, roads, pipelines and any other areas to be stripped.
- C. Contractor shall protect trees or groups of trees, designated by the City to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.
- D. Areas outside the easements or limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas, unless prior written permission is granted before use of these areas.
- E. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

3.2 STRIPPING

- A. The Contractor shall strip topsoil from all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the Site as approved by the City. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as directed. Dispose of any remaining topsoil as directed by the City.

3.3 DISPOSAL OF MATERIALS

- A. All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material shall be removed from the Site and disposed of in a manner satisfactory to the City. Disposal (including hauling) of cleared, grubbed, and unsuitable material and debris shall be the responsibility of the Contractor.
- B. Burning of cleared and grubbed materials will not be permitted.

3.4 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

- A. The Contractor shall avoid unnecessary disturbance of private property along the route of the construction. See Section 02920-Restoration for requirements.
- B. The Contractor shall clean up the construction site across private property immediately after construction is completed.

3.5 PRESERVATION OF PUBLIC PROPERTY

- A. The appropriate paragraphs of Articles 3.1, 3.2, and 3.4 of these specifications shall apply to the preservation and restoration of public lands, parks, rights-of-way, private easement, public

utility easement, and all other damaged areas.

3.6 EXCAVATED MATERIALS UNSUITABLE FOR CONVENTIONAL DISPOSAL

- A. It will be the Contractor's responsibility to properly dispose of materials unsuitable for conventional disposal. The cost of disposal shall be included in the Contractor's Bid Price.

- END OF SECTION -

SECTION 02120

WORKMANSHIP

PART 1 – GENERAL

1.1 DESCRIPTION

Specific requirements for the Work are indicated throughout the Specifications and Drawings. The requirements of this Section are primarily related to the Workmanship and Craftmanship skills, necessary to obtain a finish product of quality.

1.2 DEFINITIONS

"Workmanship" - The degree of skill with which a product is made, or a job done, skill in an occupation or trade, the skill and quality of a product based on a design, is measured by the skill of the person, the quality of the materials, and the craft involved in their use.

"Craftmanship" - A person who practices or is highly skilled in a craft, a skill in a particular craft, the quality of design and work shown in something made by hand, the skill with which something was made or done.

1.3 WORKMANSHIP/CRAFTMANSHIP

- A. The Contractor is to perform the essential workmanship to obtain a finish product of quality.
- B. The Contractor is to supply sufficient qualified personnel and/or firm(s), for all aspects of work relating to the project/contract.
- C. The Contractor is to comply with industry standards except when more restrictive tolerances, as referenced in specified requirements, indicate more ridged standards or more precise craftmanship.

1.4 PERFORMANCE

- A. Work is to be performed to produce a specified finish product of quality.
- B. Work is to be performed to Specifications, details, and/or referenced standards.
- C. Work is to be performed in accordance with Industry standards.
- D. Work is to be performed in accordance with Manufacturer's standards.

- E. Work is to be performed by persons qualified in accordance with manufacturer's qualifications/instructions and/or other detailed instructions or project/component specific requirements.
- F. Work is to be performed by persons qualified to achieve the more restrictive tolerances of specific project requirements, project standards or project workmanship.
- G. Work is to be performed by persons qualified to operate specialized equipment and/or machinery to provide proper handling, rigging, lifting, and transportation of components by approved methods.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

- A. The City reserves the right to request removal of any personnel and/or firm, not deemed competent by City staff.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the contract Documents. The Contractor shall secure all necessary permits to complete the requirements of this Section of the Specifications. Refer to Specification Sections 01065 – Permits & Fees and Section 01066 – NPDES Requirements.

1.2 QUALITY CONTROL

- A. It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- B. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- C. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement, which may develop. The responsibility for conducting the dewatering operation in a manner, which will protect adjacent structures and facilities, rests solely with the Contractor. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.
- D. All dewatering shall comply with the regulations of the South Florida Water Management District and any other agency with jurisdiction.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. Dewatering may include the use of well points, deep wells, and temporary pipelines for water disposal. The temporary pipelines shall not be used as permanent piping for the WORK. Standby pumping equipment shall be maintained on the jobsite.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The Contractor shall provide all equipment necessary for dewatering. It shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the operation of the pumping equipment.

Adequate standby equipment shall be kept available at all times to assure efficient dewatering and maintenance of dewatering operation during power and or mechanical failure.

- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. 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.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with crushed rock meeting FDOT Specification No. 57 gradation requirements.
- F. The Contractor shall maintain the water level one-foot below the bottom of excavation in all work areas where groundwater occurs during excavation, construction, backfilling, and testing.
- G. The Contractor shall prevent flotation by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages, which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. Well points cannot be jetted in with City irrigation water. A continual check by the Contractor shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation. IMMEDIATELY UPON WITHDRAWAL OF WELL POINTS, THE Contractor SHALL BACKFILL THE HOLE WITH CLEAN SAND, BEDDING ROCK MEETING FDOT No. 89 GRADATION REQUIREMENTS OR EQUAL.
- I. The Contractor shall dispose of water from the WORK in a suitable manner without damage to adjacent property. The Contractor shall be responsible for obtaining any permits that may be necessary to dispose of water. No water shall be drained into work built or under construction unless hydraulic compaction is employed as their means of compaction and with prior approval of the City. Water shall be filtered using an approved method to remove sand and fine-sized soil particles before disposal into any drainage system.
- J. The reestablishment of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.

- K. Contractor shall provide sound attenuating structures for the above ground pumps as required and directed by the City.

- END OF SECTION -

SECTION 02150

TRENCH SAFETY

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide Trench Safety in accordance with the Florida Trench Safety Act to ensure worker safety at the construction site. The Contractor shall be responsible for the implementation and maintenance of trench safety standards.

1.2 SUBMITTALS

- A. The Contractor shall prepare and submit a trench safety plan which shall include the means to be utilized and the conditions determining which type of trench safety standard(s) will be used during construction.
- B. The trench safety plan shall include the names, positions, experience, and training information of "Competent Persons", who shall assure the implementation of the measures and standards for complying with the Florida Trench Safety Act.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

- 3.1. The Contractor shall provide Trench Safety measures as required and shall maintain the necessary supervision on site at all times to assure the Trench Safety requirements are being implemented on their project. The Contractor shall monitor his Subcontractors to assure they comply also with the Florida State Trench Safety Act.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all earthwork indicated and required for construction of the work, complete and in place, in accordance with the Contract Documents. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to perform the work.
- B. The Contractor shall examine the site and review the results of subsurface investigations provided including soil borings, prior to commencing the work. In particular, the Contractor shall make a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which may arise as a result of nearby water courses and flood plains, especially in areas where construction activities may encounter water bearing sands and gravels. The Contractor shall make his own investigations necessary to determine ground conditions at the project site.
- C. Any damage caused by the Contractor's excavation, backfill, or compaction efforts will be the sole responsibility of the Contractor to repair, at no expense to the City.

1.2 QUALITY CONTROL

- A. The Contractor shall engage the services of a qualified testing firm which is approved by the City of Cape Coral to provide quality control testing and inspection services during earthwork operations as required in the Contract Documents. The Contractor shall provide the testing firm access to the site and earthwork under construction at such times as the testing firm requests and as necessary for testing of the work.

1.3 QUALITY ASSURANCE BY OTHERS

- A. The City may utilize its own personnel or retain its own testing firm to perform quality assurance of the quality control functions performed by the City. The quality assurance function is to confirm and document the accuracy of testing provided by the Testing Laboratory. The City and the Contractor shall cooperate with the City's quality assurance program and shall provide access and samples when requested.

1.4 CONTRACTOR SUBMITTALS

- A. The Contractor shall provide access for the Testing Laboratory to the source location of all bedding and backfill materials proposed to be used in the work in accordance with the requirements in Section 01300 - Contractor Submittals. The sample sizes shall be as determined by the Testing Laboratory.

- B. The Contractor shall provide submittals for any alternative methods of placement of materials, in accordance with the requirements in Section 01300 - Contractor Submittals.
- C. Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, bedding, filling, compaction and backfilling for the various portions of the work. Review shall be for information only. The Contractor shall remain responsible for the adequacy and safety of the methods. Where sheeting and bracing is required for construction, the design shall be performed by a Professional Engineer.
- D. Submit to the Engineer for review the Report, as performed by a Professional Engineer, that indicates all muck has been removed from the proposed project area and that backfilling has been conducted in substantial accordance with the project specifications herein.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. General: Materials for use as bedding and backfill, whether insitu or borrow, shall be as described herein. Fill, backfill, and embankment materials shall be suitable materials selected from the onsite operations or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other organic material.
- B. Common Fill: Common fill material shall be non-cohesive and shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash and other objectionable material which may be compressible, or which cannot be properly compacted. Common fill shall not contain stones larger than 6 inches in any dimension, asphalt, broken concrete, masonry, rubble or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling. Additionally, common fill shall be no more than 12 percent by weight finer than the No. 200 mesh sieve unless finer material is approved for use in a specific location by the City.
- C. Select Common Fill: Select common fill material shall be as specified above from common fill, with the exception that the material shall contain no stones more than 1-1/2 inches in largest dimension and shall be no more than 5 percent by weight finer than the No. 200 mesh sieve.
- D. Bedding Rock: Bedding rock material used in pipe trench within pipe zone, under abutments, and under concrete structures shall be crushed stone or gravel meeting the gradation and durability requirements of FDOT No. 89 and FDOT No.57 stone, as indicated on the Contract Drawings. With written approval from the City, number 131 and 132 Screenings may be substituted for FDOT No. 89 and FDOT No. 57 stone.
- E. Structural Fill: Materials for structural fill shall be bedding rock or select common fill as specified herein or suitable material as approved by the City.
- F. Unsuitable Material: Materials deemed not suitable for use on the project by the City.

2.2 USE OF FILL, BACKFILL, AND BEDDING MATERIAL TYPES

- A. Backfill and bedding material types shall be used as indicated in the Drawings.
- B. Structural Fill shall be used as backfill against the exterior walls of structures, or as shown on the Contract Drawings.

PART 3 -- EXECUTION

3.1 EXCAVATION - GENERAL

- A. General: Excavation shall include the removal of all existing soil materials encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of these materials shall conform to the lines and grades indicated in the Contract Drawings. Where indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Excavations shall be sloped or otherwise supported in a safe manner in accordance with the Florida Trench Safety Act and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926). The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations.
- B. Sheet piling and Bracing:
 - 1. Furnish, put in place, and maintain sheet piling and bracing as required to support the sides of excavations, to prevent movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If the City is of the opinion that sufficient or proper supports have not been provided, the City may order additional supports be installed at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids besides the sheet piling, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the City.
 - 2. The Contractor shall construct sheet piling outside the neat lines of the foundation unless another configuration is desirable for his method of operation. Sheet piling shall be plumb and securely braced and tied in position. Sheet piling and bracing shall withstand all pressure to which the structure or trench will be subjected. Any deformation shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.
 - 3. Where sheet piling and bracing is required for construction, the Contractor shall engage a Professional Engineer, registered in the State of Florida, to design the sheet piling and bracing. The sheet piling and bracing installed shall conform to the design, and certification of this shall be provided by the Professional Geotechnical Engineer. The City reserves the

right to require sheeting and bracing where it is deemed necessary, at the sole discretion of the City.

4. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
5. The Contractor shall leave in place to be embedded in the backfill, all sheeting and bracing not shown on the Drawings but which the City directs him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The City may direct that timber used for sheeting and bracing be cut off at any specified elevation.
6. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction, or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted for that purpose, or otherwise directed by the City.
7. The right of the City to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
8. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than one (1) foot above the top of any pipe.

C. Pumping and Drainage

1. All dewatering activities shall be in accordance with specification 02140, when applicable.
2. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, 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 as stipulated in Section 02140. The Contractor shall submit to the Engineer for review a plan for dewatering systems prior to commencing work. The installed dewatering system shall be in conformity with the overall construction plan. 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.
3. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the bottom of the excavation and

to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent intermixing of finer grained soil from the surrounding ground.

4. 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.
4. The Contractor shall take all additional precautions to prevent buoyant uplift of any structure during construction.
6. The conveying of dewatered liquids in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. The Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the City or the authority having jurisdiction, at no cost to the City.
7. 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.
8. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.
9. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater quality.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. General: Excavations shall conform to the elevations and dimensions shown on the Contract Drawings within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removing formwork, installation of piping services and other construction, and inspection. In excavating for footings and foundations, care shall be exercised not to disturb the bottom of the excavation. Bottoms shall be trimmed to required lines and grades to leave a solid base to receive concrete.
- B. Excavation for Structures and Embankments: Except where otherwise indicated for a particular structure, excavation shall be carried to the grade of the bottom of the footing or slab. Where unsuitable materials are encountered at the bottom of a footing or slab, areas beneath the structures or fills shall be over-excavated and backfilled to grade with Structural Fill material compacted to the requirements of the adjacent fill material.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches as indicated in the Contract Drawings.
- B. Trench Bottom: The bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding.
- C. Open Trench: The maximum amount of open trench permitted in any one location shall be 500 feet, or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. For open trenches greater than 500 feet in length, pre-approval from the City of Cape Coral must be obtained. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. If steel plates are used, no more than 40 feet in length along the trench will be allowed. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located more than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades, orange safety fences, and warning lights meeting safety requirements shall be provided and maintained.
- D. Over-Excavation: Where trenches or excavations are required to be over-excavated to remove unsuitable materials, the excavation shall be to the minimum depth required to remove the unsuitable material and shall be backfilled with common fill to the grade of the bottom of the pipe bedding as indicated in the Contract Drawings. Classification of the material as unsuitable shall be made by a City approved testing laboratory based on test results and or inspection of the material in the excavation at the time of construction.
- E. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

3.4 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following:
 - 1. All boulders and rock, which require breaking by the use of special equipment or extraordinary excavation methods (may include hammers, wrecking balls, rock trenchers, drills, or other approved equipment).
 - 2. All rock material in ledges, bedding deposits, and unstratified or conglomerate masses which cannot be removed using normal excavation methods and equipment.
- B. Rock excavation shall be performed by the Contractor. The cost for removal and disposal shall be included in the Contractor's Bid Price
- C. Blasting will not be permitted without prior written authorization of the City.

3.5 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. The Contractor shall remove and dispose of all excess excavated material not suitable or required for use on the project at a site selected and obtained by the Contractor at his own expense. The removal shall be timely, and the disposal of all excess excavated materials shall be performed at least once a month.
- B. Backfill replacement for unsuitable materials shall be provided from excess common fill available from on-site stockpiles. Refer also to Section 02100 – Site Preparation.
- C. The Contractor shall obtain all required permits, landowner, and agency approvals for disposal of excess excavated material and shall pay all costs associated with the removal and disposal.
- D. Depositing clean fill on private property within the City of Cape Coral limits will not be permitted unless the property owner possesses a current building permit that requires fill. Contractors shall provide proof of said permit to the Engineer for review and approval prior to placing clean fill on the permitted property.

3.6 BACKFILL - GENERAL

- A. The Contractor shall examine the areas and conditions under which excavating, filling and grading are to be performed, and shall not proceed with the work until unsatisfactory conditions have been corrected. The Contractor shall examine existing grade prior to commencement of the work and report to the City if elevations of existing grade vary from elevations shown on the Drawings.
- B. The Contractor shall employ a qualified testing laboratory for all testing required. The Contractor shall notify the City a minimum of 48 hours in advance of any scheduled testing.
- C. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength (minimum of 75% of the 28-day design strength) to support the loads imposed.
- D. Except for rock bedding materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.
- E. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. The Contractor shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.
- F. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.
- G. The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the Drawings. No soft spots or uncompacted areas will be allowed in the work.

- H. Backfill shall be compacted to 98 percent of maximum density (AASHTO T-180) under structures and paved areas, and 95 percent of maximum density (AASHTO T-180) elsewhere unless otherwise indicated on the drawings.

3.7 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted, each layer shall not exceed 6 inches in thickness. Thicker lifts of backfill may be permitted when the Contractor has satisfactorily demonstrated that proper compaction has been achieved with the methods and materials in use. The use of thicker lifts will be at the sole discretion of the City.
- B. The use of flooding and jetting methods to achieve compaction may be permitted upon approval. The Contractor shall submit methods documenting procedures to be utilized for approval to the Engineer and for the City for final approval.
- C. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Backfill around pipes shall be manually spread around the pipe so that when compacted the backfill will provide uniform bearing and side support.
- D. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
- E. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.
 - 1. Backfilling shall be carried up evenly on all walls of an individual structure. No backfill shall be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength (minimum of 75% of the 28-day design strength).
 - 2. Bedding rock shall be used for bedding under all structures and pipe as indicated on the Drawings. The Contractor shall take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of the bedding.
 - 3. In locations where pipes pass through structure walls, Structural Fill shall be placed for a distance of not less than 3 feet either side of the vertical center line of the pipe and the Contractor shall make special efforts to consolidate the fill up to the horizontal centerline of the pipe.

3.8 COMPACTION OF FILL, BACKFILL, AND BEDDING MATERIALS

- A. Any damage caused by the Contractor's compaction efforts will be the sole responsibility of the Contractor to repair, at no expense to the City.
- B. Each layer of backfill materials shall be compacted to the density indicated on the Drawings. A compacted effort approved by the City shall be employed to compact backfill layers before the water table is reestablished. Equipment that is consistently capable of achieving the required

degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

- C. Hydraulic compaction will be an acceptable alternative under certain soil conditions. Contractor shall submit methods to the City for approval.
- D. Flooding, ponding, or jetting shall not be used for backfill around structures, for final backfill materials, or aggregate base materials without written authorization of the City.
- E. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

3.9 PIPE AND UTILITY TRENCH BACKFILL

- A. Backfilling over and around pipes shall begin as soon as practical after the pipe has been laid, jointed and inspected.
- B. After compacting the bedding the Contractor shall perform a final trim using a string line or other method for establishing grade, such that each pipe section when laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells shall be made as required.
- C. Bedding and backfill under, around and over pipes shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least two feet of compacted backfill over the top of pipeline, heavier compaction equipment may be used to complete the trench backfill.
- D. If a moveable trench shield is used during backfill operations the shield shall be lifted so as to not displace the pipe or backfill while the shield is being moved.

3.10 FILL AND EMBANKMENT CONSTRUCTION

- A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and organic material. The surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Each layer shall not exceed 6 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted.
- B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers. Material thus cut shall be re-compacted along with the new material at no additional cost. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

- C. Where embankment or structure fills are constructed over pipelines, the first 2 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe. Heavy construction equipment shall maintain a minimum distance from the edge of the trench equal to the depth of the trench until at least 2 feet of fill over the pipe has been completed.

3.11 QUALITY CONTROL TESTING

- A. Compaction Tests: Three compaction test locations shall normally be required for each lot. A Lot shall not exceed 300 linear feet of pipe or 100 square feet of backfill around structures, or as shown on the Drawings. The locations of the compaction tests within the trench shall be in conformance with the following schedule:
 - 1. One test at the spring line of the pipe.
 - 2. One test at an elevation of one foot above the top of the pipe.
 - 3. One test for each 2 feet of backfill placed from one foot above the top of the pipe to finished grade elevation.
 - 4. At least two test locations are required for each trench crossing existing pavement.
 - 5. Manholes, Wet Wells, and Vaults: A minimum of two tests for every 2 twelve-inch (12") lifts of backfill. Tests will be taken no less than 6 inches or no more than 3 feet away from each structure alternating around the structure.
- B. Lift Station Pads. Prior to placement of concrete pads, a minimum of one test will be taken for each pad. Lift Station Pads shall be treated as structures for the purposes of determining density.
- C. In case the test of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to ensure compliance.
- D. The Contractor shall provide test trenches and excavations including excavation, trench support, and groundwater removal for the soils testing operations. The trenches and excavations shall be provided at the locations and to depths required by the testing firm. All work for test trenches and excavations shall be provided at no additional cost.

END OF SECTION

SECTION 02269

TEMPORARY EROSION CONTROL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide effective temporary erosion control and sediment control measures during construction or until permanent erosion controls become effective so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project and damage to WORK on the project.
- B. The CONTRACTOR'S attention is called for complying with all necessary NPDES requirements during the execution of the WORK.
- C. All temporary erosion control measures shall be in accordance with FDOT specifications section 104 and 125. If a conflict exists between the FDOT and the City Specifications, the Contractor shall bring that discrepancy to the attention of the City for clarification prior to construction.
- D. Related Specification Sections:
 - 1. 01066 - NPDES Requirements
 - 2. 01300 – CONTRACTOR Submittals
 - 3. 02920 – Restoration

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - CONTRACTOR Submittals.
- B. Product Data: Manufacturer's catalog sheets on geotextile fabrics.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Temporary erosion and water pollution control features consist of, but are not limited to, temporary grassing, temporary sodding, temporary mulching, turbidity barriers, and silt fence.

2.2 SEEDING AND SODDING

- A. Seeding and sodding material will be in accordance with Section 02920-Restoration.

2.3 FILTER FABRIC

- A. Fabric shall be woven or non-woven consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, or polyamid. The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultra-violet light, heat exposure and chemicals. The fabric shall be free of any treatment that may significantly alter its physical properties. The edges of the fabric shall be salvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric.
- B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D 4632	100 lb.
Burst strength	ASTM D 3786	200 psi
Apparent opening size	ASTM D 4751	Between 200 and 70 sieve size

- C. Fabric Manufacturer, or City Approved equal:

1. Mirafi

2.4 FENCING

- A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6 inches, maximum 14- gauge, at least 30 inches tall.

2.5 FASTENERS

- A. Fasteners to wood posts shall be steel, at least 1 1/2 inches long.
- B. Fasteners to steel posts shall be galvanized clips or tie wire.

2.6 SYNTHETIC BARRIERS

- A. All synthetic barriers shall be in accordance with FDOT Standard Specifications section 104. The use of hay bales is not permitted.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments with fuels, oils, bitumens, calcium chloride, or other harmful materials. The CONTRACTOR shall conduct and schedule operations to avoid or otherwise minimize

pollution by siltation.

- B. Provide and maintain, for the duration of the project, erosion control barriers as required to prevent erosion and silt loss from the Site. Erosion control measures shall remain in place until an adequate stand of grass has been established, per FDOT standards.
- C. The CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities that may cause erosion until barriers are in place.

3.2 SEEDING AND SODDING

- A. Seeding and sodding shall be placed in accordance with Section 02920-Restoration.

3.3 HANDLING AND STORAGE

- A. The geotextile fabric shall be wrapped in a protective covering which is sufficient to protect it from sunlight, dirt, and other debris during shipment and storage.

3.4 INSTALLATION

- A. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire fencing to the posts that are spaced a maximum of 6 feet apart and embedded a minimum of 12 inches. Install posts at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.
- D. Securely fasten the fabric materials to the woven wire fencing with tie wires or galvanized clips.
- E. Reinforced fabric barrier shall have a minimum height of 18 inches.
- F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.5 MAINTENANCE

- A. Regularly inspect and repair or replace damaged components of the barrier. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.
- B. Remove sediment deposits when silt reaches a depth of 6 inches or 1/2 the height of the barrier, whichever is less. Dispose of sediments at an acceptable site arranged by the CONTRACTOR

that is not in or adjacent to a stream, floodplain, canal, lake, reservoir, or other water impoundments.

- C. During periods of heavy rain, the CONTRACTOR shall monitor the temporary erosion control measures to ensure that they are not causing localized flooding. The CONTRACTOR may be required to cut slits in the fabric to drain flooded areas. Fabric shall be replaced after heavy rain events.

- END OF SECTION -

SECTION 02340

BORING AND JACKING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide bored and jacked steel casing, complete and in place, in locations as shown on the Contract Drawings and General Details. Pipe installation within the steel casing shall be in accordance with the requirements contained within this Section and the applicable portions of other Sections. Casings may also be installed by open cut methods for future driveways for new construction. Bedding material is not required on direct buried casings.
- B. In the performance of the Work, the Contractor shall comply with the requirements of the affected railway companies, public agencies, and owners of public utilities or other facilities for the safeguarding of traffic and improvements which might be endangered by the boring and jacking operations. Approach trenches and jacking pits in public streets will not be permitted to remain open for extended periods of time and must be covered at night and other non-working hours. All excavations in public streets must comply with the applicable Maintenance of Traffic and permit requirements.
- C. If the Contractor is not ready to place the carrier pipe in the casing at the time of completion of boring and jacking operations, the ends shall be bulkheaded, and the approach trenches shall be backfilled, temporary surfacing placed thereon, and the affected portion of the street reopened to traffic.
- D. The Contractor shall be responsible for maintaining the required line and grade, and for preventing settlement of overlying structures, or other damage due to the boring and jacking operations.
- E. Depending on circumstances the City may allow an open cut methodology of local roads, however all pipe placed under pavement in City owned right of way and easements shall be ductile iron pipe.
- F. Special written permission must be obtained by the City's transportation division for any proposed open cuts on collectors and major arterial roadways.

1.2 BORING AND JACKING AT CONTRACTOR'S CONVENIENCE

- A. The Contractor may choose for his own convenience to install additional pipes and/or casing by boring and jacking at locations in addition to those shown on the Drawings. The Contractor shall request permission, in writing, for any such operation at least 3 days prior to installation. Payment for such operations will be considered only for the items of Work normally included in an open cut operation, these being the installation of the pipe, restoration of the grass or sod and restoration of the driveway or pavement. The quantity of pavement patching will be based on the typical top width of the trenches above to the boring operation multiplied by the length

of the pipe or casing installed by the bore and jack method. The quantity of restoration will be based on the linear foot of pipe under non- paved areas above the boring operation.

- B. The Contractor may jack and bore under driveways with the casing extending not more than depicted in the Contract Drawings and General Details on either side of the driveway. Where restrained joints are required on the piping, the carrier pipe shall be restrained. The casing shall be sized to accommodate the carrier pipe restraint system. The piping length inside the casing shall not be included in the restraining length calculation.
- C. Where restrained joints are not required on the piping, no more than one unrestrained joint shall be allowed in the casing.

1.3 EXISTING FACILITIES AND UTILITIES

- A. Contractor shall undertake the following steps prior to commencing boring and jacking operations in this project location that contains existing underground facilities.
 - 1. Contact the utility location/notification service and other agencies as required for the construction area.
 - 2. Positively locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are located within 10 feet of the designed jack and bore path.
 - 3. Modify boring and jacking practices to prevent damage to existing facilities.
- B. Contractor shall be responsible for locating any and all underground facilities regardless of any previous efforts in this regard. Contractor shall be responsible for all losses and repairs occasioned by damage to underground facilities resulting from boring and jacking operations.

1.4 SHOP DRAWINGS

- A. Shop Drawings: The Contractor shall submit shop drawings of pipe casing in accordance with the requirements in Section 01300 - Contractor Submittals, and the following supplemental requirements as applicable:
 - 1. Installation Plan which include schedules of excavation, pipeline installation, and backfill operations.
 - 2. Material list including diameter, thickness, and class of steel casing.
 - 3. Detailed locations and sizes of all boring and jacking and receiving pits.
 - 4. Permits associated with the boring and jacking operations.
 - 5. Letters of notification to all other utilities within the limits of construction
- B. Certifications: Welders qualifications per ANSI/AWS D.1.1

1.5 QUALITY CONTROL

- A. Boring and jacking operations shall be done by qualified personnel with sufficient experience involving Work of a similar nature. Documentation of prior work experience shall be provided to the City of Cape Coral.
- B. The Contractor shall give the City a minimum of 3 days advance notice of the start of excavation or boring operations.
- C. Work shall be performed in the presence of the City, unless granted prior approval to perform such Work in its absence.
- D. Welding Requirements: Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local agency prior to commencing Work on the casing or pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The Contractor shall be responsible for all material and bear the expense of qualifying welders.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The steel pipe casings shall be new and conform to ASTM A 139, straight seam, Grade B with a minimum 35,000 psi yield strength or equal, subject to the following supplemental requirement: The Contractor may recommend to the Utilities a greater diameter or thickness or different material for the method of Work and loadings involved, site conditions, and possible interferences.
- B. Casing spacers shall be manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** and shall be sized to fit the carrier pipe and casing.
- C. Each end of the steel casing shall be equipped with electronic markers as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Markers should not be located more than four (4) feet deep.
- D. Casing pipe ends shall be sealed in accordance with the General Details.

PART 3 -- EXECUTION

3.1 INSTALLATION OF STEEL CASING

- A. Jacking Pit: The excavations for the boring or jacking operations shall comply with the Florida Trench Safety Act, shall be adequately shored to safeguard existing substructures and surface improvements, and ensure against ground movement in the vicinity of the jack supports. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring or jacking alignment. The Contractor shall provide adequate space

within the excavation to permit the insertion of the lengths of casing to be bored or jacked. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

- B. Control of Alignment and Grade: The Contractor shall control the application of the jacking pressure and excavation of materials ahead of the casing as it advances to prevent the casing from becoming earthbound or deviating from the required line and grade. The Contractor shall restrict the excavation of the materials to the least clearance necessary to prevent binding in order to avoid loss of ground and consequent settlement or possible damage to overlying structures. Allowable grade deviations in horizontal and vertical alignments shall be no greater than 0.2 feet per 100 feet in any direction over the length of the jacking or boring to a maximum deviation of 0.5 feet at any point.
- C. Installation: The installation of the casing shall be in accordance with the Contract Documents and be subject to the approval of the agency having jurisdiction over the area containing the boring and jacking operations.

3.2 INSTALLATION OF CARRIER PIPE

- A. Carrier pipe shall be installed in accordance with the instructions of the pipe spacer manufacturer. After jacking equipment and excavated materials from the boring or jacking operations have been removed from the jacking pit, the Contractor shall prepare the bottom of the jacking pit as a pipe foundation. The Contractor shall remove loose and disturbed materials below pipe grade down to undisturbed earth and shall re-compact the material in accordance with Section 02200 - Earthwork.

END OF SECTION

SECTION 02347

HORIZONTAL DIRECTIONAL DRILLING

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. All horizontal direction drills shall require written pre-approval from the City of Cape Coral.
- B. The Contractor shall obtain all necessary permitting prior to performing and directional drilling. A separate permit with the City of Cape Coral is required for all directional drills.
- C. This Section provides the minimum requirements for installing the utilities by horizontal directional drilling (HDD).
- D. The Work of this Section includes all labor, machinery, construction equipment, material, and appliances required to perform, in a good workmanlike manner, all horizontal directional drilling delineated in the Drawings.
 - 1. The overall Work scope shall include, but not be limited to, directional boring (drilling) equipment, boring pits and equipment, sheeting, supporting, location signs as required, miscellaneous appurtenances to complete the entire Work as shown on the Drawings, and restoration, including irrigation system replacement. Directional boring operations shall be performed within the right-of- way and/or easements shown on the Drawings.
 - 2. The equipment used in directional boring, also known as Horizontal Directional Drilling, shall be of adequate commercial size and satisfactory working condition for successful operation, in conformance with the local, state, and federal safety requirements, and may be subject to approval by the State or County at the discretion of the City. Such approval, however, shall not relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein. Only workmen experienced in directional boring operations shall be used in performing the Work.
 - 3. The Contractor shall expect to install the specified HDD crossings in the material as described in the borehole logs and subsurface information included in the Contract Documents. The Contractor attests to the practicality and feasibility of the Contractor's selected method based on the available soil and subsurface data/conditions and/or any other investigations and analysis performed by the Contractor or others.
 - 4. Furnish structures, safety equipment, and professional services required to provide for the health and safety of the general public and of personnel involved in directional boring work in accordance with the requirements of the regulatory agencies having jurisdiction.
 - 5. Take all measures necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, and appurtenances from damage due to directional

boring work. Responsibility and payment for correction of such damage shall be the sole responsibility of the Contractor.

6. The Directional Boring work is to be performed in a manner to eliminate the discharge of water, drilling mud, and cuttings to water channels, bodies or to the land areas involved during the construction process.
7. The HDD pipe shall be installed at a radius no more than 80% of the manufacturer's maximum recommended value.
8. The Contractor shall attach three (3) continuous 10-gauge UF solid insulated braided copper tracer wires to the pipe prior to directional drill.
9. The Contractor shall record location and depth at intervals of ten (10) feet over the course of the bore.

1.2 RELATED WORK

- A. Section 02200 - Earthwork
- B. Section 02594 - High Density Polyethylene (HDPE) Pipe
- C. Section 02598 - Potable Water Pipe
- D. Section 02599 - Irrigation Water Pipe
- E. Section 02666 - Pressure Pipe Testing and Disinfecting
- F. Section 02597 – Wastewater Force Main Pipe

1.3 QUALIFICATIONS

- A. Contractor Qualifications and Experience: The Contractor shall have demonstrated successful experience installing pipelines using the horizontal directional drilling process on at least five (5) projects with similar diameters, installation lengths, and ground and groundwater conditions. The Contractor shall demonstrate successful completion of at least three (3) projects where HDPE pipe was installed with horizontal directional drilling techniques.

1.4 CONTRACTOR SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300 – Contractor Submittals. Submittals requiring the ENGINEER's review shall be submitted to the City, prior to commencing any horizontal directional drilling activities at the crossing location.
- B. Submit list and description of materials and equipment to be used.
- C. Submit written documentation of Contractor's qualifications for company and personnel experience in accordance with Article 1.3A and 1.3.B of this Section. Submit evidence of OSHA certification for the Site Safety Representative.
- D. The Contractor shall prepare and submit an installation plan indicating, but not limited to, the following: construction schedule, the location and limits of installation pits, pit support system, mitigation plan for potential operation induced damages to adjacent utilities/structures (settlement, frac out, heave, fluid leak), equipment and material to be used, and a general procedure to be used in the installation to the City for review. Upon completion, the Contractor shall submit all data from the locator/tracking system including the location and depth measurements every ten (10) feet over the course of the bore.

PART 2 -- PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE

- A. Installed pipe shall be as described in Section 02594 - High Density Polyethylene (HDPE) Pipe.

2.2 HDPE / PVC TRANSITION

- A. In accordance with the General Details.

2.3 DRILLING FLUID

- A. The drilling fluid shall be a Bentonite/water slurry that is totally inert and poses no environmental risk. Technical criteria for the Bentonite slurry shall be as described in API Specification 13A, "Specification for Oil Well Drilling Fluids Material" for fresh water drilling fluids.
- B. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the City for review. The City retains the right to sample and monitor the waste drilling mud, cuttings, and water.
- C. Disposal to be off-site and in accordance with all Local, State, and Federal regulations.

2.4 DRILL PIPE

- A. Drill pipe shall be API Steel Drill Pipe, Range 2, premium class or higher, Grade S-135 in diameter, with sufficient strength to withstand the maximum rated pullback and pushing load of the drilling equipment. Drill pipe joints shall be flush and capable of transmitting maximum rated torque of the drilling equipment.

2.5 DRILLING EQUIPMENT

- A. The directional boring equipment shall be suitable for installing pipe sizes as denoted on the Drawings or the Contractor submitted and approved HDD plan.
- B. The Contractor shall provide all materials for completing the installation and for adequate protection of the Work.
- C. Drilling equipment shall have a maximum sound power level of 72 dBA (as defined in ANSI S1.4) at 10 feet. Measure sound power level in accordance with ISO 3740 and 3744.
- D. Mixing, pumping, and holding/separation tanks shall be capable of delivering mixed drilling fluid to the cutting head. Drilling fluids circulating equipment shall be designed to minimize spillage.

2.6 DOWNHOLE TOOLS

- A. Cutting heads, back reamers, and hole openers shall be suitable for the soil conditions anticipated by the Contractor.
- B. Grips, pulling heads, and swivels shall be compatible with the pipe material. Design shall transmit the maximum rated pullback force of the equipment used without distortion. Grips, pulling heads, and swivels shall be specifically engineered for directional drilling applications.
- C. Tracking equipment shall be capable of determining the location of the cutting head within ± 3 inches horizontally and vertically.

2.7 WATER

- A. Contractor is responsible for obtaining, transporting, and storing of any water required for drilling fluids.
- B. It will be the responsibility of the Contractor, to legally dispose of any excess water, left over from HDD activities.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The Contractor shall comply with Florida's "Trench Safety Act" in the performance of all Work. The Contractor shall be responsible for the design, installation, maintenance and removal of any

sheeting and shoring necessary for the drilling operation, including fluid containment and permitted disposal practices.

3.2 INSTALLATION

- A. The pipe shall follow the line and grade shown in the Drawings or the Contractor submitted and approved HDD plan, and shall exit the ground within 1 foot of the design location.
- B. Install the pipe in a manner that does not cause upheaval, settlement, cracking, movement, or distortion of the surface materials including bridge walls, rock and concrete retaining walls, channel bottoms, and other structural improvements.
- C. Locate the entrance and exit pits within the City's right-of-way.

3.3 EARTHWORK AND TRENCHING

- A. Accomplish trenching and earthwork in accordance with Section 02200 - Earthwork.

3.4 PIPE JOINING

- A. For HDPE/PVC Transition connections, refer to Standard Details in the Drawings.
- B. For HDPE Pipe, refer to Section 02594 – High Density Polyethylene (HDPE) Pipe.
- C. Where the staging area permits, join entire length of pipe to be pulled through bore prior to commencement of pullback operation. If not feasible because of the length of the bore and the size of the staging area, each pipe section may be fused or welded to the previous section before the pull back. Support weight of joined pipe suspended on rollers to minimize pulling forces.

3.5 PRE-BORE AND POST-BORE PRESSURE TESTING

- A. Prior to pulling the HDPE pipe through the directional bore hole, the pipe shall be pressure tested in accordance with Section 02666 – Pressure Pipeline Testing and Disinfection. Perform pressure testing again after final installation of the HDPE pipe and before final acceptance by the City. Only potable water shall be used for testing any part of the potable water system.
- B. At the Contractor's option, pipe need not be pressure tested before pulling the pipe through the bore hole. In such case, if the pipe does not pass the pressure test after installation, then remove the entire pipe from the bore hole, repair the pipe, and perform pressure testing prior to reinstalling the pipe and again after reinstallation, at no additional cost to the City.

3.6 PILOT BORE

- A. Construct a pilot bore at least 6 inches in diameter at the centerline alignment and grade as shown in the Drawings. Circulate drilling fluids to maintain an open bore at all times. If the path of the pilot bore is successfully completed, then proceed with the reaming procedure, and pull the pipe from the receiving location (exit pit) to the sending location (entry pit). If the pilot bore could not be successfully completed, then do not proceed with the reaming procedure until the

City, Engineer and Contractor have met to discuss alternative options for the pipeline. The pilot bore and reaming procedure shall be controlled by a magnetic survey system including accelerometers, magnetometers, connector wire, and survey probe. The guidance system shall be capable of measuring depth, location, pitch, and roll of the bore and shall be able to indicate depth up to 40 feet.

- B. As-Built Survey: At the completion of pilot hole drilling, the Contractor shall submit tabulation and drawings(s) of coordinates referenced to the drilled entry point, which accurately describe the location of the pilot hole, the drilled exit point, the transition points between pipe material changes, and the lowest point of the pilot hole to the City for review.

3.7 DRILLING FLUIDS

- A. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. These fluids must not be discharged into the waterways. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions. Drilling fluid pressure in the borehole shall not cause any leakage to the adjacent utilities; Contractor will be responsible for repair of all the related damages. All drilling operations shall occur within the right of way or City owned easement, including temporary construction easements.

3.8 BACKREAMING AND PIPE INSTALLATION

- A. Upon completion of an acceptable pilot hole, the hole opening or enlarging phase of the installation shall begin. The borehole diameter shall be increased to accommodate the pullback operation of the HDPE pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The reamer type shall be at the Contractor's discretion.
- B. The pipes shall be assembled in a manner that does not obstruct adjacent roads or City, and/or Public activities adjacent to the layout areas.
- C. The Contractor shall provide adequate support/rollers along the stringing area to support the required length of the HDPE pipe for each bore. Such support/rollers shall be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback.
- D. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining. See Sections 02594 - High Density Polyethylene (HDPE) Pipe for additional requirements on HDPE pipe.
- E. Pulling Loads: The maximum pull (axial tension force) exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not overstressed.

- F. Torsion and Stresses: A swivel shall be used to connect the HDPE pipeline and tracer wires to the drill pipe to prevent torsional stresses from occurring in the pipe.
- G. Pipeline Support: The pipelines shall be adequately supported during installation so to prevent overstressing or buckling.
- H. The Contractor shall at all times handle the HDPE pipe in a manner that does not overstress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 80% of the manufacturer's maximum recommended value for yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. The Contractor shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.
- I. During the pullback operation, the Contractor shall monitor roller operation and sidebooms if required to assist movement of the HDPE pipe. Surface damage shall be repaired by Contractor before pulling operations resume.
- J. The lead end of the pipe shall be closed during the pullback operation.
- K. After the carrier pipe is completely pulled through the tunnel, a sufficient relaxation period, as recommended by the specified pipe manufacturer, shall be provided prior to the final pipe tie-in.
- L. The Contractor shall install, maintain, and leave in place any sheeting, underpinning, cribbing, and other related items (other than that required for the boring and receiving pits) to support any structure or facility affected by the boring operations. The City, depending upon existing conditions, may require that additional sheeting for the excavation be left in place.
- M. Contractor shall hydrostatically test each line in accordance with the testing procedures defined in the Specification Section 02666 – Pressure Pipeline Testing and Disinfection. Pressure and temperature shall be monitored with certified instruments during the test.

3.9 NEARBY UTILITIES

- A. Nearby Utilities: The Contract Drawings show existing buried utilities that are believed to be near the directional drill alignment. There is no guarantee that these utilities are located as shown or that other utilities may not be present. It will be the Contractor's responsibility to locate all nearby utilities or other subsurface obstructions (such as retaining wall tie backs, and anchors) that may interfere with the Work by excavating windows on the pipeline alignment or other means. Additionally, the Contractor shall be required to supply proof of written notices to all potential utilities within the limits of construction to the City of Cape Coral and the City's Engineering Inspector. The Contractor shall accept responsibility for any and all damage of utilities caused by construction.
- B. Monitoring Nearby Utilities: The nearby utilities within the zone of influence of construction (depending on the depth and diameter of the HDD hole) shall be monitored and surveyed by the Contractor prior to construction to set up the baseline and during construction to adjust the operation and avoid damages. All the data shall be submitted to the City on daily basis.

3.10 CLEANING, SIZING AND PIGS

- A. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for abnormalities in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dents, buckles, gouges, and internal obstructions) greater than 2-percent of the nominal pipe diameter, or excessive out-of-roundness greater than 5-percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of five feet or less. Pipe out-of-roundness shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, out-of-roundness locations are those defined above which exceed a span of five feet.

3.11 SUCCESSFUL COMPLETION

- A. The Contractor shall be considered as having completed the requirements of any directional boring when he has successfully completed the Work and tested the pipe to the satisfaction of the City.

END OF SECTION

SECTION 02512

ASPHALTIC CONCRETE PAVEMENT, BASE AND STABILIZED SUBBASE (FDOT)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all WORK associated with Asphaltic Concrete Pavement and Base as shown and as specified herein including all labor, materials, equipment supplies, and facilities associated with providing a finished product satisfying all the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section 01090 – Reference Standards.

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor shall provide to the City materials testing reports, job-mix formulas, and other pertinent information demonstrating that the materials and methods Contractor proposes to utilize will comply with the provisions of this Section. Submittals shall be in accordance with Section 01300 – Contractor Submittals. Where the Contractor is using a standard mix from an established plant facility, the plant's mix and standards may be submitted for review.

PART 2 -- PRODUCTS

2.1 STABILIZED SUBBASE

- A. Stabilized sub-base shall be Type "B" with a minimum LBR of 40, per Section 160 of FDOT Standard Specifications.

2.2 BASE

- A. Materials for base shall comply with Section 285 of the FDOT Standard Specifications. The Optional Base Group shall be as depicted on the Roadway and Sidewalk General Details in the Contract Drawings.
- B. Lime rock, if used, shall comply with Sections 200 and 911 of the FDOT Standard Specifications, shall have a minimum LBR of 100. The base material shall be produced from approved FDOT sources. Each delivery ticket shall be sealed and certified as FDOT material. Limerock shall not be used when ground water estimated seasonal high level is within 2 feet of the bottom of the base.
- C. If crushed concrete is to be used as base material, the location and thickness shall be approved by the City and shall comply with FDOT Standard Specifications Section 204. The base course

shall have a minimum LBR of 100. The base material shall be produced from approved FDOT sources. Each delivery ticket shall be sealed and certified as FDOT material. The limits of the base shall be shown on As-builts; complete street shall be provided, not just sections.

- D. Limerock stabilized base, if used, shall be as specified in Section 230 of the FDOT Standard Specifications. The limerock material shall meet the requirements of Paragraph 2.2.B. above.
- E. Use of reclaimed asphalt pavement (RAP) shall be for a base course only, on non-limited access paved shoulders in accordance with Section 283 of the FDOT Standard Specifications.

2.3 PRIME COAT

- A. Prime coat shall be as specified in FDOT Standard Specification Section 300-2.1. Prime coat shall be applied per FDOT Standard Specification Section 300-7. Cover for prime coat shall be as specified in FDOT Standard Specification Section 300-2.2.

2.4 TACK COAT

- A. Tack coat material shall be as specified in Section 300-2.3 of the FDOT Standard Specifications. Tack coat shall be applied per FDOT Standard Specification Section 300-8. Emulsified asphalt shall comply with the requirements of AASHTO M 140 (ASTM D 977) or M 208 (ASTM D 2397).

2.5 MINERAL AGGREGATE

- A. Mineral aggregate shall be crushed stone, crushed slag, crushed gravel, stone or slag screening, sand, mineral filler, or a combination of two or more of these materials. Aggregate for asphaltic concrete shall be as specified in Section 334-2 of the FDOT Standard Specifications. Coarse and fine aggregates shall comply with all the quality requirements, except soundness, of ASTM D 692 and D 1073, respectively. Coarse aggregate failing to comply with abrasion requirements may be used if experience has demonstrated it to be satisfactory.
- B. Mineral filler shall comply with ASTM D 242.
- C. Combinations of aggregates having a history of polishing shall not be used in surface courses.

2.6 ASPHALT PAVEMENT

- A. Asphalt pavement shall be SP 9.5 or SP 12.5 asphaltic concrete as depicted on the Contract Drawings and as specified in Sections 320, 330, and 334 of the FDOT Standard Specifications. Paving asphalt shall comply with the requirements of AASHTO M 226 (ASTM D 3381).

2.7 PAVEMENT MARKING PAINT

- A. Pavement marking paint shall be a product specifically formulated for use on asphalt concrete pavement and shall have a proven record of performance and durability. Products shall conform to Sections 710 (Painted Pavement Markings), 711 (Thermoplastic Pavement Markings) and 971 (Pavement Marking Materials) of the FDOT Standard Specifications. Temporary pavement marking shall be required until asphalt had cured per the FDOT standard specifications.

2.8 REFLECTIVE PAVEMENT MARKERS

- A. Reflective pavement markers (RPM's) shall conform to Section 706 of the FDOT Standard Specifications. Materials requirements shall conform to Section 970 of the FDOT Standard Specifications. Reflective pavement markers shall be as follows, unless otherwise indicated on the Drawings:
 - 1. 4-lane road:
Permanent: RPM Type B, 2 way reflective, color: white/red (W/R).
 - 2. At potable water fire hydrant assemblies:
Permanent: RPM Type B, two way reflective, color: blue/blue (B/B). Do not provide RPM's at irrigation water hydrant assemblies.

PART 3 -- EXECUTION

3.1 SUBGRADE PREPARATION

- A. The subgrade shall be prepared as specified in the Section 02200, "Earthwork" as applicable to roadways and embankments and FDOT Standard Specification Section 160. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for base material shall not vary more than 0.04-foot from the specified grade and cross section.

3.2 BASE

- A. Base shall be provided where shown and to the thickness shown. Construction of the base course shall be as specified in Section 200, 204, and/or 234 of the FDOT Standard Specifications. Imported bases shall be delivered to the job site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6 inches or less, the base materials may be spread and compacted in one layer. Where the required thickness is more than 6 inches the base material shall be spread and compacted in two or more layers of approximately equal thickness and the maximum compacted thickness of any one layer shall not exceed 6 inches. The relative compaction of each layer of base shall not be less than the maximum density shown on the Contract Drawings. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 foot from the specified grade or cross-section.

3.3 PRIME COAT

- A. Prior to placing of pavement, a prime coat shall be applied to the compacted base at a rate of 0.10 gal/sq yd in accordance with FDOT Standard Specification Section 300.

3.4 TACK COAT

- A. A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement and in accordance with FDOT Standard Specification Section 300-8. It shall also be applied to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like immediately before the adjoining asphalt pavement is placed. Care shall be taken to

prevent the application of tack coat material to surfaces that will not be in contact with the new asphalt concrete pavement. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sq yd.

3.5 ASPHALT CONCRETE

- A. Asphalt Concrete shall be in accordance with FDOT Standard Specifications Section 320 (Hot Mix Asphalt – Plant Methods and Equipment), FDOT Standard Specifications Section 327 (Milling of Existing Asphalt Pavement), FDOT Standard Specifications Section 330 (Hot Mix Asphalt – General Construction Requirements) and FDOT Standard Specifications Section 334 (Superpave Asphalt Concrete).
- B. Paving cannot be conducted until after all pipelines are satisfactorily pressure tested.
- C. At the time of delivery to the WORK site, the temperature of mixture shall not be lower than 260 degrees F or higher than 320 degrees F, the lower limit to be approached in warm weather and the higher in cold weather.
- D. Asphalt concrete shall not be placed when the atmospheric temperature is below 40 degrees F, when the roadway is wet or during unsuitable weather. Any materials that are in transit prior to the starting of inclement weather may be placed at Contractor's risk.
- E. The asphalt concrete shall be evenly spread upon the base to such a depth that, after rolling, it will be of the specified cross section and grade of the course being constructed.
- F. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation for the entire width of roadway of the proposed paving by means of a self-propelled mechanical spreading and finishing machine designed especially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical the self-propelled requirement shall be waived.
- G. Spreading, once commenced, must be continued without interruption.
- H. The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, or vibratory roller shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
- I. Upon completion the pavement shall be true to grade and cross-section. When a 15-ft straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 3/16-in except at intersections or changes of grade. Acceptance testing shall be in accordance with FDOT Standard Specifications Section 330-9 (Surface Requirements) using the above noted tolerances. Contractor shall provide a

calibrated rolling straight edge as required by the City. Overlay of existing roadways will not be subject to the surface tolerances as specified above.

- J. The relative density after compaction shall be in accordance with FDOT Standard Specification Section 330-9. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slabs or cores may be laboratory tested in accordance with ASTM D 1188.

3.6 CUTTING AND RESTORING EXISTING PAVEMENT

- A. Where street surfacing is damaged or destroyed in connection with performing the WORK it shall be replaced with the same kind or better surface in accordance with the latest specifications, rules, and regulations, and subject to the inspection of the agency having jurisdiction. If a strip of existing pavement less than 4 feet wide is left between a trench and the pavement edge, it shall be removed and new pavement shall be placed. In cutting or breaking up street surfacing, do not use equipment which will damage the adjacent pavement. Asphaltic-concrete pavement shall be saw cut to clean straight lines and removed.

3.7 RESURFACING PREPARATION

- A. Level areas of uneven surface to within 1/4 inch using a 15-foot straightedge. Area requiring leveling includes the intersection with existing pavement.
- B. Repair of paving shall consist of removal of existing deteriorated asphalt patches and limerock, replacement and compaction of limerock to 12-inch depth as depicted on the Contract Drawings and leveling courses to meet requirements of Paragraph A above.
- C. Deteriorated paving or inadequate base shall be saw cut and removed, and restored per these Specifications prior to resurfacing.
- D. Resurfacing shall be 1-inch minimum thickness with leveling courses as required with 1.5-inch maximum thickness per Type S-III surface course.
- E. Where asphaltic overlay terminates at existing paving or curbing, the existing paving shall be milled a minimum of 1-inch depth at the tie-in point to provide a smooth transition / tie-in of the existing pavement or curbing to the new asphalt roadway. Reimbursement shall be included in the applicable overlay pay items.

3.8 REFLECTIVE PAVEMENT MARKER PLACEMENT

- A. Placement of reflective pavement markers shall be in accordance with Section 706 of the FDOT Standard Specifications.

3.9 PAVEMENT MARKING

- A. Pavement marking paint shall be applied only when the pavement surface is dry and clear, and when the air temperature is above 40 degrees F. All equipment used in the application of pavement marking shall produce stripes and markings of uniform quality with clean and well-

defined edges that conform to Sections 710, 711, and/or 971 of the FDOT Standard Specifications. Drips, overspray, improper markings and paint material tracked by traffic shall be immediately removed from the pavement surface.

- B. Disturbed existing paving markings shall be replaced in kind at no additional cost to the City.

3.10 FOUR LANE ROADWAY ADDITIONAL REQUIREMENTS

- A. Contractor shall provide automatic level controls on the final lift of all four lane roadways.
- B. The final lift of pavement on all four lane roadways shall be installed as close to substantial completion as possible and is a requirement of substantial completion.

END OF SECTION

SECTION 02590

STORM DRAIN PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide storm drain pipelines for use in gravity flow applications and all appurtenant Work, complete in place, in accordance with the Contract Documents.
- B. Provide storm drain pipelines with integral bell joints fabricated out of either corrugated High Density Polyethylene (HDPE) pipe, corrugated PVC Pipe, elliptical and round Reinforced Concrete Pipe, or Fiber Reinforced Concrete Pipe.

1.2 CONTRACTOR SUBMITTALS

- A. Catalog data submittals shall be made in accordance with Section 01300 – Contractor Submittals.

PART 2 -- PRODUCTS

2.1 CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. All corrugated high-density polyethylene pipes shall conform to FDOT Standard Specifications Section 948.2.3. Corrugated HDPE pipe for storm drain shall conform to AASHTO M294 with the following exception: corrugations may only be annular. Pipe shall also conform to the minimum cell classification 435400C as specified in ASTM D 3350.
- B. Pipe and fittings shall be joined by the use of integral bell joints with a gasket compressed between the spigot and belled ends of the pipe. Elastomeric gaskets shall comply with the requirements of ASTM F 477. All joints and fittings shall be watertight. No thermal butt fusion type joints shall be provided for HDPE pipe for use in storm drainage.
- C. Manufacturer's, or City approved equal

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 CORRUGATED POLYVINYL CHLORIDE (PVC) PIPE

- A. All corrugated polyvinyl chloride pipe shall conform to FDOT Standard Specifications Section 948.1.7. Corrugated PVC pipe for storm drain shall conform to ASTM F949 and ASTM F794 manufacturing and testing requirements. Pipe shall also conform to the minimum cell classification 12454 as specified in ASTM D 1784.
- B. Pipe and fittings shall be joined by the use of integral bell joints with a gasket compressed between the spigot and belled ends of the pipe. Elastomeric gaskets shall comply with the requirements of ASTM F 477. All joints and fittings shall be water tight.
- C. Manufacturer's, or City approved equal

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 ELLIPTICAL REINFORCED CONCRETE PIPE (ERCP) AND ROUND REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall be used at all driveway culverts as shown on the Drawings.
- B. Elliptical reinforced concrete pipe shall conform to the requirements of ASTM designation C 507 for Class HE-III and FDOT Standard Specifications Section 430/449.
- C. Round reinforced concrete pipe shall conform to applicable requirements of ASTM C76 and as specified in FDOT Standard Specifications Section 430/449. Pipes shall be Class III, Wall B or C.
- D. All joints shall have a tongue and groove joint designed to be self-centering with a gasket compressed between tongue and groove. Gaskets shall meet all the requirements set forth in ASTM C 443 and FDOT Standard Specifications Section 942. All joints and gaskets shall be water tight.
- E. Joints for elliptical reinforced concrete pipe shall be of a cold adhesive preformed plastic gasket material conforming to FDOT Standard Specifications Section 942 or a continuous rubber gasket type, **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** .
- F. Joints for circular reinforced concrete pipe shall be of the rubber gasket type, and shall conform to FDOT Standard Specifications Section 942.
- G. Manufacturer's, or City approved equal

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage, shall be performed in the presence of the City, and shall be subject to its approval before acceptance. All material found to have defects will be rejected and the Contractor shall promptly remove such defective material from the Site.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.
- B. Storage: After unloading and before installation, pipe shall be stored on flat, level ground with no rocks, timbers or other objects under the pipe. The maximum stacking height for various diameters of pipe is:

15- to 21-inch diameter	4 rows
24- to 30-inch diameter	3 rows
33- to 48-inch diameter	2 rows
54-inch and larger	1 row

- C. Pipe shall be transported, stored, and handled with care. It shall not be rolled or dragged over gravel or rock, and during placement, shall be prevented from striking rock or other hard objects. Damaged, bent, out-of-round, or otherwise defective pipe shall be removed from the Site and the Contractor shall replace it as part of the Work.

3.3 INSTALLATION OF HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. Installation shall conform to the requirements of ASTM D 2321 and the applicable requirements of Section 02200 - Earthwork, instructions furnished by the pipe manufacturer, and to the requirements herein. Wherever the requirements are in conflict, the more stringent shall apply.

3.4 INSTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE

- A. Installation shall conform to the requirements of ASTM F794 and ASTM F949 and the applicable requirements of Section 02200 - Earthwork, instructions furnished by the pipe manufacturer, and to the requirements herein. Wherever the requirements are in conflict, the more stringent shall apply.

3.5 INSTALLATION OF ELLIPTICAL AND ROUND REINFORCED CONCRETE PIPE

- A. Installation shall conform to the requirements of ASTM C 1478 and C 1479, and the applicable requirements of Section 02200-Earthwork, instructions furnished by the pipe manufacturer, and to the requirements herein. Wherever the requirements are in conflict, the more stringent shall apply.
- B. All reinforced concrete pipe laying shall begin at the downstream end of the line and proceed upstream. Pipe shall be laid carefully and true to line and grade. All reinforced concrete pipe joints shall be wrapped with a filter fabric jacket per FDOT Standard Specifications Section 430/449 to prevent infiltration.

3.6 GENERAL INSTALLATION GUIDELINES FOR HDPE, PVC, ELLIPTICAL AND ROUND REINFORCED CONCRETE PIPES

- A. Contractor's attention is called for pipelines to be installed in accordance with manufacturer's recommendations for proper installation.
- B. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying from downstream to upstream. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with watertight plugs or bulkheads.
- C. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where necessary and where indicated.
- D. Where unstable trench walls or trench bottom is encountered, such as may be found by excavation below ground water, this condition shall be stabilized before laying the pipe. Depending on the severity of the condition, the Contractor may elect to use tight sheeting, stay bracing, a trench box, well points, an under drain, removal of the unstable soil and replacement with a suitable foundation material, or a combination of methods.
- E. With the gasket properly placed in the spigot groove, the gasket shall be stress-relieved by passing a screwdriver under the gasket and then around the circumference of the spigot.
- F. The pipe ends shall be wiped clean and a thin coat of lubricant applied to both the outside surface of the spigot end with the gasket in place, and the inside surface of the bell end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall then be forced into the bell end of the adjoining pipe. A backhoe bucket or a cable winch may be used, but the force shall be steady, not an impact force, and shall be evenly distributed so as not to damage the pipe end.
- G. The pipe shall not be deflected either vertically or horizontally in excess of 80% of the manufacturer's recommended allowable deflection

- H. Pipe trench backfill and bedding shall be in accordance with the requirements of Section 02200 – Earthwork, with minimum backfill compaction in the pipe zone as specified.

END OF SECTION

SECTION 02594

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish and install all high density polyethylene (HDPE) pipeline, complete in place, in accordance with the Contract Documents.
- B. The requirements for pipe materials are indicated on the Drawings.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall provide manufacturer data for all pipe, fittings, and appurtenances.
- C. Contractor shall provide welding technician qualifications.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All high density polyethylene pipe shall be Ductile Iron Pipe Size (DIPS), SDR 11 rating.
- B. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and SDR rating or minimum pipe stiffness in psi. Pipe shall be marked with a one- inch wide stripe of continuous color (green-sewer, blue-water, and purple-irrigation).
- C. Pipe shall be marked by manufacturer with extrusion code on the pipe. Records shall be maintained by the manufacturer for 2 years, covering date of extrusion, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.
- D. Polyethylene pressure pipe shall conform to the applicable requirements of ANSI/AWWA C 906 and shall be subject to additional requirements specified herein.
- E. Material Requirements: Pipe shall be high molecular weight, high density polyethylene pipe. The material shall have a standard PE code designation of PE 3408 and have a cell classification of 345464C as described in ASTM D 3350. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

- F. The pipe shall be homogenous throughout and free of visible cracks, bubbles, holes, foreign inclusions or other injurious defects. It shall be uniform in color, capacity, density, and other physical properties. Any pipe not meeting these criteria shall be rejected.
- G. Joints: All joints for the buried polyethylene pipe shall be of the thermal butt fusion or electrofusion type unless otherwise specified. Flanged adapters may be butt welded or electrofusion welded. Mechanical joints to PVC, other materials, equipment, valves, and appurtenances will not be considered. For transitions between PVC and HDPE pipelines, HDPE molded flanges with 316 American made stainless steel backup rings shall be used. HDPE pipe for storm drain use shall not be welded (Ref. Section 02590 – Storm Drain).

2.2 FITTINGS

- A. Polyethylene fittings shall conform to Section 2.3 of AWWA C 906. Molded fittings shall conform to ASTM D3261 for butt-type fittings or ASTM F1055 for electrofusion-type fittings.
- B. All fittings shall be close radius molded fabrication. No miter joints allowed.
- C. Each fitting shall be clearly labeled by manufacturer identifying its size and dimension ratio.
- D. All pipe and fittings shall be Ductile Iron Pipe Size (DIPS).

2.3. MANUFACTURERS, OR CITY APPROVED EQUAL:

- A. HDPE PIPE MANUFACTURERS (**SEE CITY OF CAPE CORAL QUALIFIED PRODUCTS LIST**)
- B. HDPE FITTING MANUFACTURERS (**SEE CITY OF CAPE CORAL QUALIFIED PRODUCTS LIST**)

PART 3 -- EXECUTION

3.1 GENERAL

- A. Any material found to have defects during the progress of the project shall be immediately removed from the site by the Contractor at no additional cost.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.
- B. Storage: Pipe shall be stored at the job site in unit packages provided by the manufacturer. Pipe shall be stored in such a way as to prevent sagging or bending.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation shall conform to the requirements for utility pipeline construction as specified in Section 02200 - Earthwork.

3.4 INSTALLATION

- A. Installation shall conform to the pipe manufacturer recommendations, and the applicable requirements of Section 02347 - Horizontal Directional Drilling, supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.5 JOINT WELDING

- A. Sections of high density polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the thermal butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. Fusion equipment used in the joining procedure shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure.
- B. Butt fusion shall conform to ASTM D 2657 and pipe manufacturer's criteria for the type of joining. Joint strength shall be equal to that of the adjacent pipe.
- C. Fusion equipment shall be operated by technicians who have been certified the fusion equipment suppliers, and must have sufficient experience fusion welding pipelines with diameters that are found in the project that the operator will be undertaking.
- D. Storm drain pipe joints shall be as specified in Section 02590 – Storm Drain.

3.6 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection of water mains shall conform to the requirements of Section 02666 - Pressure Pipeline Testing and Disinfection.

END OF SECTION

SECTION 02595

POLYETHYLENE PIPE FOR SERVICE CONNECTIONS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. Furnish and install polyethylene (PE) pipe and fittings for service connections complete in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall provide manufacturer data for all pipe, fittings, and appurtenances.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PE pipe two inches or less in size shall meet AWWA C-901, ASTM D-3350 cell classification of 334434C and be permanently marked with the type/size/use of the pipe. PE pipe two and one half (2 ½) inches or three (3) inches in size shall meet AWW C-901, ASTM D-3350 cell classification of 334434C and be permanently marked with the type/size/use of the pipe and shall only be permitted by specific written approval by the City. The minimum radius of curvature shall be thirty (30) pipe diameters and bending shall not cause kinking. The potable water pipe shall be blue in color, and the reclaimed water pipe shall be lavender in color.
- B. Brass Compression Coupling Fittings: Brass compression coupling fittings shall be permitted as approved by the City.
- C. HDPE Compression Coupling Fittings: PE piping with HDPE compression and molded fittings shall be permitted with prior written approval by the City of Cape Coral. PE piping with the HDPE 4710 molded fittings does not require stainless steel stiffeners.
- D. Mechanical Coupling Fittings: The mechanical coupling fittings shall meet and/or exceed the maximum design pressure requirements of the piping system. The couplings shall prevent the entry of dust, dirt, and moisture. Mechanical coupling fittings shall not be permitted unless specifically approved in writing by the City.
- E. PVC Compression Coupling Fittings: PE piping with PVC compression fittings shall not be permitted unless specifically approved in writing by the City.

2.2 FITTINGS MANUFACTURERS OR CITY APPROVED EQUAL:

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For additional information on fittings used on service connection please see Section 15001 – Saddles, Stops, and Small Valves.

2.3 PIPE MANUFACTURERS

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 GENERAL

- A. Any material found to have defects during the progress of the project shall be immediately removed from the site by the Contractor at no additional cost.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.
- B. Storage: Pipe shall be stored at the job site in unit packages provided by the manufacturer. Pipe shall be stored in such a way as to prevent sagging or bending.

3.3 TRENCHING AND BACKFILL

- A. Trench excavation shall conform to the requirements for utility pipeline construction as specified in Section 02200 - Earthwork.

3.4 INSTALLATION

- A. Installation shall conform to the pipe manufacturer recommendations. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.5 FIELD TESTING AND DISINFECTION

- A. Field testing and disinfection of water piping shall conform to the requirements of Section 02666 - Pressure Pipeline Testing and Disinfection.

END OF SECTION

SECTION 02596

GRAVITY SEWER PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide polyvinyl chloride (PVC) gravity sewer pipe, complete in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 – Contractor Submittals.
- B. The Contractor shall provide manufacturing data for all pipe, fittings, and appurtenances.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC gravity sewer pipe (4-inch through 15-inch) shall conform to the applicable requirements of ASTM D 3034, SDR 26 subject to additional requirements herein.
- B. PVC gravity sewer pipe (18-inch through 27-inch) shall conform to the applicable requirements of ASTM F 679, SDR 26 subject to additional requirements herein.
- C. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and DR rating or minimum pipe stiffness in psi. Pipe shall be green.
- D. The Contractor shall also require the manufacturer to mark the extrusion or manufacturing code on the pipe. Records shall be maintained by the manufacturer for 2 years, covering date of extrusion, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.

2.2 PIPE

- A. The pipe shall be of the diameter and SDR as shown in the drawings or shown, shall be furnished complete with rubber gaskets, all specials and fittings as required.
- B. Joints: Joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D 3212 and ASTM F 477.
- C. Manufacturers, or City approved equal:

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2.3 FITTINGS

- A. Fittings for PVC gravity sewer pipe (4-inch through 15-inch) shall conform to the requirements of ASTM D 3034 (Heavy Wall). The ring groove and gasket ring shall be compatible with PVC pipe ends.
- B. Fittings for PVC gravity sewer pipe (18-inch through 27-inch) shall conform to the requirements of ASTM F 679 (Heavy Wall). The ring groove and gasket ring shall be compatible with PVC pipe ends.
- C. The minimum wall thickness of the fittings shall not be less than the minimum wall thickness of the equivalent size of pipe.
- D. Manufacturers, or City approved equal:

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- E. Tee-wyes shall be heavy wall tee-wyes manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.

2.4 LUBRICANT

- A. Lubricant for PVC gravity sewer pipe shall conform to manufacturer's requirements.

2.5 BEDDING MATERIAL

- A. Unless otherwise indicated, pipe bedding shall conform to Section 02200 - Earthwork.

2.6 IDENTIFICATION AND LOCATING DEVICES

- A. All service lateral pipes shall be provided with "early warning" protection tape as shown on the Contract Drawings, from edge of pavement to right-of-way-line. The tape shall be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**, 3-inch minimum width and shall have a metallic detectable strip included and color-coded Green.
- B. Locating Markers shall be installed at the end of service laterals. **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Material found to have defects shall be immediately removed from the site by the Contractor at no additional cost.
- B. Installation shall conform to the requirements of ASTM D 2321 and to the supplementary requirements or modifications specified herein. Wherever the provisions of this section and the requirements of ASTM D 2321 are in conflict, the more stringent provision shall apply.
- C. The internal diameter of the pipe barrel shall not be reduced by more than 5 percent of its base diameter when measured after backfilling and compacting but prior to final paving. If this amount of allowable pipe deflection is exceeded, the Contractor shall uncover the pipe and

shall improve the quality of the pipe zone backfill material and/or compaction to the extent that the allowable pipe deflection is not exceeded. The City shall check for excessive deflection by pulling a mandrel through the pipe or inspection by video camera.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 02200- Earthwork, and as specified herein.

3.3 INSTALLATION

- A. The pipe shall be installed in accordance with the requirements of ASTM D 2321 and as specified herein and shown and the sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition, as well as during and after laying. All openings in the pipeline shall be closed with watertight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at its own expense.
- F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with owners of such utility structures. Unless otherwise indicated, this work shall be performed at the Contractor's expense.

3.4 HANDLING AND STORAGE

- A. Handling: Handling of the PVC pipe shall be done with implements, tools, and facilities as recommended by the pipe manufacturer to ensure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation. Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective should be rejected. Pipe and fittings shall be free from fins and burrs. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.
- B. Storage: Pipe shall be stored, if possible, at the site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression damage or deformation to the pipe. Pipe shall be stored in such a way as to prevent sagging or bending. Pipe more than two years old may be approved by the City depending on the state of the pipe and gaskets. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. The City may reject excessively faded or dirty pipe.

3.5 METALLIC LOCATING TAPE AND MARKERS

- A. All service laterals shall have an “early warning” protection tape installed continuously from the edge of pavement to the right-of-way line. The protection tape shall be installed during backfilling 12 to 18 inches directly above the pipe at a uniform elevation.
- B. Electronic Pipe Markers shall be placed only at service points. Markers shall not be installed more than four feet deep.

3.6 FIELD JOINTING

- A. Compression type joint shall consist of a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. At this time a thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. The end of the pipe shall be then forced into the ring to complete the joint.
- C. The pipe shall not be deflected either vertically or horizontally in excess of 80% of the printed recommendations of the manufacturer of the coupling, according to the pipe size.
- D. Fittings shall be carefully connected to pipe, and joints shall be checked to assure a sound and proper joint.
- E. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water, sand and debris from entering pipe. Adequate backfill shall be deposited on the pipe to prevent floatation of pipe. Any pipe, which has floated, shall be removed from the trench, cleaned, and reinstalled in an acceptable manner. No pipe shall be laid when, in the opinion of the City, the trench conditions or weather are unsuitable for such work.

3.7 INSTALLATION OF BENDS

- A. Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling. Fittings shall be carefully connected to pipe or other facility, and joints shall be checked to assure a sound and proper joint.

3.8 CONNECTIONS TO EXISTING SEWER LINES

- A. The Contractor shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the Contractor shall make arrangements with the serving utility through the City well in advance of the connections and shall expedite the work to minimize service outages to the users.

3.9 SERVICE CONNECTIONS

- A. Service laterals and fitting shall be as indicated on the Contract Drawings. Service laterals shall be connected to the wye utilizing approved fittings and adapters.
- B. Service pipe shall be laid with a minimum grade of 1/8" per foot.

3.10 TESTING

- A. Field testing of gravity sewer pipe shall conform to the requirements of Section 02622 – Sanitary Sewer System Testing and Section 02623 – Television Inspection.

3.11 REPAIRS

- A. If defects are identified during inspection, immediately notify the City. City shall determine if replacement or repairs are required.
- B. The Contractor shall repair all visible leaks. NO GEL REPAIR OF LEAKS WILL BE ALLOWED.
- C. Contractor shall repair pipe as directed by the City.

3.12 ACCEPTANCE - SLOPES

- A. All gravity sewer mains shall be installed to the slopes as indicated on the Drawings. Acceptance of any piping section found to have dips on flat spots shall be as follows:
 - 1. Dips or flat spots in the gravity sewer main up to and including 3/4" in actual water depth from invert of pipe are acceptable.
 - 2. Dips greater than 3/4" in depth will not be accepted and shall be. Corrective measures may include pipe replacement or pipe vibrations (such as ACP sag correction) and each method will be considered on a case by case basis, with final approval being granted by the City. All corrective measures shall be at the Contractor's cost and at no additional cost to the City.

3. Dips or flat spots in the gravity sewer main greater than 1 ½" in actual water depth from invert of pipe shall be removed and repaired at the Contractor's expense.
- B. The Contractor is required to grade all sewer runs in accordance with the Contract Drawings. The minimal acceptable sewer slope between two consecutive manholes shall be within plus or minus 10% of the slope as shown on Drawings with the City's approval. If these maximum or minimum slopes between two consecutive manholes are not maintained, the gravity sewer main shall be removed and replaced to provide the required minimum slope.

END OF SECTION

SECTION 02597

WASTEWATER FORCE MAIN PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide Polyvinyl Chloride (PVC) or Ductile Iron Pipe (DIP) pressure pipe, complete in place, in accordance with the Contract Documents. The use of DIP shall only be when approved by the City of Cape Coral.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall provide manufacturing data for all pipe, fittings, and appurtenances.

PART 2 -- PRODUCTS

2.1 All force main pipe less than and including 24-inches shall be PVC unless otherwise indicated on the Drawings

2.2 PVC PIPE

- A. PVC pressure pipe shall not be permitted above ground.
- B. PVC force mains below ground or in a casing shall conform to the applicable requirements of ANSI/AWWA C 900, DR 18 or ANSI/AWWA C 909 for Molecular Oriented Poly Vinyl Chloride (PVC).
- C. The pipe shall be of the diameter and pressure class specified in this Section, and shall be furnished complete with rubber gaskets, all specials, and fittings as required in the Contract Documents.
- D. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and DR rating or pressure rating. Pipe shall be green.
- E. Additives and Fillers: Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds shall have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F.
- F. Joints: Joints for the buried PVC pipe shall be an integral bell manufactured on the pipe employing a rubber ring joint in accordance with ASTM C 477. The bell shall be the same or greater thickness as the pipe barrel.
- G. Joint Deflection: Deflection at the joint shall not exceed 80% of the deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.

- H. Pipe Manufacturers, or City approved equal:

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- I. Restrained joints for PVC pipe shall properly fit the pipe being installed and shall be manufactured by the following, or City approved equal:

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- J. Bell restrained harnesses shall be used where in-line PVC restrained joints are required. Bell restrained harnesses for PVC pipe shall be manufactured by the following, or City approved equal:

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2.3 DIP PIPE

- A. Above ground piping shall be Ductile Iron Pipe conforming to ANSI/AWWA C 115 for flanged pipe, Pressure Class 250, or restrained joint pipe meeting ANSI/AWWA C151 pressure Class 250, or a combination of these.
- B. All Ductile Iron Pipe shall be internally lined with Protecto 401 ceramic epoxy or polyethylene lined as per Section 2.6. If Ductile Iron Pipe is stamped with the Special Class rating in lieu of the Pressure Class rating, a letter is to be supplied by the vendor stating that the particular Special Class meets the specified Pressure Rating for each size of pipe. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and DR rating or pressure rating.
- C. The Contractor shall also require the manufacturer to mark the extrusion or manufacturing code on the pipe. This coding shall be done in conjunction with records to be held by the manufacturer for 2 years, covering date of manufacture, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.
- D. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness. Lining and coating shall be in accordance with the requirements of Section 2.6 and Section 2.7 of this Section.
- E. Polyethylene Sleeve: Material for the polyethylene sleeve shall conform to the requirements of ANSI/AWWA C 105.
- F. Pipe Manufacturers, or City approved equal:

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- G. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
1. Mechanical and push-on joints shall conform to ANSI/AWWA C 111/A21.11.

2. Flanged joints shall conform to ANSI/AWWA C 115/A21.15. Special ductile iron flanges to match up to 250 psi valve and equipment flanges shall meet ANSI/AWWA C 110 and be specially drilled to ANSI/ASME B16.1 class 250 standard dimensions with raised face.
- H. Restrained joints shall be as manufactured by the following, or City approved equal:

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- I. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed.

2.4 HDPE PIPE

- A. Force mains which are installed by directional drilling or as shown on the Drawings shall be high density polyethylene pressure piping in accordance with Section 02594 – High Density Polyethylene (HDPE) Pipe.
- B. The force mains will be HDPE pipe as they enter pump station wet wells. Refer to Section 02594 – High Density Polyethylene (HDPE) Pipe for the requirements on pipe material.
- C. The lift stations force main discharge piping shall be HDPE pipe as noted on the Drawings and Details. Refer to Section 02594 – High Density Polyethylene (HDPE) Pipe for the requirements on pipe material.

2.5 FITTINGS

- A. Ductile iron fittings shall be used with both PVC pipe and DIP pipe and shall conform to the requirements of ANSI/AWWA C 153/A21.53 or ANSI/AWWA C 110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi.
- B. All fittings shall be lined and coated in accordance with the requirements of Article 2.6 and Article 2.7 of this Section.
- C. All HDPE fittings shall be molded fittings with a fused close radius. Refer to Section 02594 – High Density Polyethylene (HDPE) Pipe for the requirements on pipe material.
- D. Each fitting shall be clearly labeled to identify its size, pressure class, and lining.
- E. Manufacturers, or City approved equal:

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2.6 EPOXY OR POLYETHYLENE LINING FOR DIP SEWER FORCE MAINS

- A. All ductile iron pipe and fittings for force mains shall be coated internally with either factory applied epoxy lining or factory applied polyethylene lining.
- B. Epoxy lining shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. All ductile iron piping and fittings furnished for this internal coating application shall be delivered to the application

facility without asphalt, cement lining or any other lining on the interior surface. Coating shall be 40 mils nominal dry film thickness. Coating shall be applied and inspected in strict accordance with the manufacturer's recommendations and specifications by a certified coatings applicator.

- C. The polyethylene lining shall be a composite lining utilizing a primer coating containing fusion bonded epoxy (FBE) and a surface coating containing fusion bonded polyethylene (FBP). The lining shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Polyethylene lining application must be performed by the pipe manufacturer at the pipe manufacturer's facility. Linings applied by individuals other than the pipe manufacturer are unacceptable and shall be rejected.
- D. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as recommended by the manufacturer.

2.7 EXTERIOR COATING OF DIP PIPE

- A. All Ductile Iron wastewater force main pipes above ground shall be painted Green conforming to the requirements in Section 09800-Protective Coating.
- B. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be abrasive blasted to a minimum commercial Grade SSPC-SP-6, NACE 3 and given a high solids epoxy primer coat **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Intermediate coating shall be applied at the factory. Finish coat shall be applied after installation. Exterior coating of exposed piping shall be in accordance with Section 09800 - "Protective Coating," Ferrous Metals - Not Galvanized.
- C. Polyethylene Encasing: Buried ductile iron pipe shall be shop coated as required with manufacturer's standard coating. Where directed in the field, the coated pipe shall be encased with 8 mil polyethylene material in accordance with the requirements of ANSI/AWWA C 105/A21.5.

2.8 IDENTIFICATION AND LOCATING DEVICES

- A. All force main pipes shall be provided with an electronic marking system caution tape , 6-inches wide.. The tape shall be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** and shall be color coded Green.
- B. Markers shall be installed at all fittings and changes in direction and shall be Color: Green, **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.

2.9 LUBRICANT

- A. Lubricant for forcemain pipe shall conform to manufacturer's requirements.

2.10 BEDDING MATERIAL

- A. Unless otherwise indicated, pipe bedding shall conform to Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Material found to have defects shall be immediately removed from the site by the Contractor.
- B. PVC pipe installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. DIP pipe installation shall conform to the requirements of ANSI/AWWA C 600. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

The DIP pipe shall be handled by devices designed and constructed to prevent damage to the pipe coating/exterior. DIP shall not be installed where the lining or coating show defects as determined by the City. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

- B. Storage: Pipe shall be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution shall be exercised to avoid compression damage or deformation to the pipe. PVC pipe shall be stored in such a way as to prevent sagging or bending. Pipe more than two years old may be approved by the City depending on the state of the pipe and gaskets. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. The City may reject excessively faded or dirty pipe.

3.3 INSTALLATION

- A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with plugs.
- B. All transitions between dissimilar pipe materials (i.e., Ductile Iron Pipe to PVC, PVC to Ductile Iron Pipe, etc.) shall be accomplished with an appropriately sized approved mechanical joint. No bell to spigot transitions will be allowed on dissimilar pipe materials. All transitions between dissimilar pipes shall be inspected and approved by the City.

- C. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place in accordance with Section 15006 – Pipe Supports. Fittings shall be independently supported.
- D. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.
- E. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made
- F. Deflection at the joint shall not exceed 80% of the deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.
- G. In laying pipe, it shall be laid to the setline and grade, within approximately one inch plus or minus.
- H. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Contractor may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection noted above. No joint shall be misfit by any amount that will be detrimental to the strength and water tightness of the finished joint.
- I. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable plugs or bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, the pipe shall be prevented from floating.
- J. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, and any other debris following completion of pipe laying, and perform any necessary repairs prior to testing the completed pipeline.
- K. Field Cutting: Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut, or per the manufacturer's written procedure. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, sander, or abrasive disc.

3.4 METALLIC LOCATING TAPE AND MARKERS

- A. All force mains shall have an electronic marking system caution tape , 6-inches wide installed continuously along the alignment. The tape shall be installed during backfilling 12 to 18 inches directly above the pipe at a uniform elevation.

- B. Locating markers shall be installed at all fittings and changes in direction. Locating markers shall not be installed more than four (4) feet deep. Locating markers shall not be placed within 12-inches of the fittings. Locating markers shall be 3M Model 1258, Color: Green.

3.5 CONNECTIONS TO EXISTING FORCEMAINS

- A. The Contractor shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the Contractor shall make arrangements with the serving utility through the City a minimum of seven days in advance of the connections and shall expedite the work to minimize service outages. Where sections of existing pipelines are taken permanently out of service and abandoned in place, the cut ends shall be sealed with a restrained plug.

3.6 RUBBER GASKETED JOINTS

- A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a lubricant recommended by the pipe manufacturer shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with the same lubricant. The spigot end of the pipe shall then be inserted into the bell of the previously laid joint and pushed into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.7 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to ensure proper operation.
- C. All valves shall be installed so that the valve stems are plumb and in the location shown.

3.8 FIELD TESTING

- A. Pressure testing of sewer force mains will be performed in accordance with Section 02666 – Pressure Pipeline Testing and Disinfection.

3.9 FIELD ADJUSTMENT OF EXISTING FORCE MAINS

- A. The Contractor shall notify the City when conflicts with new improvements and existing force mains are found. When directed by the City, the Contractor will field adjust the existing force mains as required to provide adequate separation. The existing force mains shall be restrained in accordance with the Restrained Joint Schedule as shown in the Drawings. Field adjusted existing force main piping shall be visually inspected under normal line pressure before backfilling. Pressure test of the field adjusted force main piping will not be required.

END OF SECTION

SECTION 02598

POTABLE WATER PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide polyvinyl chloride (PVC) or Ductile Iron Pipe (DIP) pressure pipe, complete in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 – Contractor Submittals.
- B. The Contractor shall provide manufacturing data for all pipe, fittings, and appurtenances.

PART 2 -- PRODUCTS

2.1 PVC PIPE

- A. Potable water mains below ground shall conform to the applicable requirements of ANSI/AWWA C 900, DR 18. All new potable water mains shall be 6" or larger.
- B. The pipe shall be of the diameter and pressure class specified in this Section, shall be furnished complete with rubber gaskets, and all specials and fittings as required in the Contract Documents.
- C. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and DR rating or pressure rating. Pipe shall be blue.
- D. Additives and Fillers: Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds shall have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for potable water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). Additives and fillers must be approved by AWWA for use in potable water systems.
- E. Joints: Joints for the buried PVC pipe shall be an integral bell manufactured on the pipe employing a rubber ring joint in accordance with ASTM C 477. The bell shall be the same or greater thickness as the pipe barrel.
- F. Pipe Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- G. Restrained joints for PVC pipe shall properly fit the pipe being installed and shall manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- H. Bell restrained harnesses shall be used where in-line PVC restrained joints are required. Bell restrained harnesses for PVC pipe shall be manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 DIP PIPE

- A. Ductile Iron Pipe below ground shall conform to ANSI/AWWA C 151, C150, C 104, and C 105 subject to additional requirements herein. Ductile iron pipe wall thickness shall meet the requirements of Pressure Class 250 with cement mortar lining. Ductile Iron Pipe shall be Class 350 in sizes up to and including 12-inches in diameter. If Ductile Iron Pipe is stamped with the Special Class rating in lieu of the Pressure Class rating, a letter is to be supplied by the vendor stating that the particular Special Class meets the specified Pressure Rating for each size of pipe.
- B. Above ground piping, flanged and/or fully restrained, shall be Ductile Iron Pipe conforming to ANSI/AWWA C 151, C150, C 104, and C 105. Ductile iron pipe wall thickness shall meet the requirements of Pressure Class 250 with cement mortar lining. If Ductile Iron Pipe is stamped with the Special Class rating in lieu of the Pressure Class rating, a letter is to be supplied by the vendor stating that that particular Special Class meets the specified Pressure Rating for each size of pipe.
- C. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and pressure rating.
- D. The Contractor shall also require the manufacturer to mark the extrusion or manufacturing code on the pipe. This coding shall be done in conjunction with records to be held by the manufacturer for 2 years, covering date of manufacture, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.
- E. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness. Lining and coating shall be in accordance with the requirements of Section 2.4 and Section 2.5.
- F. Polyethylene Sleeve: Material for the polyethylene sleeve shall conform to the requirements of ANSI/AWWA C 105.
- G. Pipe Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- H. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
 - 1. Mechanical and push-on joints shall conform to ANSI/AWWA C 111/A21.11.

2. Flanged joints shall conform to ANSI/AWWA C 115/A21.15. Special ductile iron flanges to match up to 250 psi valve and equipment flanges shall meet ANSI/AWWA C110 and be specially drilled to ANSI/ASME B16.1 class 250 standard dimensions with raised face.

- I. Restrained joints shall be as manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- J. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. Gaskets shall conform to ASTM C 477.

2.3 FITTINGS

- A. Ductile iron fittings shall be used with both PVC pipe and DIP pipe and shall conform to the requirements of ANSI/AWWA C 153/A21.53 or ANSI/AWWA C 110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi.
- B. All fittings shall be lined and coated in accordance with the requirements of Section 2.4 and Section 2.5.
- C. Each fitting shall be clearly labeled to identify its size, pressure class, and lining.
- D. Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.4 CEMENT-MORTAR LINING FOR WATER LINES

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C 104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. The minimum lining thickness shall be as follows:

<u>Nominal Pipe Diameter (in)</u>	<u>Minimum Lining Thickness (in)</u>
6-12	1/8
14-24	3/16
30-54	1/4

- C. Protection of Pipe Lining/Interior: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

2.5 EXTERIOR COATING OF DIP PIPE

- A. All potable water pipes above grade shall be painted battleship grey conforming to the requirements in Section 09800-Protective Coating. Pipes should also be stenciled on the side in the specific color and type.
- B. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be abrasive blasted to a minimum commercial Grade SSPC-SP-6, NACE 3 and given a high solids epoxy primer coat, **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. If intermediate coating is required as per Section 09800 – “Protective Coating,” it shall be applied in the factory. The finish coat shall be applied after installation in accordance with Section 09800 - “Protective Coating.”
- C. Polyethylene Encasing: Buried ductile iron pipe shall be shop coated as required with manufacturer’s standard coating. Where directed in the field, the coated pipe shall be encased with 8-mil polyethylene material in accordance with the requirements of ANSI/AWWA C 105/A21.5.
- D. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as recommended by the manufacturer.

2.6 IDENTIFICATION AND LOCATING DEVICES

- A. All potable water pipes and services shall be provided with an electronic marking system caution tape , 6-inches wide . The tape shall be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** and shall be colored coded Blue.
- B. All potable water piping shall be marked with an Electronic Marker System (EMS), **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Markers shall be installed at all fittings, casing pipe ends and changes in direction.

2.7 LUBRICANT

- A. Lubricant for potable water pipe shall conform to manufacturer’s requirements.

2.8 BEDDING MATERIAL

- A. Unless otherwise indicated, pipe bedding shall conform to Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Material found to have defects shall be immediately removed from the site by the Contractor.
- B. PVC pipe installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. DIP pipe installation shall conform to the requirements of ANSI/AWWA C 600. Wherever the provisions

of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

- C. All transitions between dissimilar pipe materials (i.e., Ductile Iron Pipe to PVC, PVC to Ductile Iron Pipe, etc.) shall be accomplished with an appropriately sized approved mechanical joint. No bell to spigot transitions will be allowed on dissimilar pipe materials. All transitions between dissimilar pipes shall be inspected and approved by the City.

3.2 HANDLING AND STORAGE

- A. Delivery to Site: All potable water pipe including pipe ends shall be properly covered with a tarp or shrink wrap on the delivery truck to prevent truck exhaust fumes from contaminating the pipe or it will be rejected. This requirement will be strictly enforced.
- B. Handling: Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

The DIP pipe shall be handled by devices designed and constructed to prevent damage to the pipe coating/exterior. DIP shall not be installed where the lining or coating show defects that may be harmful as determined by the City. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

- C. Storage: Pipe shall be stored, if possible, at the site in unit packages provided by the manufacturer. Pipe shall be stored in a manner to prevent exposure to sunlight (UV) until such time as it is installed. Caution shall be exercised to avoid compression damage or deformation to the pipe. PVC pipe shall be stored in such a way as to prevent sagging or bending. Pipe more than two years old, may be approved by the City depending on the state of the pipe and gaskets. Contractor shall receive written approval from the City of Cape Coral prior to use of any pipe which is more than two years old. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. The City may reject excessively faded or dirty pipe.

3.3 INSTALLATION

- A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with plugs.
- B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to

accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place in accordance with Section 15006 – Pipe Supports. Fittings shall be independently supported.

- C. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.
- D. Joints shall be installed according to manufacturer's recommendations. Contractor shall take precautions to prevent "over homing" of the pipe. The indication line marked on the spigot of the pipe shall in all cases remain visible after joining of the pipe, in accordance with the manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made.
- E. Deflection at the joint shall not exceed 80% of the deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.
- F. In laying pipe, it shall be laid to the setline and grade, within approximately one inch plus or minus.
- G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Contractor may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection noted above. No joint shall be misfit by any amount that will be detrimental to the strength and water tightness of the finished joint.
- H. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable plugs or bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, the pipe shall be prevented from floating.
- I. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, and any other debris following completion of pipe laying, and perform any necessary repairs prior to testing and disinfecting the completed pipeline.
- J. Field Cutting: Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut, or per the manufacturer's written procedure. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, sander, or abrasive disc.

3.4 ELECTRONIC MARKING SYSTEM TAPE AND MARKERS

- A. All water mains shall have an electronic marking system caution tape , 6-inches wide installed continuously along the alignment. The tape shall be installed during backfilling 12 to 18 inches directly above the pipe at a uniform elevation.

- B. Locating markers shall be installed at all fittings, casing pipe and changes in direction. Locating markers shall not be installed more than four (4) feet deep. Locating markers shall not be placed within 12-inches of the fittings.

3.5 CONNECTIONS TO EXISTING POTABLE WATER MAINS

- A. The Contractor shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the Contractor shall make arrangements with the serving utility through the City a minimum of seven (7) days in advance of the connections, to allow adequate time for draining of the existing line, if necessary, and shall expedite the work to minimize water outages to the users. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, they shall be sealed with a Megalugged Plug. The Contractor shall comply with all City and County Health Department Requirements.

3.6 RUBBER GASKETED JOINTS

- A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a lubricant recommended by the pipe manufacturer shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with the same lubricant. The spigot end of the pipe shall then be inserted into the bell of the previously laid joint and pushed into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.7 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust all stem packing and operate each valve prior to installation to ensure proper operation.
- C. All valves shall be installed so that the valve stems are plumb and in the location shown.

3.8 SERVICE CONNECTIONS

- A. DIP Pipe Service Connections: No direct tapping or threading of ductile iron pipe will be permitted. Double strap ductile iron service saddles anchored by a minimum of four bolts shall be used for service connections on ductile iron pipe. Service saddles shall be sized to fit the pipe outside diameter and shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. Maximum outlet size permitted with service saddles is 2 inches. Refer to Section 15001 – Saddles, Stops and Small Valves for additional requirements.
- B. PVC Pipe Service Connections: Direct tapping will not be permitted. Brass service saddles shall be used on mains up to six inches (6") in diameter. Double strap ductile iron saddles shall be used on mains 8 inches (8") and larger. Double strap ductile iron service saddles anchored

by a minimum of four (4) bolts shall be used for all service connections. Service saddles shall be sized exactly to the pipe outside diameter and shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters, twist drills, or hole saws are not acceptable. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service clamps or saddles is 2 inches.

- C. Tapping sleeves and valves for full body fittings shall be used for all outlet sizes greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's recommendations.
- D. Where existing potable water services are present in an area, the entire existing long and short side potable water service including curb stop are to be located, removed and replaced by the Contractor. Existing potable water meters and meter boxes are to be maintained. The Contractor, at his option, may either convert the existing corporation stop from a HDPE tubing connector to a Schedule 80 PVC connector or to hot tap the existing water main and provide a new corporation stop. If a hot tap is provided the original corporation stop is to be turned off and the outlet is to be plugged. The Contractor is to perform the replacement of the existing water services in a timely manner to minimize the outage to the Homeowner. The Contractor shall provide all necessary notifications to the Homeowner including the impending outage and any notices required by the Health Department.

3.9 FIELD TESTING AND DISINFECTION

- A. Field-testing and disinfection of water mains shall conform to the requirements of Section 02666 – Pressure Pipeline Testing and Disinfection.

3.10 FIELD ADJUSTMENT OF EXISTING POTABLE WATER MAINS

- A. The Contractor shall notify the City when conflicts with new improvements and existing potable water mains are found. When directed by the City, the Contractor will field adjust the existing potable water mains as required to provide adequate separation. All Lee County Health Department rules and Florida Administrative Code requirements will be adhered to by the Contractor when adjusting the potable water mains, including but not limited to boil water notices and bacteriological sampling of lines (currently minimum of 2 samples per line break) when the pressure is reduced below 20 psi. The existing potable water mains shall be restrained in accordance with the Restrained Joint Schedule as shown in the Drawings. Field adjusted existing potable water piping shall be visually inspected under normal line pressure before backfilling. Pressure test of the field adjusted potable water piping will not be required.

END OF SECTION

SECTION 02599

IRRIGATION WATER PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide polyvinyl chloride (PVC) or Ductile Iron Pipe (DIP) pressure pipe, complete in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. The CONTRACTOR shall provide manufacturing data for all pipe, fittings, and appurtenances.

PART 2 -- PRODUCTS

2.1 PVC PIPE

- A. Irrigation water mains below ground shall conform to the applicable requirements of ANSI/AWWA C 900, DR 18.
- B. The pipe shall be of the diameter and pressure class specified, shall be furnished complete with rubber gaskets, and all specials and fittings as required in the Contract Documents.
- C. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and DR rating or pressure rating. Pipe shall be lavender.
- D. Additives and Fillers: Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds shall have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F.
- E. Joints: Joints for the buried PVC pipe shall be an integral bell manufactured on the pipe employing a rubber ring joint in accordance with ASTM C 477. The bell shall be the same or greater thickness as the pipe barrel.
- F. Pipe Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- G. Restrained joints for PVC pipe shall properly fit the pipe being installed and shall be manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- H. Bell restrained harnesses shall be used where in-line PVC restrained joints are required.

Bell restrained harnesses for PVC pipe shall be manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 DIP PIPE

- A. Ductile iron pipe below ground shall conform to ANSI/AWWA C 151, C 150, C 104, and C 105 subject to additional requirements herein. Ductile iron pipe wall thickness shall meet the requirements of Pressure Class 250 with cement mortar lining. If ductile iron pipe is stamped with the Special Class rating in lieu of the Pressure Class rating, a letter is to be supplied by the vendor stating that the particular Special Class meets the specified Pressure Rating for each size of pipe.
- B. Above ground piping, flanged, and/or fully restrained, shall be Ductile Iron Pipe conforming to ANSI/AWWA C 151, C 150, C 104, and C 105. Ductile iron pipe wall thickness shall meet the requirements of Pressure Class 250 with cement mortar lining. If Ductile Iron Pipe is stamped with the Special Class rating in lieu of the Pressure Class rating, a letter is to be supplied by the vendor stating that the particular Special Class meets the specified Pressure Rating for each size of pipe.
- C. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and pressure rating.
- D. The CONTRACTOR shall also require the manufacturer to mark the extrusion or manufacturing code on the pipe. This coding shall be done in conjunction with records to be held by the manufacturer for 2 years, covering date of manufacture, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.
- E. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness. Lining and coating shall be in accordance with the requirements of Section 2.4 and Section 2.5.
- F. Polyethylene Sleeve: Material for the polyethylene sleeve shall conform to the requirements of ANSI/AWWA C 105.
- G. Pipe Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- H. Joint Design: Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, and restrained joints as required.
 - 1. Mechanical and push-on joints shall conform to ANSI/AWWA C 111/A21.11.
 - 2. Flanged joints shall conform to ANSI/AWWA C 115/A21.15. Special ductile iron flanges to match up to 250 psi valve and equipment flanges shall meet ANSI/AWWA C110 and be specially drilled to ANSI/ASME B16.1 class 250 standard dimensions with raised face.
- I. Restrained joints shall be as manufactured by the following, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- J. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. Gaskets shall conform to ASTM C 477.

2.3 FITTINGS

- A. Ductile iron fittings shall be used with both PVC pipe and DIP pipe and shall conform to the requirements of ANSI/AWWA C 153/A21.53 or ANSI/AWWA C 110/A21.10 for diameters 3-inch through 48-inch and shall have a minimum pressure rating of 250 psi.
- B. All fittings shall be lined and coated in accordance with the requirements of Section 2.4 and Section 2.5.
- C. Each fitting shall be clearly labeled to identify its size and pressure class.
- D. Manufacturers, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.4 CEMENT-MORTAR LINING FOR IRRIGATION WATER LINES

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C 104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. The minimum lining thickness shall be as follows:

<u>Nominal Pipe Diameter (in)</u>	<u>Minimum Lining Thickness (in)</u>
4-12	1/8
16-24	3/16
30-54	1/4

- C. Protection of Pipe Lining/Interior: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

2.5 EXTERIOR COATING OF DIP PIPE

- A. All irrigation water pipes above ground shall be painted lavender conforming to the requirements in Section 09800 - Protective Coating.

- B. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be abrasive blasted to a minimum commercial Grade SSPC-SP-6, NACE 3 and given a high solids epoxy primer coat, **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.** If intermediate coating is required as per Section 09800 – Protective Coating, it shall be applied in the factory. The finish coat shall be applied after installation in accordance with Section 09800 -Protective Coating.
- C. Polyethylene Encasing: Buried ductile iron pipe shall be shop coated as required with manufacturer's standard coating. Where directed in the field, the coated pipe shall be encased with 8-mil polyethylene material in accordance with the requirements of ANSI/AWWA C 105/A21.5.
- D. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as recommended by the manufacturer.

2.6 IDENTIFICATION AND LOCATING DEVICES

- A. All irrigation water pipes and services shall be an electronic marking system caution tape , 6-inches wide. The tape shall be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** and shall be colored coded Lavender.
- B. All irrigation water piping shall be marked with an Electronic Marker System (EMS), **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.** Markers shall be installed at all fittings, casing pipe ends and changes in direction.

2.7 LUBRICANT

- A. Lubricant for irrigation water pipe shall conform to the manufacturer's requirements.

2.8 BEDDING MATERIAL

- A. Unless otherwise indicated, pipe bedding shall conform to Section 02200 - Earthwork.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Material found to have defects shall be immediately removed from the site by the CONTRACTOR.
- B. PVC pipe installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. DIP pipe installation shall conform to the requirements of ANSI/AWWA C 600. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.
- C. All transitions between dissimilar pipe materials (i.e., Ductile Iron Pipe to PVC, PVC to Ductile Iron Pipe, etc.) shall be accomplished with an appropriately sized approved mechanical joint.

No bell to spigot transitions will be allowed on dissimilar pipe materials. All transitions between dissimilar pipes shall be inspected and approved by the City.

3.2 HANDLING AND STORAGE

- A. Handling: Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

The DIP pipe shall be handled by devices designed and constructed to prevent damage to the pipe coating/exterior. DIP shall not be installed where the lining or coating show defects that may be harmful as determined by the CITY OF CAPE CORAL. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

- B. Storage: Pipe shall be stored, if possible, at the site in unit packages provided by the manufacturer. Pipe shall be stored in a manner to prevent exposure to sunlight (UV) until such time as it is installed. Caution shall be exercised to avoid compression damage or deformation to the pipe. PVC pipe shall be stored in such a way as to prevent sagging or bending. Pipe more than two years old, may be approved by the City depending on the state of the pipe and gaskets. Contractor shall receive written approval from the City of Cape Coral prior to use of any pipe which is more than two years old. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. The City may reject excessively faded or dirty pipe.

3.3 INSTALLATION

- A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with plugs.
- B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.
- C. Joints shall be installed according to manufacturer's recommendations. Contractor shall take precautions to prevent "over homing" of the pipe. The indication line marked on the spigot of the pipe shall in all cases remain visible after joining of the pipe, in accordance with the manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made.

- D. Deflection at the joint shall not exceed 80% of the deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.
- E. In laying pipe, it shall be laid to the setline and grade, within approximately one inch plus or minus.
- F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the CONTRACTOR may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection noted above. No joint shall be misfit by any amount that will be detrimental to the strength and water tightness of the finished joint.
- G. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable plugs or bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, the pipe shall be prevented from floating.
- H. Pipe Cleanup: As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, and any other debris following completion of pipe laying, and perform any necessary repairs prior to testing the completed pipeline.
- I. Field Cutting: Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut, or per the manufacturer's written procedure. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, sander, or abrasive disc.

3.4 ELECTRONIC MARKING SYSTEM TAPE AND MARKERS

- A. All irrigation mains shall have an electronic marking system caution tape , 6-inches wide installed continuously along the alignment. The tape shall be installed during backfilling 12 to 18 inches directly above the pipe at a uniform elevation.
- B. Locating markers shall be installed at all fittings, casing pipe and changes in direction. Locating markers shall not be installed more than four (4) feet deep. Locating markers shall not be placed within 12-inches of the fittings.

3.5 CONNECTIONS TO EXISTING IRRIGATION WATER MAINS

- A. The CONTRACTOR shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the CONTRACTOR shall make arrangements with the serving utility through the CITY OF CAPE CORAL well in advance of the connections, to allow adequate time for draining of the existing line, if necessary, and shall expedite the work to minimize water outages to the users. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, the pipe shall be drained first and then the cut ends shall be sealed with a Megalugged Plug.

3.6 RUBBER GASKETED JOINTS

- A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a lubricant recommended by the pipe manufacturer shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with the same lubricant. The spigot end of the pipe shall then be inserted into the bell of the previously laid joint and pushed into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.7 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where pipe is encased in polyethylene sleeves, buried appurtenances shall also be encased in polyethylene.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to ensure proper operation.
- C. All valves shall be installed so that the valve stems are plumb and in the location shown.

3.8 SERVICE CONNECTIONS

- A. DIP Pipe Service Connections: No direct tapping of ductile iron pipe will be permitted. Double strap ductile iron service saddles anchored by a minimum of four bolts shall be used for service connections on ductile iron pipe. Service saddles shall be sized to fit the pipe outside diameter and shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. Maximum outlet size permitted with service saddles is 2 inches. Refer to Section 15001 – Saddles, Stops and Small Valves for additional requirements.
- B. PVC Pipe Service Connections: Direct tapping will not be permitted. Brass service saddles shall be used on mains up to six inches (6") in diameter. Double strap ductile iron saddles shall be used on mains 8 inches (8") and larger. Double strap ductile iron service saddles anchored by a minimum of four (4) bolts shall be used for all service connections. Service saddles shall be sized exactly to the pipe outside diameter and shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters or twist drills are not acceptable. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service clamps or saddles is 2 inches.
- C. Tapping sleeves and valves for full body fittings shall be used for all outlet sizes greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's recommendations.

- D. Where existing irrigation water services are present in an area, the entire existing long and short side irrigation water service including curb stop are to be located, removed and replaced by the CONTRACTOR. Existing irrigation meter boxes are to be maintained. The CONTRACTOR, at his option, may either convert the existing corporation stop from a HDPE tubing connector to a Schedule 80 PVC connector or to hot tap the existing irrigation main and provide a new corporation stop. If a hot tap is provided the original corporation stop is to be turned off and the outlet is to be plugged. The CONTRACTOR is to perform the replacement of the existing irrigation services in a timely manner to minimize the outage to the Homeowner. The CONTRACTOR shall provide all necessary notifications to the Homeowner.

3.9 FIELD TESTING

- A. Field-testing of irrigation water mains shall conform to the requirements of Section 02666 – Pressure Pipeline Testing and Disinfection.

3.10 FIELD ADJUSTMENT OF EXISTING IRRIGATION MAINS

- A. The CONTRACTOR shall notify the CITY OF CAPE CORAL when conflicts with new improvements and existing irrigation mains are found. When directed by the CITY OF CAPE CORAL, the CONTRACTOR will field adjust the existing irrigation mains as required to provide adequate separation. The existing irrigation mains shall be restrained in accordance with the Restrained Joint Schedule as shown in the Drawings. Field adjusted existing irrigation piping shall be visually inspected under normal line pressure before backfilling. Pressure test of the field adjusted irrigation piping will not be required.

END OF SECTION

SECTION 02622

SANITARY SEWER SYSTEM TESTING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all pipeline flushing and cleaning, complete, for sanitary sewerage system piping as specified herein and in accordance with the requirements of the Contract Documents. All lines shall be properly flushed, cleaned, and drained prior to TV testing and final inspection. The Contractor will provide a flushing truck as part of the TV inspection. Two passes of a cleaning hose will be conducted prior to this TV inspection for each sewer section between manholes. The flushing truck shall be capable of producing 65 gpm at 1500 psi for this flushing. If the sewer is found to require further cleaning beyond this requirement, the cleaning will be conducted at the Contractor's expense. If the TV testing reveals questionable pipe, the Contractor may be required to conduct further testing, in accordance with this specification, at their own expense. All TV inspections will be performed by the Contractor, in the presence of the City of Cape Coral or their authorized representative.
- B. The Contractor shall be responsible for conveying test water from a designated source to the point of usage and also for disposal, as required, of water used in the testing operations.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor's proposed plans for testing in accordance with the requirements of Paragraph 3.2 of this Specification Section, and for water conveyance, control, and disposal, shall be submitted in writing at least 30 days prior to implementation.
- B. The Contractor shall also submit minimum 14 days advance written notice of its proposed testing schedule for review and concurrence of the City.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Temporary valves, plugs, bulkheads, and other air pressure testing and water control equipment and materials shall be provided by the Contractor subject to the City review. No materials shall be used which would be injurious to pipeline structure and future function. Air test gages shall be laboratory-calibrated test gages and shall be re-calibrated by a certified laboratory at the Contractor's expense prior to the leakage test, if required by the City.
- B. Deflection Mandrel:
 - 1. Mandrel Design: For each size of pipe, the Contractor shall provide a mandrel of steel or rigid plastic which can withstand a force of 200 psi without deforming. The mandrel shall have 9 or more "runners" or legs, as long as the number is an odd number. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter.

2. Mandrel Diameter: The outside diameter shall equal 95 percent of the inside diameter of the pipe. For the purpose of determining the mandrel diameter, the inside diameter of the pipe shall be the average outside diameter of the pipe minus 2 minimum wall thickness' for OD controlled pipe and shall be the average inside diameter for ID controlled pipe, all dimensions in accordance with the respective pipe standards. Statistical or "tolerance packages" shall not be considered in mandrel sizing. The mandrel shall be stamped or engraved at a location other than a runner with the pipe size and material it is intended to test.
3. Proving Ring: Provide a 1/2-inch thick, 3-inch wide steel bar proving ring bent to a circle 0.02-inches larger than the mandrel diameter. Furnish the proving ring to the City before any pipe is backfilled. The Contractor shall verify the mandrel size by passing the mandrel through the proving ring at times determined by the City.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Release of water from pipelines, after testing has been completed, shall be performed as approved by the City. Irrigation water and Potable water must be land applied and not allowed to directly enter storm drainage systems.
- B. No materials shall be used which would be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated test gauges, and if required by the City, shall be re-calibrated by a certified laboratory prior to the leakage test. Air test gauges shall have a size and pressure range appropriate for the pipe being tested.
- C. All testing operations shall be performed in the presence of the City's Inspector.

3.2 TESTING OF PIPING

- A. General: Gravity sewer pipes and service laterals shall be tested for exfiltration and/or infiltration and deflection, as specified if required by the City. Pipes must be backfilled, but pavement resurfacing left undone prior to testing. Manhole backfilling, prior to or after testing is at the Contractor's discretion, cost and risk. All manholes shall be tested for leakage, as specified. All leakage tests shall be completed and approved prior to placing of permanent paving. When leakage or infiltration exceeds the amount allowed by the Specifications, the Contractor at its expense shall locate the leaks and make the necessary repairs or replacements in accordance with the Specifications to reduce the leakage or infiltration to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests. The maximum length of pipe tested shall be the 4 segments between 5 manholes. Water for testing will be provided by the CITY. The Contractor shall convey the water from the CITY approved source to the points of use.

B. Leakage Tests

1. Perform the type of leakage tests determined from the table below, based on pipe size, slope between manholes (Criterion 1), and difference in water levels (Criterion 2).

	Criterion 1		Criterion 2	
Nominal Pipe Size	Manhole Delta H, feet		Test Water vs. Ground Water Delta H, feet	
	Less than or equal to 10 ft	Greater than 10 ft	Greater than or equal to 4 ft	Less than 4 ft
Less than or equal to 24 inches	See Criterion 2	Infiltration or Air See Note 1	Exfiltration	Infiltration or Air
Greater than 24 inches	See Criterion 2	See Criterion 2	Exfiltration	Infiltration

Note 1. If ground water is present, perform an infiltration test or air test at the option of the Contractor; if no ground water is present, perform an air test.

2. Definitions

- a. Delta H is the difference between 2 elevations, expressed in feet.
- b. Manhole Delta H is the invert elevation difference in 2 adjacent manholes.
- c. Test Water vs. Ground Water Delta H is the required elevation of water surface for testing minus the average elevation of ground water adjacent to the pipe to be tested.

C. Air Pressure Test – Required on All Installations:

1. The Contractor shall furnish all materials, equipment, and labor for making an air test. Air test equipment shall be approved by the City.
2. The Contractor may conduct an initial air test of the sewer main line after densification of the backfill but prior to installation of the house connection sewers. Such tests will be considered to be for the Contractor's convenience and need not be performed in the presence of the City.
3. Each section of sewer shall be tested between successive manholes by plugging and bracing all openings in the pipe and the upper ends of all house connections. Prior to insertion in the sewer, each plug shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released and the leaks eliminated or the plug replaced.
4. The test of the pipe and branching house connections shall be conducted in the presence of the City. Testing of pipe, regardless of the pipe material, shall be performed in accordance with ASTM F 1417 - Standard Test Method for Installation of Plastic Gravity Sewer Line Using Low Pressure Air.

5. Air pressure in the sewer line shall be increased to 4.0 psi above groundwater pressure (1.0 psi for each 2.3 feet of water elevation above the highest point of the pipe). Do not allow the pressure at any point in the pipe to reach 9 psi under any circumstances. Allow the pressure to stabilize for 5 minutes, then reduce the pressure to 3.5 psi above groundwater pressure and start the test. Stop the air release and record the decrease in pressure over time.
6. Pass/Fail Criterion: The time taken for the pressure to decrease from 3.5 to 2.5 psi above groundwater pressure shall be equal to or greater than the time below.

Nominal Pipe Diameter, Inches	Minimum Time, min:sec	Length for Minimum Time, ft	Increased Time for Longer Lengths, seconds per foot
4	3:46	597	.0380
6	5:40	398	0.854
8	7:34	298	1.520
10	9:26	239	2.374
12	11:20	199	3.418
18	17:00	133	7.692
24	22:40	99	13.674
30	28:20	80	21.366
36	34:00	66	30.768

7. Testing criteria of pipe 12-inches and larger may be adjusted if the City approves. The air pressure decrease may be 0.5 psi instead of 1.0 psi, and the corresponding minimum times will be one-half of the tabulated' times.
8. For pipe larger than 24 inches, air pressure tests may be performed on each joint. The time for the pressure to fall from 3.5 to 2.5 psi, both above groundwater pressure, shall not be less than 10 seconds regardless of pipe diameter.
9. If the time is less than the allowable time, the pipe will be considered defective and shall be repaired and re-tested. The Contractor shall furnish all materials, equipment and labor for making an air test when pipe is installed above the water table. Air test equipment shall be approved by the City.

D. Deflection Test – Required on All Installations:

1. Mandrel Test
 - a. The City shall be allowed to test the mandrel with the proving ring at any time. The mandrel shall pass through the proving ring with no greater than 0.02-inch clearance, and if it does not, the mandrel will be considered defective and shall be replaced.
 - b. The Contractor shall test all flexible pipe 30 inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill, but prior to permanent pavement resurfacing.

- c. Pipe with diameter less than the mandrel will be considered defective, and the Contractor shall replace it.

E. Manhole Test (Vacuum Test) – Required on All Installations:

1. Install the vacuum test head on top of the manhole. Install and brace sealing devices on influent and effluent pipes.
2. With a vacuum pump, draw a vacuum of 10 inches of mercury, deactivate the pump, and measure the time in seconds for the vacuum to drop to 9 inches of mercury.
3. Compare the time to the table below.

Manhole Depth, ft	Minimum Time, min: sec			
	Manhole Diameter, inches			
	36	48	60	72
8	0:14	0:20	0:26	0:33
10	0:18	0:25	0:33	0:41
12	0:21	0:30	0:39	0:49
14	0:25	0:35	0:48	0:57
16	0:28	0:40	0:52	1:7
18	0:32	0:45	0:59	1:13
20	0:35	0:50	1:5	1:21
22	0:38	0:55	1:12	1:30
24	0:42	0:59	1:18	1:37
26	0:46	1:4	1:25	1:45
28	0:49	1:9	1:31	1:53
30	0:53	1:14	1:38	2:1

4. If the time is less than the time in the table, the manhole is defective, and it shall be repaired and re-tested until it is acceptable.

F. Lamping: Contractor shall perform lamping as required by the City.

G. Television Inspection – Required on All Installations: Television inspections will be performed in accordance with Section 02623 - Television Inspection. If the results of the television inspection are unsatisfactory, the City can require the Contractor to perform additional tests as defined in this Section until acceptable results are achieved.

H. City Television Inspection: The CITY reserves the right to spot check any or all lines by visual observation (i.e. video or lamping). Contractor shall provide support as requested by the City.

I. Water Exfiltration Test

1. Each section of sewer shall be tested between successive manholes by closing the lower end and the inlet sewers of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point 4 feet above the centerline of the sewer

at the center of the upper manhole; or if ground water is present, 4 feet above the average adjacent ground water level, whichever is higher. The water level will be defined as the test level. Laterals above the test level shall not be included.

2. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.
3. Unless indicated otherwise, the Contractor shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.
4. The allowable leakage will be computed by the formula: $E = 0.000012 LD \sqrt{H}$

Where:

—

E= Allowable leakage in gallons per minute of sewer tested.

L= Length of sewer and service laterals tested below the test level, in feet.

D= Internal diameter of the pipe in inches.

H= Difference in elevation between the water surface in the upper manhole and the centerline of the pipe at the lower manhole; or if ground water is present above the centerline of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the ground water at the lower manhole.

J. Water Infiltration Test:

1. The end of the sewer at the upper structure shall be closed to prevent the entrance of water and pumping of ground water shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.
2. The infiltration into each individual segment of sewer between adjoining manholes shall not exceed that allowed by the formula for the water exfiltration test, where H is the difference in the elevation between the ground water surface and the invert of the sewer at the downstream manhole.
3. Unless otherwise indicated, infiltration shall be measured by the Contractor, and witnessed by the City's Inspector.

K. Smoke Testing: The CITY reserves the right to require smoke testing on an as needed basis, at the sole discretion of the CITY.

END OF SECTION

SECTION 02623

TELEVISION INSPECTION

PART 1 -- GENERAL

1.1 SECTION INCLUDES

- A. Contractor shall supply television inspection of the line to obtain quality videos and Television Inspection Reports upon which the City can make decisions regarding the acceptability of installed pipe and determine any required corrective action necessary.

1.2 DEFINITIONS

- A. Television Inspection: Video inspection by TV INSPECTION Contractor of sewer lines designated for evaluation to confirm acceptability of construction, location of service connections, conformance of construction to contract Drawings and Specifications and that the inspected pipes are defect-free.
- B. Post-Repair Television Inspection: Video inspection to determine whether required corrective action resulting from defects identified in the Television Inspection has been completed to the satisfaction of the City.
- C. Television Inspection Report: A form that is filled out by each television operator for any Television Inspection effort that is submitted to the City on the form provided at the end of this section. Substitute forms may be provided to the City for approval.

1.3 PERFORMANCE REQUIREMENTS

- A. The City may or may not approve any corrective action proposed by the Contractor that may be necessary to repair improperly installed pipe identified during review of the television inspection video. Defective pipe or manholes discovered in the video will be repaired at the Contractor's expense. Upon completion of such repairs, the Contractor shall re-video the pipe for approval by the City at the Contractor's expense.
- B. The pipelines shall not be flushed concurrently with the television inspection effort.
- C. All television inspections must be performed in the presence of the City of Cape Coral or their representative.

1.4 SUBMITTALS

- A. Comply with Section 01300 – Contractor Submittals.
- B. Submit 2 videos and 2 Television Inspection Reports (hard copy) and 1 digital copy of the Television Inspection Report to the City for review.
 - 1. Provide videos of quality sufficient for the City to evaluate the condition of the sanitary sewer and locate each sewer service. If quality is poor, re-record the sanitary sewer

segment and provide a new DVD and report at no additional cost. Camera distortion, inadequate lighting, dirty lens and blurred or hazy pictures will be causes for rejection of DVD and associated line segment.

2. One copy of all videos submitted will become the property of the City.
3. City shall maintain the master originals of all videos and Television Inspection Reports submitted, until final acceptance of the sewer piping.

1.5 QUALITY ASSURANCE

- A. Qualifications: TV Contractor must use experienced personnel to operate television inspection equipment and devices.

PART 2 -- PRODUCTS

2.1 VIDEO EQUIPMENT

- A. Video Equipment: Select and use video equipment that will produce color video.
- B. Video: Provide video in DVD format, recorded at Standard Play (SP). Permanently label each DVD with the following information:

Project No.: _____ Contractor's Name: _____

Inspection Type: ☐ Survey ☐ Pre-Installation ☐ Post-Installation

DVD No.: _____ Date Recorded: _____ Date Submitted: _____

Pipe Diameter: _____ Pipe Length: _____

Manhole No.: From _____ To _____

1. Provide two labels on the DVD, one on the spine and the other on the face of the DVD.
 2. DVDs shall show only one pump station collection area. Only line segments from the same pump station collection area shall be included on a single DVD.
 3. Up to 5 (maximum) line segments may be included on the same video if they are in the same pump station collection area.
- C. Pipe Inspection Camera: Produce a video using a pan-and-tilt radial-viewing pipe inspection camera that pans 275 degrees and rotates 360 degrees. Use a camera with an accurate footage counter that displays on the monitor the exact distance of the camera from the centerline of the starting manhole. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being videoed. Provide a gauge attachment to the camera capable to determining the depth of dips or flat spots in the sewer mains. Provide a lighting system that allows the features and condition of the pipe to be

clearly seen. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Videotaping of the line shall not take place until after the lime rock base and manhole inverts have been installed and accepted. Videotaping is to be performed prior to installation of the asphalt pavement. All defects are to be corrected and accepted prior to the placement of asphalt pavement.
- B. Results of video inspections must be documented including all information required by Article 3.5 of this Section.

3.2 TELEVISION INSPECTION

- A. TELEVISION INSPECTION Contractor shall notify the City at weekly Contractor meetings to provide 2 weeks' notice of any required TV inspection requirements.
- B. Perform Television Inspection of sanitary sewers as follows:
 - 1. Perform a television inspection on sanitary sewers within the boundary of the project, as directed by the City. After reviewing videos, the City will determine which sanitary sewers require corrective action, if any. All work to manholes, including benches, inverts and pipe penetrations into manholes, should be complete prior to initial Television Inspection.
 - 2. Videos shall pan beginning and ending manholes to show post-construction condition. Complete and submit a Television Inspection Report for every sewer segment video submitted to the City.
 - 3. Perform post-repair television inspection to confirm completion of repair work, if applicable. Verify that repair work conforms to the requirements of the Drawings and Specifications. Provide a color video showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Report forms providing location of service connections along with location of any discrepancies. Manhole work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-repair video work.
- C. Survey Television Inspection DVDs shall be continuous for pipe segments between manholes. Do not leave gaps in the recording of a segment between manholes and do not show a single segment on more than one DVD.

3.3 FLOW CONTROL – IN LIVE SYSTEMS

- A. Perform survey Television Inspection on one manhole section at a time. Adequately control the flow in the section being videoed. Do not exceed the depth of wastewater flow shown below:

<u>Pipe Diameter (Inches)</u>	<u>Depth of Flow (Percentage of Pipe Diameter)</u>	
6 - 10	10 %	
12 - 24	15 % Over 24	20 %

1. If during survey Television Inspection of a live manhole section, the wastewater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the survey television inspection during minimum flow hours, by diversion pumping, or by pulling a camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Video made while floating the camera is not acceptable unless approved by the City.

B. Minimize flow in the line while performing Television Inspection. If required by the City, normal flow diversion shall be by method approved by the City.

C. No flow is allowed in the line while performing post-installation video inspection.

3.4 PASSAGE OF VIDEO CAMERA

A. Do not pull or propel the video camera through the line at a speed greater than 60 feet per minute.

B. If during survey Television Inspection of a manhole section, the camera is unable to pass an obstruction even though flow is unobstructed, televise the manhole section from the other direction (reverse setup) in order to obtain a complete video of the line. Whenever such a condition arises, notify the City to determine whether an obstruction removal or point repair is necessary. If a point repair is authorized, repair the pipe at the designated location and then re-video the manhole section to verify completion of the point repair.

1. When the camera is being sent from the other direction in order to survey on either side of an obstruction, and a second obstruction or repair location is encountered away from the first obstruction, notify the City and request a review of the video. The City may direct the Contractor to make one or both point repairs. No extra costs shall be incurred by the City for any delays associated with these repairs.

2. If two-point repairs are allowed and completed, re-video the manhole section.

C. For post-repair television inspection, exercise the full capabilities of the camera equipment to document the completion of the repair work and the conformance of the work to the Drawings and Specifications. Provide a full 360-degree view of pipe, joints and service connections.

3.5 TELEVISION INSPECTION REPORT

A. For each television inspection video provide a completed Television Inspection Report, using the following format. The Contractor shall submit the proposed Inspection Report to the City prior to commencing videotaping. The Report is a written narrative log of pipe defects, sags and service connection locations and conditions, indexed to the footage counter. Fill out the Television Inspection Report as follows:

B. Header Section

1. Job Description: Name of construction project (e.g. SW1 Northeast).
2. Recording Date: The date that the video was produced (same as the date shown on the display screen), a numeric field (e.g., 2/21/03).
3. Video Contractor: The Video Contractor's name; an alpha-numeric field (e.g. KIN (Kinsel)).
5. DVD Number: Each video produced must have DVD number for identification, affixed to the cassette label. This number must not be duplicated in the same project. This is an alpha-numeric field (e.g., SW1NE001).
6. Video Index: The numeric location of the line segment on the DVD indicating upstream and downstream manholes; an alpha-numeric field (e.g., MH-512-01 to MH-512-02).

C. Summary Information

1. Type of video (e.g., Television Inspection, Post-Repair Television Inspection)
2. General Contractor (Name)
3. Pipe material.
4. Pipe Size: The inside diameter of the liner or pipe in inches, based on new pipe size, material and SDR; a numeric field (e.g., 6.00 IN PVC SDR 26).
5. Length: The length of the line segment from center of manhole to center of manhole, in feet. The length shown on the Television Inspection Report must be the same as the length shown on the video. Also, the length on the top portion of the Television Inspection Report shall match that shown on the bottom portion of the Television Inspection Report. This is a numeric field (e.g., 305 FT).
6. Direction Of Flow: Indicate the direction of flow in the line segment. (Circle with or against flow). Input Section – Note the following items/defects on the TV Inspection Report:

D. Input Section – Note the following items/defects on the TV Inspection Report.

1. Television Inspection Codes: Codes to be used in reports are specified and defined on the Television Inspection Codes sheet (attached following this Section and Sample Report Form).
2. Footage Reading U/D: Show the up/down designation under the section titled "Footage Reading" in the boxes marked "U" and "D." This will make it clear what direction footage is measured from.
3. Clock Position: Show the clock position, with 12 o'clock straight up, of each defect (e.g., 12:00, 3:00). Also, show the clock position of each service connection and state the condition of the connection. Include the distance the connection is protruding into the pipe, when appropriate, and the type of connection, such as "service lateral."

4. Cracks: List cracks in the pipe. Report the size (length and width) of all cracks.
5. Joints: List misaligned and broken.
6. Laterals: List all laterals.
7. Debris: List any debris in the pipe.
8. Inflow/Infiltration: Report any inflow and infiltration.
9. Alignment: Report the existence of any sags in the field. Report the beginning of sags for one-quarter pipe, one-half pipe and underwater, as well as where the camera pulls out of the sag.
10. Comments: Place comments in this field. Comments must be accompanied by a corresponding footage reading. Items to report in this field: collapses in pipe, stabilized material, mineral deposits, changes in pipe material, reverse setup, drop stack, large voids, multiple cracks, leaking services, infiltration, when unable to continue video, etc.
11. Clamp/Splice Location: The clamp/splice location shall be shown in the Comments field. Clamp/splice location must be accompanied by a footage reading.

END OF SECTION

SECTION 02666

PRESSURE PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform flushing and testing of all potable water, irrigation water, gravity sewer and wastewater force main pipelines and appurtenant piping, and disinfection of all potable water pipelines and appurtenant piping, complete, including conveyance of test water from CITY designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.
- B. Flushing Plan: Flushing Plan shall include marked up Master Plans for each testing area indicating the limits of the areas to be flushed, valves to be operated to achieve a flushing velocity of 2.5 ft/second, volume of water required, proposed water source, and flushing water disposal method.
- C. Hydrostatic Test Plan: Hydrostatic Test Plan shall include marked up Master Plans for each testing area indicating the limits of the areas to be tested, valves to be opened and closed during the test, volume of pipeline being tested, allowable leakage calculation per paragraph 3.3.H and I, and points used for bleed down after testing.
- D. Positive Service Identification Plan: Positive Service Identification shall include marked up Master Plans for each testing area indicating the limits of the areas to be tested, and valves to be closed during the test.

1.2 CONTRACTOR SUBMITTALS

- A. Flushing Plan, Hydrostatic Test Plan, and Positive Service Identification Plan shall be provided to the City, a minimum of 7 days before testing is to start.

PART 2 -- PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Temporary valves, plugs, bulkheads, and other air pressure testing and water control equipment and materials shall be provided by the Contractor subject to the City's review. No materials shall be used which would be injurious to pipeline structure and future function. Air test gages shall be laboratory-calibrated test gages and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test, if required by the City. Pressure test pump assemblies must be fabricated using threaded iron or brass fittings only. PVC assemblies are not allowed. Contractor shall demonstrate to the City that the assemblies are free from defects, corrosion or other hazards prior to attachment to the system.

- B. The Contractor will provide potable water jumper assemblies and backflow preventers for temporary use on the Project. The jumper assemblies and backflow preventers may be available by the CITY. The Contractor shall provide a \$1,000 refundable deposit to use the CITY supplied jumper assembly if available. All other test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor. No materials shall be used which would be injurious to the construction or its future function.
- C. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300. If granules or tablets are used, they must be dissolved in water in a separate container (55-gallon drum) and introduced as a liquid into the pipe.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise provided herein, water for testing and flushing all pressure rated lines and disinfecting potable water pipelines will be furnished by the CITY; however, the Contractor shall make all necessary provisions for conveying the water from the CITY designated source to the points of use.
- B. All pressure pipelines shall be hydrostatically tested and leak tested. Disinfection of all potable water lines shall be accomplished by chlorination.
- C. Disinfection shall be scheduled by the Contractor as directed by the City so as to assure the maximum degree of sterility of the facilities at the time the WORK is accepted. Bacteriological testing shall be performed by a certified testing laboratory approved by the CITY and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency. Contractor shall dispose of test water at location and by methods approved by City or other governing body. Contractor shall be responsible to periodically flush the line to maintain the minimal chlorine residual required by the Health Department until final acceptance. Bacteriological test results and clearance shall be received before the pipelines are considered substantially complete.
- D. The Contractor shall provide 48 hours' notice to the ENGINEER and the City prior to all pressure testing. All pressure testing must be done in the presence of the ENGINEER or City of Cape Coral Representative.
- E. Only potable water shall be used for the flushing of potable water mains. Irrigation mains and force mains may be flushed with the use of irrigation water.

3.2 FLUSHING (PRESSURE MAINS 4" TO 12" DIAMETER)

- A. Pipelines shall be cleaned and flushed to remove all sand and other foreign matter. Water used for flushing shall achieve a minimum velocity of 2.5 feet per second in every section of the pipe and the flow shall be maintained for sufficient duration to assure a complete change of the volume of water within the pipe.
- B. The Contractor shall be responsible for developing a flushing plan to be submitted to the City for approval prior to flushing. The Contractor shall dispose of all water used for flushing without causing a nuisance or property damage. Any permits required for the disposal of flushing water shall be the responsibility of the Contractor.
- C. Pressure mains larger than 12" diameter may be flushed with written approval of the City.

3.3 PIGGING (PRESSURE MAINS GREATER THAN 12" DIAMETER)

- A. The Contractor shall clean the system thoroughly by pigging to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Pigging shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.
- B. Pigging shall be defined as passage of a sufficient number of pigs through the pipeline to achieve the clean conditions above. Flushing will not be acceptable as a substitute for pigging.
- C. Provision for pig access and egress points and disposal of water and materials shall be the Contractor's responsibility. Pigging shall be performed through butterfly valves for water and irrigation mains or plug valves for force mains. Pigging stations shall be placed at locations between valves.
- D. Pigs shall be individually marked, and their location shall be controlled and monitored so that no pigs remain in the system after cleaning.
- D. Pigging may be done in conjunction with initial filling for the hydrostatic test.

3.4 HYDROSTATIC TESTING OF PIPELINES

- A. Prior to hydrostatic testing, all potable water, and irrigation water pipelines and force mains less than or equal to 12 inches shall be flushed at a minimum of 2.5 ft/second. The Contractor shall test all completed pipelines in accordance with the approved test plan. Complete installation shall include all water services, blow-offs, air release valves, and other appurtenances in their final position. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary plugs in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test plugs are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be

restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The Contractor shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

- B. The pressure gauge utilized for pressure testing shall be less than one (1) year old or calibrated within the past year. The pressure gauge will be liquid filled with a range of 0 to 200 psi. The City and an authorized CITY representative must approve the pressure gauge being used. The Contractor will perform hydrostatic testing of all distribution areas and will conduct the tests in the presence of the City and the CITY representative, with 7-days advance notice provided.
- C. The pressure system should be filled slowly with a flow velocity less than 2 feet per second (fps). The drinking water systems will be filled using a potable water source and the irrigation and force main systems will be filled using the CITY irrigation water or another approved source.
- D. All the air must be expelled from the systems prior to pressure testing. It is recommended the Contractor use services, hydrants, air release valves, blow-offs, and temporary taps to expel the air.
- E. After the pipeline or section has been filled, flushed or pigged, and most of the air has been expelled, the system shall be pumped up to 60 psi (approximately 5 psi over the existing pressure). Then the system shall be allowed to stand for at least 24 hours. This will allow the remaining air to escape and the pressure to stabilize. During this period, bulkheads, valves, services, hydrants, blow-offs, and connections shall be examined for leaks. If leaks are found, corrective measures shall be taken. After the above process has been completed, re-pump the system to the test pressure specified: 150 psi for the potable water and irrigation mains and 100 psi for the force mains. The pressure shall be maintained for one hour prior to the final pressure test.
- F. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours. The test pressure shall be measured at the lowest point of the pipeline section being tested. All visible leaks shall be repaired.
- G. If during the two-hour period the pressure gauge drops more than 5 psi, re-pump the system back to the specified test pressure and measure the volume of water required in gallons. At the end of the two-hour test period re-pump the system to the specified test pressure and measure the volume of water required in gallons. The leakage volume of the pipe is the sum of the volume of water required to maintain the specified test pressure during the 2-hour hydrostatic test and the water required at the end of the hydraulic test to re-pump the system to the specified pressure.
- H. The maximum allowable leakage for distribution and transmission pipelines shall be computed on the basis of AWWA Standard C600 or the applicable formula for other than 20-foot lengths. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

Per AWWA C600: No pipe installation will be accepted if leakage is greater than that determined by the following formula:

In inch-pound units, Where:

$$L = \frac{SD\sqrt{P}}{148,200}$$

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet (maximum of 2,000 feet, see I. below)

D = nominal diameter of the pipe, in inches (the smallest pipe diameter along the pipe length tested – see I. below)

P = average test pressure in pounds per square inch (gauge)

Note: For 20-foot pipe lengths, use factor of 148,200, as shown in formula above. For 18-foot pipe lengths, use factor of 133,200 instead of 148,200.

- I. The Contractor shall test pressure pipeline systems between consecutive valves (valve to valve). In areas with valves in close proximity, consideration will be given by the City on a case by case basis to extend this test length. The Contractor may elect to test pipe lengths greater than the segments as defined above, however the allowable leakage (L) shall not exceed the amount calculated using a 2,000-foot length of pipeline (S) and the smallest diameter pipe (D) in the test segment. If the Contractor chooses to test a pipe section greater than 2,000 linear feet that could be isolated into a smaller test length, the allowable leakage shall be calculated using the actual length of the smallest pipe first, then using the next larger size pipe and successive larger pipe sizes until the 2,000 linear feet of pipe length is calculated, i.e., if there was 500 linear feet of 4-inch pipe, 500 linear feet of 6-inch pipe, and 12,000 linear feet of 8-inch pipe, the allowable leakage would be calculated as follows: 500 linear feet at 4-inch, 500 linear feet at 6-inch, and 1,000 linear feet at 8-inch.
- J. The system will be bled down to zero psi after it has passed the test by bleeding off the pressure at the ends of the pressure system using hydrants, blow-offs, services, and any other appropriate appurtenances. One person should monitor the pressure gauge while another, in contact with the first, will supervise the bleed down process. This will verify that the pressure gauge is working properly and that the entire system has been tested. If the system being bled down has more than one tie-in (connection point), bleed off enough pressure from each area of the system to make the gauge show a drop for each area. If after all pressure has been released and the gauge reads zero psi, the test will be deemed acceptable.
- K. The Contractor shall fill in any washouts and repair any damaged pipe or appurtenances caused by the test.
- L. Final paving cannot be installed until after all pipelines are satisfactorily pressure tested. If the pavement is to be placed in two lifts, testing must be completed prior to installation of the final layer of asphalt.

3.5 DISINFECTING PIPELINES

- A. General: All potable water pipelines shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.
- B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the potable water pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water; the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.
- C. Retention Period: Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.
- D. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.
- E. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to thoroughly neutralize the chlorine residual remaining in the water. The Contractor shall discharge water to a location and by methods approved by City. Care shall be taken to prevent chlorinated water from being discharged into storm sewer systems.
- F. Bacteriological Testing: After final flushing and before the pipeline is placed in service, samples shall be collected at the sample points determined by the Health Department and shall be tested for bacteriological quality in accordance with the requirements of the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained. The City shall notify the Contractor of the test results.

3.5 CONNECTIONS TO EXISTING SYSTEM

- A. The City will notify the Contractor when a Letter of Clearance is received from the Health Department. At this time the Contractor will be allowed to schedule the connection of the new line to the existing system. The Contractor shall notify the CITY Utility Department and schedule a time for connection to the existing system. Where connections are to be made to an existing water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and

shall be continued until discolored water is eliminated. Additional sampling after connection shall be performed as required by the Health Department.

- B. It will be not necessary to pressure test services that are installed on existing mains. These services are to be visually inspected at the existing line pressure.

3.6 TESTING OF WATER AND IRRIGATION SERVICES

- A. Once service boxes have been installed in a test plan area, the Contractor shall demonstrate flow through every potable water and irrigation water service by opening the curb stop. The Contractor shall then isolate the irrigation main in the area and bleed the pressure to 0 psi. After bleeding the irrigation main to 0 pressure, the Contractor shall open every potable water and irrigation curb stop to demonstrate flow in the potable water service and no flow in the irrigation water service. The Contractor shall provide all necessary personnel to perform the Positive Service Identification and will be required to endorse the test results. The City's Inspector shall witness and endorse all Testing of Water and Irrigation Services.

END OF SECTION

SECTION 02822

SOLID SODDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. Furnish all labor, materials, equipment and incidentals required to prepare lawn bed and install sodding as specified.
2. All sodded areas disturbed by Contractor activities shall be replaced with like kind.

B. Related Work Described Elsewhere

1. Shop Drawings, Working Drawings, and Samples: Section 01340.
2. Earthwork: Section 02200.
3. Loaming, Seeding, and Mulching: Section 02922.

1.02 QUALITY ASSURANCE (NOT APPLICABLE)

1.03 SUBMITTALS

- A. Provide technical data as required in Section 01340 regarding all materials or installation procedures required under this Section.
- B. Submit representative topsoil samples for analysis by a private laboratory to determine nutrient deficiencies and outline a proper fertilization program.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Loam (topsoil) shall be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the Contractor shall furnish additional loam at his own expense, if required.

2.02 SOIL CONDITIONERS

A. Fertilizer:

1. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.
2. Fertilizer shall be 6% nitrogen, 6% phosphorus and 6% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water-insoluble nitrogen.
3. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer or a City of Cape Coral Representative. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

B. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 available phosphoric acid.

C. Lime shall be ground limestone.

2.03 SOD

A. Sod shall match existing kind and be of firm texture having a compacted growth and good root development as approved.

B. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type, and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.

C. Before being cut and lifted the sod shall have been mowed 3 times with the final mowing not more than a week before cutting into uniform dimensions.

PART 3 - EXECUTION

3.01 PREPARATION

A. Areas to be sodded shall be cleared of all rough grass, weeds, and debris, and ground brought to an even grade as approved.

B. The soil shall then be thoroughly tilled to a minimum 8 inch depth.

C. Loam shall be placed to a minimum depth of 4 inches and shall be lightly compacted. No loam shall be spread in water.

D. Lime shall be applied at a rate necessary to achieve a pH of 6 to 7.

- E. Apply superphosphate at a rate of 5 pounds per 1,000 square feet and apply fertilizer at a rate of 16 pounds per 1,000 square feet.
- F. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over 1-inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.02 INSTALLATION

- A. During delivery, prior to planting, and during the planting of the lawn areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod shall be stacked during construction and protected so as not to be damaged by sweating or excessive heat and moisture.
- B. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope and with the joints offset relative to upper and lower panels. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.
- C. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean weed free sand may be required at no additional cost to the Owner if deemed necessary by the Engineer or City.

3.03 MAINTENANCE

- A. The Contractor shall produce a dense, well established lawn. The Contractor shall be responsible for the repair and resodding of all eroded or bare spots until project acceptance and during the warranty period. Repair sodding shall be accomplished as in the original work except that fertilizing may be omitted. Sufficient watering shall be done by the Contractor to maintain adequate moisture for optimum development of the lawn areas. Sodded areas shall receive no less than 1.5 inches of water per week. The Contractor shall also mow lawn areas once per week until final completion of the Project.

3.04 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATIONS

- A. Lawn areas planted under this Contract and lawn areas outside the designated areas damaged by Contractor's operations shall be repaired at once by proper sod bed preparation, fertilizing and resodding, in accordance with these Specifications.

END OF SECTION

SECTION 02900

PUMP STATION LANDSCAPING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide landscaping and appurtenant work, complete and in place, in accordance with the Contract Documents and the Land Use and Development Regulations as required by the City of Cape Coral Department of Community Development.
- B. All landscaping around pump stations shall be outside of the pump station easement and maintained by the developer, HOA, or other responsible party. Any landscaping within the pump station easement must be pre-approved by the City of Cape Coral. Requests for landscaping within the pump station easement shall be accompanied by a planting plan for review and approval by the City of Cape Coral.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.

1.3 QUALITY ASSURANCE

- A. General: All plants shall be true to type or name as indicated in the Contract Documents and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of Florida, however, determination of plant species or variety will be made by the City.
- B. All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations.
- C. The Contractor shall obtain clearance from the County Agricultural Commissioner, as required by law, before planting plants delivered from outside the County in which they are to be planted. Evidence that such clearance has been obtained shall be filed with the City.
- D. Inspections will be made by the City or its representative during preliminary WORK, planting, finish grading, final WORK, prior and after maintenance period. The Contractor shall request inspection at least 24 hours in advance of the time inspection is required.
- E. Rejected plants shall be identified as such in an obvious manner, shall be immediately removed from the Site, and be replaced with acceptable plants.
- F. Plants shall have been grown in nurseries in accordance with accepted horticultural practices, which have been inspected by the governing authorities. Inspection of plant materials required by City, County, State, or Federal authorities shall be the responsibility of the Contractor, who shall have secured permits or certificates prior to delivery of plants to Site.

- G. Invasive plant species, including but not limited to, ficus, melaleuca, Brazilian pepper, etc. shall not be planted.
- H. The Contractor shall utilize 'Florida Friendly Plants' and draught tolerant landscaping as much as possible when furnishing the landscape.

1.4 CLEANUP

- A. Upon completion of all planting operations, the portion of the Site used for WORK or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the Site.
- B. All walks or pavement shall be swept or washed clean upon completion of the WORK of this Section.

1.5 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

- A. General: The Contractor shall be responsible for protecting, watering, and maintaining all planting and irrigation systems until final acceptance of all WORK under the Contract.
- B. Maintenance shall begin immediately after planting. Trees, shrubs and sod shall be maintained, or replaced if deemed unacceptable by the City, during the 3-year warranty period.
- C. Trees, shrubs and sod shall be maintained by mowing, pruning, cultivating and weeding as required for healthy growth. Stakes, guy supports, and wrappings shall be tightened and replaced; trees and shrubs shall be reset to proper grades or vertical position and shall be sprayed to keep them free of insects and disease. Sprinkler lines broken or disrupted shall be replaced to proper working order prior to completion of the WORK under this Contract and shall be acceptable to the City.
- D. Protection: The Contractor shall provide adequate protection to all newly seeded areas including erosion control, until Final Completion.
- E. The Contractor shall replace any materials or equipment which are damaged.
- F. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

1.6 FINAL INSPECTION AND GUARANTEE

- A. Inspection of lawns and planting will be part of final inspection under the Contract.
- B. Written notice requesting inspection shall be submitted to the City at least 10 days prior to the anticipated inspection date.
- C. Final acceptance prior to start of the guarantee period of the Contract will be on written approval by the City, on the satisfactory completion of all WORK, including maintenance, but exclusive of the replacement of plant material.

- D. Any delay in the completion of any item of WORK in the planting operation which extends the planting into more than one season shall extend the correction period in accordance with the date of completion given above.
- E. The Contractor shall replace within three days, all dead plants and all plants not in a vigorous, thriving condition, which are noted at the end of the three-year warranty period.
- F. Plants used for replacement shall be of the same size and variety as shown on the drawings. Replacement plants shall be furnished, planted, staked, and mulched as indicated for new plants.
- G. All WORK under this Section shall be left in good order to the satisfaction of the City and the City, and the Contractor shall, without additional expense to the City, replace any trees, shrubs, etc., which develop defects or die during the three-year warranty period.

1.7 MAINTENANCE AND GUARANTEE FOLLOWING ACCEPTANCE OF PROJECT

- A. General: The Contractor shall be responsible for maintenance until Final Completion.
- B. The inspection of lawn areas is independent of the final inspection and maintenance period. After the lawn has been accepted, the responsibility for mowing and irrigation will be turned over to the City.
- C. All plant materials shall be in a condition acceptable to the City or its representative at the end of the three-year warranty period.
- D. The Contractor shall make adjustments necessary to the automatic sprinkler system and shall replace any dead or diseased plants during the three-year warranty period.
- E. Final Inspection: The City and Contractor shall make a final inspection at the end of the three-year warranty period. Any plants and materials found defective at time of final inspection shall be replaced within 3 days.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All landscaping materials for soil conditioning, weed abatement, or planting shall be first-grade, commercial quality. A list of the materials used, together with typical certificates of each material, shall be submitted to the City prior to final acceptance.

2.2 TOPSOIL

- A. Topsoil shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval upon delivery.

2.3 FERTILIZER AND ADDITIVES

- A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. Fertilizers shall comply with the state

fertilizer laws.

- B. Chemical fertilizers shall be a mixed commercial fertilizer with percentages of nitrogen, phosphoric acid, and potash at 16-4-8. At least 50% of the phosphoric acid shall be from normal super phosphate or an equivalent source that will provide a minimum of 2 units sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or container. Fertilizers shall be uniform in composition, dry, and free flowing. Contractor shall observe requirements for seasonal fertilizing and use appropriate fertilizer mixes at all times.

2.4 MULCH

- A. Mulch shall be fresh cypress mulch. The rate of application shall correspond to depth not less than 3-in. according to texture and moisture content of mulch material.
- B. Straw mulch or native hay for a soil/seed stabilizer shall be clean hay or straw, consisting of oat, rye, or wheat straw, or of pangola, peanut, coastal Bermuda or bahia grass, hay or compost; and shall be free from noxious weeds and plants. Mulch shall not contain large sticks, stones, or other foreign materials that will prevent the eventual decay of the mulch necessary for its complete effectiveness. Mulch shall be applied at a rate of 3 tons per acre. Mulch is to be crimped into soil with a mulch crimper. Only undeteriorated mulch shall be used.
- C. All fertilizers shall be of an organic source and shall be compatible with the type of plant that they are applied.

2.5 PLANT MATERIALS

- A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. Plants shall be true to name, genera, species, and variety in accordance with reference publications.
- B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.
- C. Plants shall be marked legibly for identification for delivery to the Site.
- D. All plant material furnished by the Contractor shall be nursery grown in accordance with acceptable horticultural practices. Unless otherwise specified, all plant material shall be Florida No. 1 or better in accordance with Grades and Standards for Nursery Plants, State Plant Board of Florida. The City reserves all rights to determine acceptability of plant material submitted for planting. Trees and palms must meet specification contained herein but need not necessarily be nursery grown stock.
- E. Plants shall be of sound health, vigorous, and free from plant disease and shall be well branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system.

- F. All trees must have a fully developed fibrous root system, be heavily branched, or in the case of palms, heavily fronded, free from all insects, fungus, and other diseases. All trees and palms except cabbage palms shall be balled and burlapped (unless otherwise specified).
- G. Shrubs and vines shall be heavily caned and leafed with foliage to base and shall be free from insects, diseases and mutilations of any nature.
- H. All ground covers shall have a sturdy fibrous root system; unless unrooted cuttings are called for on the plans shall be heavily leafed and must be free of all insects, diseases and injuries.

2.6 STAKING MATERIALS

- A. Stakes and Guys: Stakes and deadmen shall be of sound new hardwood, or treated softwood, free of knot holes and other defects. Wire ties and guys of 2-strand, twisted, pliable galvanized iron wire not lighter than 12 ga shall be provided. New 2-ply garden hose not less than 1/2-inch hose size, cut to required lengths to protect tree trunks from damage by wires shall be provided. All guys shall be flagged.

2.7 MISCELLANEOUS MATERIALS

- A. Wrapping material for trees, 2-inch diameter or larger, shall be 2 thicknesses of crinkled paper cemented together with bituminous material in strips 4-inch wide. Twine for tying shall be medium or coarse sisal yarn with a light impregnation of oil condensate from asphalt or tar.
- B. All stone shall be FDOT #57 stone. Setting bed shall be 4 inches below grade with Mirafi filter fabric under the stone.
- C. Continuous decorative concrete curbing shall be required at the master pump station as shown on the drawings.
- D. HDPE bulb type plastic edging required at each duplex station as shown on the Drawings shall be at least 6 inches wide.

2.8 WATER

- A. It is the Contractor's responsibility to supply all water to the site during sodding and planting operations and through the maintenance period and until the WORK is accepted. The Contractor shall arrange for adequate supply of water needed for HIS WORK. The Contractor shall also furnish all necessary equipment and accessories for the adequate irrigation of lawns and planted areas. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The landscape WORK shall not be performed at any time when it may be subject to damage by climatic conditions.

- B. The Contractor shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shall be coordinated with City and final location shall be Site-oriented by the planter and City. Any discrepancies or inconsistencies shall be brought to the attention of the City.
- C. Substitutions for the indicated plant materials may be considered pursuant to the Contract Documents.
- D. The Contractor shall remove and/or relocate landscape items such as trees, shrubs, grass, other vegetation, improvements, and obstructions as required.
- E. Waste materials shall be removed and disposed of off the Site, unless otherwise indicated.
- F. The Contractor is responsible for obtaining information regarding utilities in the area of WORK and shall protect them as necessary.
- G. Burning of combustible materials on the Site shall not be permitted.
- H. The Contractor shall provide temporary fencing, barricades, covering, or other protections to protect the adjacent properties and other structures from damage. The Contractor shall protect structures, sidewalks, pavements, and other facilities which are subject to damage during landscape WORK. All excavations shall be backfilled at the end of the day.

3.2 SOIL PREPARATION

- A. The landscape WORK shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompact, and refinished to finish grades. The City shall be notified of all areas which prevent the landscape WORK from being executed.
- B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.
- C. The landscape WORK shall not proceed until after walks, curbs, paving, edging, and irrigation systems are in place.
- D. During grading, waste materials in the planting areas such as weeds, rocks 2 inches and larger, building materials, rubble, wires, cans, glass, lumber, sticks, etc., shall be removed from the Site. Weeds shall be dug out by the roots. After removal of waste materials, the planting area subgrade shall be scarified and pulverized to a depth of not less than 6 inches, and all surface irregularities below the cover of topsoil shall be removed.
- E. Fertilizers, additives, peat, etc. subject to moisture damage shall be kept dry in a weatherproof storage place.
- F. Finish grading shall consist of:
 - 1. Final contouring of the planting areas.
 - 2. Placing all soil additives and fertilizers.

3. Tilling of planting areas and bringing areas to uniform grades by floating and/or hand raking.
 4. Making minor adjustment of finish grades as directed by the City.
 5. Removing waste materials, raking, disking, dragging, and smoothing soil ready for planting.
 6. Finish grade of all planting areas shall be 1-1/2 inches below finish grade of adjacent pavement of any kind.
- G. Topsoil shall be uniformly distributed over all areas where required. Subgrade and topsoil shall be damp.
- H. Surface drainage shall be provided as indicated by shaping the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.

3.3 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

- A. Plants shall be planted no later than 2 days after delivery.
- B. All balled and burlapped plants which cannot be planted immediately after delivery shall be set on the ground and be well protected with soil, wet moss, or other acceptable material. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots.
- C. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.
- D. Plants shall not be picked up or moved by stem or branches but shall be lifted and handled from the sides of the containers. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the Site.

3.4 TREE AND PLANT LOCATIONS

- A. The Contractor shall locate and stake all tree and shrub locations and have the locations approved by the City before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by City before final approval.
- B. No trees shall be located closer than 72 inches to structures unless otherwise indicated. Ground covers and shrubs may be planted up to structures or curbs.

3.5 PLANT PITS

- A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes unless indicated otherwise:
 - 1. Tree pits shall be at least 2 feet greater in diameter than the specific diameter of ball or spread of roots and at least 6 inches below depth of ball or roots. A 3-inch layer of manure shall be worked thoroughly to a depth of 6 inches below the pit bottom.
 - 2. Shrubs shall be planted in pits or holes of soil 24 inches deep below finished grade, or deeper as necessary to properly set the plant at finished grade with a minimum of 6 inches of planting soil under balls of all plants. Shrubs with balls shall be planted in pits that are at least 24 inches greater in diameter than the bottom of ball. Bare root shrubs shall be planted in pits at least 12 inches below the roots of the plant.

3.6 PREPARED BACKFILL

- A. Topsoil for use in preparing soil for backfilling plant pits shall be a fertile, friable, natural topsoil of loamy character, without mixture of subsoil materials, and obtained from a well-drained, arable site. It shall be free from heavy clay, coarse sand, stones, lime, lumps, plants, roots, obnoxious grasses (such as Bermuda or nut grass) and weeds. It shall not be excessively acid or alkaline nor contain toxic substances which may be harmful to plant growth.

3.7 ROCKS OR UNDERGROUND OBSTRUCTIONS

- A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations will be selected by the City. Moving of trees to alternative locations shall not entail additional costs to the City.

3.8 SETTING PLANT MATERIALS

- A. A layer of planting soil shall be placed and compacted in the bottom of the excavation.
- B. Balled stock shall be placed in the excavation with the top of the ball to match adjacent finished grade. Soil shall be added as required under the ball to achieve plumbness.
- C. Backfill shall be placed in 2- to 3-inch thick layers. Each layer shall be worked by hand to complete backfill and eliminate voids. Trees shall be kept plumb during backfilling. When excavation is approximately 2/3 full, backfill hole shall be filled with water. Watering shall be repeated until no more water can be absorbed. Remainder of backfill shall be placed and compacted and watered again.
- D. Container-Grown plants shall be placed and backfilled as specified for Balled and Burlapped stock, and the bottom of the container removed immediately before placing.
- E. The top of the backfill shall be dished to allow for mulching and an earthen berm constructed around the rim of the original excavation to hold six inches of water.

3.9 STAKING

- A. Staking of trees shall be done immediately after planting. Plants shall stand plumb after staking. Staking shall be as required.
- B. No balled and burlapped specimen "tree-like" shrubs shall be staked.
- C. Trees of 2-inch caliper and larger shall be guyed at points of branching with 3 wires spaced equally around and outside the perimeter of the ball. Guy wires shall be covered with rubber hose at the bark at points of contact. Each guy shall be positioned below crotches and fastened to a 4-inch diameter by 18-inch wood deadman, driven 12 inches into ground. Stakes will be removed by the City.
- D. Trees less than 2-inch caliper shall be supported by 2 stakes placed diametrically opposite at perimeter line of ball and to sufficient depth to hold tree rigid. Stakes shall be driven vertically and not twisted or pulled. Trees shall be wired to each stake as indicated on staking details. Trees shall be protected with rubber hose over wires at points of contact. Stakes will be removed by the City.

3.10 PRUNING AND MULCHING

- A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the City.
- B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.
- C. Cuts over 3/4-inch diameter shall be painted with approved tree paint. Paint shall cover all exposed cambium as well as other living tissue. Paint shall be waterproof, adhesive, and elastic antiseptic; shall be free from kerosene, coal tar, creosote, or other materials injurious to the life of the tree; and shall be approved before it is used.
- D. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials shall be spread on finished landscaping grade within all planting areas to a depth of 3 inches. All shrub and ground cover beds shall be completely covered with the mulch.

3.11 SODDING

- A. Preparation of sub-grade grading shall be per the paragraphs entitled "General" and "Soil Preparation" above.
- B. Finish grading shall be per the paragraph entitled "Soil Preparation" above. The soil additives shall be provided as recommended by manufacturer's instructions and the fertilizer for finish grading shall be spread at a rate of 20 lb/1000 ft² or as recommended by the manufacturer.
- C. Sod shall be laid within 24 hours from the time of stripping. Dormant sod shall not be laid.

- D. Sod shall be laid to form a solid mass with tightly fitted joints. Ends and sides of sod strips shall abut without overlap. Strips shall be staggered to offset joints in adjacent courses. Sod shall be tamped or rolled lightly to ensure contact with subgrade. Sifted soil shall be worked into minor cracks between pieces of sod with excess removed to avoid smothering of adjacent grass.
- E. Sod shall be watered thoroughly with a fine spray immediately after planting.

3.12 MISCELLANEOUS ITEMS

- A. After all edging, plants, and sprinkler emitters are in place, and the existing grass in all wood mulch, cobble, and gravel areas has been removed to a depth of 4 inches, place filter fabric over the entire area to receive wood mulch, cobble, or gravel.
- B. Cypress chip mulch shall be placed in all shrub areas where indicated to a minimum depth of 3 inches over planted areas.
- C. Gravel shall be placed as indicated on the Drawings to a minimum depth of 4 inches over the entire area.

END OF SECTION

SECTION 02920

RESTORATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all restoration Work indicated and required in accordance with the Contract Documents. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform the Work.
- B. The Contractor shall examine the site and identify items that require restoration during construction and prior to completion and shall coordinate the restoration of such items with the City and the landowner as needed.

1.2 QUALITY CONTROL

- A. The City shall perform quality control to confirm and document that all restoration Work performed by the Contractor has been completed to the satisfaction of the City and/or the landowner.

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor shall perform Work in accordance with the requirements in Section 01300 - Contractor Submittals.

PART 2 -- PRODUCTS

2.1 REQUIREMENTS

- A. General: Materials for use shall be as indicated in this Section, unless specified otherwise. For earthwork restoration, the soil materials shall be as specified in Section 02200 – Earthwork.
- B. Contractor shall notify the property owner of any landscape, trees, bushes, decorative fencing, etc. located within the right-of-way conflicting with construction 60 days prior to commencing construction activities. Property owner will have 60 days to remove any landscape, trees, bushes, decorative fencing, etc. located within the right-of-way during that 60-day period. Contractor shall be required to remove and dispose of any landscape, trees, bushes, decorative fencing, etc. left within the right-of-way after 60 days.

PART 3 -- EXECUTION

3.1 REQUIREMENTS

- A. General: Restoration WORK shall be performed as indicated in this Section. For restoration Work related to earthwork, the execution shall be as specified in Section 02200 – Earthwork. Restoration shall begin as soon as practical after the utility has been installed. Mailboxes shall be replaced daily unless other provisions have been made. All practical efforts shall be made to complete roadway restoration including the prime coat within 60 days of beginning Work in an area. Contractor shall properly restore roadway access at the end of each workday, unless otherwise approved by the City. Asphalt paving shall be completed within 90 days of the application of the prime coat. Prime coat shall be maintained until such time as the asphalt installation is complete. Driveways, finish grading, seeding, sodding, and other final restoration shall be started in an area within 14 days of the installation of the asphalt paving. Final restoration must be completed within 60 days of the installation of the asphalt paving. All areas disturbed by construction activities shall be restored, including lots used for access to Work, lay-down, storage, excess earth stock piles, etc., to a condition equal to or better than existing prior to construction.

3.2 LAWN AREAS

- A. Driveways, lawns and landscaping areas shall be restored and property such as mailboxes shall be replaced. Mailboxes shall be replaced in accordance with FDOT 2013 Design Standards Index No. 532. Where excavation occurs in lawn areas, the Contractor shall re-sod the lawn to match the existing type of grass after completion of the Work. All lots with homes or businesses shall be re-sodded in accordance with Section 02822 – Solid Sodding.
- B. Right-Of-Way areas at lots without houses or businesses shall be seeded and mulched in accordance with FDOT Standard Specifications 2013 Section 981. All lots without houses or businesses shall be seeded and mulched or shall be hydro-mulch seeded in accordance with Florida Department of Transportation Section 981 and shall be green mulch mix. If seed and mulch is used for restoration, a strip of sod with a minimum width of 12" minimum shall be placed along the street side of the excavation to provide erosion protection along the pavement edge. Seed shall conform to the requirements of the Florida Department of Agriculture and Consumer Services and all applicable State laws. The seed shall have been harvested from the previous year's crop. All seed bags shall have a label attached stating the date of harvest, LOT number, percent purity, percent germination, noxious weed certification and date of test. Seed, which has become wet, moldy, or otherwise damaged prior to use, will not be accepted.
- C. Each of the species or varieties of seed shall be furnished and delivered in separate labeled bags. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.
- D. All quantities of seed specified shall be for pure live seed. It is the responsibility of the Contractor to calculate and apply the actual pure live seed poundage based on the label attached to each bag of seed. Shipping tickets shall indicate both pure live seed weight and bulk weight for each species.

- E. Grass seed shall be fresh, clean, new-crop seed, composed of the varieties listed below mixed in the proportions by weight. Purity and germination percentage shall be the results of testing. Germination rate of all seed shall not be less than 80% and no seed with an excess of 5% weed shall be used.
- F. A bahia/millet seed mixture will be utilized between March 1 and November 1. A rye/bahia mixture will be utilized between November 1 to March 1. The seed mixture will be spread uniformly on the prepared soil. Hay mulch will then be spread uniformly upon the seeded area to provide erosion control until the seeds germinate. The hay mulch will then be cut into the soil and crimped with specialized equipment ensuring further soil stability. Lots without houses or businesses may also be hydro-mulch seeded in accordance with Florida Department of Transportation Section 981 and shall be green mulch mix.
- G. The existing sod may be carefully removed, dampened, and stockpiled to preserve it for replacement or new sod may be provided. Contractor must provide new sod if stockpiled sod has not been placed within 72 hours of cutting. Excavated material may be placed on the lawn provided that a drop cloth, plywood, or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn to a condition, which meets or improves the original condition.

3.3 LANDSCAPING AND TREES

- A. Only trees that directly impede construction activities shall be removed. City must approve any and all tree removal. Trees removed under such conditions may be required to be replaced. All trees that interfere with Work improvements and proper storm drainage flow shall be removed at no additional cost to the City, at the City's direction.

3.4 SOD FOR STABILIZATION

- A. At all locations where the excavated area is within 4 feet of the street pavement and where no natural stand of grass exists, two (2) strips of sod of at least 2-foot 8 inches in width shall be planted along the edge of the pavement as a means of erosion stabilization and pavement protection. The sod strips, or blocks, shall be placed with staggered transverse joints. This shall include all areas to be seeded as the basic means of stabilization and restoration. Provide two (2) strips of sod around all meter boxes installed on vacant lots. All sod shall be properly rolled when installed.

3.5 RESTORATION OF SIDEWALKS OR PRIVATE DRIVEWAYS

- A. Wherever sidewalks or private driveways have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or driveways promptly after backfilling and shall maintain them in satisfactory condition until the replacement sidewalk or driveway is constructed.
- B. Private driveways shall be provided with temporary access within a maximum time of 12 hours after removal for construction. The Contractor shall provide a minimum of 48 hours' notice to

all affected parties prior to removing private driveways. The final restoration of the driveway shall be completed within 14 days after paving the local street. The Contractor shall maintain temporary sidewalks or driveways until the final restoration has been made. The concrete shall have a minimum cure time of 3 days. During this time period the concrete must be protected from rain, traffic and all other elements that could cause damage by the Contractor at no additional cost to the City.

- C. In order to obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of driveway. Damaged edges of driveways along excavations and elsewhere shall be trimmed by saw cutting in straight lines. Incidental driveway repair (driveways that new pressure pipe mains are not installed under) shall be full width and to a minimum length of three feet. Construction/control joints shall be at least three feet apart. Driveway replaced due to the installation of new pressure pipe mains shall be replaced from the roadway to the nearest construction or control joint or the Right-Of-Way line. All driveway restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed driveway and pavement.
- D. All driveways shall be restored to preexisting conditions.
- E. At Contractor's option, he may bore and jack under existing driveways and sidewalks in lieu of open cut pipe installation, utilizing ductile iron pipe with restrained joints. See Section 02340 – Boring and Jacking.

3.6 WATERING

- A. Upon completion of the erosion control seeding, sodding, and other trees and plantings, the entire area shall be soaked to saturation by a fine spray. The new plantings shall be adequately watered during dry weather to establish and maintain a healthy stand of grass and viability of all plants. At no time shall the plantings be allowed to dry out. Care shall be taken to avoid excessive washing or pooling on the surface and any such damage caused thereby shall be repaired by the Contractor.

3.7 MAINTENANCE PRIOR TO FINAL ACCEPTANCE

- A. The Contractor shall maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary, and sufficient watering to maintain the plant materials in a healthy condition. The City may require replanting of any areas in which the establishment of the vegetative ground cover does not appear to be developing satisfactorily. Contractor shall mow sod at inlets on undeveloped lots and four lane medians prior to substantial completion.

3.8 MISCELLANEOUS ITEMS

- A. Improvements to the land such as fences, walls, outbuilding, mail boxes, and other structures that of necessity must be removed, shall be replaced with equal or better quality materials and workmanship. The Contractor shall provide the homeowner the opportunity to retain any

mailbox, fence, wall, outbuilding, etc. prior to removal. Mailboxes shall be replaced to match the originals at the locations encountered prior to commencement of the Work. The mailbox shall be replaced in accordance with FDOT Design Standards 2013 Index. No. 532 with the face located at least 2 feet from the edge of payment and the bottom 42" from the top of pavement.

- B. Disturbed swales shall be regraded to provide positive drainage.
- C. Any commercial signs, disturbed or removed, shall be restored to their original condition within 24 hours.
- D. Special Items- Decorative rocks, yards signs, and other landscaping items shall be replaced in kind at the original locations.

END OF SECTION

SECTION 03310

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide cast-in-place concrete, complete and in place, in accordance with the Contract Documents.

1.2 LIMITATIONS

- A. Use of this specification is limited to slabs on grade, footings, driveways, curbs, and equipment pads and support piers for pipes, fittings and valves.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications and Standards

UU-B-790A (1) (2)	Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant)
PS 1	Construction and Industrial Plywood
PS 20	American Softwood Lumber Standard

B. Commercial Standards

ACI 214	Evaluation of Strength Test Results of Concrete
ACI 301	Specification for Structural Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ACI 347	Guide to Formwork for Concrete
ASTM A 82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Standard Specification for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement
ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	Standard Specification for Portland Cement
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
	Concrete Paving and Structural Construction
WRI	Manual of Standard Practice for Welded Wire Fabric

1.4 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. Shop Drawings
 - 1. Shop bending diagrams, placing lists, and drawings of all reinforcing steel prior to fabrication. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the earliest possible date after receipt of the Notice to Proceed. Details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The Shop Drawings shall include bar placement diagrams, which clearly indicate the dimensions of each bar splice.
- C. Mix Designs: Prior to beginning the Work, submit concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete

herein. The mix designs shall be checked by an independent testing laboratory acceptable to the City. All costs related to such checking shall be borne by the Contractor.

- D. Delivery Tickets: Where ready-mix concrete is used, furnish certified delivery tickets to the City at the time of delivery of each load of concrete. Each ticket shall show the FDOT certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the time when water was added to the batch, when it left the plant, when it arrived at the Site, number of drum revolutions, when unloading began, and when unloading was finished.

1.5 QUALITY ASSURANCE

A. Testing of Reinforcing Steel

- 1. If requested by the City, the Contractor shall furnish manufacturer certified test reports and/or samples from each heat number of reinforcing steel in a quantity adequate for testing. Costs of initial tests will be paid by the City. Costs of additional tests of non-compliant steel shall be paid by the Contractor.

B. Testing of Materials

- 1. Tests on component materials and for compressive strength of concrete will be performed as indicated herein. Test for determining slump will be in accordance with the requirements of ASTM C 143 – Standard Test Method for Slump of Hydraulic- Cement Concrete. Testing shall be included in the Contract price.
- 2. The cost of laboratory tests on cement, aggregates, and concrete, will be paid by the City. However, the Contractor will be charged for the cost of any additional tests and investigations on Work which does not meet the Specifications. The laboratory will meet or exceed the requirements of ASTM C 1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.
- 3. Concrete for testing shall be supplied by the Contractor at no additional cost to the CITY, and the Contractor shall assist the City in obtaining samples and disposal and cleanup of excess material.

C. Field Compression Tests

- 1. Compression test specimens will be taken from the first placement of each class of concrete herein and at intervals thereafter as selected by the City to ensure continued compliance. Each set of test specimens will be a minimum of 5 cylinders.
- 2. Compression test specimens for concrete will be made in accordance with Section 9.2 of ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field. Specimens will be 6-inch diameter by 12-inch high cylinders.

3. Compression tests will be performed in accordance with ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test cylinder will be tested at 7 days and two (2) at 28 days. The remaining cylinders will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318 – Building Code Requirements for Structural Concrete, Chapter 5 “Concrete Quality,” and as indicated herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete that fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no additional cost.

- E. Construction Tolerances: The Contractor shall set and maintain concrete forms and perform finishing operations to ensure that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Permissible deviations will be in accordance with ACI 117.

PART 2 -- PRODUCTS

2.1 FORM AND FALSE WORK MATERIALS

- A. Except as otherwise specifically accepted by the City, all lumber brought on the Site for use as forms, shoring, or bracing shall be new material.

2.2 REINFORCEMENT STEEL

- A. General: Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to the requirements of ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, for Grade 60 Billet Steel Reinforcement, unless otherwise indicated.
 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement, and the details indicated. Welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10-inches. Welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
 3. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82 - Steel Wire, Plain, for Concrete Reinforcement.

B. Accessories

1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Slab bolsters shall have gray plastic-coated legs.
2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength than required for the concrete in which they are located. Where concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface.

2.3 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled to prevent damage. Only one brand of cement shall be used and accepted by the City prior to its use. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the Work shall comply with the requirements of Sections 201, 203, and 204 of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of Section 205 of ACI 301. D.

Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand Portland cement conforming to ASTM C 150, Type I, II or III.
2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.
3. Ready-mix concrete shall conform to the requirements of ASTM C 94.
4. Air-entraining agent meeting the requirements of ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete shall be used. Sufficient air- entraining agent shall be used to provide a total air content of 3 to 5 percent. The City reserves the right, at any time, to sample and test the air- entraining agent. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
5. Admixtures: Admixtures may be added at the Contractor's option to control the set, affect water reduction, and increase workability. The addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the City. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture. Admixtures shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or

not an admixture is used. Admixtures shall contain no free chloride ions, shall be non-toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air-entraining admixture.

- a. Concrete shall not contain more than one water-reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the City.
 - b. Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as Sika Corporation's Plastiment; Master Builder's Pozzoloth 440-N, or City approved equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees, a set accelerating admixture such as Sika Corporation's Plastocrete 161FL; Master Builder's Pozzutec 20; or City approved City equal shall be used.
 - c. Low range water reducer shall conform to ASTM C 494, Type A. It shall be WRDA by Grace Concrete Products; Pozzoloth 322-n by Master Builders; or approved City equal. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.
6. Calcium Chloride: Calcium chloride will not be permitted in concrete.
 7. Flyash: Flyash may be used as a substitute to cement. The amount by weight of flyash shall be limited to not more than 20% of the combined weight of flyash plus cement. Slag will not be permitted for use.

2.4 CURING MATERIALS

- A. Materials for curing concrete shall conform to the following requirements and ASTM C 309:
 1. Curing compounds shall be white pigmented and resin based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be Kurez by Euclid Chemical Company; Masterkure N-Seal-HS by ChemRex; L&M Cure R; or approved City equal. Water based curing compounds shall be used only where local air quality regulations prohibit the use of a solvent-based compound and when curing compound must be removed for finishes or grouting. Water based curing compounds shall be Aqua-Cure by Euclid Chemical Company; Masterkure-100W by ChemRex; L&M Cure R-2; or City approved equal.
 2. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.
 3. Evaporation retardant shall be a material such as Confilm by Master Builders; Eucobar by Euclid Chemical Company; or City approved equal.

2.5 JOINT MATERIALS

A. Materials for joints in concrete shall conform to the following requirements:

1. Joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 for Type I.
2. Elastomeric joint sealer shall conform to the requirements of Section 07920 - Sealants and Caulking.
3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the City.

2.6 MISCELLANEOUS MATERIALS

A. Epoxy adhesives shall be the following products:

1. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi- Mod Epoxy Adhesive, by Sika Corporation; Concessive Liquid (LPL), by Master Builders; BurkEpoxy MV by The Burke Company; or City approved equal.
2. For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel by Sika Corporation; BurkEpoxy NS by The Burke Company; Concessive Paste (LPL) by Master Builders; or City approved equal.

B. Cement Grout

1. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.
2. The cement used shall be 1/2 gray and 1/2 white Portland cement, or other proportion as determined by the City. White Portland cement shall be Atlas white, or City approved equal. No cement from kilns burning metal-rich hazardous waste fuel shall be used.

C. Non-Shrink Grout (cement-based)

1. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type precision grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.
3. Grout shall not contain chlorides or additives that may contribute to corrosion.
4. Grout shall be formulated to be used at any consistency from fluid to plastic.
5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - a. Minimum tensile splitting strength of 500 psi per ASTM C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - b. Minimum flexural strength of 1000 psi per ASTM C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - c. Minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - d. Grout shall be certified for use in a marine environment where applicable.
6. Non-shrink grout shall have a minimum 28-Day compressive strength of 9000 psi when mixed at a fluid consistency.
7. Non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
8. Grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827 - Test Method for Early Volume Change of Cementitious Mixtures. The grout when tested shall not bleed or segregate at maximum allowed water.
9. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090 - Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
10. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.

11. Non-Shrink Grout shall be Masterflow 928 by MBT/Degussa Building Systems (for non-marine environment applications only), Sikagrout 328 by Sika Corporation,; High-Flow Grout by Euclid Chemical Company, CG200 PC by Hilti, or approved City equal.

2.7 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates and water, all of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and be smooth. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the CITY. All changes shall be subject to review by the City.
2. The Contractor is cautioned that the limiting parameters specified below are NOT a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the Contractor's construction methods. The Contractor is responsible for any costs associated with furnishing concrete with the required workability.

- B. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

Class of Concrete Min 28-Day Compressive Strength (psi)	Type of Work	Max Size Aggregate (in)	Min Cement Per cu yd (lbs)	Max W/C Ratio (by weight)
3,000	Sidewalks and Driveways	1	470 (min)	0.50
4,500	Structural Concrete	1	564 to 600	0.45

Note: One sack of cement equals 94 lb.

2.8 CONSISTENCY

- A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slump shall be 3 inches plus 1 inch.

2.9 MEASUREMENT OF CEMENT AND AGGREGATE

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the Contractor and acceptable to the City; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

2.10 MEASUREMENT OF WATER

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the City and capable of measuring the water in variable amounts within a tolerance of one percent.

2.11 READY-MIXED CONCRETE

- A. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, placing and the supplementary requirements as required herein and in accordance with ASTM C 94.
- B. Ready-mixed concrete shall be delivered to the Site, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.
- C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- E. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a certified delivery ticket in accordance with the Paragraph 1.4.D entitled "Delivery Tickets."
- F. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the City.
- G. The use of hydraulic cement in wet well interiors is prohibited. This includes new construction, all repairs, and patches.

PART 3 -- EXECUTION

3.1 GENERAL FORMWORK REQUIREMENTS

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms, which are unsafe or inadequate in any respect, shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, false work, and shoring shall comply with applicable local, state and federal regulations. All design, construction, maintenance, preparation, and removal of forms shall be in accordance with ACI 347 and the requirements herein.
- B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.2 CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the CITY OF CAPE CORAL. Pipe stubs and anchor bolts shall be set in the forms where required.
- C. Slab Elevations: All concrete slabs shall be poured in place at equal elevations to prevent trip hazards, unless otherwise shown on the drawings. All slabs to include but not limited to: transition slabs between wet well lids and valve vaults, control panel slabs, pipe support slabs, etc. Prior to pouring slabs, Contractor shall ensure that the area to be poured is sufficiently compacted to prevent settling. Any settlement of concrete pads due to lack of subgrade compaction shall be removed and replaced at the sole expense of the Contractor. See specification 02200 for further requirements on excavation, backfilling, and compaction.
- D. Concrete Coating: Prior to coating of wet wells, Contractor shall administer a pH test to ensure that the concrete has sufficiently cured. pH testing shall be in the form of a TSW6 test or City approved equal. All concrete must pass pH testing prior to coating.
- E. Wet Well Bottoms: Prior to placement of any concrete in wet wells the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.

3.3 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the City.

3.4 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this Work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members, which must support their own weight, shall not have their forms removed until they have attained at least 75 percent of the 28-day strength of the concrete. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the City.

3.5 GENERAL REINFORCEMENT REQUIREMENTS

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.
- B. Reinforcing spliced by mechanical connectors or welding is not permitted.

3.6 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes required, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
2. The Contractor shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the Contractor.
3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

- B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. No bars with kinks or bends not required shall be used. All bars shall be bent cold, unless otherwise permitted by the City. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the City.

3.7 PLACING

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers, which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobbies) shall be used, in sufficient numbers to support the bars without settlement,

but in no case shall such support be continuous. For concrete on formwork, the Contractor shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

- B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least ½-inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
- D. Bars additional to those indicated which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. The minimum spacing requirements of ACI 318 shall be followed for all reinforcing steel.
- G. Unless specific permission is granted by the City prior to each occurrence, no concrete shall be delivered to the job site before 7:00am or after 5:00pm.

3.8 SPLICING

- A. General: Reinforcement bar splices shall be used as required. When it is necessary to splice reinforcement the character of the splice shall be as acceptable to the City.
- B. Splices of Reinforcement
 - 1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class C splice.
 - 2. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3.9 CLEANING AND PROTECTION

- A. Reinforcement steel shall at all times be protected from corrosive conditions until concrete is placed around it.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

3.10 PROPORTIONING AND MIXING

- A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 ACI 301.
- C. Slump: Maximum slumps shall be as indicated in Paragraph 2.8 of this Section.
- D. Retempering: Retempering of concrete or mortar which has partially hardened will not be permitted.

3.11 PREPARATION OF SURFACES FOR CONCRETING

- A. General: Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the City, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete and foreign material. Such cleaning shall be accomplished by hydroblasting. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to achieve an initial set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent Work; provided that construction joints shall be made only where acceptable to the City.
- D. Embedded Items
 - 1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the City at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
 - 2. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by Shop Drawings and shall be accepted by the CITY OF CAPE CORAL before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
- E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.

- F. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the City.
- G. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete to ensure a minimum of 2 inches for above-grade installations and 3 inches for on-grade installations, clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.
- H. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- I. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
- J. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.12 HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced.
- C. Notification of Concrete Placement: No concrete shall be placed except in the presence of a duly authorized representative of the City. The Contractor shall notify the City in writing at least 24 hours in advance of placement of any concrete.
- D. Conveyor Belts and Chutes: Ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not segregate. Conveyor belts, if used, shall be of a type acceptable to the City. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the required consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the cement adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below

40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the required minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water, using ice, or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

F. Cold Weather Placement

1. Placement of concrete shall conform to ACI - 306.1 - Cold Weather Concreting, and the following:
 - a. Earth foundations shall be free from frost or ice when concrete is placed upon or against them.
 - b. Maintain the concrete temperature above 50 degrees F for at least 3 days after placement.

3.13 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment
 1. The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
 2. The minimum diameter of the hose (conduits) shall be 2 inches.
 3. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
 4. Aluminum conduits for conveying the concrete shall not be permitted.
- C. Proportioning
 1. Minimum compressive strength, cement content, and maximum size of aggregates shall be as required in this Section.
 2. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible.
 3. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand used shall not be over 3.00.

3.14 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high-speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.

3.15 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated in Part 1 above. These tolerances are to be distinguished from irregularities in finish as described herein.
- B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects.
- C. Unformed Surfaces: After proper and adequate vibration and tamping, all unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. The finish specified for unformed concrete surfaces are designated and defined as follows:
 - 1. Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 - 2. After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed ¼-inch. Joints and edges shall be tooled where indicated or as determined by the City.
 - 3. After the surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.
 - 4. Trowel the surface to remove local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.

3.16 CURING AND DAMPPROOFING

- A. General: Concrete shall be cured for not less than 14 days after placing, in accordance with the methods indicated below for the different parts of the Work.

<u>Surface to be Cured or Damp-proofed</u>	<u>Method</u>
Un-stripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4.
- C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. Method 4: The surface shall be sprayed with a liquid curing compound. Curing compound shall not be used on surfaces to receive coatings, tile, additional concrete, etc., where the adhesion of the additional treatments may be affected.
1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film, which will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the completion of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 3. Wherever curing compound may have been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, curing compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
 4. Where curing compound is required, it shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms from contact with formed concrete surfaces. Repairs required to be

made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

5. Whenever the air temperature exceeds 85 degrees F or the wind speed exceeds 25 mph at the time of placement, the concrete shall be treated as follows. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each Work operation as necessary to prevent drying shrinkage cracks.
 6. During the curing period, no traffic of any nature and no depositing of any materials, temporary or otherwise, shall be permitted on surfaces coated with curing compound. Foot traffic and the depositing of materials may be allowed after three days if the surface is covered with 5/8-inch plywood placed over polyethylene sheets.
- F. The Contractor may submit alternate methods of curing, which maintain the concrete in a continuously wet condition for acceptance by the City.

3.17 PROTECTION

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The Contractor shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring. Immediately following the first frost in the fall, the Contractor shall be prepared to protect all concrete against freezing. The concrete shall be maintained at a temperature not lower than 50 degrees F for at least 72 hours after it is placed.
- B. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed Work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

3.18 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the City. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as required herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be promptly executed.

- B. Defective surfaces to be repaired shall be cut back from true line a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32-inch depth of the surface film from all hard portions, by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with neat cement so that while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed Work will conform to the requirements of this Section, using methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

END OF SECTION

SECTION 03400

PRECAST CONCRETE STRUCTURES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide precast concrete wet well structures, manholes, vaults, and storm drain inlets, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. Shop Drawings
 - 1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
 - 2. Structural design calculations for all precast concrete structures shall be signed and sealed by a professional structural engineer licensed and registered in the state of Florida.

1.3 QUALITY ASSURANCE

- A. Inspection: After installation, the Contractor shall demonstrate that manholes and vaults have been properly installed, leveled true and plumb with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 -- PRODUCTS

2.1 MANHOLES

- A. The Contractor shall provide precast manhole sections and conical sections conforming to ASTM C 478 and the requirements of this Section. Adjusting rings shall be standard items from the manufacturer of the manhole sections. Minimum wall thickness of adjusting rings shall be as indicated on the Drawings. Bricks are not allowed except for wedges used for final shimming of the ring and cover.
- B. Axial length of sections shall be selected to provide the correct total height with the fewest joints.
- C. Conical sections shall be designed to support cast iron frames and covers under an H-20 loading, unless indicated otherwise.
- D. Where the manhole barrel diameter is greater than 48-inches, a flat slab-transition, either concentric or eccentric, shall be used to transition to 48-inch diameter riser sections. Underside of the transition shall be at least 7-feet above the top of the bench.

- E. A manhole shall be classified as a “drop manhole” when the difference in elevation between the inverts of pipes entering or leaving the manhole is greater than 2.00 feet.
- F. Design Criteria: Manhole walls, transitions, conical sections, and bases shall be designed per ASTM C 478 for the depths indicated and the following:
1. AASHTO H-20 loading applied to the cover.
 2. Unit weight of soil of 120 pcf located above all portions of the manhole.
 3. Lateral soil pressure based on saturated soil producing 100 pcf acting on an empty manhole.
 4. Internal fluid pressure based on unit weight of 63 pcf with manhole filled from invert to cover with no balancing external soil pressure.
 5. Dead load of manhole sections fully supported by the base and transition.
 6. Additional reinforcing steel in walls to transfer stresses at openings.
 7. The minimum clear distance between the edges of any 2 wall penetrations shall be 12-inches or one-half of the diameter of the smaller penetration, whichever is greater, unless otherwise directed by the City.
 8. The minimum structural member thickness for manholes shall be as shown on the Drawings. Cement shall be Type II Portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
 9. All precast manholes shall include Xypex C1000-Redadditive in accordance with manufacture specifications. Coal tar on exterior of manholes will not be permitted.
- G. Joints shall be sealed with double bitumastic strip seal conforming to ASTM C 443 as shown on Drawings. Seal shall be Ram-nek as manufactured by Henry. All exterior joints and seems in manholes shall also be wrapped in Bidco joint sealing wrap.
- H. Concrete for cast-in-place base and invert channel formation shall be 4000 psi concrete conforming to Section 03310 - Cast-In-Place Concrete.
- I. Barrel section to sewer pipe connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be American made stainless steel. Flexible Connection Boot shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
- J. Manhole Manufacturers or City Approved Equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 FRAMES AND COVERS

- A. Castings: Castings for manhole frames and covers shall be non-rocking and shall conform to the requirements of ASTM 48 A, Class 35B. Unless otherwise indicated, cast iron covers and frames shall be heavy traffic type, 24 inches in diameter, with embossed lettering stating "Sanitary Sewer" and "City of Cape Coral." Frame and cover shall be designed for H-20 traffic loading.
- B. Castings Manufacturers, or City Approved Equal

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 VAULTS AND WET WELLS

- A. The Contractor shall provide precast vaults and wet wells designed for the indicated applications and of the sizes indicated.
- B. The minimum structural member thickness for vaults and wet wells shall be as shown on the Drawings. Cement shall be Type II Portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. Precast vault and wetwell structures shall include Xypex C1000 - Red additive in accordance with manufacture specifications. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.

- C. Design Loading: Vaults and wet wells shall be designed for H-20 traffic loading. Lateral loads on vaults and wet wells in all areas shall be calculated from:

$$L = 90 h, \text{ plus surcharge of 240 psf in areas of vehicular traffic}$$

$$\text{Where } L = \text{loading in psf}$$

$$h = \text{depth of fill in feet}$$

- E. Where joints are designed in pre-cast concrete vaults and wet wells, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
- F. Where openings for access to the vault or wet well are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.
- G. Joints and Lids shall be sealed with double bitumastic strip seal conforming to ASTM C 443 as shown on Drawings. Seal shall be Ram-nek as manufactured by Henry. Exterior portion of joint shall be horizontally wrapped with bitumastic strip seal material as manufactured by Bidco.

- H. Concrete for cast-in-place base and invert channel formation shall be 4500 psi concrete or grout conforming to Section 03310 – Cast-in-Place Concrete.
- I. Barrel section to sewer pipe connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be American made stainless steel. Flexible Connection Boot shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
- J. Covers for access openings shall be provided. Frames for covers shall be fabricated in accordance with Specification Section – 05530 Aluminum Covers.
- K. Where penetrations of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or circular cores performed in the field, as directed by the City of Cape Coral. Thin wall knock-out sections shall not be permitted. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault. A separate penetration shall be provided for each pipe or conduit entering the pre-cast section. HDPE will be used for all piping entering the valve box, unless otherwise indicated on the Drawings.

2.4 COATINGS AND LININGS

- A. The interior of all wet wells, master manholes, valve vaults and specific sanitary manholes as shown on the Drawings shall be coated in accordance with Section 09800-Protective Coating. The exterior of all precast items shall be coated in accordance with Section 09800-Protective Coating.

2.5 STORM DRAIN INLETS

- A. All storm drain inlet tops and bottoms shall conform to applicable detail sheets and FDOT Standard Indices 200, 201, and 232.
- B. Grates in paved areas: Grates shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Inlets (Type C and E) to have concrete top over inlet with opening to fit frame and grate, as shown on the Contract Drawings. Grates in grassed areas: Grates shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** for 'Type C' inlets and **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** for 'Type E' inlets.
- C. Storm drain manhole top shall be as depicted on the Design Drawings.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

- B. Buried pre-cast concrete vaults and wet wells shall be assembled and placed in excavations as detailed in the Drawings. Pre-cast concrete vaults and wet wells shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.
- C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults and wet wells shall be filled with Type II Portland Cement. Around pipe and conduit penetrations, openings shall be sealed.
- D. Eccentric conical sections shall be aligned to place the manhole lid in the quarter points of the roadway.

3.2 STONE BEDDING BENEATH PRECAST CONCRETE STRUCTURES

- A. Bed all precast concrete structures with a well graded, compacted layer of FDOT #57 stone. Bedding layer of stone under lift station wet wells shall be a minimum of 12-inches in depth. All other structures shall require a minimum layer of 6-inches in depth. The layer of stone bedding for all structures shall extend a minimum of 12-inches beyond the outside footprint of the precast concrete structure.

3.3 SURFACE DEFECTS

- A. All exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the City. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as required herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be promptly executed.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide miscellaneous metalwork and appurtenances, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Shop Drawings: Shop Drawings of all miscellaneous metalwork shall be submitted in accordance with Section 01300 - Contractor Submittals.
- B. Weld Submittals: All weld procedures, welder qualifications and certification shall be submitted to the City by the Contractor prior to welding.
- C. All stainless steel to be used on the project must be accompanied by a manufacturer's certificate of origin to evidence that the material is of American manufacture.

1.3 QUALITY ASSURANCE

- A. All weld procedures and welder qualifications shall be available for review as required in this Section.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

- 1. Plates, Bars, Angles ASTM A 36
- 2. Pipe, Pipe Columns, ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
- 3. Tubes ASTM A 500 Grade C
- 4. Shapes (W, WT) ASTM A992
- 5. Shapes (S, M, HP, C) ASTM A36 or ASTM A572 Grade 50

- B. Corrosion Protection: All metalwork shall be coated in accordance with Section 09800 - Protective Coating.

- C. Stainless Steel: Unless otherwise indicated, stainless steel metalwork and bolts shall be of

Type 316 stainless steel and American made. A manufacturer's certificate of origin will be required for all stainless steel to be used.

- D. Aluminum: Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6 or 5052. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with Section 09800.
- E. Cast Iron: Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

2.2 CHECKERED PLATE

- A. Checkered plate shall have a pattern of raised lugs on one face and shall be smooth on the opposite face. Lugs shall be a minimum of one inch in length and raised a minimum of 0.050 inch above the surface. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in two orthogonal directions. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.
- B. Where no plate material type is indicated on the Drawings, aluminum shall be provided. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4-inch or the span divided by 240, whichever is less.

2.3 IRON CASTINGS

- A. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shot blasting.
- B. Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding finished surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
- C. Unless otherwise indicated on the drawings covers and grates with matching frames shall be designed for AASHTO HS-20 loading unless indicated otherwise.

2.4 BOLTS AND ANCHORS

- A. Standard Service (Non-Corrosive Application): Unless otherwise indicated, bolts, anchor bolts, washers, and nuts shall be steel as indicated herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, steel for bolt material, anchor bolts and cap screws shall be in accordance with the following:
 - 1. Structural connections: ASTM A 307, Grade A or B, hot-dip galvanized.
 - 2. Anchor Bolts: ASTM F1554 A 36, hot-dip galvanized.
 - 3. High strength bolts where indicated: ASTM A 325, hot-dip galvanized.
 - 4. Pipe and equipment flange bolts: ASTM A 193, Grade B-7, hot-dip galvanized.

- B. Corrosive Service: All bolts, nuts, and washers in the locations listed below shall be type 316 stainless steel and American made as indicated below:
1. All buried locations.
 2. All submerged locations.
 3. All locations subject to seasonal or occasional flooding.
 4. Inside hydraulic structures below the top of the structure.
 5. Inside buried vaults, manholes, and structures.
 6. All chemical handling areas.
 7. Inside trenches, containment walls, and curbed areas.
 8. Locations indicated by the Contract Documents or designated by the Contractor to be provided with stainless steel bolts.
 9. Unless otherwise indicated
- C. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be American made type 316 stainless steel, class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.
1. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF, organization which develops standards relating to public health safety and the environment.
- D. Bolt Requirements
1. The bolt and nut material shall be free-cutting steel.
 2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 3. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.
 4. The length of each bolt shall be such that after the joint is made up, the bolt extends through the entire nut with a minimum of two threads protruding from the nut, but in no case more than 1/2-inch beyond the nut.

5. All bolts and nuts shall be cathodically protected from dissimilar metals through the use of nylon washers or other galvanic isolators as applicable.
- E. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. Products shall be tested in accordance with ICC A308, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete. No substitutions will be considered unless accompanied with ICBO report verifying strength and material equivalency.
 1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Threaded rod shall be stainless steel Type 316, conforming to ASTM F593 (CW), and American made.
- F. Expanding-Type Anchors: Expanding-type anchors if indicated or permitted shall be stainless steel Type 316 and American made. Products shall be single component anchors tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete.

2.5 POWDER-DRIVEN PINS

- A. Materials: Powder-driven pins for installation in concrete or steel shall be heat-treated steel alloy. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads to the shanks. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank.

2.6 IMPACT ANCHOR

- A. Impact anchors shall be an expansion type anchor in which a nail type pin is driven to produce the expansive force. The pin shall have a zinc sleeve with a mushroom style head and stainless steel nail pin. Anchors shall be Metal Hit Anchors, manufactured by Hilti, Inc., Rawl Zamac Nailin, manufactured by the Rawlplug Company; or equal.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- B. Powder-Driven Pins: Powder-driven pins shall be installed by a craftsperson certified by the manufacturer as being qualified to install the manufacturer's pins. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration. Driven pins shall conform to the following requirements where "D" = pin's shank diameter:

<u>Material Penetrated by Pin</u>	<u>Material Minimum Thickness</u>	<u>Pin Shank Penetration in Supporting Material</u>	<u>Minimum Space From Pin's CL to Edge of Penetrated Material</u>	<u>Minimum Pin Spacing</u>
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.2 WELDING

- A. Method: Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. Quality: In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

- A. Structural steel plates, shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox," "Galvo-Weld," or equal.

3.4 DRILLED ANCHORS

- A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dried. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 05530

ALUMINUM COVERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide aluminum covers, complete and in place, in accordance with the Contract Documents. The covers shall be provided for valve vaults and wet well structures.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. Shop Drawings: Include layouts, hinges locations and spacings, cover location, anchors details, construction details, manufacturer's engineering data, installation instructions, and product data.

PART 2 -- PRODUCTS

2.1 SYSTEM DESIGN AND STRUCTURAL PERFORMANCE OF COVER

- A. General: All covers and installation shall be in accordance with the manufacturer's published recommendations and specifications.
- B. Codes: All codes, as referenced herein, are specified in Section 01090 – Reference Standards.
- C. In case of conflict between codes, reference standards, Drawings, and these Specifications, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the CITY OF CAPE CORAL for clarification and directions prior to ordering or providing any materials or labor.

2.2 MATERIALS

- A. Cover: Door leaf shall be 1/4-inch-thick aluminum diamond plate reinforced for a AASHTO H-20 live load as indicated on the drawings. A staple for padlock shall be included for security. The hatch shall be provided with an automatic American made stainless steel hold-open arm with release handle and latch.
- B. Frame: The frame shall be extruded aluminum channel section with an integral anchor flange on all four (4) sides. The frame shall include an EPDM odor reduction gasket. A nut rail shall be provided integral to the frame on all sides.
- C. Fall Through Prevention Device: The cover shall be equipped with an aluminum grate to prevent fall through incidents (wet well structure cover only). The grate shall be designed for a

minimum 300 p.s.f. live load, with hardware components made of 316 American made stainless steel to resist corrosion and lock-open mechanism. The grate shall operate independent of the cover's reinforcing so that the cover will continue to meet the specified load requirements, even if the grate's leaves are damaged or removed. The leaves of the grate shall pivot on aluminum hinge devices with type 316 American made stainless steel hardware that permit them to rotate upward and automatically lock into position. When open the grate shall act as an additional fall through prevention barrier to the cover opening.

- D. Welding Rods: Aluminum welding rods shall be of type recommended by the aluminum manufacturer.
- E. Fasteners: Fasteners, screws, and bolts shall be concealed and shall be of 316 American made stainless steel.
- F. Miscellaneous Hardware: All hardware, but not limited to all parts of the latch, lifting mechanism assemblies, hold open arms and guides, brackets, hinges and pins shall be 316 stainless steel, and American manufactured. Springs shall be American made stainless steel Type 302, 304, or 316.

2.3 FABRICATION

- A. The floor access door shall be equipped with a flush watertight handle that does not protrude above the cover and an American made stainless steel hold open arm with red vinyl grip that automatically locks the cover in the 90-degree open position.
- B. The door shall have stainless-steel hinges with stainless steel flat head bolts. All stainless-steel components shall be Type 316 American made alloy.
- C. The door shall be manufactured and assembled in the United States. Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten (10) years.
- D. An American made stainless steel slam lock latching device for the cover lid shall be provided to enable full closure of the lid flush with the surrounding slab structure.

2.4 MANUFACTURERS, OR CITY APPROVED EQUAL

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken package or container bearing the label of the manufacturer.
- B. Storage: All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

3.2 CRAFTSMANSHIP

- A. All WORK shall be performed by craftsmen experienced in the installation of mechanical metal work. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field in advance. Joints, junctions, miters, and butting sections shall be precision-fitted, with no gaps occurring between sections, and all surfaces shall be flush and aligned and without sharp edges.

3.3 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's attached instructions and shall be embedded in the precast top at the time of casting. All Aluminum surfaces in contact with concrete shall be coated in accordance with Section 09800 – Protective Coating.

END OF SECTION

SECTION 07920

SEALANTS AND CAULKING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide caulking, sealing, and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. Technical Data: A complete materials list including the manufacturer's technical data and literature, specifications, color sample, joint width, depth tables and installation instructions.

PART 2 -- PRODUCTS

2.1 SEALANTS AND CAULKING MATERIALS

- A. General:
 - 1. Manufacturer's Standards: In addition to the standards listed below, the sealants and caulking products and application shall be in accordance with the manufacturer's published recommendations and specifications.
 - 2. Wherever manufacturer's names and products are listed in this Section, "or equal" products will be considered in accordance with Section 01300 - Contractor Submittals.
- B. Materials shall conform to the following requirements:
 - 1. Significant Movement Sealants (plus or minus 25% movement capability)
 - a. For expansion wall joints; masonry and metal curtain wall joints; precast concrete joints and concrete panels; perimeter sealing (windows, doors, and panels); control joints; interior and non-traffic horizontal joints.
 - 1) Two component, non-sag, polyurethane or polysulfide sealant conforming to Federal Specification TT-S-227E, Class A, Type II, and ASTM C 920, Type M, Class 25, Grade NS.

Products Silaflex "2c NS", Dow Corning "983".
 - 2) One component, non-sag, low modulus, polyurethane or polysulfide sealant

conforming to Federal Specification TT-S230C, Class A, Type II, and ASTM C 920, Type S, Class 25, Grade NS.

Sikaflex "1a" Tremco "Dymonic"

- 3) One component, non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.
Pecora "865" Dow Corning "795"

2. Sealants

a. For non-structural applications

- 1) One component non-sag, medium modulus, neutral cure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

Pecora "865" Dow Corning "795"

- 2) One component, non-sag, high modulus, acetoxycure, silicone sealant conforming to Federal Specification TT-S-1543A, Class A, and ASTM C 920, Type S, Class 25, Grade NS.

3. Interior Sealant and Caulking

a. For general applications

- 1) One component, acrylic latex caulking conforming to ASTM C 834

Pecora Corp. "AC-20" Tremco "Tremflex 834"

4. Preformed Sealants: Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air, and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.
5. Tape Sealant: Dimensions shall be as required for application conditions. Tape sealants shall be type recommended by tape manufacturer for connecting and bonding to surfaces.
6. Joint backing (backer rod) material shall be resilient, closed-cell polyethylene foam conforming to ASTM D 1752, Type II or III, and/or bond breakers of proper size for joint widths. Joint backing shall be compatible with sealant manufacturer's product and shall not stain the sealant nor the materials to which applied.
7. Primer: Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants and shall not stain the sealant nor the materials to which applied.

Manufacturer shall be consulted for all surfaces not specifically covered in submittal application instructions. Primer shall be used in accordance with manufacturer's instructions with all primers being applied prior to the installation of any backer rod or bond breaker tape.

8. Cleaning and cleanup solvents, agents, and accessory materials shall be as recommended in the manufacturer's printed instructions for cleaning up.

2.2 COLOR OF SEALANTS

- A. Color of sealants that are visible after installation shall match adjacent building finish. If in doubt of color match, obtain color approval from CITY OF CAPE CORAL.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages or containers bearing the manufacturer's label. Packages or containers shall be delivered to the site with seals unbroken.
- B. Shelf Life: Materials whose shelf life dates have expired shall not be used in the WORK. Such materials shall be promptly removed from the project site.
- C. Storage: All materials shall be carefully stored in accordance with the manufacturer's instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the product. Materials shall be stored at temperatures between 40 and 90 degrees unless otherwise specified by the manufacturer.

3.2 INSTALLATION

- A. Manufacturer's Recommendations: All WORK under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications, and installation instructions except where more stringent requirements are indicated herein; and, except where project conditions require extra precautions or provisions to assure performance of the caulking or sealant system.
- B. Authorized Installers: Caulking and sealants shall be complete systems and be installed only by installers authorized and approved by the respective manufacturers.

C. Surface Preparation:

1. General: The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints which will be in contact with the sealant. Ferrous metal surfaces shall be cleaned of all rust, mill scale, and other coatings by wire brush, grinding, or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants.
2. Concrete and Masonry Surfaces: Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence, and loose mortar shall be removed from the joint cavity.
3. Steel Surfaces: Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finishes, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.
4. Aluminum Surfaces: Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall not leave a residue, shall be as recommended by the manufacturer of the aluminum and shall be non-staining.
5. Wood Surfaces: Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

- D. Joint Types and Sizes: Joint shapes and sizes shall be as indicated or as necessary for job conditions where not indicated. Joints to be caulked or sealed include through- bolt holes, door frames, louver and ventilator frames, joints between openings where items pass through exterior walls, concrete masonry, or combination of these surfaces, and as otherwise indicated or required for water-tightness, weatherproofing, or air- tightness. Use sealing compound at both exterior and interior surfaces of exterior wall penetrations.

3.3 SEALANT FILLED JOINTS

- A. Sealant: Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be installed to the required depth without displacing the backing. Unless otherwise indicated or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealants shall be installed free of air pockets, foreign embedded matter, ridges, and sags. Sealer shall be applied over the sealant if recommended by the sealant manufacturer.

- B. Sealant Depth: Sealant depth in joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- C. Masking Tape: Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.
- E. Backing: Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.
- F. Bond-Breaker: Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.
- G. Primer: Primer shall be used on concrete, concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.
- H. Applications: A full bead of sealant shall be applied into the joint under sufficient pressure, with the nozzle drawn across sealant, to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. During application, the tip of the nozzle shall be kept at the bottom of the joint thereby forcing the sealant to fill from the bottom to the top. Sealants shall be tooled immediately after exposure with a caulking tool or soft bristled brush moistened with solvent. The finished sealant-filled joint shall be slightly concave unless otherwise indicated.

3.4 CLEANING

- A. After application of sealant and caulking materials, adjacent materials, which have been soiled, shall be cleaned and left in a neat, clean, undamaged, or unstained condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

END OF SECTION

SECTION 09800

PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
- C. The following surfaces shall not be protective coated:
 - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.
- E. Where protective coatings are to be performed by a lower tier contractor, the contractor shall possess a valid state license as required for performance of the painting and coating WORK called for in this specification.

F. EXISTING COATINGS/LININGS

1. To maintain all warranties, manholes and wet wells that have an existing coating or lining must only be penetrated and repaired with same lining material with the consent of the existing lining manufacturer. CONTRACTOR must not compromise any existing warranty.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.
- B. Technical Data: Manufacturers technical data and literature, specifications and installation instructions.
- C. Color Samples: CONTRACTOR shall submit color samples for paint and coatings where colors are designated in the specifications. CITY OF CAPE CORAL will select, with CITY concurrence, the colors to be used.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. Warranty Inspection: A warranty inspection may be conducted during the eleventh month following completion of all coating and painting WORK or as deemed necessary by the CITY. The CONTRACTOR and a representative of the coating material Manufacturer may be requested to attend this inspection. All defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the CITY OF CAPE CORAL. The CITY OF CAPE CORAL may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the three-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability: The CONTRACTOR shall use suitable coating materials as recommended by the Manufacturer.
- B. Compatibility: In any coating system only compatible materials from a single Manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- C. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

- D. Colors: Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples.

2.2 INDUSTRIAL COATING SYSTEMS

- A. Material Sources: Each of the following manufacturers is capable of supplying many of the industrial coating materials indicated herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. All industrial-coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- B. System 1 – Ferrous metal surfaces, indoors or outdoors, exposed or covered, galvanized and not galvanized: All surfaces exposed to the atmosphere that do not come into contact with wastewater or corrosive atmosphere including pumps, motors, machinery, above ground piping, valves and pipe supports, miscellaneous steel shapes, angles, exposed surfaces of electric panels, conduit, ventilation fans, air-conditioning units, duct work, shall have surface preparation and coating system as listed in Article 3.10 of this Section.

Metal surfaces that are submerged in wastewater or subjected to wastewater gases including new equipment specified and installed in this Contract, miscellaneous steel, pumps, piping and valves, shall have surface preparation and coating system as listed in Article 3.10 of this Section.

- C. System 2 – Interior coatings for wet wells, valve vaults, master manholes, force main discharge manholes, and manholes within 100-feet of master manholes: The interior of the wet wells of lift stations, valve vaults, the first manhole upstream of a wetwell, manholes where force mains discharge, manholes within 100-feet of master manholes, and other structures as indicated in the Drawings shall be lined as listed in Article 3.11.A. of this Section. All surface preparation shall be as indicated in Article 3.11.A of this Section. A ten-year comprehensive warranty against failure of workmanship and materials shall be provided by the coating supplier.
- D. System 3 – Exterior coatings for wet wells, manholes, master manholes, force main discharge manholes and valve vaults is not required with the application of Xypex waterproofing additive in concrete mixes. Xypex waterproofing additive is required for all precast concrete wet wells, manholes, master manholes, force main manholes and valve vaults, in accordance with Section 03400 – Precast Concrete.
- E. System 4 - All aluminum surfaces in contact with concrete: All aluminum surfaces in contact with concrete, such as hatch covers for vaults and wetwell shall be coated with coal tar epoxy as listed in Article 3.11.C of this Section.
- F. System 5 – Non-Ferrous Metal, Plastic, and Fiber Glass: The interior of isolated non-ferrous parts associated with equipment or piping shall have surface preparation and shall be coated as listed in Article 3.12 of this Section. Do not coat handrails, gratings, frames or hatches. Only

primers recommended by the coating manufacturer shall be used.

- G. System 6 – Exterior Exposed PVC Piping: The exterior of exposed PVC piping shall have surface preparation and shall be coated as listed in Article 3.13 of this Section.

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. If requested by the CITY OF CAPE CORAL, the CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary.

3.2 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Special attention shall be given to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures. Pinholes or holidays will not be allowed in the finished surface of the coating.
- C. All damage to surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition and to the satisfaction of the CITY. If coating systems are damaged prior to the acceptance by the CITY, the CITY reserves the right to reject the product or item and require it be replaced at the CONTRACTOR's expense.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective-coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

- A. General: All surfaces to receive protective coatings shall be cleaned prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust. Interiors of all wet wells including wet well bottoms shall be completely cleaned and inspected by the OWNER or OWNER'S REPRESENTATIVE prior to any coating.
- B. Protection of Surfaces not to be coated: Surfaces, which are not to receive protective coatings, shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent WORK during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blast cleaning or coating operations.
- E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

3.5 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires finish coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating WORK performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet

shall be submitted with the shop drawings for the equipment.

- D. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 30 days before being topcoated or less time if recommended by the coating manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions. If coating systems are damaged prior to the acceptance by the CITY, the CITY reserves the right to reject the product or item and require it be replaced at the CONTRACTOR's expense.
- G. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment shop drawings.
- H. Manufacturers of components regularly used in the CITY's utility system may submit factory applied coating systems for pre-approval through the CITY's Qualified Products List (QPL) process described in Section 01600. As part of the submittal process, the CONTRACTOR shall provide written verification or certification that the factory applied coating is suitable for the intended use. Factory applied coating systems that have been pre-approved through the CITY's QPL process may be used instead of the coating system schedules described herein.

3.6 APPLICATION OF COATINGS

- A. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- B. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thickness are likely to be present.
- C. Special attention shall be given to materials, which will be joined so closely, that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- D. Finish coats, including touch-up and damage repair coats shall be applied in a manner, which will present a uniform texture, and color matched appearance.
- E. Coatings shall not be applied under the following conditions:

- 1. Temperature is above the manufacturers allowable maximum or below the manufacturer's

allowable minimum.

2. Dust or smoke laden atmosphere.
 3. Damp or humid weather that exceeds recommended maximum allowable.
 4. When the substrate or air temperature is less than 5 degrees F above dew point.
 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.
 6. When wind conditions are not calm.
- F. The finish coat on all WORK shall be applied after all concrete, masonry, and equipment installation is complete and the WORK areas are clean and dust free. Finish coat shall be applied within 30 days of factory shop prime coating application.
- G. Prior to coating of concrete, CONTRACTOR shall administer a pH test to ensure that the concrete has sufficiently cured. pH testing shall be in the form of a TSW6 test or City approved equal. All concrete must pass pH testing prior to coating.
- H. The full interior of wet wells including the wet well bottom shall be coated prior to installation of the stainless-steel base plate for the pumps.

3.7 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section; whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary may be required until the coatings have fully cured.

3.8 IDENTIFICATION OF PIPING

- A. Identification of above ground piping shall be in accordance with the table provided below and with additional requirements set forth in Section 15000 – Mechanical, General.
- B. Tnemec Safety Paint colors or a city approved equal shall be used for all projects as indicated below.
- C. All above-ground pipe and fittings, Polyvinyl Chloride (PVC) pipe and fittings, metallic and non-metallic marking tapes, and any other marking device, will be color coded in accordance with the APWA Uniform Color Guide, which is as follows:

Color	Paint Color Number		Application
Red	Candy Apple Red/Safety - 06SF	RGB 186,42,26	Potable Water Hydrant Bonnet (6")

Color	Paint Color Number		Application
Orange	Tangerine Orange/Safety - 04SF	RGB 217,110,25	Potable Water Hydrant Bonnet (8" and 10"), Communication, Telephone, Alarm, or
Green	Spearmint Green/Safety - 09SF	RGB 48,142,84	Potable Water Hydrant Bonnet (12" and greater)
Yellow	Lemon Yellow/Safety - 02SF	RGB 224,201,62	Potable Water Hydrant Body, Gas, Oil, Steam, Petroleum or Gaseous Material
Lavender	Purple Rain/Safety - 14SF	RGB 137,52,103	Irrigation Water Main
Lavender	Purple Rain/Safety - 14SF	RGB 137,52,103	Irrigation Water Hydrant Body
White	White - 00WH	RGB 248,253,254	Irrigation Water Hydrant Bonnet
Green	Spearmint Green/Safety - 09SF	RGB 48,142,84	Waste Water Forcemain, Sewer
Blue	True Blue/Safety - 11SF	RGB 0,94,145	Potable Water Main
White	White - 00WH	RGB 248,253,254	Irrigation Hydrant Bonnet
Black	N/A	N/A	Above ground HDPE pipe – no coating required

D. The following colors shall be used in conjunction with the Safety Paint colors for all projects:

Color	Paint Color Number	Application
Light Gray	32GR ANSI No. 70	Electrical (Conduits, Boxes, Motors, Generators, Signal Lines, Etc.) Stainless steel is not coated.

3.9 SHOP AND FIELD INSPECTION AND TESTING

- A. Inspection Devices: The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- B. Holiday Testing: As directed by the CITY, the CONTRACTOR shall holiday test all coated ferrous surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems including manholes and wet wells. Areas, which contain holidays, shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
 1. Coatings with Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or City approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Coatings with Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, or City approved equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or City approved equal, shall be added to the water prior to wetting the detector sponge.
- C. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage such as Mikrotest model FM, Elcometer model 111/1EZ, or City approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gage.
 - D. Surface Preparation: The exterior surfaces of pipes, valves and other above ground items that will be exposed to the atmosphere inside structures or above ground will be abrasive blasted to a maximum commercial Grade SSPC-SP-6, NACE 3 and given a high solids epoxy primer coat of Tnemec Series 66 Hi-Build Epoxoline, 4.0 mils DFT at the factory. A finish coat will be applied after installation according the color schedule specified in this Section or as listed in Specification 15000. Evaluation of blast cleaned surface preparation WORK will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

3. 10 SYSTEM 1 COATING SYSTEM SCHEDULES - FERROUS METALS

A. Coating System Schedule, Ferrous Metal - Not Galvanized:

Item	Surface Prep.	System No.
Non-immersion: All surfaces indoors and outdoors, exposed or covered, except those included below.	SP-6	(1) Tnemec Primer at the factory – Hi-Build Epoxoline (66), DFT = 3.0 - 5.0 mils Second coat - Hi-Build Epoxoline (66), DFT = 3.0 - 5.0 mils Finish coat – Endura Shield III (73), DFT = min. 2.0 - 3.0 mils Or City approved equal

Immersion: All surfaces indoors and outdoors, exposed or covered, submerged in wastewater or subjected to wastewater gases	SP-10. Spot field repair damaged areas per SSPC-SP10.	<p>(1) Tnemec Primer at the factory – Tnemec Series 1 Omnithane @ 2.5-3.5 mils DFT</p> <p>Spot Field Repair of Damaged Shop Primer: Tnemec Series 1 @ 2.5-3.5 mils DFT</p> <p>First Coat: Tnemec Series 446 Perma-Thane @ 5.0-7.0 mils DFT.</p> <p>2nd Coat: Tnemec Series 446 @ 5.0-7.0 mils DFT.</p> <p>Or City approved equal</p>
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B. Coating System Schedule, Ferrous Metal - Galvanized:

Item	Surface Prep.	System No.
All exposed surfaces indoors and outdoors, except those included below.	SP-7 or per Manufacturer's Instructions	<p>(1) Tnemec Primer at the factory - Hi-Build Epoxoline (66), DFT = 2.5-3.5 mils DFT</p> <p>Finish coat – 73 Endurashield @ 2.0-3.0)</p> <p>Or City approved equal</p>
Immersion: All exposed surfaces indoors and outdoors, submerged in wastewater or subjected to wastewater gases	SP-7 or per Manufacturer's Instructions	<p>(1) Tnemec Primer at the factory - Hi-Build Epoxoline (66), DFT = min. 4.0 mils Finish coat – 66 @ 2.5-3.5 mils DFT</p> <p>Or City approved equal</p>

3. 11 SYSTEM 2 COATING SYSTEM SCHEDULES – WETWELLS, VALVE VAULTS AND MANHOLES

A. Interior Coating System Schedule, Wetwells, Valve vaults, Force main Manholes, Manholes within 100-feet of Master Manholes, and Master Manholes:

Item	Surface Prep.	System No.
All interior surfaces of sewer wetwells, valve vaults, manholes within 100-feet of master manholes, master manholes, and manholes where forcemains discharge	IET System “Duplex Prep Method” and applications shall be as specified by IET Systems	(1) Wetwell Liner Coating System as manufactured by IET Systems, DFT = min. 60 mils (125 mils for repair lining) (2) Gas guard

3. 12 SYSTEM 3 COATING SYSTEM SCHEDULES – WETWELLS MANHOLES, AND VALVE VAULTS

- A. Exterior Coating System Schedule, Wetwells, Manholes, Master Manholes, and Valve Vaults:
 - a. Exterior coating not required with the application of Xypex waterproofing additive. Xypex waterproofing additive is required for all precast concrete structures, in accordance with Section 03400 – Precast Concrete.

3. 13 SYSTEM 4 COATING SYSTEM SCHEDULES – ALUMINUM SURFACES

- A. Aluminum surfaces in contact with concrete:

Item	Surface Prep.	System No.
All aluminum surfaces in contact with concrete (covers for vaults and wetwells)	Per Manufacturer’s Instructions SP-1 and SP-7 or per Manufacturer’s Instructions	(4) - Tnemec Primer at the factory - Hi-Build Epoxoline (66), DFT = min. 4.0 mils Finish coat – Hi-Build Tnemec-Tar (46H-413), DFT = min. 16.0 mils - Or City approved equal PROTECTIVE COATING REVISED MARCH 2022

3.14 SYSTEM 5 COATING SYSTEM SCHEDULES - NON-FERROUS METAL, PLASTIC, and FIBER GLASS

Item	Surface Prep.	System No.
Interior (non-immersion) non-ferrous parts, plastic and fiberglass	SP-1 and scarify	(5) Tnemec Primer at the factory - Hi-Build Epoxoline (66), DFT = 2.5-3.5 mils Finish coat- Hi-Build Epoxoline(66), DFT = min. 2.5-3.5 mils City Approved Equal
Exterior (non-immersion) non-ferrous parts, plastic and fiberglass	SP-1 and scarify	(5) Tnemec Primer at the factory - Hi-Build Epoxoline (66), DFT = 2.5-3.5 mils Finish coat - Endura Shield III (73) , DFT = min. 2.0 - 3.0 mils City Approved Equal

3. 15 SYSTEM 6 COATING SYSTEM SCHEDULES - EXPOSED PVC PIPE

Item	Surface Prep.	System No.
Exterior PVC Pipelines	SP-1 and scarify	(6) Tnemec Primer at the factory - Endura Shield III (73), DFT = min. 2.0 - 3.0 mils Finish coat - Endura Shield III (73), DFT = min. 2.0 - 3.0 mils City Approved Equal

END OF SECTION

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide all equipment and appurtenant work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all equipment except where otherwise indicated.
- C. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer in all cases. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

1.2 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01300 - Contractor Submittals. 1.3

QUALITY ASSURANCE

- A. Costs: Responsibility shall be the Contractor's for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The City will provide a meter for all water provided. Contractor shall be responsible for the cost of power until the equipment is turned over to the City. If available, the City's operating personnel will provide assistance in the field-testing.
- B. Inspection: The Contractor shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness all required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, and related items to obtain all required permits and certificates, and shall pay all inspection fees.
- C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

1. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.
2. All materials shall meet the physical and mechanical properties in accordance with the reference standards.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Noise Level: When in operation, no single piece of equipment shall exceed the noise level requirements of OSHA, the City of Cape Coral or any other regulatory agencies.

- B. Mechanical Service Factors

	Mechanical Service Factors	
	Electric Motor	Internal Combustion Engine
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

- C. Where load classifications are not indicated, service factors based on AGMA 514.02 shall be used for standard load classifications and service factors for flexible couplings.
- D. Welding: Unless otherwise indicated, welding shall conform to the following:
 1. Latest revision of AWWA D100, Welded Steel Tanks for Water Storage.
 2. Latest revision of AWWA C206, Field Welding of Steel Water Pipe.
 3. Butt fusion welding in accordance with ASTM D 2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
 4. Welding Requirements and Procedures per ANSI/AWS D.1.1.
 5. American Welding Society Welding Handbook (AWS-032) and Welded Joint Design (AWS-062)
 6. All welding shall be in accordance with the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
 7. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

- E. Protective Coating: Equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated as indicated in Section 09800 – Protective Coating. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- F. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.
- G. Identification of Equipment: Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number for the particular item.
- H. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations.
- I. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, and wind loads.
- B. Equipment Foundations: Mechanical equipment, tanks, electrical and control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to ensure compatibility with equipment.

2.3 BEARINGS

- A. General: Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.
- C. Re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

- D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to ensure maximum bearing life and best performance.
- E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life (years) (whichever comes first)	L-10 Design Life (hours)
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

- F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lowercasing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

2.4 EQUIPMENT LUBRICANTS

- A. The Contractor shall install lubricants for all equipment during storage and prior to initial testing of the equipment. When specified, after successful initial testing, final testing, and satisfactory completion startup testing, the Contractor shall conduct one complete lubricant change on all equipment. In addition, the Contractor shall be responsible for the proper disposal of all used lubricants. The City will then be responsible for subsequent lubricant changes.

2.5 FACTORY TESTING

- A. The following tests shall be conducted on each indicated pump system:
 - 1. Motors: Motors shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test reports shall indicate test procedure and instrumentation used to measure and record data, be certified by the motor manufacturer's test personnel and be submitted to the City. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the shop drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be

approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.

- a. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation. Test results shall be furnished to the pump manufacturer prior to the pump test.
 - b. Any equipment or material which fails a test shall be removed and replaced.
2. Pump Systems: All centrifugal pump systems shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) acceptance Level "A" or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the project motor and variable speed drive if equipped with variable speed drive. Testing of prototype models will not be acceptable. The following minimum test results shall be submitted:
- a. Hydrostatic test results
 - b. At maximum speed, a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute. For variable speed driven pumps, each pump shall be tested between maximum and minimum speed at 100 rpm increments.
 - c. Pump curves showing head, flow, BHP, and efficiency requirements.
 - d. NPSH required test curve if required by the pump specification. Otherwise, a calculated NPSH required curve may be submitted.
 - e. Certification that the pump shaft horsepower demand did not exceed the motor horsepower equivalent to the 1.0 service rating at any point on the curve.
3. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested until found satisfactory.

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
 1. Installation of equipment
 2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity
4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

B. Instruction of the City's Personnel

1. Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for a number of days indicated in those sections to instruct the City's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
2. The representative shall have at least 2 years' experience in training.
3. Training shall be scheduled 3 weeks in advance of the scheduled session.
4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the City shall be incorporated into the material.
5. The training materials shall remain with the trainees after the session.
6. The City may videotape the training for later use by the City's personnel.

3.2 INSTALLATION

- A. General: Equipment shall be installed in accordance with the manufacturer's written recommendations.

3.3 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with lower tier contractors to avoid interferences.
- B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the Contractor shall coordinate such features with the City OF CAPE CORAL and provide all material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

- A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with "Never Seize" compound or City approved equal.

3.5 WELDING

- A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

- A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.
- B. The following field testing shall be conducted:
 - 1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.
 - 2. Obtain concurrent readings of motor voltage, amperage, capacity, and bearing temperatures.
- C. Field-testing shall be witnessed by the City. The Contractor shall notify the City of the test schedule three weeks in advance.
- D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

SECTION 11148

SUBMERSIBLE NON-CLOG PUMPS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide submersible non-clog pumps and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump which will best satisfy the indicated requirements.
- C. The requirements of Section 11000 – Equipment General Provisions apply to this Section.

1.2 EXTENDED PERIOD FOR CORRECTION OF DEFECTS

- A. The Contractor shall correct all defects in the pumping system upon notification from the City within three years of operation from the date of Substantial Completion. Corrections shall be completed within 5 days of notification.

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor's Submittals.
- B. Contractor shall submit shop drawings including manufacturer's data, performance data curves, cut sheets, UL or FM rating certificate, and factory test data.
- C. Contractor shall submit OPERATION AND MAINTENANCE MANUALS in accordance with Section 01730 – Operating and Maintenance Data.

PART 2 -- PRODUCTS

2.1 GENERAL DESCRIPTION

- A. Identification: See Pump Station Drawings for the pump station name, the pump station location, and the pump information.
- B. Operating Conditions: The WORK of this Section shall be suitable for long term operation under the following conditions:
 - 1. Duty - Intermittent
 - 2. Drive - Constant speed
 - 3. Ambient environment - Outdoors, submerged
 - 4. Ambient temperature, (degrees F) - 30 to 120

- | | | | |
|-----|-------------------------------------|---|---|
| 5. | Ambient relative humidity (percent) | - | 30 to 100 |
| 6. | Fluid service | - | Municipal Wastewater |
| 7. | Fluid temperature, (degrees F) | - | 35 to 100 |
| 8. | Fluid pH range | - | 5 to 10 |
| 9. | Fluid specific gravity | - | 1 |
| 10. | Project site elevation (m.s.l) | - | As shown on the Drawings |
| 11. | Minimum available NPSH (ft) | - | As per manufacturer's instruction |
| 12. | Pump removal method | - | Rails |
| 13. | Power supply | - | See Drawings for voltage & phase, 60 HZ |
| 14. | Minimum Horse Power | - | As shown on the Drawings |

C. Performance Requirements: See Pump Station Drawings for the pump performance requirements.

2.2 PUMP REQUIREMENTS

A. General:

1. Each pump, with its cable and appurtenances, shall be able to withstand continuous submergence to a minimum depth of 65 feet, when running or off, without leakage.
2. Each pump shall be able to operate for short periods at zero static suction head without causing any damage to any part of the unit.
3. For new lift station construction, all pumps shall be a minimum of 5 HP

B. Pump Construction: Construction of submersible non-clog pumps shall conform to the following requirements:

- | | | | |
|----|-------------|---|---|
| 1. | Connections | - | Machined metal-to-metal quick disconnect type, for withdrawal of unit from above without disconnecting pipe. When lowered into place, the pump shall automatically connect and lock into the discharge pipe, allowing for zero leakage at all anticipated pump heads. |
| 2. | Pump Design | - | Single stage, centrifugal type, close-coupled to sealed or submersible electric motor, for operation in wet well, without external cooling. |
| 3. | Impeller | - | Non-clog type with replaceable wear rings on impeller and in casing, to handle raw unscreened sewage, solids, and fibrous materials. |

4. Bearings - Permanently lubricated, heavy-duty axial and radial ball or roller bearings, top and bottom, with a minimum L-10 life of 60,000 hours, at continuous, maximum load and speed, supported by detailed calculations, to be submitted with the shop drawings.
5. Seals - Dual mechanical tandem, one stationary and one revolving shaft seals with individual springs, tungsten carbide ring, each not requiring any maintenance, and capable of withstanding 1.5 times pump shutoff head.
6. Oil Chamber - To supply oil for lubrication and cooling of the shaft seals.
7. Support - Cast duckfoot bend or discharge elbow with machined face, anchored to sump floor.
8. Cables - Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. Provide 5 ft. slack in all cables. All cables shall be connected to the pumps and tested at the factory.
9. Lifting Devices - American made type 316 stainless steel guide rails with brackets and stainless-steel lifting system of sufficient operating length or with a stainless-steel guide cable system with hooks and tension device. Provide 5 ft. slack in all guide cables. All guide rails must be installed level and straight without bends.

C. Materials:

1. Pump, volute, oil casing, - Cast iron sliding, bracket, motor frame, ASTM A-48 Class 35B
2. Impeller - Cast iron, statically and dynamically balanced.
3. Pump shaft - American made Type 420 stainless steel, or 1045 carbon steel with Type 420 stainless steel sleeve.
4. Exposed bolts, nuts, washers - American made type 316 stainless steel.
5. Mechanical seals - Independently operating tandem tungsten carbide or silicon carbide and carbon rings with stainless steel springs.
6. Wear rings - American made type 304 or 416 stainless steel and nitrile rubber with steel insert, with a Brinell hardness of 300 on impeller and 350 on case.

2.3 MOTOR

- A. Insulation: The pump motors shall be designed for continuous duty in hazardous locations. The stator and stator leads shall be moisture-resistant, insulated using the trickle impregnation method, capable of withstanding a temperature rise of up to 130 degrees C. The allowable temperature rise of the motor at full load condition shall not exceed 40 degrees C.
- B. Stator: The motor stator shall be mounted in an air-filled, watertight casing, and shall not be fixed in place by externally mounted screws that may cause leakage in the motor.
- C. Motor Rating: Motor voltage shall be as shown on the Drawings. Motor shall have a minimum service factor of 1.15. For motors driven by variable frequency drives, motor horsepower shall be the greater of:
 - 1. Non-overloading conditions throughout the pump curve.
 - 2. 1.15 times the horsepower required by the pump at maximum indicated flow.
- D. Junction Box: The motor shall have a junction box capable of being sealed completely from the stator casing to prevent leakage through the junction box into the stator housing should a motor cable be damaged, or some other means to prevent leakage into the junction box under any condition.
- E. Cable Entry: The pump cable entry seal design shall accommodate specific torque requirements to ensure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. If Secondary-sealing system is used, the manufacturers shall supply a cable cap as part of the spare parts for each pump. All cables shall be continuous, without splices from the motor to the control panel or associated junction box. The junction chamber, containing the terminal board, shall be leak proof.
- F. Cooling System: Each pump shall be provided with an adequately designed cooling system using a wastewater jacket and thermal radiator integrally cast with the stator casing. Cooling medium channels and ports shall be non-clogging by virtue of their dimensions. Wastewater jackets are not required for motors that are designed to operate continuously at full load with ambient cooling.

2.4 PUMP CONTROLS

- A. Pumps shall be controlled in accordance with Section 16480 – Pump Control Panel and as shown on the Electrical Drawings.

2.5 SPARE PARTS

- A. New Construction, Per Station Constructed:
 - 1. One pump impeller to match type and size installed
 - 2. One set of pump wear rings
- B. Lift Station Rehabilitations:
 - 1. None

2.6 FACTORY TESTING AND SHIPMENT

- A. The following procedures shall be included with the factory test for all pumps prior to shipment:
 - 1. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4 and full flow and recording the measured head and motor current for each flow.
 - 2. Verification of cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation, whether submerged, semi-submerged, or dry.
 - 3. Pump seals shall be designed for complete water tightness at 65 feet submergence for 30 minutes and data on factory testing and quality control shall be submitted with the shop drawings.
 - 4. All parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.
 - 5. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.
 - 6. The finished surfaces of all exposed flanges shall be protected by strong wooden blind flanges.
 - 7. Each pump shall be properly crated to protect the units against damage during shipment.

2.7 MANUFACTURER

- A. For pumps up to 5 HP – Myers (Pentair Pump Group) (See Drawings for pump model number). Pumps below 5 HP shall be used to replace existing pumps in rehabilitations only. No new construction shall use pumps smaller than 5 HP.
- B. For pumps 5 HP and larger

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The Contractor shall ensure that all anchor bolts be set only after the discharge piping has been properly installed, to ensure exact fit with piping components. The Contractor shall install the rail system plumb and shall provide five feet minimum slack in power and lifting device guide cables for easy removal.
- B. The City will arrange to have electrical power furnished to the area by Lee County Electric Cooperative as indicated on the drawings. The Contractor is responsible for connecting to the power junction box. Contractor shall provide sufficient conduits and wire in accordance with Specifications 16120 and 16140, with minimum 3 feet of cover, to establish power connection to the pump station. Contractor is made aware that location for pump stations may vary from side of the road to the median of the road. Sizing of conduit and wire per Subcontract Drawings.
- C. The Contractor shall arrange and pay for bracing (“holding”) existing power poles, as necessary.
- D. The Contractor shall coordinate with pump manufacturer and electric motor manufacturer to ensure that pump and electric motor match the requirements of the pump station and work properly.

3.2 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The Contractor shall demonstrate that all equipment meets the specified performance requirements. Contractor shall provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment who shall visit the site of WORK to perform the following tasks:
 - 1. Assist the Contractor in the installation of the equipment.
 - 2. Inspect, check, adjust if necessary, and approve the equipment installation.

3. Start-up and field-test the equipment for proper operation, efficiency, and capacity. A start-up test report shall be provided showing the results of the installation.
 4. Perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the City.
 5. Instruct the City's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. Start-up Testing shall be performed as follows:
1. Each pump individually under normal flow conditions
 2. Each pump individually under shut-off head condition
 3. All pumps running under normal flow conditions
 4. The following test data shall be recorded for each of the start-up test scenarios:
 - a. Phase Conductor megger tests;
 - b. Voltage Phase Measurements;
 - c. Neutral/Ground current measurement;
 - d. Phase Amperage measurements;
 - e. Listing of Pump model, HP, Impeller, Voltage, Serial numbers, and Overload Type;
 - f. Pump discharge flow (gpm) and pressure (psi).
- C. Contractor shall provide the Start-Up data test reports to the City within 5 days of the completion of the start-up testing.

END OF SECTION

SECTION 11150

LIFT STATION START-UP AND PERFORMANCE TESTING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall be responsible for performance testing all lift stations installed under this Contract.
- B. The requirements of Section 11000 – Equipment General Provisions apply to this Section.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall provide the City the documentation required by the testing procedures discussed in this Section.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 LIFT STATION START-UP

- A. Contractor Requirements Prior to Start-Up:
 - 1. The Contractor shall notify the City five (5) working days in advance of all lift station start-ups.
 - 2. Start-ups shall occur on Tuesday, Wednesday, and Thursday between the hours of 9:00 AM and 1:00 PM only.
 - 3. An email meeting request sent to the city of Cape Coral is required to schedule a lift station start-up.
 - 4. The following parties are required to attend the lift station start-up:
 - a. Prime contractor and/or project supervisor
 - b. Electrical contractor
 - c. Mechanical contractor
 - d. Pump and control panel representative
 - e. Project engineer
 - f. City inspector

5. All parties shall be notified and coordinated by the Contractor.
6. A minimum of two working days prior to the lift station start-up, the Contractor shall notify the City when the wet well is cleaned and emptied for inspection. The City will inspect the wet well and test the removal of the pumps using the guide rails prior to the filling of the wet well with testing water.
7. If the Contractor fails to comply with any of the requirements of this section the start-up shall be rescheduled at the Contractor's expense with a minimum of two working days' notice for the next scheduled date.
8. It is the sole responsibility of the Contractor to maintain the security of the station and site until acceptance by the City. The Contractor shall be financially responsible and liable for the lift station prior to acceptance by the City.

B. Lift Station Inspections and Start-Up

1. All RTU work must be completed and tested by the City prior to start-up. Contractor shall allow sufficient time for the City to complete this work prior to requesting a start-up.
2. The Contractor shall verify that all systems are clear for operation and all valves are in the proper position.
3. The Contractor shall inspect all electrical, mechanical, wet well, and valve vault components prior to the station start-up.
4. The wet well shall be empty and clean and all inverts in the wet well must be plugged prior to filling the wet well with water for testing (see 3.1 A. 6. Above).
5. After the City has inspected the emptied and cleaned wet well, the contractor shall fill the wet well with irrigation or portable water only. An irrigation or potable water line is required to fill the wet well for the start-up and three day test. A two-inch water line is required for start-up and testing. A one-inch line may be used if a two-inch service is not available with prior written approval by the City.
6. The Contractor shall have a full water truck on site to supply additional water which may be needed during the start-up.
7. The City will perform a test of the portable generator connection to the lift station prior to start-up.

C. Contractor Responsibilities During Start-Up

1. The contractor shall supply a four-inch or six-inch (as applicable) flange assembly or cam-lock cap adapted with a pressure gauge for installation on the emergency pump out connection in the valve vault.
2. The contractor shall supply a 0-15, 0-30, and 0-60 PSI liquid filled pressure gauge. All three gauges must be on site during the start-up.
3. All pump test results must be documented by the pump manufacturer or there representative.

- D. Upon completion of the lift station start-up, the Contractor and pump manufacturer shall complete the Lift Station Information data sheet provided in this section.

3.2 LIFT STATION THREE DAY TEST PROCEDURES

A. Contractor Requirements:

1. The Contractor shall contact the City's Water Reclamation department to schedule the three day test. An email meeting request is required to schedule the test.
2. The three day test must run three consecutive working days. All three day tests shall be scheduled Monday through Friday between the hours of 7:00 AM and 3:00 PM. No testing shall begin after Wednesday of each week.
3. The Contractor shall employ a competent contact person to be on-site each morning of the testing period. This person's name and phone number must be provided to the City prior to testing.
4. Two working days' notice is required in advance of scheduling the three day test.
5. For lift station rehabilitation projects (Capital Improvement projects only), the three day test will be conducted using gray water and will run continuously for 72 hours after returning the station to normal operation and power. Station operation will be monitored, recorded, and turned over to the City's engineer. Bypass pumping capabilities must stay in operation until successful completion of the three day test.
6. An irrigation or potable water fill line/hopes is required for the three day test to fill the wet well. A two-inch diameter line is required. If a two-inch line is not available at the lift station site, a one-inch diameter line may be used with prior approval from the City.
7. It is the sole responsibility of the Contractor to maintain the security of the station and site until acceptance by the City. The Contractor shall be financially responsible and liable for the lift station prior to acceptance by the City.
8. If deemed necessary and at the sole discretion of the City, the three day test may be required to be extended due to abnormal operation or failure during the three day test. The contractor shall be responsible for supplying all necessary personnel and materials necessary for the additional testing.

B. Testing Procedures:

1. The Contractor shall fill the wet well with irrigation or potable water to the point where all float switches are tipped.
2. Once filled, the City will verify the activation of the floats and alarms in the following sequence:
 - a. Lead pump on
 - b. Lag pump on
 - c. High water alarm with red indicator light on panel
 - d. High water alarm with RTU
3. If potable water is being used for the three day test, the Contractor shall ensure that proper backflow devices are in use. Additionally, the Contractor shall contact the City's Utilities Collection and Distribution division for further information and requirements.
4. After all floats and alarm operations have been successfully verified, each pump will be manually operated from the control panel using the HOA switch in the "automatic" position. The City will monitor the pump operation to verify proper telemetry operation.
5. With both pumps on, the City will verify that the high water alarms have been cleared.

6. Once the water level reaches the off position, the pumps should automatically shut off.
7. Once the pumps have shut off, the City will assist in setting the level indicators (floats) and water inflow rate into the station for the remainder of the three day test.
8. At the end of each day, the City will confirm successful operation of the test.
9. The pumps will be turned to the “off” position using the HOA switch in the control panel.
10. The water supply will be turned off.
11. At the completion of the third day, the City’s Maintenance Supervisor will confirm if the test has been successfully completed or if additional testing is required.

END OF SECTION

SECTION 11312

COLLECTION SYSTEM BYPASS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this Section consists of providing all temporary bypassing to perform all operations in connection with the flow of wastewater around pipe segment(s) or lift stations. The purpose of bypassing is to prevent wastewater overflows and provide continuous service to all wastewater customers. The Contractor shall maintain wastewater flow in the construction area in order to prevent backup and/or overflow and provide reliable wastewater service to the users of the wastewater system at all times.

PART 2- PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide and maintain adequate equipment, piping, tankers and other necessary appurtenances in order to maintain continuous and reliable wastewater service in all wastewater lines as required for construction. The Contractor shall have tankers, backup pumps, backup generators, piping and appurtenances ready to deploy immediately.
- B. Bypass pumps shall be skid mounted diesel pumps as manufactured by Godwin Pumps, Thompson, or an approved equal.
- C. Blocked gravity lines shall include two (2) line stops, one (1) primary and one (1) redundant.
- D. Bypass equipment shall include discharge flow meter and multiple pressure gauges.

PART 3- EXECUTION

3.01 GENERAL

- A. The Contractor shall have scheduled delivery of all materials, equipment and labor necessary to complete the repair, replacement or rehabilitation to the job site prior to isolating the gravity main segment, manhole, or pump station. The Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows and is to view a minimum of two (2) cycles of station operation prior to existing the job site. The bypass pumping system shall be sized to pump a minimum firm capacity of the combined total flow of all lift station pumps, and the system shall include redundant backup pumps in case of failure to primary pumps. This shall be completed for each bypass operation required to complete the project.

3.02 TRAFFIC CONSIDERATIONS

- A. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways, and alleys. This requirement may necessitate temporary trenching of piping at critical intersections. Ingress and egress to adjacent properties shall be maintained at all times. Ramps, steel plates or others methods shall be deployed by the Contractor to facilitate traffic over surface piping. High traffic commercial properties may require alternate methods.

3.03 BYPASS PLAN

- A. The Contractor shall submit a comprehensive written plan according to Specification 01340: Shop Drawings, Working Drawings, and Samples, that describes the intended bypass for the maintenance of flows during construction. The Contractor shall also provide a sketch showing the location of bypass pumping equipment for each pump station or line segments around which flows are being bypassed. The plan shall include any proposed tankers, pumps, bypass piping, backup plan and equipment, work schedule, monitoring log for bypass pumping, monitoring plan of the bypass pumping operation and maintenance of traffic plan. The Contractor shall cease bypass operations and return flows to the new and/or existing sewer when directed by the City. All piping shall be designed to withstand at least twice the maximum system pressure or a minimum of 50 psi, whichever is greater. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system. When bypass operations are complete, all bypass piping shall be drained into the wastewater system prior to disassembly.

3.04 BYPASS OPERATION

- A. The City shall review and provide written comments to the bypass plan prior to implementation of the bypass. The Contractor shall plug off and pump down the sewer manhole or line segment in the immediate work area and shall maintain the wastewater system so that surcharging does not occur.
- B. Where work requires the line to be blocked beyond NORMAL WORKING HOURS and bypass pumping is being utilized, the Contractor shall be responsible for on-site monitoring the bypass operation 24 hours per day, 7 days per week, by on-site personnel with expertise in the operation and maintenance of any repair of the bypass pumps. If accepted in the bypass plan by the City, any electronic monitoring in lieu of on-site monitoring must be detailed in the comprehensive written plan and approved by the City.
- C. The Contractor shall insure that no damage will be caused to private property as a result of bypass pumping operations. The Contractor shall complete the work as quickly as possible and satisfactorily pass all tests, inspections and repair all deficiencies prior to discontinuing bypassing operations and returning flow to the sewer manhole, line segment, or lift station.
- D. The Contractor shall immediately notify the City should a sanitary sewer overflow occur, and the Contractor shall take the necessary action to clean up and disinfect the spillage to the satisfaction of the City and/or other governmental agency. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up and disinfect the spillage to the satisfaction of the City and/or other governmental agency. When bypassing a pump station, one back-up pump equal to the primary unit shall be required on site at all times. Bypass

pumps and motors shall have a maximum rating of 60 decibels at 20 feet for sound attenuation.

3.05 CONTRACTOR LIABILITY

- A. The Contractor shall be responsible for all required pumping, equipment, piping and appurtenances to accomplish the bypass and for any and all damage that results directly or indirectly from the bypass pumping equipment, piping and/or appurtenances. The Contractor shall also be liable for all City personnel and equipment costs, penalties and fines resulting from sanitary sewer overflows. In addition to the aforementioned costs to be paid by the Contractor, a fine of \$5,000 per overflow occurrence or sanitary sewer disruption shall be assessed. For each 24-hour period following overflow that the wastewater overflow/damage is not completely cleaned, disinfected, and returned to full operational capacity an additional \$5,000 fine will be assessed daily. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

END OF SECTION

SECTION 13480
ELECTRICAL PANELS (MOV)

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install electrical control panels and panel mounted equipment as specified herein and shown on the Drawings.
- B. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.
- C. The Contractor shall furnish, install and test all control panels as required, all in accordance with the requirements of the Contract Documents.
- D. The Contractor shall furnish, install, and test the remote telemetry unit in accordance with Specification 17250.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with the Contract Documents.
- B. Contractor shall submit shop drawings and technical information for all materials and equipment required for construction and installation of the control panel. Manufacturer's cut sheets showing materials, dimensions and operating systems shall be submitted as part of the shop drawings. Shop drawing submittals shall include the following:
- C. Shop Drawings
 - 1. Enclosure NEMA 4X rating, dimensions, material, and color.
 - 2. Arc Flash warning signs as required by OSHA and per Article 110.16 of the NEC, most recent edition, as applicable.
 - 3. Bus ampacities, voltage rating and interrupting capacity. Include materials of construction.
 - 4. Ground bus size and material of construction.
 - 5. Conduit entrance provisions.
 - 6. Main incoming line entry provision (top or bottom).
 - 7. Control unit nameplate schedule.

8. All circuit breaker types, frames and settings.
9. Relays, timers, pilot devices, control transformer VA and fuse sizes.
10. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished. Diagrams shall include all remote devices. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the Contractor stamped "REJECTED-RESUBMIT." Once schematics have been either "APPROVED" or "APPROVED AS NOTED", Contractor shall laminate and mount schematics to inside of the exterior door to the control panel. Schematics shall be posted in accordance with OSHA requirements.
11. Short circuit rating of the complete assembly.
12. Replacement parts lists and operation and maintenance procedures.

1.3 QUALITY ASSURANCE

- A. General: Each electrical control panel shall be the product of a single manufacturer. All materials and parts in this unit shall be new and unused, of current manufacture, and of the highest grade, and free from all defects that may affect performance.
- B. Unit Responsibility: Each electrical control panel and all appurtenant equipment specified herein shall be provided by a single manufacturer/vendor, establishing one source of responsibility for the equipment performance and assuring high standards of quality, coordination, reliability and service.
- C. Factory Test: Prior to delivery at the job site, each electrical control panel and appurtenant equipment shall be tested at the manufacturer's testing facility to verify that the equipment is free of any defects. All cabinets shall bear UL label, as applicable. Provide factory test report at time of delivery.

1.4 WARRANTY

- A. Warranty: Equipment furnished under this Section shall be guaranteed against defective parts and workmanship under the terms of the manufacturer's and supplier's standard warranty. In no event shall it be for a period of less than five (5) years from date of final acceptance of the system and shall include labor, materials and travel costs for necessary repairs at the job site.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Each electrical control panel shall be built in accordance with the details as required by the Contract drawings and/or as specified herein.

- B. The electrical control panel construction shall comply with applicable requirements of NEMA 250 and UL Standards 50 and 508.
- C. Wiring of electrical control cabinets shall utilize stranded copper conductor rated for 600- volts and UL listed as specified in Section 16120 Wires for annunciator and indication circuits shall be No. 16 AWG minimum. All others shall be No. 14 AWG minimum. All incoming and outgoing status or signals shall be terminated on master set of terminal blocks. All wiring from the master terminals to internal components shall be factory- installed and shall be contained in 4-inch wide by 4-inch high plastic wireways having removable covers. Wiring to door mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- D. All wiring within the enclosure shall be neatly routed by the use of slotted type wiring duct with snap on type covers i.e. ("Panduit" sized correctly, not overstuffed). Wiring on the rear of the inner door shall be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage.
- D. Terminal points of all terminal strips shall be permanently identified. All terminal numbers and identifying nomenclature shall correspond to and be shown on electrical diagrams. All terminal points shall be shown on electrical schematic diagrams.
- E. All wiring terminal points within the electrical enclosure(s) shall be outfitted with an insulated crimped on wire ferrule.

2.2 ELECTRICAL CONTROL PANEL

- A. Main circuit breaker and enclosure for each electrical control panel shall be marked as "Suitable for Use as Service Equipment" as required by the local or national electric codes. Arc Flash warning signs shall be provided as specified in 1.2. C.2.

The electrical control panel shall be housed in a NEMA 4X 316 American made stainless steel enclosure with 30% extra mounting space for additional equipment. Enclosure shall have provisions for padlocking the door and a dead front inner door unit for mounting controls. The control panel enclosure shall be Underwriters Laboratories (UL) 50.

- B. There shall be permanently affixed to the interior side of the exterior enclosure door both a nameplate and a 10" x 12" pocket for log sheet storage. The nameplate shall contain the following information, voltage, phase, rated horsepower, speed, date manufactured and pump and control panel manufacturer's name, address and telephone number.
- C. Power supply to the control panel shall be 120/208 volts, 120/240 volts, or 277/480 volts, 3-phase, 4- wire (30kva to 50kva WYE Bank Transformer); or 120/240 volts, 1-phase, 3-wire, as shown on the Contract Drawings. Service shall be as indicated on Drawings.

- D. A non-fusible service disconnect switch in a NEMA-4X American made stainless steel enclosure and surge arrestor shall be installed between the meter and the control panel. Additionally, in conformance to LCEC Service Requirements, a non-fusible service disconnect switch in a NEMA-4X American made stainless steel enclosure and surge arrestor shall be provided on the input to the meter for 480 volts only.
- E. The electrical control panel containing motor starters shall be combination circuit breaker type; unit shall have panel mounted control devices as specified herein. Metal dividers shall be provided in the interior panels to isolate electrical components having different functions.
- F. Circuit breakers shall conform to the circuit breaker criteria as specified below:
 - 1. The control panel shall consist of a main utility circuit breaker and 15 ampere, 120-volt circuit breakers as required.
 - 2. Circuit breakers shall be factory-assembled, molded-case circuit breakers with permanent instantaneous magnetic and thermal trips in each pole, sealed trip units, and with fault-current limiting protection, ampere ratings as indicated. Construct with over center, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Provide push-to-trip feature for testing and exercising circuit breaker trip mechanism. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with AL/CU-rated mechanical screw type removable connector lugs. The breaker contact material shall be a non-weldable silver alloy. The breakers shall have arc-extinguishing chutes.
- G. Lights and Alarms
 - 1. Indicator Lights: There shall be installed on the face of the inner door unit, heavy duty oil tight indicator lights as shown on the Drawings
- H. Control Devices
 - 1. Products of the same type shall be of the same make. This requirement applies to all control devices and, insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this project.
 - a. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts, shall be heavy-duty, corrosion resistant Type 4/4X shall have the number of positions and poles shown.
 - b. Indicating Lights: Indicating lights shall be 120 volt, full-voltage, push-to-test type, and shall be heavy-duty, corrosion resistant Type 4/4X, as specified above for selector switches. Each shall be nickel-plated with a screwed-on glass prismatic lens approximately one-inch in diameter.
 - c. Magnetic Relays: Magnetic relays shall be general-purpose miniature plug-in-type relays with 115-volt AC coils and 10-amp contacts, unless otherwise shown. Relays shall

be socket-mounted to a common mounting channel. Mounting dimensions and drilling for AC and DC relays shall be identical.

- d. Control Relay: The control relays shall operate from 24VAC. They shall be enclosed, plug-in 8-pin type with octal-style screw terminal sockets, including retainer clip.
- e. Terminal Blocks: Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 volts. White or other light-colored marking strips shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number imprinted on the marking strip with permanent marking fluid.
- f. Fuses: Fuses shall be used in the primaries and secondaries of control transformers.

I. Voltage Surge Arrester:

- 1. Voltage surge arresters shall be furnished and installed for protection of actuator motors and controls. It shall be suitable for use with a 120/240 volt, 1-phase, 3-wire, grounded neutral system or a 120/208-volt, 120/240 volt, or 277/480 volt, 3-phase, 4-wire, grounded neutral system, as applicable. Surge protectors shall be U.L. listed and installed per power company requirements and manufacturers' specifications, surge protectors shall be attached to the main disconnects. Surge arresters shall be manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.

J. Breakers and Receptacles:

- 1. Panels shall be provided with two 120-volt GFI duplex receptacles mounted on the control panel dead front, fed from dedicated single-pole 20-amp circuit breakers.
- 2. Panels shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that a fault in a branch circuit will trip only the branch breaker but not the main breaker.

K. Nameplates:

- 1. Nameplates shall be fabricated from white-letter, blackface-laminated plastic engraving stock, Formica type ES-1, or City approved equal. Each shall be fastened securely, using fasteners of American made stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.

L. Manufacturers of Electrical Control Panels:

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2.3 EXTERIOR CONTROL PANEL REQUIREMENTS

- A. Service disconnects shall be provided as shown on drawings and shall be NEMA 4X 316 SS Enclosure. Furnish and install disconnect switch for 277/480-volt, 3-Phase installations on the utility side and ahead of the meter box immediately adjacent to the meter socket. The disconnecting switch shall be rated not less than the load to be carried and must have an interrupting rating at system voltage sufficient for the current to be interrupted and a fault current rating greater than the system fault current. The disconnecting switch for 277/480V service shall be readily accessible to LCEC personnel and shall accept an LCEC lock. The Contractor shall coordinate with LCEC as regards to the required interrupting rating. For all other installations (120/208-volt, 3-Phase, 120/240-volt & 1- Phase, 120/240-volt, 3- Phase), the Contractor shall furnish and install a disconnect switch and surge arrestor on the load side of the disconnect as shown on the contract drawings.
- B. Furnish and install Electrical Meter NEMA 3R Aluminum Box (no bolt). Meter box shall in accordance with the utility provider (LCEC) requirements.
- C. Step-down Electrical Transformer (as required).

PART 3 -- EXECUTION

3.1 GENERAL

- A. The Contractor shall install and test all electrical control panels in accordance with manufacturer's published instructions. Conduit installation shall be coordinated so that all conduit stub-ups are within the area allotted for conduit as indicated on the drawings.

3.2 INSTALLATION

- A. Each electrical control panel shall be set level within 1/32-inch per horizontal foot. After leveling and shimming, the Contractor shall anchor control panel to concrete pad and shall grout in place so that no space exists between the pad and support beams. Installation shall be above 100-year flood level as indicated on the drawings.
- B. When possible, mount the electrical / control cabinet(s) doors facing north or south with top sunshield (Top) to help reflect and alleviate the heat on the metal surface area for controlling internal high temperatures within the enclosures.
- C. The Contractor shall:
 - 1. Tighten all sheet metal and structure assembly bolts.
 - 2. Inspect all protective devices to verify operation under normal conditions. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors.

3. After equipment is installed, touch up scratches and verify that the affixed nameplate and other identification is accurate and in compliance with these Specifications.

3.3 WARRANTY

- A. The manufacturer shall furnish a five (5) year warranty against defects in materials and workmanship covering parts and labor on all items supplied under this section.

END OF SECTION

SECTION 15000

MECHANICAL, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide all piping and mechanical systems indicated, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all piping sections in Divisions 2 and 15.
- C. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, and connectors for a complete and functional system.
- D. All above-ground pipe, valves, fittings, metallic and non-metallic marking tapes, and any other marking device, will be color coded as specified in Section 09800 – Protective Coating.
- E. Pipeline markers shall be as specified in Sections 02596, 02597, 02598, and 02599 for sanitary sewer and force main, potable water and irrigation water, respectively, if applicable. The markers will not be placed in contact with DIP fittings.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.
- B. Certifications
 - 1. All necessary certificates, test reports, and affidavits of compliance shall be submitted by the Contractor.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Extent of Work: All pipes, fittings, couplings and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and as indicated.
- B. Pipe Supports: All pipes shall be adequately supported, restrained, and anchored as required on the Contract Drawings and Section 15006 – Pipe Supports.
- C. Lining: Application, thickness, and curing of lining shall be in accordance with the

requirements of the applicable Sections of Division 2, unless otherwise indicated.

- D. Coating: Application, thickness, and curing of coating shall be in accordance with the requirements of the applicable Sections of Division 2, unless otherwise indicated. Pipes, valves and fittings above ground or in structures shall be field-coated in accordance with Section 09800 - Protective Coating.
- E. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined in Section 02666 - Pipeline Testing and Disinfection, or as indicated in this Specification.
- F. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the City shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with requirements.
- G. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as recommended by AWS.
- F. Torque Requirements: Tightening shall be performed as recommended by ASME PCC-1.

2.2 PIPE FLANGES

- A. Steel Pipe Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C 207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, 150- lb. class. Where the design pressure is greater than 150 psi up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C 207 Class E or Class F, or ANSI/ASME B16.5 150-lb class. However, AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI/ASME B16.5, 300-lb class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards indicated for these pipes.
- B. Flanged ductile iron pipe (with ductile iron threaded flanges): Where the design pressure is 125 psi or less, flanges shall conform to either ANSI/AWWA C115/A21.15 Class D or ANSI B16.1 125-lb class. Where the design pressure is greater than 125 psi, up to a maximum of 250 psi, flanges shall conform to either ANSI/AWWA C115/21.15 or ANSI B16.1 250-lb class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA 115/21.15. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.

- C. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C 207, or as indicated for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in the form of welded or screwed eye bolts.
- D. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- E. Flange Bolts: All bolts and nuts shall conform to the materials as shown on the Construction Drawings, or as specified in the Specifications. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts. The cut ends of all-thread shall be free of burs and sharp edges. Flange bolts/nuts shall be torqued to bolt specifications unless otherwise indicated. All threads on stainless steel bolts shall be protected with an anti-seize lubricant suitable for submerged stainless-steel bolts, to meet government specification MIL-A-907E. Anti-seize lubricant shall be classified as acceptable for potable water use by the NSF, organization which develops standards relating to public health safety and the environment. Buried bolts in poorly drained soil shall be coated the same as the buried pipe. Unless otherwise indicated, flange bolts shall be of Type 316 stainless steel (SS) and American made.
- F. Flange Gaskets: Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of aramid fiber base, with nitrile binder and non-stick coating, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated.
- G. Flange Gasket Manufacturers, or City approved equal:

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2.3 PIPING CONNECTIONS

- A. Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 15006 – Pipe Supports.
- B. Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ANSI B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ANSI/ASME B1.20.1.
- C. Flexible Connectors: Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and in piping systems where indicated. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F

shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rate for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9 inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the Manufacturer. The Contractor shall submit manufacturer's shop drawings and calculations.

2.4 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with this Section.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the City.

2.5 LIFT STATION DISCHARGE PIPING

- A. Discharge piping in lift stations shall be HDPE, unless otherwise specified in the Drawings. All pipe penetrations in the wet well and valve vault shall be core bit drilled. Breaking, hammering, and other methods of concrete removal in these areas will not be accepted. All pipe penetrations in the wet well and valve vault shall be sealed with modular seals.

2.6 LOW-LEAD BRASS

- A. All brass shall comply with the Federal Reduction of Lead in Drinking Water Act.

PART 3 -- EXECUTION

3.1 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

3.2 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Divisions 2 and 15.
- B. Lined Piping Systems: The lining manufacturer shall take full responsibility for the complete, final product and its application. All pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.
- C. All underground pipes shall be installed with 3" detectable marking tape, of appropriate color, along the entire pipe length in accordance with manufacturer's specification.

- D. All pipe, fittings, and identification tape shall be color coded in accordance with the APWA Uniform Color Code as specified in the respective pipe service specifications section. Electronic markers shall be installed at all fittings and changes in direction.
- E. The detectable marking tape shall be installed during back-filling to 12 to 18 inches directly above the pipe.
- F. Locating markers, as manufactured by 3M, shall be placed at all changes of direction, start and end of vertical deflections, and potable water and sanitary sewer services at the curb stop and property line respectively. Markers will be located at a maximum depth of 4 feet and shall not be placed in direct contact with metallic fittings.
- G. The use of burlap, wood, or other similar temporary plugs will not be permitted on and pipes or valves.
- H. Cleanup: After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be turned over in a clean and functional condition.

END OF SECTION

SECTION 15001

SADDLES, STOPS AND SMALL VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide all miscellaneous small valve systems indicated, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all piping sections in Divisions 2 and 15.
- C. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, and connectors for a complete and functional system.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.
- B. Contractor shall provide manufacture data for all valves, saddles, and stops.

PART 2 -- PRODUCTS

2.1. GATE VALVES FOR SERVICES (2-INCH)

- A. All Gate Valves shall be resilient-seated gate valves. Resilient-seated gate valves shall conform to ANSI/AWWA C 515 – Resilient-Seated Gate Valves for Water Supply Service. The valves shall be suitable for a design working water pressure of 250 PSI. The valve body, bonnet, and disc shall be of ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 1 of ANSI/AWWA C 515. The stem, stem nuts, glands, and bushings shall be of bronze, with the stem seal per ANSI/AWWA C 515. Gate Valves shall be provided on all 2-inch services. The valves shall be threaded. Brass nipples shall be used to connect the valve to the tapping saddle, and the valve to the Sch. 80 PVC transition coupling.
- B. Manufacturers for Gate Valves for Services (2-inch):

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 VALVE BOXES

- A. Cast iron valve boxes shall be provided for all valves that are below finished grade elevations. Valve boxes shall be a two-piece screw type consisting of a cast iron base and adjustable cast iron top section with cover that shall be marked "WATER," "IRR" or "SEWER", unless otherwise noted on the Drawings.

- B. Manufacturers of Valve Boxes for Water, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- C. Manufacturers of Valve Boxes for Irrigation Water, or City approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 METER BOXES

- A. Meter boxes shall be provided for all potable water and irrigation water meters below finished grade elevations.
- B. Meter boxes for potable water service shall consist of a base box and adjustable cover with dimensions shown in the Drawings. The meter box shall have appropriate pipe penetrations for service connections. The box cover shall have a hinged lid marked "City of Cape Coral" and "POTABLE WATER" as shown on the Drawings. The base box and hinged lid shall be black color for identification.

- C. Meter boxes for irrigation water service shall consist of a base box and adjustable cover with dimensions shown in the Drawings. The meter box shall have appropriate pipe penetrations for service connections. The box cover shall have a hinged lid marked "City of Cape Coral" and "Reuse Water for Irrigation Only – Do Not Drink – No Beber" as shown on the Drawings. The base box and hinged lid shall be lavender color for identification.

- D. Manufacturers of Meter Boxes

- 1. Unimproved Properties

- a. No meter boxes on unimproved properties.

- 2. Improved Properties

- a. Single Residential Potable Water Service (1") to Accommodate One 5/8" Meter: **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Boxes shall be black, reading CITY OF CAPE CORAL, POTABLE WATER, furnished with a hinged cover without reading lead, snap lock tab & no hole. The box shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** with 12" deep body. Provide one 3" wide x 4" tall mouse hole centered at both ends of box body.
 - b. Double Residential Potable Water Service (1") to Accommodate Two 5/8" Meters: **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Boxes shall be black, reading CITY OF CAPE CORAL, POTABLE WATER, furnished with a hinged

cover without reading lead, snap lock tab & no hole. The box shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** with 12" deep body. Provide one 3" wide x 4" tall mouse hole centered on the inlet end of box body. Provide two 3" wide x 4" tall mouse holes centered 6.5" apart at outlet end of box body.

- c. Single Commercial/Residential Potable Water Service (2") to Accommodate One 1.5" or 2" Meter: **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Boxes shall be black, reading CITY OF CAPE CORAL, POTABLE WATER, furnished with a flush solid cover without reading lead, snap lock tab & no hole. The box shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** with 12" deep body. Provide one 3" wide x 4" tall mouse hole centered at both ends of box body.
- d. Single and Double Residential Irrigation Water Service (1") to Accommodate No Meters: **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Boxes shall be lavender, reading CITY OF CAPE CORAL, REUSE WATER FOR IRRIGATION USE ONLY, furnished with a hinged cover without reading lead, snap lock tab & no hole. The box shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** with 12" deep body. Provide one 3" wide x 4" tall mouse hole centered at both ends of box body.
- e. Single Commercial/Residential Irrigation Water Service (2") to Accommodate One 1.5" or 2" Meter: **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**. Boxes shall be lavender, reading CITY OF CAPE CORAL, REUSE WATER FOR IRRIGATION USE ONLY, furnished with a flush solid cover without reading lead, snap lock tab & no hole. The box shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** with 12" deep body. Provide one 3" wide x 4" tall mouse hole centered at both ends of box body.

2.4 SERVICE SADDLES

- A. Service saddles up to 6-inches shall be brass only. Service saddles 10-inches and greater shall be double strap, ductile iron saddles. Saddles shall be anchored by a minimum of two bolts for brass saddles up to 6" and a minimum of four bolts for cast iron saddles 10" and larger and sized to fit the pipe material of the line being tapped. For AWWA C 900 PVC pipe the saddle shall be sized for the exact outside diameter of the pipe. The saddles will have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets will be BUNA-N rubber and straps will be corrosion resistant alloy steel. If the outlet is greater than 2 inches then tapping sleeves and valves for full body fitting will be used.
- B. An internal shell cutter will be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters, twist drills or hole saws are not acceptable. Shell cutter will have sufficient depth to handle the heavy wall PVC pipe.
- C. Ductile iron pipe may not be directly tapped. Service Saddles must be used on all pipes that are to be tapped.
- D. Manufacturers for Service Saddles:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.5 CORPORATION STOPS

- A. All corporation stops shall be designed and manufactured to conform to AWWA Standard C-800 and shall be ball valve type. This specification covers thread dimensions, the metal alloy, and the pressure rating for all valves. All corporation stops shall be individually inspected and tested for leaks with air pressure. The corporation stops shall all be compatible with tapping machines of current design. Corporation stops shall be designed to withstand working pressures up to 300 psi.
- B. Manufacturers for Corporation Stops:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.6 CURB STOPS AND BRASS FITTINGS

- A. All curb stops shall be designed and manufactured to conform to AWWA Standard C-800 (ASTM B-62) and shall be oriseal or ball valve type of same size as the connecting service line unless otherwise indicated on the drawings. Curb stops shall be compression fitting and ensure tightness in both directions at all pressures, easy turning, non-binding, with minimum pressure loss. Curb stops shall be a solid one-piece tee-head and stem. Curb stops shall allow 90° motion and shall be enclosed and protected. Curb stops shall have a heavy cast bronze body and shall be designed to withstand working pressures up to 300 PSI. The ends shall be integral or secured with adhesive to prevent unintentional disassembly. A bronze or plastic ring shall lock the stem solidly into the body of the valve. EPDM O-rings in the stem shall assure permanent watertight seal at top. The curb stops shall have lock wings. Irrigation water curb stops shall be positively identified by manufacturer supplied tag or bronze imprint. Potable water curb stops shall be positively identified by field attached blue plastic tie-wrap fixed to the body of the curb stop on the inlet and outlet side of the valve or through hole in the tee-head.
- B. Manufacturers for Curb Stops and Brass Fittings:

The following equipment and manufacturers shall be used for potable water and irrigation water curb stops as shown on the Contract Drawings:

1. 1" SINGLE POTABLE WATER (RESIDENTIAL, SHORT AND LONG SIDE)

Ball type curb stop with CTS compression x FNPT.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2. 1" SINGLE IRRIGATION WATER (RESIDENTIAL, SHORT AND LONG SIDE)

Ball type curb stop with CTS compression x FNPT for reclaimed water.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

3. 1" DOUBLE POTABLE WATER (RESIDENTIAL, SHORT SIDE AND LONG SIDE)

1" x ¾" x 6 ½" U-branch and two (2) ¾" ball type curb stop with FNPT x FNPT.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

4. 1" DOUBLE IRRIGATION WATER (RESIDENTIAL, SHORT AND LONG SIDE)

1" x 1" x 1" Brass Tee and two (2) 1" ball type curb stop with CTS compression x FNPT for reclaimed water.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

5a. 2" POTABLE WATER (COMMERCIAL/RESIDENTIAL) – HDPE OPTION

Ball type curb stop with CTS compression adaptor x FNPT.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

5b. 2" POTABLE WATER (COMMERCIAL/RESIDENTIAL) – PVC OPTION

Ball type curb stop with PVC compression adaptor x FNPT.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

6a. 2" IRRIGATION WATER (COMMERCIAL/RESIDENTIAL) – HDPE OPTION

Ball type curb stop with CTS compression adaptor x FNPT for reclaimed water.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

6b. 2" IRRIGATION WATER (COMMERCIAL/RESIDENTIAL) – PVC OPTION

Ball type curb stop with PVC compression adaptor x FNPT for reclaimed water.

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.7 LEAD REQUIREMENTS

All products shall comply with the Safe Drinking Water Act (SDWA), including the amendment from Bill S. 3874 *the Reduction of Lead in Drinking Water Act*. This amendment reduces the maximum allowable percentage of lead from 8.00% to 0.25% (weighted average) as it pertains to "pipe, pipe fittings, plumbing fittings and fixtures".

PART 3 -- EXECUTION

3.1 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

3.2 GENERAL

- A. All valves and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Divisions 2 and 15, and in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 15006

PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide pipe supports, hangers, guides, and anchors, complete, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. Contractor shall submit manufacturer's data.
- C. The requirements of Section 15000 – Mechanical, General apply to this Section.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with and meet the requirements of the latest edition of the applicable plumbing code or local administration requirements.
- B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, the Contractor shall provide such supplementary members. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the City.
- C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.
- D. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the

loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

- E. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.
- F. Heat Transmission: Supports, hangers, anchors, and guides shall be so designed and insulated to prevent excessive heat from being transmitted to the structure or to other equipment.
- G. Riser Supports:
 - 1. Above Grade: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
 - 2. Below Grade: Riser supports shall be anchored into the wet well walls as shown on the Drawings.
- H. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- I. Materials of Construction:
 - 1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be 316 American made stainless steel construction, unless otherwise indicated.
 - 2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24 inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 American made stainless steel, unless otherwise indicated.
 - 3. Corrosive: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 American made stainless steel or FRP, unless otherwise indicated.
- J. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or 316 American made stainless steel shields.

- K. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

- A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thickness, the pipe support spacing shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

1. Support Spacing for Ductile-Iron Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
All Diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint) (except at canal crossings)

2. Support Spacing for Copper Tubing:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

3. Support Spacing for Schedule 80 PVC Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

2.3 COATING

- A. Galvanizing: Only where indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. General: All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME 831.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the placement of concrete.
- B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other WORK.

END OF SECTION

SECTION 15060

PVC PRESSURE PIPE, SOLVENT-WELDED (ASTM D 1785, MODIFIED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents. This Section specifies PVC pressure pipe with solvent-welded or flanged. Screwed or threaded PVC joints are not allowed.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. CONTRACTOR shall submit manufacturer's data.
- C. The CONTRACTOR shall provide manufacturer's list of approved solvent and primers for each type of pipe.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

- A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, Schedule 80, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 80, as called out on the Drawings. Pipe material shall be blue for potable water and purple for irrigation water.

2.2 PIPE JOINTS

- A. Pipe joints shall be solvent-welded with solvent cement in accordance with ASTM D 2564 - Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems, and with primer in accordance with ASTM F 656 - Primers for use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings. Thread sealant will not be permitted. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ANSI/ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene.

2.3 FITTINGS

- A. Solvent Welded: Solvent-welded shall be Schedule 80 PVC fittings in accordance with ASTM D 2464 - Socket-Type Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

- B. Flanged Fittings: Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. Flanges in accordance with ANSI/ASME B 16.5.

2.4 GLUE AND PRIMER

- A. Solvent cement shall be NSF approved and shall meet the requirements of ASTM D 2564 – Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems.
- B. Primers shall be NSF approved and shall meet the requirements of ASTM F 656 – Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.

PART 3 -- EXECUTION

3.1 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Pipe fittings shall be thoroughly cleaned before assembly.

3.2 PIPE JOINTS

- A. General: PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. It is recommended that the CONTRACTOR obtain the assistance of the pipe manufacturer's field representative to instruct the pipefitters in the correct installation and support of PVC piping. Refer to Section 15006 – Pipe Supports for requirements on PVC pipe support.
- B. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket. The pipe manufacturer shall approve cement and primer.
- C. Supports and Anchors: Piping shall be firmly supported with fabricated or commercial hangers or supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.
- E. Flange Joints: Flanged joints shall be made with gaskets and Type 316 American made

stainless steel bolts and nuts. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

3.3 INSPECTION, FIELD TESTING, AND DISINFECTION

- A. Inspection: Finished installations shall be carefully inspected for proper joints and sufficient supports, anchoring, interferences, and damage to pipe, fittings, and coating. Incomplete installation or damage shall be repaired to the satisfaction of the CITY OF CAPE CORAL.
- B. Field Testing: The CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. When services are hot-tapped into an existing live pressure main, the PVC service piping shall be service tested with corporation stops open and curb stops closed. The service test shall be a witnessed visual inspection for leaks conducted at the existing main work pressure prior to backfilling and compacting the service. When the PVC service piping is installed as a part of a new system, the services shall be tested as a part of the main testing. CONTRACTOR shall verify that all new corporation stops are open prior to performing testing of the mains. The CONTRACTOR shall furnish all test equipment, labor, materials, and devices.
- C. Disinfection of Potable Water Services: Disinfection of potable water services shall be performed at the time chlorination of the pressure main is being conducted. To ensure that potable water services are properly disinfected, each service line shall be flushed continuously for a minimum of 10 seconds measured from the time water begins to flow from the curb stop. Bacteriological sampling shall be performed in conformance with State Department of Health requirements and Section 02666- Pressure Pipeline Testing and Disinfection.
- D. Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures. Testing shall be as specified in Section 02666 – Pressure Pipeline Testing and Disinfection.
- E. Leaks shall be repaired to the satisfaction of the CITY OF CAPE CORAL, and the system shall be re-tested until no leaks are found.

-END OF SECTION-

SECTION 15201

TAPPING VALVES AND SLEEVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide tapping valves, sleeves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 – Contractor Submittals.
- B. Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 TAPPING VALVE AND SLEEVE

- A. Construction: Tapping valves shall conform to ANSI/AWWA C 515 - Standard for Resilient seated gate valves for Water Supply Service except as modified for passage and clearance of tapping machine cutters. Tapping valves shall allow full-size cutters to be used. Seats in the body shall be replaceable without removing the valve from the pipeline. Tapping sleeves shall conform to AWWA C223 and be constructed of ductile iron, gaskets shall be vulcanized natural or synthetic rubber. Stainless steel sleeves are not allowed. Hardware and fasteners for tapping sleeves and valves shall be 304 or 316 stainless steel and American made. Tapping sleeves shall be epoxy coated inside and out. The epoxy coating shall conform to City of Cape Coral Technical Specifications Section 09800 for potable water use or for force main fittings.
- B. Actuators: Unless otherwise indicated, all gate valves shall have manual actuators.
- C. Manufacturers for MJ Tapping Sleeves:
SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST
- D. Manufacturers for Tapping Valves:
SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 INSTALLATION

- 1. All tapping valves and sleeves shall be installed in strict accordance with the Manufacturer's

written recommendations. DO NOT drill a hole in PVC pipe with a twist drill or auger bit. DO NOT use a hand-held drill. Cutting tool shall be of a shell type design, having a minimum of two slots that retains the cut coupon after penetrating the pipe wall and shall be designed to accommodate C900 PVC pipe. Tapping branches of same diameter as pipeline being tapped shall not be permitted. In this case a cut-in tee shall be provided.

1. All materials including but not limited to the tee, valve, and cutting tool shall be disinfected prior to assembly.
2. The assembly shall be pressure tested at 150 PSI under the supervision of a City of Cape Coral inspector with a minimum of 48-hours advanced noticed required.
3. Remove the coupon of flush out all debris after the tap has been completed.
4. The Contractor is responsible to retrieve any coupon that was not removed after the tap and flush. This may include flushing the nearest hydrant and/or removing a section of the water main to remove the coupon. Any bacteriological testing required due to removal is the sole responsibility of the contractor.
5. All tapping sleeves must be located a minimum of 24" from an existing bell, flange, fitting, or tap.
6. Size on size taps are not permitted.

END OF SECTION

SECTION 15202

BUTTERFLY VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300.
- B. Contractor shall submit manufacturer's data, including all pertaining information for materials of construction, dimensions, and compliance with specified valves.

1.3 QUALITY ASSURANCE

- A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 -- PRODUCTS

2.1 BUTTERFLY VALVES (AWWA) (Potable Water & Irrigation Water Valves Larger than 12-inch)

- A. General: Butterfly valves shall be placed on secondary water and potable water pipe larger than 12-in. diameter. Butterfly valves for water working pressures up to 150 psi shall conform to ANSI/AWWA C 504 - Rubber Seated Butterfly Valves, subject to the following requirements: Valves shall be of the size indicated. Valves shall be Class 150 with actuator for Class 150 unless indicated otherwise. Flanged valves shall have ANSI 125-lb flanges. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not have any obstructions or stops. The valve shall be epoxy coated in the interior per ANSI/AWWA C 550 - Protective Epoxy Interior Coatings for Valves and Hydrants. Valves shall have 2" actuating nuts.
- B. Valves shall be of the body type, pressure class, end joint, and actuator specified.
- C. Construction: Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, Rubber-Seated Butterfly Valves, suitable for the service. Seats shall be positively clamped and / or bonded into the body of the valve only. Valves shall not utilize seating on the discs. Cartridge-type seats which rely on a high coefficient of friction for retention shall not be acceptable.

Description	Material Standards
Valve Bodies	Ductile Iron, ASTM A536 Grade 65-45-12
End flanges	Same material as valve bodies
Valve shafts	Wrought Stainless steel or Nickel-Copper Alloy
Description	Material Standards
Valve discs	Same material as valve bodies. All discs must utilize 316 stainless steel edges along the discs.
Rubber seats	New natural or synthetic rubber. Rubber seats must be on the valve body, not the valve disc.
Seat mating surfaces	Stainless steel or Nickel-Copper Alloy
Clamps and retaining rings	Type 316 American made stainless steel retaining rings and cap screws.
Valve bearings	Self-lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09800 – Protective Coating

- D. Manual Actuators: Actuators shall be subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a 2-inch square actuating nut. Screw-type (traveling nut) actuators will not be permitted for valves 30 inches in diameter and larger.
- E. Worm Gear Actuators: All submerged and buried valves, and valves, 30 inches and larger, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.
- F. Manufacturers:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All exposed butterfly valves shall be installed to allow the removal of the complete valve assembly without dismantling the valve or operator. Valve installation shall be in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 15203

CHECK VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide check valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 – Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 CHECK VALVES (3-INCH AND SMALLER)

- A. Check valves 3 inches and smaller in size shall be bronze swing check valves complying with all requirements for Type III and Type IV valves as covered in Federal Specification WW-V-51a for Class "A" 125-pound Bronze Check Valves. Check valves for chemical feed lines, except sulfuric acid lines, shall be swing check valves with PVC body and EPDM seats and seals by Asahi/America, Inc., Medford, Mass.

2.2 CHECK VALVES (4-INCH AND LARGER)

- A. The valves shall be designed, manufactured, tested and certified to American Water Works Association Standard ANSI/AWWA C508.
- B. The valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.
- C. The valves shall have flanges with drilling to ANSI B16.1, Class 125.
- D. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line.

- E. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.
- F. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with alloy steel. The flex portion of the disc contains nylon reinforcement and shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short 35-degree disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig.
- G. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.
- H. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
- I. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.
- J. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- K. All exposed bolts, nuts, hardware, and other miscellaneous items shall be 316 stainless steel and American made.
- L. Manufacturers:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 15206

RESILIENT WEDGE GATE VALVES

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300- Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems.

2.2 RESILIENT-SEATED GATE VALVES (12 inches and smaller)

- A. General: All Gate Valves shall be resilient-seated gate valves.
- B. Construction: Resilient-seated gate valves shall conform to ANSI/AWWA C 515 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a design working water pressure of 200 psig, with flanged or mechanical joint ends. The valve body, bonnet, and disc shall be of ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C515. The stem, stem nuts, glands, and bushings shall be of bronze or stainless steel, with the stem seal per ANSI/AWWA C 515. Valves shall have 2" actuating nuts. All associated plugs, bolts, hardware and other miscellaneous items for valves shall be 304 or 316 stainless steel unless otherwise specified.
- C. Two stem seals will be provided and the stem seals will be of the O-ring type. The stem nut must be independent of the gate.
- D. Protective Coating: All valves shall be factory painted and coated in accordance with Section 09800 - Protective Coating.

- E. Actuators: Resilient-seated gate valves shall have manual actuators. The actuator must be the same manufacture or brand of the installed valve. All associated plugs, bolts, hardware and other miscellaneous items for valves shall be 304 or 316 stainless steel unless otherwise specified.
- F. Manufacturers: SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 RESILIENT-SEATED GATE VALVES (Above Ground Installation)

- A. General: All Gate Valves shall be Resilient-Seated Gate Valves.
- B. Construction: Resilient-seated gate valves shall conform to ANSI/AWWA C 515 - Resilient-Seated Gate Valves for Water and Sewerage Systems. The valves shall be suitable for a design working water pressure of 250 psig (unless otherwise specified), with flanged ends. The valve body, bonnet, and disc shall be of ductile iron and the disc shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 2 of ANSI/AWWA C515. The stem, stem nuts, glands, and bushings shall be of bronze or stainless steel, with the stem seal per ANSI/AWWA C 515. Valves shall have handwheel operation. All associated plugs, bolts, hardware and other miscellaneous items for valves shall be 304 or 316 stainless steel unless otherwise specified.
- C. Two stem seals (minimum) will be provided and the stem seals will be of the O-ring type. The stem nut must be independent of the gate.
- D. Protective Coating: All valves (interior and exterior) shall be factory fusion-bonded epoxy-coated in accordance with AWWA C550. See Section 09800 - Protective Coating.
- E. Actuators: Resilient-seated gate valves shall have manual actuators. The actuator must be the same manufacture or brand of the installed valve. All associated plugs, bolts, hardware and other miscellaneous items for valves shall be 304 or 316 stainless steel unless otherwise specified. Valve installation (vertical or horizontal) must be verified for proper gear orientation.
- F. Manufacturers: SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 GENERAL

- A. All gate valves shall be installed in accordance with the manufacturer's instructions. All valves in plastic lines shall be properly supported at each end of the valve.

END OF SECTION

SECTION 15207

PLUG VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 – Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 PLUG VALVES (all sizes)

- A. General: Only plug valves as specified below shall be used on wastewater force main systems. All plug valves shall be installed so that the direction of flow through the valve is in accordance with the manufacturer's recommendations. Valves shall be eccentric plug valve type.
- B. Valve Construction: Valves shall be of the non-lubricated eccentric type, epoxy lined, with resilient faced plugs and shall be furnished with the end connections as shown on the Drawings. For above ground installation, flanged valves shall be faced and drilled to the ANSI 125/150 lb. Standard. For below ground installation, mechanical joint ends shall meet AWWA C 111, Class B.

Valve bodies shall be of ASTM A536, 65-45-12 ductile iron. All exposed nuts, bolts, springs, washers, etc. shall be 316 stainless steel and American made. Resilient plug facings shall be of Hycar or Neoprene. Valve bodies shall be coated with Tnemac two-part epoxy to a minimum dry film thickness of 16 mils.

Port areas for valves 4 inches through 20 inches shall be minimum 80 percent of the nominal pipe diameter, unless otherwise shown in the Drawings. Valves 24 inches and larger shall have a minimum port area of 70 percent of nominal pipe diameter, unless otherwise shown in the Drawings. All exposed nuts, bolts, springs, washers, etc., shall be 316 stainless steel and American made.

Valves shall be furnished with permanently lubricated stainless steel or oil-impregnated bronze upper and lower plug stem bushings.

Seats in 4-inch and larger valves shall have a welded-in overlay of a high nickel content on all surfaces contacting the plug face. Valve shaft seals shall be adjustable.

- C. Actuators: All buried plug valves shall be installed with gear actuators. Above ground 4-inch valves shall have lever type manual actuators and all above ground valves 6-inch and larger shall be equipped with gear actuators. All gearing shall be enclosed in a ductile iron housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. All actuator shafts shall be supported on permanently lubricated bronze bearings. Above ground actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be 316 stainless steel and American made. Valve packing adjustment shall be accessible without disassembly of the actuator. Hand wheels shall be provided on all valve vaults and other above ground valves. Below ground valves shall be provided with a 2" square actuator nut. The actuator must be the same manufacturer or brand of the installed valve.

- D. Manufacturers: General:

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PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All plug valves shall be installed in strict accordance with the manufacturer's published recommendations.
- B. If the valve is installed in a horizontal sewage force main (i.e. suspended solids), the valve shall be installed with the flow entering the "seat end" (marked on the valve) of the valve and the shaft in a horizontal position with the plug up when open. For vertical installations, the valve shall be installed with the "seat end" up regardless of flow direction.

END OF SECTION

SECTION 15208

AIR RELEASE VALVES AND COMBINATION AIR/VACUUM RELEASE VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide air release valves and combination air/vacuum release valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 – Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 AIR RELEASE AND COMBINATION AIR/VACUUM RELEASE VALVES FOR SEWER FORCE MAINS

- A. General: All sewer force mains shall have air release valves or combination air/vacuum release valves installed as indicated on the Drawings. Valves shall be slow-closing type. All combination air/vacuum release valves shall be installed so that the direction of flow through the valve is in accordance with the manufacturer's recommendations. The floats, float-guide, and stem shall be type 316 stainless steel and American made. All below ground air release valves shall be covered with a cast iron manhole lid, minimum 24-inches in diameter.
- B. Manufacturers, or approved equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 COMBINATION AIR RELEASE VALVES FOR WATER SERVICE

- A. General: All potable water and irrigation water mains shall have air release valves or combination air/vacuum release valves installed as indicated on the Drawings. Valves shall be slow-closing type. The floats, float-guide, and stem shall be type 316 stainless steel and American made. All below ground air release valves shall be covered with a cast iron manhole lid, minimum 24-inches in diameter.
- B. Manufacturers, or approved equal:
 - 1. All combination air/vacuum release valves for water and irrigation service shall be:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 AIR RELEASE VALVE AND COMBINATION AIR/VACUUM RELEASE ASSEMBLY

- A. Construction: The air release and combination air/vacuum release valve assembly shall include a pedestal housing designed to accommodate the assembly. The housing shall be self-latching with locking mechanism and shall have complete 360-degree access working area. The base shall be ribbed for strong support and stability. A location stripe shall be available for customized labeling and identification.
- B. A total of six keys for the locking mechanism for each air release valve and combination air/vacuum release assemblies shall be provided by the Contractor to the City. The locking device shall be series LOO locking device.
- C. All air release and combination air/vacuum release valve assemblies shall be provided with a one-foot concrete pad at the base as shown in the drawings.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All combination air release valves shall have an isolation valve connection for control as shown on the Drawings and shall be installed in strict accordance with the Manufacturer's published recommendations.
- B. All piping shall be installed to prevent sewage from draining onto the ground.
- C. Air release valve assemblies shall not be located in swales. Where swales are present, the ARV's shall be located one-foot from Right-Of-Way line as shown on the Drawings.

END OF SECTION

SECTION 15235

HYDRANTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide fire hydrants for potable water services, complete and operable, including all appurtenances and accessories, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 HYDRANTS

- A. Construction: Hydrants shall have 5 ¼-inch main valve opening and shall comply with AWWA Standard C502 for hydrants for water works service. Hydrants shall be designed for a 200-psi working pressure. Each hydrant shall have 6-inch mechanical joint ends with harnessing lugs ("dog ears") and shall open by turning to the left (counter-clockwise). Hydrants shall be of ample length for 3 ½ -foot depth of bury. Hydrants shall be provided with 2 each, 2 ½-inch hose nozzles and one 4 ½-inch pumper nozzle, all having National Standard hose threads. Nozzles shall have caps attached by chains. Shoe and barrel shall be epoxy coated. Traffic model hydrants shall be provided. Operating nuts shall be AWWA Standard (pentagonal, measuring 1 ½-inch point to flat). Hydrants shall be equipped with "O-Ring" packing. All nuts, bolts, washers, and other hardware shall be 304 or 316 stainless steel and American made. The use of weep holes on fire hydrants is not permitted.
- B. Painting: All iron parts of the hydrant, both inside and outside shall be painted, in accordance with AWWA C502. All inside surfaces and the outside surface below the ground line shall be coated with asphalt varnish. They shall be covered with the two coats, the first having dried thoroughly before the second is applied.
- C. Manufacturers, or City Approved Equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.2 HYDRANTS OFFSETS

- A. In order to meet the required location and grade, hydrants may be installed using an offset device to provide vertical and horizontal adjustment to the final setting of the hydrant. Locator devices shall be used in all locations where offsets are placed. The hydrant offset shall be in accordance with AWWA C153/ANSI A21.53 Ductile Iron. The offset shall match the hydrant diameter center to center.

The hydrant offset shall have an anchoring feature on both ends to provide a restrained joint. The hydrant offset shall be tar coated outside and cement lined inside per AWWA C104 to provide corrosion protection.

- B. Manufacturers, or equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 HYDRANT FLUSHING UNITS

- A. The automatic flushing system shall be constructed of durable, powder-coated heavy gauge aluminum construction for long life and reliability. Unit shall be of a self-supporting, free standing design that limits stress on both the hydrant and flushing device. The flushing system shall include a sampling valve.

Unit shall be adjustable for hydrant connections between 15.5" to 21" in order to accommodate various types of hydrants. Connection shall be 2-1/2" NST brass or as specified. Unit shall be operated by a 9-event battery powered programmer (powered by two Alkaline AA batteries. Unit shall have an integrated splash plate for erosion control.

- B. Manufacturers, or equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All hydrants shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes. All installations shall be to the satisfaction of the local and building department. After installation and until the hydrant is active, the contractor will cover the hydrant with black polyethylene to denote a non-functional hydrant.
- B. Hydrants shall not be placed within five-feet of power poles, communications pedestals, and other obstructions that will interfere with the proper operation of the hydrant. If obstructions are present, the Contractor shall inform the City, and the City will advise Contractor of new location.
- C. Construction Details: all hydrant leads from the potable water main to the hydrant shall be constructed of ductile iron, PVC shall not be allowed. Hydrants shall be plumb and shall be set so that the lowest hose connection is, at least, eighteen (18) inches above, but no more than

twenty-four (24) inches above, the finished grade. All hydrants shall be inspected in the field upon delivery to the job to ensure proper operation before installation. The resetting of existing hydrants and moving and reconnecting of existing hydrants shall be handled in a manner similar to a new installation. Hydrant assemblies shall be constructed in accordance with the Standard Details. Provide a single blue bi-directional reflective pavement marker with each potable water fire hydrant only. Install markings in pavement opposite each hydrant five-feet from the edge of pavement – approximately in the middle of the lane closest to the hydrant.

- D. Fire hydrants shall be cast within three (3) years of notice to proceed. Lubricating grease consisting of acetate or acetate compounds shall not be used.
- E. Care shall be taken when installing hydrants. The use of a sling or other appropriate device shall be utilized to ensure that the hydrant is not damaged upon installation.
- F. Hydrant Bonnet shall be painted after installation in accordance with the Standard Details and Section 09800 – Protective Coatings.

END OF SECTION

SECTION 15236

IRRIGATION BLOW-OFF ASSEMBLIES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide 5 ¼-inch blow-off assemblies for 6-inch or greater irrigation water mains and 2 1/8-inch main valve post type blow-off assemblies for irrigation mains less than 6-inches, complete and operable, including all appurtenances and accessories, in accordance with the Contract Documents. This section is only applicable to blow off assemblies for non-fire maintenance purposes only. For fire hydrants on potable services see Section 15235.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with Section 01300 - Contractor Submittals.
- B. The Contractor shall submit manufacturer's data.

PART 2 -- PRODUCTS

2.1 BLOW-OFF ASSEMBLIES

- A. Construction: Blow-off assemblies shall have 5 ¼-inch main valve opening for irrigation mains 6-inches and greater and a 2 1/8-inch main valve opening for irrigation mains less than 6-inches and shall comply with AWWA Standard C502. Blow-off assemblies shall be designed for a minimum 200-psi working pressure. Each blow-off assembly for 6-inch or larger service shall have 6-inch mechanical joint ends with harnessing lugs ("dog ears") and shall open by turning to the left (counter-clockwise). Blow-off assemblies for services less than 6-inches shall have a 2-inch FIPT inlet. Blow-off assemblies shall be of ample length for 3 ½ -foot depth of bury. Blow-off assemblies for 6-inch services or greater shall be provided with 2 each, 2 ½-inch hose nozzles and one 4 ½-inch pumper nozzle, all having National Standard hose threads. Blow-off assemblies for less than 6-inch services shall be provided with one 2 1/2-inch hose nozzle, all having National Standard hose threads. Nozzles shall have caps attached by chains. Shoe and barrel shall be epoxy coated. Traffic model blow-off assemblies shall be provided. Operating nuts shall be AWWA Standard (pentagonal, measuring 1 ½-inch point to flat). Blow-off assemblies shall be equipped with "O-Ring" packing. All nuts, bolts, washers, and other hardware shall be 304 or 316 stainless steel and American made.
- B. Painting: All iron parts of the blow-off assembly, both inside and outside shall be painted, in accordance with AWWA C502. All inside surfaces and the outside surface below the ground line shall be coated with asphalt varnish. They shall be covered with the two coats, the first having dried thoroughly before the second is applied.

The outside of the blow-off assembly above the finished grade shall be thoroughly cleaned and painted with System 1, as specified in Section 09800- "Protective Coating."

- C. Manufacturers, or City Approved Equal:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All blow-off assemblies shall be installed in strict accordance with the manufacturer's published recommendations, AWWA Standards, and all applicable codes. All installations shall be to the satisfaction of the local and building department.
- B. Blow-off assemblies shall not be placed within five-feet of power poles, communications pedestals, and other obstructions that will interfere with the proper operation of the blow-off assembly. If obstructions are present, the Contractor shall inform the City, and the City will advise Contractor of new location.
- C. Construction Details: Blow-off assemblies shall be plumb and shall be set so that the lowest hose connection is, at least, eighteen (18) inches above, but no more than twenty-four (24) inches above, the finished grade. All blow-off assemblies shall be inspected in the field upon delivery to the job to ensure proper operation before installation. The resetting of existing blow-off assemblies and moving and reconnecting of existing blow-off assemblies shall be handled in a manner similar to a new installation. Blow-off assemblies shall be constructed in accordance with the City's Standard Details.
- D. Blow-off assemblies shall be cast within three (3) years of notice to proceed. Lubricating grease consisting of acetate or acetate compounds shall not be used.
- E. Blow-off assemblies shall be painted pantone purple to indicate they are on irrigation lines and not intended for firefighting.

END OF SECTION

SECTION 16050

GENERAL ELECTRICAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide electrical Work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to all sections in Division 16, except as indicated otherwise.
- C. The Work of this Section is required for operation of electrically driven equipment provided under specifications in other Divisions. The Contractor's attention is directed to the requirement for proper coordination of the Work of this Section with the Work of equipment specifications and other sections.
- D. All concrete, excavation, backfill, and steel reinforcement work required for encasement, installation, or construction of the Work of the various sections of Division 16 shall be performed per the applicable specification section, including duct banks, manholes, handholds, equipment housekeeping pads, and light pole bases.
- E. Section Includes: General administrative, procedural requirements, and installation methods for electrical installations specified in Division 16.
- F. The Drawings are schematic and are not intended to show every detail of construction.
 - 1. In general, conduits/raceways, transitions and offsets shown on Drawings indicate approximate locations in plan and elevation where the systems are intended to be run.
 - 2. Contractor shall fully coordinate electrical Work with other trades to avoid interferences.
 - 3. In the event of interferences, Contractor shall request clarification from ENGINEER in writing.

1.2 REFERENCE STANDARDS

- A. The Work of this Section and all sections in Division 16 shall comply with the following as applicable:

NEC (NFPA 70)	National Electrical Code
NETA	International Electrical Testing Association
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NFPA	National Fire Protection Association

- B. All electrical equipment including electrical control panel system shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.
- C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 FR 1926, as applicable), state building standards, and applicable local codes and regulations.
- D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

- A. Identification: Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal and state OSHA, NFPA, and NEC requirements. Refer to Section 16075 for additional requirements.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. The Contractor shall contact the serving utility and verify compliance with requirements before construction. The Contractor shall coordinate schedules. Payment for Work performed by all utilities will be provided by the CITY. Bracing of power poles and relocation of power drops, as required, will be by the Contractor.
- B. Electrical service shall be as indicated and be as required by the serving utility.
- C. The Contractor shall verify and provide all service conduits, fittings, transformer pads, grounding devices, handholes, service wires not provided by the serving utility, and any additional requirements per the utility's standard in order to provide power to the site.
- D. The Contractor shall verify with the utility and the City, the exact location of each service point and type of service. Payment of charges levied by the serving utilities will be by the Contractor.
- E. In lift station locations where there are no existing power poles on site, new electrical service shall be ran underground.

1.5 PERMITS AND INSPECTION

- A. Contractor shall procure all necessary permits and licenses, observe and abide by all applicable laws, codes, regulations, ordinances, and rules of the State, territory, or political subdivision thereof, wherein Work is done, or any other duly constituted public authority, and further agrees to hold OWNER harmless from liability or penalty which might be imposed by reason of an asserted violation of such laws, codes, regulations, ordinances, or other rules. The Contractor is responsible for acquiring the electrical permit and obtaining a satisfactory inspection of the completed facility.

1. Upon completion of Work, Contractor shall secure certificates of inspection from the inspector having jurisdiction and shall submit 3 copies of the certificates to OWNER. Contractor shall pay the fees for the permits, inspections, licenses, and certifications when such fees are required.

1.6 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals
- B. Shop Drawings: Include the following:
 1. Complete material lists stating manufacturer and brand name of each item or class of material.
 2. Shop Drawings for all grounding Work not specifically indicated.
 3. Front, side, rear elevations, and top views with dimensional data.
 4. Location of conduit entrances and access plates.
 5. Component data including size parameters.
 6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.
 7. Method of anchoring and equipment weight.
 8. Types of materials and finish.
 9. Nameplates.
 10. Temperature limitations, as applicable.
 11. Voltage, phase, and panel full load current data, as applicable.
 12. Front and rear access requirements.
 13. Test reports.
 14. Grounding requirements.
 15. Catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options.
- C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

- D. Materials and Equipment Schedules: The Contractor shall deliver to the City within 30 days of the commencement date of the Notice to Proceed, a complete list of materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- E. OWNER'S MANUALS: Complete information in accordance with Section 01300.
- F. Record Drawings: The Contractor shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record drawings shall be prepared, be available to the City, and be submitted according to Section 01300.
- G. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01730, operation and maintenance manuals for items included under this Section. Include following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.7 AREA DESIGNATIONS

A. General

- 1. Electric Work specifically indicated in sections within any Division of the Specifications shall comply with those requirements.
- 2. Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated. All influent wet wells are classified as Class I, Division I, and Group C and D.

B. Material Requirements

- 1. NEMA 4X enclosures shall be American made 316 stainless steel.
- 2. NEMA 7 enclosures shall be cast aluminum.

1.8 TESTS

- A. The Contractor shall be responsible for all factory and field tests required by the specifications. All field tests shall be witnessed by the City. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

- B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the shop drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.
- C. Any equipment or material, which fails a test, shall be removed and replaced.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All equipment and materials including electrical control panel system shall be new, shall be listed by UL, and shall bear the UL label. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the Work shall be products of the same manufacturer. All equipment and materials shall be of industrial grade standards of construction.
- B. Where a NEMA enclosure type is indicated in a non-hazardous location, the Contractor shall utilize that type of enclosure, despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.
- C. All devices indicated to display dates, shall display the year as 4-digit number.

2.2 MOUNTING HARDWARE

- A. Miscellaneous Hardware
 - 1. All nuts, bolts, and washers shall be 316 American made stainless steel.
 - 2. Threaded rods for trapeze supports shall be continuous threaded, 316 American made stainless steel, 3/8" diameter minimum.
 - 3. Strut for mounting of conduits and equipment shall be 316 American made stainless steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by Unistrut, B-Line, or City approved equal.
 - 4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be 316 American made stainless steel expansion anchors, such as "Rawl-Bolt," "Rawl-Stud" or "Lok-Bolt" as manufactured by Rawl; similar by Star, or City approved equal. Wood plugs shall not be permitted.

2.3 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, blackface laminated plastic engraving stock, Formica types ES-1, or City approved equal. Each shall be fastened securely,

using American made stainless steel fasteners screwed into inserts or tapped holes, as required. Engraved characters shall be block style with no characters smaller than 1/8-inch high.

- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or City approved equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or City approved equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Incidentals: The Contractor shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.
- B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the Contractor in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be followed as closely as possible.
- C. Where conduit development drawings or "home runs" are shown, the Contractor shall route the conduits in accordance with the indicated installation requirements. Routings shall be exposed or encased as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise. Conduits encased in a slab shall be sized for conduit OD not to exceed one-third of the slab thickness and be laid out to not impede concrete flow. Encased conduits shall not be spaced closer than 3 outside diameters on centers.
- D. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the Contractor's responsibility to provide lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum (exposed) and 1-inch minimum (encased). Where the number of current-carrying conductors in a raceway or cable exceeds three, the allowable ampacity of each conductor shall be reduced in conformance to the NEC.
- E. Workmanship: All materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Workers skilled in the Work shall accomplish installation. Installation shall be coordinated in the field with other trades to avoid interferences. All exposed conduits, fixtures, panels, etc. shall be installed in a plumb and neat manner.

- F. Protection of Equipment and Materials: The Contractor shall fully protect all materials and equipment against damage from any cause. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry. The Contractor shall replace or refinish all damaged materials or equipment, including faceplates of panels and switchboard sections, at no additional cost.
- G. Incoming utility power equipment shall be provided in conformance with the utility's requirements. Coordinate with power company high voltage and/or low voltage metering requirements. Furnish, install, and connect metering equipment not furnished, installed or connected by power company. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

3.2 CORE DRILLING

- A. The Contractor shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations are approximate. Verify all exact core-drilling locations based on equipment actually furnished as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired at no extra cost.

3.3 EQUIPMENT ANCHORING AND IDENTIFICATION

- A. Floor supported, wall, or ceiling hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4- inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.
- B. Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations.
- C. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract.
- D. Floor mounted electrical equipment shall be mounted on a 4-inch thick concrete housekeeping slab.
- E. General: Equipment and devices shall be identified as follows:
 - 1. Nameplates shall be provided for all panelboards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.

2. Control devices within enclosures shall be identified. Identification shall be similar to the subparagraph above.
3. Toggle switches which control loads out of sight of switch and all multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.
4. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, marking an adjacent surface shall identify destination.
5. Equipment names and tag numbers shall be provided on all nameplates.
6. The Contractor shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.

3.4 EQUIPMENT TESTING

- A. Equipment Testing: The following tests which are applicable for a particular item of equipment shall be performed:
 1. Megger power circuit breakers and circuits supplied phase-to-phase and phase-to-ground (100 megohms minimum).
 2. Test current transformer circuits by applying current to secondary wiring at current transformer terminals until contactor trips.
 3. Test, time, and set protective relays. Relays shall be timed at various multiples (minimum of 3 points) of the pick-up value to determine agreement with published curves and adjust as necessary to agree with coordination study required settings. Exact tests to be performed vary with type of relay. Manufacturer's instructions for relay shall be complied with.
 4. After Work has been completed, demonstrate to OWNER's Representative that entire electrical installation is in proper working order and will perform functions for which it was designed by functional testing.
 5. Perform any specific tests required by the manufacturer's installation instructions.

3.5 CHECK-OUT PROCEDURES

- A. In general, check-out procedures (as listed below) which are applicable for a particular item of equipment shall be performed:
 1. Before final acceptance, all parts of the Work shall be thoroughly cleaned. Exposed parts shall be thoroughly cleaned of cement, plaster, and other materials. All oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped, and all cracks and corners scraped out. Paint touch-up shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.
 2. Wipe clean with a lint-free cloth insulator, bushings, bus supports, etc.
 3. Check and adjust time delay, under-voltage devices, phase relay, over-current relays, etc., as required by coordination study or ENGINEER.
 4. Fill motor bearings requiring oil.

5. Check and change, as required, thermal overload heater elements to correspond with motor full-load current and service factors of installed motor.
6. Check direction of rotation of motors and reverse connections if necessary. Check rotation with motor mechanically uncoupled where reverse rotation could damage equipment.
7. Equipment with two or more sources of power connected by tie breakers, transfer switches, or generator receptacles shall be checked for rotation from each possible combination of power sources. Power sources must have the same phase sequence for each source throughout entire facility.
8. Check exposed bolted power connections for tightness.
9. Check operation of breakers, contactors, etc., and control and safety interlocks.
10. Check tightness of bolted structural connections.
11. Check leveling and alignment of enclosures.
12. Check operating parts and linkages for lubrication, freedom from binding, vibration, etc.
13. Check tightness and correctness of control connections at terminal blocks, relays, meters, switches, etc.
14. Clean auxiliary contacts and exposed relay contacts after vacuuming.

END OF SECTION

SECTION 16070
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01340, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Product data for each type of product specified.

1.03 QUALITY ASSURANCE

- A. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

- 1. Slotted Metal Angle and U-Channel Systems:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- 2. Conduit Sealing Bushings:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.02 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors, in NEMA 4 or 4X areas, or embedded in concrete shall be hot-dip galvanized.

2.03 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Riser clamps and conduit straps.

- B. Fasteners. Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: Steel springhead type.
- C. Conduit Sealing Bushings: Factory fabricated, watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable iron casting with hot-dip galvanized finish.
- E. U-Channel Systems: 12 gauge or 0.105-inch-thick steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacturer.

2.04 FABRICATED SUPPORTING DEVICES

- A. Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including, but not limited to, the following:
 - 1. Buried electrical line warnings.
 - 2. Identification labeling for cables and conductors.
 - 3. Operational instruction signs.
 - 4. Warning and caution signs.
 - 5. Equipment labels and signs.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01340, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Product Data for each type of product specified.

PART 2 - PRODUCTS

2.01 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Adhesive Marking Tape for Wires and Cables: Self-adhesive, vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- B. Pre-tensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: Flexible acrylic bands sized to suit raceway diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- C. Underground Line Marking Tape: Permanent, bright colored, continuous printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.
- D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letter.
- E. Aluminum, Wraparound Cable Marker Bands: Bands cut from 0.014-inch-thick aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.
- F. Engraved, Plastic Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16 inch minimum thick for signs up to 20 square inches or 8 inches in length;

1/8-inch thick for larger sizes. Engraved legend in black letters on white face and punched for mechanical fasteners.

1. Disconnect Switches: each disconnect switch shall be labeled to indicate its voltage, phase, amperes, and purpose or short description (e.g. Main Disconnect).
- G. Baked Enamel Warning and Caution Signs for Interior Use: Pre-printed aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.
1. 600 volts nominal or less: Entrances to enclosures that contain electrified components shall be marked with conspicuous signs prohibiting unqualified persons to enter.
 2. Lock-out/Tag-out devices will be used on the disconnect prior to startup of the panel systems.
 3. Arc Flash Protection - Panelboards, control panels, disconnects, and meter socket enclosures shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment and shall be in conformance to the guidelines and references of NFPA-70, NEC-2005 - Article 110.16.
- H. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, pre-printed cellulose acetate butyrate signs with 20-gauge galvanized steel backing, with colors, legend, and size appropriate to location. Provide 1/4-inch grommets in corners for mounting.
- I. Fasteners for Plastic Laminated and Metal Signs: Self-tapping stainless steel screws or Number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- J. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18 inch minimum width, 50-pound minimum tensile strength, and suitable for a temperature range from minus 50 to 350 degrees F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification Work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by Code.
- B. Underground Electrical Line Identification: During trench backfilling for exterior nonconcrete encased underground power, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench, do not exceed an overall width of 16 inches; install a single line marker.
- C. Install line marker for underground wiring, both direct buried and in raceway.

- D. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the Project secondary electrical system following OWNER's method of phase identification or as follows:

<u>Phase</u>	<u>480/277 Volts</u>
A	Yellow
B	Brown
C	Orange
Neutral	White
Ground	Green

E. Wiring Standards:

1. 480/277 Volt, 3-Phase Power:
 - a. Brown.
 - b. Orange.
 - c. Yellow.
 - d. Grey Neutral.
2. 208 Volt, 3-Phase and 240 Volt, 3-Phase Power:
 - a. Black.
 - b. Red.
 - c. Blue.
 - d. White Neutral
3. 240/120 Volt, 1-Phase Power:
 - a. Black.
 - b. Red.
 - c. White Neutral.
4. Motor Leads, Control Cabinet/MCC:
 - a. Black, numbered L1-T1, etc.
5. Control Wiring:
 - a. Red Control circuit wiring that is de-energized when the main disconnect is opened.
 - b. Yellow Control circuit wiring that remains energized when the main disconnect is opened.
 - c. Blue DC.
 - d. Green Ground.

F. Use conductors with color factory applied entire length of conductors except as follows:

1. The following field applied color coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last 2 laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply 3 ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

- G. Power Circuit Identification: Securely fasten identifying metal tags of aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-pound test monofilament line or one-piece self-locking nylon cable ties.
- H. Install wire/cable designation tape markers at termination points, splices, or junctions in each circuit. Circuit designations shall be as indicated on Drawings.

END OF SECTION

SECTION 16120

WIRES AND CABLES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. The Contractor shall submit manufacturer's data for all products in accordance with Sections 01300 - Contractor Submittals.
- B. Reports of field tests prepared as noted in Section 01650.

1.3 QUALITY ASSURANCE

- A. UL Compliance: Provide components which are listed and labeled by UL. For cables intended for use in air handling space comply with applicable requirements of UL Standard 710, "Test Method for Fire and Smoke characteristics of cables used in Air Handling Spaces."
- B. NEMA/ICEA Compliance: Provide components which comply with following standards:
 - 1. NEMA WC 70-1999/ICEA S-95-658-1999, Nonshielded Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
- C. IEEE Compliance: Provide components which comply with the following standard.
 - 1. Standard 82, Test procedures for Impulse Voltage Tests on Insulated Conductors.
- D. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or typewritten onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each Network cable segment shall be labeled at each end with its respective identifier.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable shall not be permitted. Insulation shall bear UL Listed label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National

Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400 and fixture wires shall conform to Article 402. All wiring shall have identical wire markers at each end.

2.2 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire

1. All wire rated for 600 volts in duct or conduit for all power and lighting circuits shall be Class B Type XHHW cross-linked polyethylene conforming to UL-44-UL Standard for Safety Rubber Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project.
2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
3. Conductors for branch circuits as defined in Article 100 of the NEC, shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent under full load conditions.
4. Wiring for 600-volt class power and lighting shall be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
5. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum (exposed) and 1-inch minimum (encased).

B. Control Wire

1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.
2. Control wiring shall be No.14 AWG minimum.
3. Control wires at panels and cabinets shall be machine tool grade type MTW, UL Listed, rated for 90 degrees C at dry locations, and be as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**

C. Instrumentation Cable

1. Instrumentation cable shall be rated at 600 volts.
2. Individual conductors shall be No. 16 AWG minimum stranded tinned copper. Insulation shall be color-coded polyethylene: black-red for two-conductor cable and black-red-white for three-conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 AWG minimum stranded tinned copper drain wire, and a PVC outer jacket with a thickness of 0.048 inches.
4. Single pair, No. 16 AWG minimum, twisted, shielded cable shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
5. Single triad, No. 16 AWG minimum, twisted, shielded cable shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**

2.3 SUBMERSIBLE PUMP CABLE

A. General

1. Cables shall be designed specifically for submersible pump applications and shall be properly sealed. The cable entry at the control panel shall be rated Class I, Division I, Groups C and D. Cable splices must be pre-approved by the City of Cape Coral.

2.4 CABLE TERMINATIONS

- A. Compression connectors shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.** Threaded connectors shall be split bolt type of high strength copper alloy. Pressure type, twist-on connectors will not be acceptable.
- B. Pre-insulated fork tongue lugs shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
- C. General purpose insulating tape shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
- D. High temperature tape shall be polyvinyl as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
- E. Labels for coding all 600-volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**

2.5 ELECTRICAL INSULATING RESIN

- A. Re-enterable splice protection shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** Re-enterable Electrical Insulating Resin.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The Contractor shall provide and terminate all power, control, and instrumentation conductors except where indicated.

3.2 INSTALLATION

- A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.
- B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where required, shall be UL Listed.
- C. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.
- D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.
- E. Ground and neutral wiring within the electrical panel shall be routed around the entire interior perimeter of panels. These cables shall be mounted to maximize separation from voltage components.

3.3 SPLICES AND TERMINATIONS

A. General

- 1. All wiretaps and splices shall be properly taped and insulated according to their respective classes.
- 2. In general, there shall be no cable splices in underground manholes or pull boxes. If splices are necessary, the cables shall be brought above-ground and terminated in a NEMA 4X, 316 stainless steel terminal or splice cabinet on a concrete pad, utilizing a 316 stainless steel mounting frame, where applicable. Splices in underground manholes and pull boxes may be made only with the approval of the City.
- 3. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
- 4. Excess control and instrumentation wire shall be properly tagged and terminated as spares.

B. Control Wire and Cable

- 1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.
- 2. In junction boxes, motor control centers, and control panels, all control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.
2. Two- and three-conductor shielded cables installed in conduit runs, which exceed available standard cable lengths, may be spliced in pull boxes.
3. Splicing of instrument wire and cable is not allowed.

D. Power Wire and Cable

1. All 120/208-volt, 120/240-volt, and 277/480-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor.
2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overlapped with a minimum of two layers of electrical insulating varnished cambric tape, Scotch 2520 or City approved equal.

3.4 CABLE IDENTIFICATION

- A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.
- B. Identification Numbers: The Contractor shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on all "as built" drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control Conductor" shall be defined as any conductor used for alarm, annunciator, or signal purposes.
 1. Multiconductor cable shall be assigned a number that shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath freestanding equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.
 2. The 240/120-volt, 1-Phase system conductors will be color coded as follows: Phase A-Black, Phase B-Red, and Neutral-White. The 208/120-volt, 3-Phase system conductors will be color coded as follows: Phase A-Black, Phase B-Red, Phase C-Blue, and Neutral-White. The 240/120-volt, 3-Phase system will be color coded as follows: Phase A-Black, Phase B-Red, Phase C-Blue, and Neutral-White. The 480/277-volt, 3-Phase system conductors shall be color coded as follows: Phase A-Brown, Phase B-Orange, Phase C-Yellow, and Neutral-Gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

3. General-purpose AC control cables shall be red. General-purpose DC control cables shall be blue.
4. All spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
5. Terminal strips shall be identified by computer printable, cloth, and self-sticking marker strips attached under the terminal strip.

3.5 TESTING

- A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-66-524 – Cross-linked Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. The following field tests, as required by the City, shall be conducted:
 1. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmmeter.
 2. Field testing shall be done after cables are installed in the raceways.
 3. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the City for review and acceptance.
 4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

END OF SECTION

SECTION 16130

RACEWAYS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Raceways for electrical wiring. Types of raceways in this Section include the following:
 - 1. Liquidtight flexible conduit.
 - 2. Underground plastic utilities duct.
 - 3. Rigid metal conduit.
 - 4. Rigid nonmetallic conduit.
 - 5. PVC externally coated rigid metal conduit.
 - 6. Electrical nonmetallic tubing.
 - 7. Conduit bodies.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Product data for the following products:
 - a. Conduit.
 - b. Conduit bodies.

1.03 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
 - 2. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Conduit:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

- 2. Liquidtight Conduit:
SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

3. Conduit Bodies:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

4. Conduit Thread Paint:

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2.02 METAL CONDUIT AND TUBING

- A. Rigid Metal Conduit: ANSI C 80.1, hot-dip galvanized.
- B. PVC Externally Coated Rigid Metal Conduit and Fittings: ANSI C 80.1 and NEMA RN 1., Type 40, 40 mil nominal coating and thickness. The bond of the PVC to the substrate shall be stronger than the tensile strength of the PVC.
- C. Liquidtight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be specifically approved for use with this raceway.

2.03 NONMETALLIC CONDUIT AND DUCTS

- A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, Schedule 80 PVC.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. Underground PVC and ABS Plastic Utilities Duct: NEMA TC 6, Type I for encased burial in concrete, Type II for direct burial.
- D. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.
- E. Liquidtight Flexible Nonmetallic Conduit and Fittings: UL 1660. Fittings shall be specifically approved for use with this raceway.

2.04 CONDUIT BODIES

- A. Provide matching gasketed covers secured with corrosion-resistant screws. Use cast covers in NEMA 4 areas and stamped steel covers in NEMA 1 and 12 areas. Use nonmetallic covers in NEMA 4X areas and threaded, ground joint covers in NEMA 7 and NEMA 9 areas.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies as follows:
 - 1. Rigid Metal Conduit: Use cast or malleable iron conduit bodies with zinc electroplating, aluminum enamel or lacquer finish, and threaded hubs.
 - 2. PVC Externally Coated Rigid Metal Conduit: Use hot-dipped galvanized or cadmium-plated cast or malleable iron conduit bodies with threaded hubs factory PVC-coated. Field application of PVC coating to conduit bodies is not acceptable. Secure covers using PVC encapsulated or stainless-steel screws.
 - 3. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL 514 B.

4. NEMA 7 and NEMA 9 Areas: Use materials conforming to UL standards for the area.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide wiring devices, complete and operable, in accordance with the Contract Documents.
- B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

- A. General: Contract submittals shall be in accordance with Section 01300 - Contractor Submittals.
- B. Contractor shall submit manufacturer's technical information for all products.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All devices shall UL listed and carry the UL label.
- B. General-purpose duplex receptacles and toggle switch handles shall be ivory. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

- A. Local branch switches shall be toggle type, rated at 20 amperes, 120 VAC, and shall be General Electric Cat. No. GE-5951-1 for single pole, GE-5953-1 for three-way and GE-5954-1 for four-way or similar types as manufactured by Hubbell.

2.3 GENERAL PURPOSE RECEPTACLES

- A. Duplex receptacles rated 120 V, 20 amperes shall be polarized 3 wire type for use with 3 wire cord with grounded lead. Duplex 120 V receptacles shall be ground-fault circuit interrupting (GFCI's) type E. GFCI's shall be rated 125V, 20A and shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
- B. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory-sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. 120-volt receptacles shall be rated for 20 amps at 125 VAC. Hazardous location receptacles shall be **SEE CITY OF CAPE CORAL QUALIFIED**

PRODUCT LIST.

- C. Where indicated, hazardous location receptacles shall be provided with ground fault protection. Ground fault protection shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**

2.4 ENCLOSURES AND COVERS

- A. Surface mounted switches and receptacles shall be in FS or FD type weatherproof conduit fittings.
- B. Switch and receptacle covers on surface mounted boxes shall be die cast copper-free aluminum.
- C. In areas where cast boxes are used, switch and receptacle covers shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST.**
- D. Receptacles in wet locations shall be provided with a hinged cover/enclosure marked "Suitable for Wet Location". There shall be a gasket between the enclosure and the mounting surface and between the hinged cover and mounting plate/base. The cover shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**

2.5 NAMEPLATES

- A. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not required. Provide receptacles for special purposes with nameplates indicating their use. Conform to requirements of Section 16050 - Electrical Work, General.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Perform work in accordance with the National Electrical Code.

3.2 CONNECTION

- A. Rigidly attach wiring devices in accordance with National Electrical Code, and as indicated, avoiding interference with other equipment.
- B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.3 GROUNDING

- A. Ground all devices, including switches and receptacles, in accordance with NEC, ART250, and Section 16450 - Grounding.
- B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and

raceway system.

- C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.4 FIELD TESTING

- A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 16050 General Electrical.
- B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

END OF SECTION

SECTION 16151

VARIABLE FREQUENCY DRIVE UNIT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide complete simplex type variable frequency drive (VFD) units and appurtenances including drive reactors, DC chokes, harmonic filters, enclosures, and certain auxiliary items, as indicated and as specified, to provide a complete operating system.
- B. Variable frequency drive unit shall be furnished, installed, and electrically connected by the electrical subcontractor.
- C. VFD units shall be manufacturer's standard technology and in production for a minimum of 5 years.
- D. Provide control system operation, input and control signals, status signals, and additional requirements, including but not limited to, conduit and wire, per the VFD manufacturer's requirements for a fully functional system.
- E. Provide Underwriter's Laboratories listed drive components where applicable.
- F. Provide VFD output filter or reactor, when cable length between VFD and motor is greater than 100 feet, to ensure motor terminals do not experience overvoltage condition as defined by NEMA Standard MG-1, section 30.02.2.9.
- G. Each VFD unit to be provided is to exhibit less than 5% voltage total harmonic distortion and less than 3% voltage distortion on each harmonic at their immediate upstream distribution bus as verified by calculation and testing. Harmonic current distortion to be in accordance with Table 2.02A. This bus to be referred to as the point of common coupling (PCC).

1.02 RELATED WORK:

- A. Division 1: General Requirements
- B. Section 16460: Electric Motors

1.03 REFERENCES:

- A. Underwriter's Laboratories Inc. (U.L.):
 - 1. UL-508 Electrical Industrial Control Equipment.
- B. National Electrical Manufacturers Association (NEMA): MG 1.

C. National Fire Protection Association (NFPA):

1. NFPA-70 National Electric Code.

1.04 SUBMITTALS:

A. Shop Drawings: Submit the following in accordance with Section 01300 – Shop Drawings and Submittals:

1. Shop Drawings: Provide a complete list of equipment components, and materials, including manufacturer's descriptive and technical literature, and catalog cuts. Provide complete wiring, system interconnection and schematic diagrams for the equipment and controls furnished including external interlocked and controlled components, equipment layout, time versus current curves for protective devices and any other details required to demonstrate that the system and the required external controls has been coordinated and will properly function as designed.
 - a. Provide data to verify that drives can be used for motor lead lengths up to 100 feet without output filters. Include information from the VFD manufacturer or output filter or reactor manufacturer (if required) stating that the motor terminal voltage limitations as defined by NEMA Standard MG-1, section 31.40.4.2, are met. For VFD's located more than a cable length of 100 feet from the motor load provide output filter or reactor at VFD.
 - b. Provide enclosure drawings and details showing all dimensions and construction details.
2. Submit information relative to location and expertise of local service office and personnel.
3. Provide installation and anchoring details to meet earthquake requirements as specified and indicated on structural drawings.
4. Submit manufacturer's printed installation instructions.
5. Spare Parts Data: Submit a list of spare parts for the equipment specified.
6. Operating and Maintenance Instruction Manuals:
 - a. Furnish:
 - (1) Operating instruction manuals outlining step-by-step procedures required for system startup and operation.
 - (2) Manufacturer's name, model number, service manual parts list.
 - (3) Brief description of equipment and basic operating features.
 - (4) Maintenance instruction manuals outlining maintenance procedures.

- (5) Troubleshooting guide listing possible breakdown and repairs.
- (6) Point-to-point connection wiring diagram for the system.
- (7) Performance Test Reports: Upon completion of installed system, submit in booklet form all shop and field tests performed to prove compliance with specified performance criteria.

1.05 QUALITY ASSURANCE:

- A. Provide conduit size and wire quantity, size, and type are suitable for the equipment supplied. Coordinate all design information with the Electrical Contractor. Review the proper installation of each type of VFD unit with the equipment supplier prior to installation.
 - 1. Services of Service Engineer specifically trained on type of equipment specified. Man-day requirements listed exclusive of travel time.
 - a. Assist in location of devices, methods of mounting, field erection, etc. (1 man-day).
 - b. Start-up and testing (3 man-day).
 - c. At the end of start-up service provide for owner's staff at the facility site to receive training from the startup/testing service Engineer. (1 man-day)
 - d. Service-inspections during first year of operation, for use at Owner's request, and exclusive of repair, malfunction or other trouble-shooting service calls: (2 man-day).
 - e. Man-day is defined as one 8-hour day, excluding travel time.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Shipping:
 - 1. Ship equipment and materials, except where partial disassembly is required by transportation regulations or for protection, complete with identification and quantity of items.
 - 2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
 - 3. Deliver spare parts after installation but as specified before start-up of drives. Deliver to Owner after completion of work.
- B. Storage:
 - 1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts.

1.07 WARRANTY AND SERVICE:

- A. Provide in accordance with Section 01740 and as specified.
- B. Guarantee components, parts, and assemblies supplied by manufacturer against defects in materials and workmanship for a period of 36 months after turning the equipment over to the Owner, and in this time period include onsite, parts and labor warranty. All labor to be performed by local factory trained service engineers.
- C. Ensure that equipment manufacturer has local branch office staff with trained, full-time employees who are capable of performing testing, inspecting, repair, and maintenance services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturer shall have at least five years commercial experience in the manufacture, operation and servicing of equipment of type, size, quality, performance, and reliability equal to that specified.

- B. Variable Frequency Drive Units:

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- C. VFD Input Filters and Output Filters/Reactors:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.02 PROVISIONS:

- A. Service Conditions:

1. Ambient Temperature Range: 0 deg. C to 40 deg. C.
2. Operational Humidity: Up to 90 percent non-condensing.
3. Environment: Enclosure NEMA 12.
4. Altitude: Below 3,300 ft. above sea level.
5. Input Power:
 - a. Nominal voltage - 240 volts (plus 10 percent or minus 10 percent), 1-phase, 3 wire
 - b. Nominal Frequency - 60 Hertz (plus or minus 2 Hz.)

- c. Service provided from feeder breaker on distribution bus.

B. Drive System: 0-500 HP Units

1. General:

- a. Furnish solid state variable frequency, microprocessor type with Pulse Width Modulated (PWM) output wave form converter. The VFD shall employ a full wave rectifier to prevent input line notching, a DC bus choke, DC bus capacitors and Insulated Gate Bipolar Transistors (IGBT) as the output switching device to convert nominal 240 volts, 1 phase, 60 Hertz, 2 wire input power into adjustable-frequency 3 wire system at 0 to 240 volts, 3 phase, 0 to 60 Hertz output power. Provide output speed control of required motor under variable torque load or constant torque as required by the driven equipment.
- b. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings. Where not indicated, the control circuits shall be standard two-wire "start-stop" and the Contractor shall furnish wiring accordingly.
- c. Variable frequency drive manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining loads, torque, speed and performance requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.
- d. The Contractor and variable frequency drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.
- e. Provide flux vector control type drives, also known as field-oriented control, with hard-wired motor speed feedback encoder or tachometer, for full torque at zero speed capability.
- e. Provide VFD control which ensures accurate zero to full load torque control at low frequencies, including zero speed, with torque repeatability accuracy of 2% or better and torque response time less than 20 ms.
- f. Provide on drive, a disconnecting device and fixed diode input rectifier (for a constant power factor).
- g. For units rated 50 Hp or less, provide 6 pulse drives with 3% impedance input line reactor.

- h. All components of the drive shall be designed and sized for the abnormal condition of continuous operation of the driven equipment specified herein at loads up to 15% above rated full load.
- i. RMS harmonic output of the drive not to provide more than 5 percent increase in motor heating over similar operation of the motor with zero harmonics in the current.
- j. The unit shall withstand drive output terminal line-to-line and line-to-ground short circuits without component failure during start-up and during operation. Drive to safely shutdown until short is cleared.
- k. NEMA type cabinet for each drive unit, as indicated on drawings and enclosure schedule. NEMA 4 and NEMA 4X enclosures to be provided with stainless steel hand operated quick disconnect devices. Provide hinged acrylic door with gasketing on front of door for each access to keypad controls.
- l. For inverter rated squirrel cage motors, per NEMA Standard MG-1, part 31.40.4.2, the following limit values at the motor terminals are to be observed:
 - (1) For motors with base rating voltage less than or equal to 600 volts, the peak instantaneous voltage must be limited to 1600 volts or less, with a voltage rise time greater than or equal to 0.1 micro-seconds.
- m. The VFD manufacturer shall guarantee that the above voltage limits will be met with the motor installed up to 100 cable feet [30 m] from the VFD drive unit. If the VFD manufacturer is not able to guarantee that the above voltage limits will be met, provide a drive output filter or reactor, appropriately rated, located within the VFD enclosure and near the VFD output terminals, which shall ensure that the limitations listed above are maintained. A device located at the motor terminals is not acceptable.
- n. The drive unit shall be of modular design to provide for ease and speed of maintenance.
- o. Control circuits shall be isolated from power circuits. Unit to accept a 4-20 mA DC speed control signal from an isolated, ungrounded transmitter with unit in remote mode and from local door-mounted manual speed potentiometer or micro-processor type keypad with unit in local mode. The input 4-20 mA signal to be optically isolated from the drive run control circuit. Manual speed potentiometer or keypad controls to have adjustable minimum speed setting of 10 to 80% of full speed and maximum speed setting of 50 to 100% of full speed. The total speed setting to follow a linear time ramp, adjustable from 1-300 seconds for acceleration and deceleration control.
- p. Provide trap filters for the drive unit to meet the requirements of the harmonic study under paragraph 2.02. Filters shall be provided with contractors and controlled by the VFD to remove them from the line when the drive is not operating. Contractors shall be provided with spare contacts for remote alarm and to energize status lamp at VFD enclosure.

- q. VFD shall be capable of full rated output when powered by incoming voltage with Total Harmonic Distortion (THD) in excess of 10%.
 - r. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.
 - s. Provide conformal coating of internal circuitry.
 - t. Properly size control panel enclosure to dissipate heat generated by VFD within limits of specified service conditions. VFDs located within control panel shall be rated NEMA 1. Provide integral fans or cooling systems as required by the application. Circuit breaker interlocks to be able to be bypassed via lever on front door surface. NEMA 1 type enclosures to have keypad controls located on deadfront of control panel. Provide visual alarm indicator on deadfront of control panel.
2. Performance characteristics:
- a. Output amps: 110 percent of rated, continuous.
 - b. Current limit: Range 0 to 130% for constant torque applications, 0 to 110% for variable torque applications, for 1 minute minimum.
 - c. Acceleration time to top speed, 1-300 seconds, minimum, adjustable.
 - d. Deceleration time from top speed, 1-300 seconds, minimum, adjustable.
 - e. Frequency stability: +/- 0.5% (at 25 degrees C, +/-10 degrees C) after reaching operating temperature.
 - f. Output voltage: Proportional to frequency with low speed boost.
 - g. Combined drive/and filtering efficiency, defined as motor shaft KW divided by VFD input KW, shall meet the following minimum requirements at the specified operating points:
 - (1) 97 percent at 60 Hz VFD output and 100 percent load.
 - (2) 92 percent at 50 Hz VFD output and 60 percent load.
 - h. VFD fundamental power factor shall be 0.98 or higher at all speeds and loads.
 - i. The VFD shall be capable of sustaining continued operation with a 30% dip in nominal line voltage. Output speed may decline only if current limit rating of the VFD is exceeded.
 - j. Losses to be utilized in drive system efficiency calculation shall include the input isolation transformer, harmonic filter and power factor correction if applicable.

Auxiliary controls such as internal VFD control boards and cooling fans shall be included in all loss calculations.

3. Drive Protection:

a. General:

- (1) Fault detection and trip circuits shall protect VFD and connected motor against line voltage transients, single-phase, power line overvoltage and undervoltage, output overvoltage and overcurrent, and VFD overtemperature. The VFD shall employ three (3) current limit circuits to provide trip free operation. The slow current regulation limit circuit shall be adjustable to a minimum 125% of the VFD's variable torque current rating. The rapid current regulation limit shall be adjustable to a minimum 170% of the VFD's variable torque current rating. The current switch off limit shall be fixed at a minimum 225% of the VFD's variable torque current rating.

b. Internal Protection: Minimum circuitry as follows:

- (1) Current limiting, fast acting, semiconductor input fuses for protection of internal power semiconductors.
- (2) Instantaneous output overcurrent trip max. - 200 percent.
- (3) DC bus and control circuit transformer fusing.
- (4) Grounded control chassis.
- (5) Under and over voltage trip, 3 phases.
- (6) Motor overload protection, with solid state relays.
- (7) Fault reset push button.
- (8) Line to ground faults.
- (9) Input metal oxide varistor and input line reactor for transient protection.
- (10) VFD over temperature.

c. Troubleshooting: Diagnostic aids to indicate cause of fault; used to assist in troubleshooting circuit problems. Isolated Form C contacts for remote indication of alarms to include the following:

- (1) Over/under voltage indication.
- (2) Overcurrent trip indication.

- (3) DC bus charged indication.
 - (4) Fault detection indication.
 - (5) Recycle start indication (to indicate that the unit tried to pick up load for three previous tries and failed).
- d. Provide power loss ride through capability which will allow the logic to maintain control due to load inertia without faulting.
 - e. Provide a programmable automatic restart function which will provide a minimum with time delays between restarts of 3 restarts following a fault condition other than a ground fault, short circuit, internal fault, or user programmable fault condition. Restart type to be programmable for time delay or coasting motor restart.

C. Auxiliary Systems:

- 1. Provide variable frequency drive unit with appropriate power circuitry and auxiliary contacts for energizing and controlling the following devices associated with the motor, if required:
 - a. Space heaters
 - b. Remote indication of motor start and stop (isolated contacts)

D. Minimum Control Features:

- 1. LOCAL-REMOTE selection of Start/Stop control.
- 2. LOCAL/REMOTE selection of Speed Control.
- 3. Accept a grounded, isolated, 4-20 mA input remote speed control signal from an external device.
- 4. Provide a 4-20 mA output signal proportion to VFD output frequency for remote speed indication.
- 5. Provide Ethernet TCP/IP communication module

E. Devices:

- 1. Provide operating, monitoring or alarm indicating devices, on keypad, with minimum as follows:
 - a. System control selector switch (RUN/OFF/REMOTE) (When in RUN position drive will run).

- b. System speed control selector switch (LOCAL/REMOTE) (When in LOCAL position, speed controlled by manual speed potentiometer).
- c. Keypad controls to set speed in manual mode.
- d. Speed indicating meter in percent speed to indicate speed of the converter powered motor.
- e. Run time meter.
- f. Alarm and status lights.

2.03 SHOP TESTING (18 pulse units only):

- A. Provide a factory performance test for each variable frequency drive unit. The test to consist of simulating the expected load to be driven. The drive to operate the actual motor load through the expected speed ranges. Test length to be a minimum of two hours.
- B. Provide a factory burn-in test for 24 hours minimum and a control and alarm test on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.
- C. Provide typical prototype factory test data for short circuit testing of each type of drive supplied. Data to verify that each drive can be started into a line-to-line fault and line-to-ground fault on the drive terminals. Each drive can be operating at full load and be subjected to a line-to-line fault and line-to-ground fault on the drive terminals. All phases (A, B & C) to be included in test data.
- D. Provide certified documentation of all tests performed.
- E. Provide above stated tests in addition to routine factory tests.
- F. Owner to have option to witness all factory tests. Notify Owner two weeks before all tests.

2.01 SPARE PARTS:

- A. Provide one spare board or card, three diodes, for each horsepower size drive. Spares will be color-coded or otherwise keyed to their original counterpart such that improper installation of spare cards is impossible. In addition to the cards, the manufacturer shall provide three spares for all expendable items such as pilot lamps, power fuses, and control fuses, and provide one spare for all additional items on the manufacturer's recommended spare parts list. Provide one keypad for every two VFD of the same model.

PART 3 – EXECUTION

3.01 INSPECTION:

- A. Examine VFD location for satisfactory preparation. Check conduits and raceway location for connection to units.
- B. Visually inspect delivered unit(s) and accessories for conformance with specification and drawings.
- C. Verify availability of appropriate pacing signal.
- D. Maintain variable frequency drive in upright position at all times.
- E. Protect variable frequency drive against damage. Store drive in clean, dry environment with temperature and humidity within range as specified by drive manufacturer. Energize space heaters during storage as recommended by manufacturer.

3.02 INSTALLATION:

- A. Erect, install, and start-up equipment.
- B. The VFD's shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- C. Install VFD's to allow complete door swing required for component removal. This is specifically required where a VFD is set in the corner of a room.
- D. Factory-trained service personnel, other than sales representatives, shall supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested.

3.03 RUBBER MATS:

- A. Three-foot-wide rubber mats shall be furnished and installed on the floor and in front of each VFD assembly. The mats shall be long enough to cover the full length of each VFD system. The mats shall be 1/2-inch-thick with beveled edges, canvas back, solid type with corrugations running the long way, and shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mats shall meet the requirements of ASTM D 178 for Type II, Class 4 insulating matting.

3.04 FIELD TESTING:

- A. Provide in accordance with Section 01650.

B. Perform testing checkout, and start-up for variable frequency drive equipment under technical direction of manufacturer's service engineer. Under no circumstances energize any portion of the drive system without authorization from manufacturer's technical representative.

C. Field Tests:

1. Test each drive over the total speed range that it will be required to operate through for the load being driven for a minimum of two hours. Determine for each drive, motor, and load combination the following at minimum speed, maximum speed, and at 1/3 and 2/3 points between the minimum and maximum speeds:
 - a. Input power (kW), voltage, current and RMS power factor on the line side of the drive isolation device.
 - b. Output to the driven load in kilowatts.
 - c. For each drive, measure the harmonic voltage distortion and harmonic current distortion for each harmonic at the main distribution bus for maximum and minimum load conditions.
 - d. Measure the total harmonic voltage distortion and total harmonic current distortion at each PCC for maximum and minimum load conditions.
2. Test each drive by using the actual control signal for remote and local operation.
3. Test each driver's alarm functions.
4. Perform all tests in the presence of the Owner's representative.
5. Perform the above test in addition to the manufacturer's normal field tests.
6. Submit final test report with summary comparing field test data with harmonic analysis design calculated values for each drive.

3.05 CONTRACT CLOSEOUT:

- A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 16420

MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Types of motor controllers, including:
 - 1. Combination controllers.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Shop Drawings: Submit Shop Drawings of motor controllers showing dimensions and sizes.
 - 2. Product Data: Submit manufacturer's data and installation instructions on motor controllers.
 - 3. Wiring Diagrams: Submit power and control wiring diagrams for motor controllers

1.03 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. UL Compliance: Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components which are UL listed and labeled.
 - 2. NEMA Compliance: Comply with applicable requirements of NEMA Standards ICS 2, "Industrial Control Devices, Controllers and Assemblies," and Pub No. 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)," pertaining to motor controllers and enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.02 MOTOR CONTROLLERS

- A. Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design, and construction in accordance with published product information and as required for a complete installation.

- B. Combination Controllers: Consist of controller and circuit breaker or fusible disconnect switch mounted in common enclosure of types, sizes, ratings, and NEMA sizes indicated. Equip starters with block-type manual reset overload relays. Provide control and pilot devices indicated. Provide 90 degree C SIS or MTW, No. 14 AWG control wiring, tagged at each termination. Provide operating handle for disconnect switch mechanism with indication and control of switch position, with enclosure door either opened or closed, and capable of being locked in OFF position with 3 padlocks. Construct and mount controllers and disconnect switches in single NEMA-type enclosure suitable for the location in which it is installed; coat with manufacturer's standard color finish.
1. The 3-phase starter shall be the following type:
 - a. Full Voltage Non-reversing (FVNR): One 3-pole magnetic contactor with a set of 3 overload devices.
- C. Control and Pilot Devices: Provide an individually fused control power transformer in each starter unit. Provide 2 fuses in the transformer primary circuit and 1 in transformer secondary circuit. Size transformers such that they can supply 100VA in excess of the unit requirements or provide 150VA rated transformer, whichever is greater. Provide 300 volt rated, oil tight type pilot lights, push buttons with extended guard and black color insert. Equip stop push buttons with half guard and red color insert. Provide 120/6-volt transformer type push-to-test pilot lights with lens color indicated. Provide machine tool type relays, each with 1 spare N.O. contact. Provide 6-digit elapsed time indicators with one-tenth hour increments. When timers are required, they shall be synchronous type.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 16450

GROUNDING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.
- B. The requirements of Section 16050 - General Electrical, apply to this Section.
- C. Single Manufacturer: Similar products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.
- D. Codes and Standards:
 - 1. UL Compliance: Comply with applicable requirements of UL Standards No. 467, "Electrical Grounding and Bonding Equipment," and No. 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits, and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL listed and labeled for their intended usage.
 - 2. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141, and 142 pertaining to grounding and bonding of systems, circuits, and equipment.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section 01300 - Contractor Submittals.
- B. Contractor shall submit a grounding report from an independent testing company, certifying compliance with the requirements of this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes. The Contractor shall provide drawings clearly showing the Electrical Grounding System. An underground perimeter cable grounding system shall be installed with connections to at least the following equipment:
 - 1. Control Panels including generator outlet

2. Stationary Generator, if provided
3. Electrical Meter Box, including transformer and main disconnect switch
4. Wet Well Hatch and all Guide Rail (not to interfere with removal of pump)
5. Fence and Gate Posts, if provided

2.2 GROUNDING ELECTRODE SYSTEM

- A. Grounding loop conductors shall be bare tinned copper conductors suitable for direct burial. Conductors shall be No. 4/0 AWG unless indicated otherwise.
- B. Ground rods shall have a uniform covering of electrolytic copper metallurgically bonded to a rigid steel core conforming to ANSI/UL 467. The copper to steel bond shall be corrosion resistant.
 1. Ground rods shall be 3/4-inch diameter and 10 feet long unless indicated otherwise
 2. Where ground rod lengths indicated on the Contract Drawings are unavailable, ground rods shall be coupled together using threaded copper alloy couplings.
- C. Underground cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds. Exothermic welds shall be by Cadweld by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**
- D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
- E. Grounding clamps shall be used above ground to bond each conductor to the system. F.

Equipment Grounding Circuit Conductors

1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.
 2. Metallic conduit systems shall have equipment grounding wires as well as being equipment grounding conductors themselves.
- G. Manufacturers of grounding materials shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
 - H. Bond bare No. 4/0 AWG grounding cable in duct banks to grounding cable in vaults and to power equipment ground bus at ends of each duct bank.

- I. Bond strut and other metal inside of electrical manholes and vaults to bare No. 4/0 AWG grounding cable carried in duct bank.
- J. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- K. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible while following building lines to minimize transient voltage rises. Protect exposed cables and straps where subject to mechanical damage.
- L. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed and are subjected to corrosive action.

PART 3 -- EXECUTION

3.1 GROUNDING

- A. General: When sizes are not specifically indicated on the Drawings, grounding cable shall be sized by the Contractor in accordance with all applicable code requirements, but not smaller than No. 4/0. The location of ground rods shall be as indicated. The lengths of rods forming an individual ground array shall be equal and shall be of the quantity required to obtain a ground resistance of no more than 5 ohms. City shall witness ground resistance test. Contractor shall provide a test report and shall record the information on the As-Built Panel Drawings. The grounding system shall be in strict accordance with Article 250 of the N.E.C.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by means of a ground conductor run in all conduits. Grounding conductors run in conduit shall be insulated copper conductors, sized in accordance with the N.E.C. and the Drawings. Conductors shall meet the requirements of Section 16120 - Wire and Cables.
 - 1. Metal equipment platforms, which support any electrical equipment, shall be bonded to the nearest ground bus or to the nearest grounding loop. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph. If not indicated otherwise, provide No. 2 AWG conductor in 3/4-inch conduit.
 - 2. Copper bonding jumpers shall be used to obtain a continuous metallic ground for equipment such as control panels.
- C. Grounding Electrode System: The Contractor shall install the grounding electrode system with all required components in strict accordance with National Electrical Code Article 250.
 - 1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench tight to manufacturer's requirements.

2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pull boxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, fasten with double locknuts.
3. Copper bonding jumpers shall be used to obtain a continuous metallic ground across non-conductive structural members.
4. Within buildings, the grounding cable shall, where possible, be embedded in or installed beneath the slabs.
5. Wiring from ground electrodes connecting to system components, listed in paragraph 2.1.A, from the ground plane shall be contained in ¾ inch conduit.

D. Shield Grounding

1. Shielded instrumentation cable shall be grounded at one end only; this shall typically be at the "receiving" end of the signal carried by the cable.
2. Termination of each shield drain wire shall be on its own terminal screw. All grounding screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

- E. Ohm Test: Contractor shall perform an Ohm test to ensure that grounding is adequate. Testing shall be performed during normal dry weather conditions with at least 5 non-rain days elapsing prior to test. Where tests show resistance-to-ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less by driving additional ground rods; then retest to demonstrate compliance

END OF SECTION

SECTION 16460

ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. General: The Contractor shall provide electric motors, accessories, and appurtenances complete and operable, in conformance with the individual driven equipment specifications and the Contract Documents.
- B. The provisions of this Section apply to all low voltage AC squirrel cage induction motors except as indicated otherwise.
- C. The Contractor shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the City. Such review will consider future availability of replacement parts and compatibility with driven equipment.
- D. Electrical Codes, Ordinances, and Industrial Standards: The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment, and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable State and local requirements. UL listing and labeling shall be adhered to under this Contract. Any equipment that does not have a UL, FM, CSA, or other listed testing laboratory label, shall be furnished with a notarized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electrical Code and OSHA requirements. Any additional cost resulting from any deviation from codes or local requirements shall be borne by Contractor.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with Section 01300-Contractor Submittals.
- B. Complete motor data shall be submitted with the driven machinery Shop Drawings. Motor data shall include:
 - 1. Machine name and specification number of driven machine
 - 2. Motor manufacturer
 - 3. Motor type or model and dimension drawing. Include motor weight.
 - 4. Nominal horsepower
 - 5. NEMA Design
 - 6. Enclosure
 - 7. Frame Size

8. Winding insulation class and temperature rise class
9. Voltage, phase and frequency ratings
10. Service factor
11. Full load current at rated horsepower for application voltage
12. Full load speed
13. Guaranteed minimum full load efficiency and nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or over temperature protection, if included
15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable
16. Bearing data. Include recommendation for lubricants of re-lubricatable type bearings.
17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
18. Power factor at 1/2, 3/4, and full load
19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Electric motors driving identical machines shall be identical.
- B. Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and be verifiable from the submittal data of the driven machinery.
- C. Minimum motor HP: The Contractor shall size motors to continuously carry the maximum load imposed through the full range for driven equipment operation; however, power ratings shall not be less than the specified values, when indicated in the specification. If the specified values are less than those required from the first criterion above, then the Contractor shall provide greater capacity motors. In addition, increases in circuit breaker, magnetic starter, conductor, and conduit size capacities related to increased motor size shall also be provided.
- D. Exempt Motors: Motors which are for submersible pumps or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

- A. General: Electrical Motor design and application shall comply with current ANSI, IEEE, NEMA, and AFBMA standards and with the NEC where applicable. They shall be squirrel cage induction motors rated 60 hertz, continuous duty for use in 40 degrees C ambient temperature. Motors shall comply with NEMA MG1-1993, Rev. 1, Part 31, Definite Purpose Inverter-Fed Motors whether used with variable frequency drives or not.
 - 1. The motors shall be sized within their rated loads under the specified conditions without utilizing the top 15 percent of the 1.0 or 1.15 service factor. Motor sizing measured at the motor output shaft shall include all loadings on the motor. Motor loadings shall include the maximum or specified load condition of the driven equipment plus all drive losses of components, located between the motor and the driven equipment.
 - 2. The motor winding temperature rise shall be NEMA Standard for the class of insulation used at the rated service factor load.
 - 3. The motors shall be capable of handling unfiltered voltage peaks of up to 1600 volts and rise times of 0.1 micro-seconds.
- B. NEMA Design: Electric motors shall be NEMA Design B, unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value specified in said ANSI/NEMA MG 1. Motors shall be suitable for the indicated starting method.
- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
 - 1. Motors below 1/2-HP shall be rated 115 volts, single-phase, 60-Hz. Dual voltage motors rated 115/230-volts, 115/208-volts, or 120-240 volts are acceptable, provided all leads are brought out to the conduit box. All 115/208-volt motors shall be pre-approved by the City of Cape Coral.
 - 2. Motors 1/2-HP and larger shall be rated 230 volts or 460 volts, 3-phase, 60-Hz. Dual voltage motors rated 230/460 volts are acceptable, provided all leads are brought out to the conduit box.
- D. Insulation: All 3-phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600-volt spikes, with dV/dt as defined in NEMA MG 1-31.
- E. Motors 50 HP or smaller located in non-hazardous areas shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 unless otherwise indicated.
- F. Motors for use in hazardous locations shall meet NEC Class 1, Division I, Group D, requirements with T2A temperature rating. Such motors shall be U.L. listed and be stamped as such.
- G. High Efficiency Motors:

1. Motors with a nameplate rating of 1 HP and larger shall be "high efficiency" units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA High Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 -Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
2. High Efficiency motors shall conform to the following guaranteed minimum efficiency requirements which are full load values:

OPEN DRIP-PROOF (ODP)								
FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS								
OPEN MOTORS								
	2 POLE		4 POLE		6 POLE		8 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1.0	--	--	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	84.0	81.5	75.5	72.0
2.0	84.0	81.5	84.0	81.5	85.5	82.5	85.5	82.5
3.0	84.0	81.5	86.5	84.0	86.5	84.0	86.5	84.0
5.0	85.5	82.5	87.5	85.5	87.5	85.5	87.5	85.5

- H. All integral horsepower motors shall have oversize conduit boxes with clamp-type grounding terminals inside which are effectively connected to all noncurrent-carrying motor parts.
- I. Multispeed motors are to be supplied with separate windings for each speed. The cost to change starters for motors supplied with reconnectable windings will be the responsibility of equipment (motor) supplier and must be coordinated with ENGINEER.
- J. Special duty and severe environment application shall have motors which are designed specifically to meet the special conditions as specified.

2.3 ACCESSORY REQUIREMENTS

- A. General: Horizontal motors 3 HP and larger, and all vertical motors, shall have split- type cast metal conduit boxes. Motors less than 3 HP shall have the manufacturer's standard conduit boxes. Motors other than open drip-proof shall be gasketed.
- B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

- C. Special Requirements: The Contractor shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.
- D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.
- E. Nameplate: Motors shall be fitted with permanent stainless-steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.
- F. Where motors are indicated by elementary schematics or specifications to have zero speed switches, the switches shall be factory mounted integral to the motors. Switches shall close contact when the motor is at zero speed.

2.4 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: Single phase 120, 208, or 230-volt motors shall have integral thermal overload protection or shall be inherently current limited.
- B. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature- actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be pre-calibrated by the manufacturer.

2.5 MOTOR BEARINGS

- A. General: Bearings shall conform to Section 11000 - Equipment General Provisions, except as indicated herein.
- B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.
- C. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with Lubricated-for-Life ball bearings.
- D. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- E. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

2.6 Manufacturers, or City Approved Equal

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Related electrical work involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 16.

3.2 FIELD TESTING

- A. The Contractor shall perform the following field tests:
 - 1. Inspect each motor installation for any deviation from rated voltage, phase, or frequency and improper installation.
 - 2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.
 - 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 - 4. Test for proper rotation prior to connection to the driven equipment.
 - 5. Test insulation (megger test) of all motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

3.3 INSTALLATION CHECK

- A. Installation Check: Manufacturer shall provide the services of a factory-trained representative to check the installation of all equipment installed in this Section. The services shall be as noted in Section 01600. Equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and equipment installation and operation is satisfactory to ENGINEER.
- B. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.
- C. Inspection Report: A written report of the installation check shall be submitted to ENGINEER. The report shall be as noted under Section 01600 certifying that the equipment:
 - 1. Has been properly installed and lubricated;
 - 2. Is in accurate alignment;
 - 3. Is free from any undue stress imposed by any connection or anchor bolts;
 - 4. Has been operated under full load condition and that it operated satisfactorily to ENGINEER; and
 - 5. That OWNER's representative has been instructed in the proper maintenance and operation of the equipment.

6. Furnish OWNER a copy of all test data recorded during the installation check including noise level and vibration readings.

END OF SECTION

SECTION 16480

PUMP CONTROL PANEL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish, install and test all single-phase and three-phase, pump control panels as required, all in accordance with the requirements of the Contract Documents. In addition, if motors furnished are different from those shown and specified, then the installation of raceway, conductors, starters, VFD's, overload elements, and branch circuit protection shall be adjusted as required to control and protect the motor furnished.
- B. The manufacturer of the control panel shall provide data to indicate that the manufacturer has a minimum of 5 years' experience in the fabrication of pump control panels.

1.2 CONTRACTOR SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section 01300 "Contractor Submittals."
- B. Contractor shall submit shop drawings and technical information for all materials and equipment required for construction and installation of the pump control panel. Manufacturer's cut sheets showing materials, dimensions and operating systems shall be submitted as part of the shop drawings. Shop drawing submittals shall include the following:
- C. Shop Drawings
 - 1. Enclosure NEMA rating, dimensions, material, and color
 - 2. Arc Flash warning signs as required by OSHA and per Article 110.16 of the NEC, most recent edition.
 - 3. Bus ampacities, voltage rating and interrupting capacity. Include materials of construction
 - 4. Ground bus size and material of construction
 - 5. Conduit entrance provisions
 - 6. Main incoming line entry provision (top or bottom)
 - 7. Control unit nameplate schedule
 - 8. All circuit breaker types, frames and settings
 - 9. All starter NEMA sizes, auxiliary contact provisions, coil voltage, VFD information (Including sizing calculations for operation on a single-phase supply).

10. Relays, timers, pilot devices, control transformer VA and fuse sizes
11. Elementary schematic ladder diagrams for each compartment. Custom schematics shall be furnished. Diagrams shall include all remote devices. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the Contractor stamped "REJECTED-RESUBMIT." Once schematics have been either "APPROVED" or "APPROVED AS NOTED", Contractor shall laminate and mount schematics to inside of the exterior door to the control panel. Schematics shall be posted in accordance with OSHA requirements.
12. Short circuit rating of the complete assembly
13. Replacement parts lists and operation and maintenance procedures

1.3 QUALITY ASSURANCE

- A. General: Each pump control panel shall be the product of a single manufacturer, meeting the experience requirements of Section 1.1.B. All materials and parts in this unit shall be new and unused, of current manufacture, and of the highest grade, and free from all defects that may affect performance.
- B. Unit Responsibility: Each pump control panel and all appurtenant equipment specified herein shall be provided by a single manufacturer/vendor, establishing one source of responsibility for the equipment performance and assuring high standards of quality, coordination, reliability and service.
- C. Factory Test: Prior to delivery at the job site, each pump control panel and appurtenant equipment shall be tested at the manufacturer's testing facility to verify that the equipment is free of any defects. All cabinets shall bear UL label, as applicable. Provide factory test report at time of delivery.

1.4 WARRANTY

- A. Warranty: Equipment furnished under this Section shall be guaranteed against defective parts and workmanship under the terms of the manufacturer's and supplier's standard warranty. In no event shall it be for a period of less than five (5) years from date of final acceptance of the system and shall include labor, materials and travel costs for necessary repairs at the job site.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Each pump control panel shall be built in accordance with the details as required by the Contract drawings and/or as specified herein. Square D by Schneider Electric, Cutler Hammer/Eaton, Allen Bradley or City approved equal, shall manufacture all major components of the pump control panels such as control devices and custom fabricated equipment including:
 1. Molded case circuit breakers

2. Disconnect switches
 3. Magnetic motor starters
 4. Control and timing relays rated at 600 volts AC
 5. Pushbuttons, lights, and selector switches, including remote mounted control stations
 6. Meters, including ammeter, voltmeter, and solid-state metering devices
 7. Pulse-width modulated variable frequency drives
- B. The pump control panel construction shall comply with applicable requirements of NEMA 250 and UL Standards 50 and 508.
 - C. Wiring of pump control cabinets shall utilize stranded copper conductor rated for 600- volts and UL listed as specified in Section 16120 Wires for annunciator and indication circuits shall be No. 16 AWG minimum. All others shall be No. 14 AWG minimum. All incoming and outgoing status or signals shall be terminated on master set of terminal blocks. All wiring from the master terminals to internal components shall be factory- installed and shall be contained in 4-inch wide by 4-inch high plastic wireways having removable covers. Wiring to door mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
 - D. All wiring within the enclosure shall be neatly routed by the use of slotted type wiring duct with snap on type covers. Wiring on the rear of the inner door shall be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage.
 - E. Terminal points of all terminal strips shall be permanently identified. All terminal numbers and identifying nomenclature shall correspond to and be shown on electrical diagrams. All terminal points shall be shown on electrical schematic diagrams.

2.2 PUMP CONTROL PANEL

- A. Main circuit breaker and enclosure for each pump control panel shall be marked as "Suitable for Use as Service Equipment" as required by the local or national electric codes. Arc Flash warning signs shall be provided as specified in 1.2.C.2.

The pump control panel shall be housed in a NEMA 4X 316 American made stainless steel enclosure with 30% extra mounting space for additional equipment. Enclosure shall have provisions for padlocking the door and a dead front inner door unit for mounting controls. The control panel enclosure shall be Underwriters Laboratories (UL) 50.

- B. There shall be permanently affixed to the interior side of the exterior enclosure door both a nameplate and a 10" x 12" pocket for log sheet storage. The nameplate shall contain the following information, voltage, phase, rated horsepower, speed, date manufactured and pump and control panel manufacturer's name, address and telephone number, pump data,

including impeller data, operating point and head, kW input, and amps at the operating point and at least two other points on the pump curve.

- C. Power supply to the control panel shall be 120/208 volts, 120/240 volts, or 277/480 volts, 3-phase, 4- wire; or 120/240 volts, 1-phase, 3-wire, as shown on the Contract Drawings. Service shall be as indicated on Drawings.
- D. A non-fusible service disconnect switch in a NEMA-4X American made stainless steel enclosure and surge arrestor shall be installed between the meter and the control panel. Additionally, in conformance to LCEC Service Requirements, a non-fusible service disconnect switch in a NEMA-4X American made stainless steel enclosure and surge arrestor shall be provided on the input to the meter for 480 volts only.
- E. The pump control panel containing motor starters shall be combination circuit breaker type; unit shall have panel mounted control devices as specified herein. Metal dividers shall be provided in the interior panels to isolate electrical components having different functions.
- F. Full voltage starter shall be NEMA Rated, Size 1 minimum. IEC (International Electrotechnical Commission) or dual rated starters will not be acceptable.
- G. Each starter unit shall have its own 120-24-volt control transformer, feeding the circuitry for the float switches. Panel shall have fused control transformers where indicated.
- H. Each starter shall be provided with a 3-pole Motor Circuit Protector, furnished by Square D or City approved equal. Refer to Section 16420 for additional requirements.
- I. The panel shall contain two motor starters, except as described below. Local Power Company Regulations shall govern. Selector switches shall be installed on the face of the inner door unit. Selector switch shall be a heavy-duty oil tight "Hand-Off-Auto" three- position switch to control the operation mode of each pump motor starter.
 - 1. Where supplied from the utility with single phase, 120/240 V power, the panel shall include a quantity of two (2) pulse width modulated, 240 V variable frequency drives (3 phase) for operation from the utility source. The drives shall be operated on 240 V, single phase input power, and shall deliver 240 V, 3 phase output to the 3-phase pump motor. The VFD single phase protection shall be disabled. Motors shall be ramped up to full speed each time the VFD is called upon to start. VFD shall be as manufactured by Eaton Electrical, or City approved equal. Submit sizing calculations to show that the drive is properly sized for the single-phase input and 3 phase output for the motor actually connected. Refer to Section 16151 for additional requirements.
- J. A plug-in solid-state alternator shall be provided to change the pump starting sequence after each pumping cycle. The alternator shall be provided with a three-position alternator test switch to control the alternation operation. Switch positions to include the "Auto" position to provide normal automatic sequence, "Off" position to disable alternator, and "test" position with a spring return to allow the alternating of the pump sequence to check alternator operation. The pump alternator shall be MPC 008-120-13N or Diversified ARA-120-ACA.

K. Circuit breakers shall conform to the circuit breaker criteria as specified below:

1. The control panel shall consist of a main utility circuit breaker and a generator breaker with mechanical interlock, an emergency power receptacle, a circuit breaker and VFD or magnetic starter for each pump motor, and 15 ampere, 120-volt circuit breakers as required.
2. Circuit breakers shall be factory-assembled, molded-case circuit breakers with permanent instantaneous magnetic and thermal trips in each pole, sealed trip units, and with fault-current limiting protection, ampere ratings as indicated. Construct with over center, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Provide push-to-trip feature for testing and exercising circuit breaker trip mechanism. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with AL/CU-rated mechanical screw type removable connector lugs. The breaker contact material shall be a non-weldable silver alloy. The breakers shall have arc-extinguishing chutes.

L. Pump Control Operation with Liquid Level Float Switches

1. In the Auto Mode, the control panel shall respond to liquid level float switches to automatically start and stop pumps as well as sound an alarm upon high wet well levels. The control panel shall operate two (2) submersible pumps at the power characteristics stipulated. The control function shall provide for the operation of the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, the lag pump shall automatically start to handle this increased flow. As the flow decreases, pumps shall be cut off at the Low-Level Float elevation as shown on the Drawings. Pumps shall alternate positions as lead pump at the end of each cycle. A failure of the alternator shall include a safe, convenient method of manual alternation and also have provisions to prevent automatic alternation without disturbing any wiring. Should the "pump off" regulator fail, the system shall keep the station in operation and provide a visual indication of the regulator failure. Pumps shall always operate at full speed, regardless of the starting means employed.
2. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. A five-float type liquid level control system shall continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps and shall operate from a 24-volt circuit. The functions of the five float switches shall be Off (Low Level), Start Lead Pump, Start Lag Pump, and High Level (Alarm) and High Level (Alarm) to RTU.

M. Lights and Alarms

1. Indicator Lights: There shall be installed on the face of the inner door unit, heavy duty oil tight indicator lights as shown on the Drawings.

2. High Level Alarm: A vapor proof, red flashing light shall be furnished and mounted on the side of the panel for high-level alarm.

N. Control Devices

1. Products of the same type shall be of the same make. This requirement applies to all control devices and, insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this project.
 - a. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts, shall be heavy-duty, corrosion resistant Type 4/4X shall have the number of positions and poles shown. They shall be Square D Class 9001 Type SKS, or City approved equal. Each shall have a factory-engraved legend plate as shown.
 - b. Indicating Lights: Indicating lights shall be 120 volt, full-voltage, push-to-test type, and shall be heavy-duty, corrosion resistant Type 4/4X, as specified above for selector switches. Each shall be nickel-plated with a screwed-on glass prismatic lens approximately one-inch in diameter. Indicating lights shall be Dialco 803-1710, Littlefuse 930407X, or City approved equal.
 - c. Magnetic Relays: Magnetic relays shall be general-purpose miniature plug-in-type relays with 115-volt AC coils and 10-amp contacts, unless otherwise shown. Relays shall be socket-mounted to a common mounting channel. Mounting dimensions and drilling for AC and DC relays shall be identical. All AC relays shall be Potter and Brumfield Type KRPA-11AN, Eagle Signal 22 series, or City approved equal.
 - d. Control Relay: The level control relays shall operate from 24VAC. They shall be enclosed, plug-in 8-pin type with octal-style screw terminal sockets, including retainer clip.
 - e. Phase Monitor: For all 3-phase, stations, a phase monitor shall be provided for protection of electrical components due to phase loss, low voltage or phase reversal. Adequate dummy pin protection shall be provided to prevent accidental interchanging of the eight-pin phase monitor with the eight-pin alternator. Phase monitors shall be by MPC, Time Mark Model 2652, or City approved equal.
 - f. Elapsed Time Meters: Elapsed time meters (ETM) shall be non-reset type; shall totalize pump running time for each pump, in hours and tenths of hours to 99999.9 hours; shall have flush panel-mount case not less than 3 inches square; shall be suitable for operation at 115 volts, 60-Hz, ac; and shall be Hecon TO 621134, or City approved equal.
 - g. Terminal Blocks: Terminal blocks for control wiring shall be molded type with barriers, rated not less than 600 volts. White or other light-colored marking strips shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number imprinted on the marking strip with permanent marking fluid. Terminal blocks shall be Square D 9080 type GRG, Marathon Series 200, or City approved equal.

- h. Strobe Light Assembly: Strobe Light Assembly shall be rated 120 volts, Ingram ALVLRX-40, 40-watt bulb.
- i. Fuses: Fuses shall be used in the primaries and secondaries of control transformers. Fuses shall be manufactured by Bussman, Shawmut, or City approved equal.
- j. Float Switches: Float Switches shall be 2-wire Roto-Float or City approved equal.
- k. A motor automatic megger furnished by Automeg, or City approved equal shall monitor motor insulation on 3-phase, 120/208- a n d 2 7 7 / 4 8 0 - v o l t stations.
- m. Moisture and Temperature Indicator: Indication of moisture or temperature failure shall be provided by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.
- n. The wet well hatch intrusion alarm switch shall be **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST** and shall meet an electrical classification of Class I, Division I, Group C and D.
- o. The control panel and RTU intrusion alarm switch shall be a spring contact switch.

O. Voltage Surge Arrester:

- 1. Voltage surge arresters shall be furnished and installed for protection of motors and controls. It shall be suitable for use with a 120/240 volt, 1-phase, 3-wire, grounded neutral system or a 120/208-volt, 120/240 volt, or 277/480 volt, 3-phase, 4- wire, grounded neutral system, as applicable. Surge protectors shall be U.L. listed and installed per power company requirements and manufacturers' specifications, surge protectors shall be attached to the main disconnects. Surge arresters shall be manufactured by **SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST**.

P. Breakers and Receptacles:

- 1. Panels shall be provided with three 120-volt GFI duplex receptacles, one mounted on the RTU panel inner door, and two mounted in the control unit, fed from dedicated single-pole 20-amp circuit breakers.
- 2. Panels shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that a fault in a branch circuit will trip only the branch breaker but not the main breaker.

Q. Nameplates:

- 1. Nameplates shall be fabricated from white-letter, blackface-laminated plastic engraving stock, Formica type ES-1, or City approved equal. Each shall be fastened securely, using fasteners of American made stainless steel, screwed into inserts or tapped holes, as

required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.

- R. Manufacturers of Pump Control Panels:

SEE CITY OF CAPE CORAL QUALIFIED PRODUCT LIST

2.3 EXTERIOR CONTROL PANEL REQUIREMENTS

- A. Service disconnects shall be provided as shown on drawings and shall be NEMA 4X 316 SS Enclosure. Furnish and install disconnect switch for 277/480-volt, 3-Phase installations on the utility side and ahead of the meter box immediately adjacent to the meter socket. The disconnecting switch shall be rated not less than the load to be carried and must have an interrupting rating at system voltage sufficient for the current to be interrupted and a fault current rating greater than the system fault current. The disconnecting switch for 277/480V service shall be readily accessible to LCEC personnel and shall accept an LCEC lock. The Contractor shall coordinate with LCEC as regards to the required interrupting rating. For all other installations (120/208-volt, 3-Phase, 120/240-volt, 1- Phase, & 120/240-volt, 3- Phase), the Contractor shall furnish and install a non-fusible disconnect switch and surge arrestor on the load side of the meter as shown on the contract drawings.
- B. Furnish and install Electrical Meter NEMA 3R Aluminum Box (no bolt). Meter box shall be Landis and Gyr HQ7.
- C. Step-down Electrical Transformer (See Specification 16480 Section 2.2.G).

PART 3 -- EXECUTION

3.1 GENERAL

- A. The Contractor shall install and test all pump control panels in accordance with manufacturer's published instructions. Conduit installation shall be coordinated so that all conduit stub-ups are within the area allotted for conduit as indicated on the drawings.

3.2 INSTALLATION

- A. Each pump control panel shall be set level within 1/32-inch per horizontal foot. After leveling and shimming, the Contractor shall anchor control panel to concrete pad and shall grout in place so that no space exists between the pad and support beams. Installation shall be above 100-year flood level as indicated on the drawings.
- B. The Contractor shall:
1. Tighten all sheet metal and structure assembly bolts.
 2. Inspect all protective devices to verify operation under normal conditions. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors.

3. After equipment is installed, touch up scratches and verify that nameplate and other identification is accurate and in compliance with these Specifications.

3.3 WARRANTY

- A. The manufacturer shall furnish a five- (5) year warranty against defects in materials and workmanship covering parts and labor on all items supplied under this section.

END OF SECTION

SECTION 16781

OUTDOOR FIBER CONDUIT & STRUCTURES

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

- A. The work required under this Section consist of furnishing outdoor fiber optic conduit systems for fiber optic cable (in future, by others) including furnishing and installing pull boxes and other ancillary equipment, involved with fiber optic conduit system for the project as shown on drawings and/or as specified herein.
- B. The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to provide a complete underground outside plant infrastructure for cable installation in future. The approved vendor, designated agent or employee is held responsible to be familiar with the provisions contained herein and is assumed to possess the proper license(s), bonding, knowledge, manpower, and material applicable to the completion of the installation.
- C. Specific requirements are shown in the Specifications and Plans.

1.02 RELATED REQUIREMENTS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1.	Section 01300	Contractor Submittals
2.	Section 01530	Protection of Existing Facilities
3.	Section 01700	Project Closeout
4.	Section 02200	Earthwork
5.	Section 02347	Horizontal Direction Drilling
6.	Section 16450	Grounding

1.03 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated in this Section of the Specifications, the Contractor shall comply with the City of Cape Coral, Engineering Design Standards
- B. BICSI TDM, Current Edition.
- C. BICSI Customer Owned Outside Plant Design Manual.
- D. NFPA 70, The National Electric Code.
- E. NESC, the National Electrical Safety Code.

- F. Common Ground Best Practices.
- G. Title 18, Chapter 60 NMAC.
- H. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
- I. ANSI/TIA/568-C.1, Commercial Building Telecommunications Cabling Standard.
- J. ANSI/TIA/568-C.2, Copper Cabling Components Standard.
- K. ANSI/TIA/568-C.3, Optical Fiber Cabling Components Standard.
- L. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces.
- M. ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- N. ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- O. ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers.

1.04 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted per Section 01340:
 - 1. Catalog Data: Catalog data on conduit system, pull boxes, conduit fittings, conduit plugs, pull rope, identification tape, warning signs.
 - 2. Detailed bill of materials.
 - 3. Plans indicating the locations and quantities of all pull boxes with station numbers.
 - 4. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.
 - 5. Cable pulling calculations for all conduit runs. Indicate on the submittal any additional pull boxes that are required, including station number and a written description of the location.
 - 6. Information on at least one successfully performing fiber optic conduit installation of comparable size and complexity installed in the recent past with name, address, and telephone number of facility owner, name of project and completion date, and type of conduit system and length of cable pulled.
 - 7. The name and qualifications of the supervisory personnel that will be directly responsible for the installation of the conduit system.

1.05 STANDARDS

- A. Provide new materials that are Underwriters Laboratory, Inc. (UL)-Listed and meet National Electrical Manufacturers Association (NEMA), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and National Electrical Code (NEC) most recent requirements.
- B. Ensure all components of the system are provided by the same supplier.
- C. The conduit system consists of outer duct, pull and splice boxes, locate wire (tracer wire), warning tape, pull tape, bends, couplings, adapters, and other accessory fittings, and when specified as a multi-duct system, inner ducts
- D. The system shall provide mechanisms to ensure that conduit expansion and contraction stresses are normalized.

1.06 APPLICABLE DOCUMENTS

- A. The outdoor fiber conduit system shall conform to the latest issue of the following standards documents which are incorporated by reference into this specification:

Schedule 40 and 80 Polyvinyl Chloride (PVC)	UL 651
HDPE SDR 13.5	ASTM F 2160
Schedule 40 and 80 HDPE	UL 651A

1.07 QUALITY ASSURANCE

- A. All work described in this Section shall meet or exceed the applicable provisions of the following documents:
 - 1. Underwriters Laboratories (UL) Standard 651 (Conduit)
 - 2. Underwriters Laboratories (UL) Standard 514 (Accessories)
 - 3. National Electrical Manufacturers Association (NEMA) TC-2 (Conduit)
 - 4. National Electrical Manufacturers Association (NEMA) TC-3 (Accessories)

1.08 RECORD DRAWINGS

- A. The Contractor shall provide as-built drawings both electronic and paper copies plus other documentation as per specification Section 01720, Project Record Documents, to the City of Cape Coral prior to final payment for this work.
- B. In compliance with Section 01720, Project Record Documents, the Contractor shall upon completing the construction of the fiber optic conduit system, shall submit to the CITY Record Drawings showing the following:
 - 1. Electronic and paper copies of fiber conduit routes

2. Horizontal alignment of fiber optic conduit
3. Vertical alignment of fiber optic conduit
4. Location of all pull boxes using Station Number, and the exact northing and easting of each pull box using the North American Datum (NAD) 83 coordinate system.

1.09 WARRANTY

- A. The Contractor shall provide an unconditional warranty on all installed conduit system for a minimum period of one (1) year. Refer to specification Section 01740, Warranties and Maintenance Bonds, for documentation requirements and start date details.
- B. The Contractor shall provide a 5-year warranty on installation associated with conduit, pull boxes and associated equipment and all other infrastructure components associated with this section. A certificate of warranty shall be provided to the City of Cape Coral as part of closeout per the specification Section 01700 Contract Closeout and Section 01740, Warranties and Maintenance Bonds.

PART 2 -- PRODUCTS

2.01 OUTDOOR FIBER CONDUIT SYSTEM

- A. Conduit System
 1. Backbone conduit system contains four (4) – 1.25" HDPE conduits. Conduit shall be smooth outside and ribbed inside with a side wall rating of SDR 13.5 or thicker. Conduit shall be Dura-Line or City approved equal.
 2. Conduits shall consist of four (4) ribbed 90% virgin High Density Polyethylene, HDPE, color coded ducts. Each duct shall have a nominal outside diameter of 1.660 inches, a minimum wall thickness of 0.123 inches and a safe working load of 1,425 lbs. The four conduits shall be assembled on the site and buried or directional bored into the ground as noted on the plans.
 3. The conduits shall be uniquely defined by the extrusion of a different color. Colors shall be green, orange, yellow w/ orange stripe, and blue OR as chosen by the City during the submittal and approval process.
 4. Conduit into termination locations shall be 2" UL listed Sch 40 PVC.
 5. Provide flat profile, low stretch polyester, 5/8-inch 2500 lb. minimum tensile strength pull tape/ rope with sequential markings in each empty conduit. The tape can be installed in factory or at the field.
- B. Outer Duct
 1. Provide the following outer duct when shown on the plans. Ensure the outer duct

has "City of Cape Coral - Fiber" permanently printed on its surface every 24 inches.

- a. PVC: For locations noted on the plans, provide 6" schedule 40 PVC conduits for outer duct when the conduit system is buried. Polyvinyl chloride (PVC) outer conduit shall meet the requirements of NEMA TC-2, "Electrical Polyvinyl Chloride Conduit" or TC-6, "PVC Plastic Utilities Duct for Underground Installations", UL 651, "Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings", and the NEC.
- b. Galvanized Steel Pipe: Provide 6" steel pipe for outer ducts when the conduit system is hung under the bridge or passing through an aerial crossing. Steel pipe shall meet the requirements of ASTM A53.

C. Conduit Locate System

1. Conduit locate system – locate wire also referred to as tone wire in these specifications and plans shall be manufactured by:
 - a. Neptco, color - Orange
 - b. Or City approved equal.
2. Place the locate system along any underground conduit installation. Ensure that the locate system includes aboveground route markers, warning tape, tone wire, and electronics that allow detection of buried conduit and other related underground facilities.
3. Furnish and install a system as shown in the plans and as directed by the Engineer. Ensure that the locate system provides:
 - a. An end-to-end electrical conductor, such as a locate wire, buried along the conduit system for conductive facility locating.
 - b. Visual notification of the presence of conduit installed on City projects.
1. Public notification of potential hazards and contact information for public or private inquiries regarding the conduit system.
2. A means of locating any conduit system pull box or splice box that is buried.
3. Surge protection and dissipation of transient voltages that may be induced into the route marker system.
4. Locate Wire Grounding Unit
 - a. Ensure that locate wires are attached to a wire grounding unit (WGU) dedicated to safely dissipate high transient voltages or other foreign electrical surges induced into the designated system. Ensure the WGU conforms to the following:

- b. Allows signals generated by locate system transmitters to pass through the protection system without going to ground.
- c. The protection system automatically resets and passes locate system transmitter signals after the unit has been grounded to dissipate over-voltages.
- d. Is intended for below or above grade applications. Ground the WGU to a driven rod within 10 feet of the system using a No. 6 AWG single conductor wire with green insulation. Ensure that the WGU is enclosed for protection from environmental hazards and is accessible for the connection of portable locate system transmitters.

D. Warning Tape

- 1. Ensure that the buried cable warning tape is flexible, elastic material 6 inches wide, intended for burial and use as an underground utility warning notice. Ensure that the surface of the warning tape is coated and sealed to prevent deterioration caused by harsh soil elements. Ensure that the tape material and ink colors do not change when exposed to acids, alkalis, and other destructive chemical variances commonly found in Florida soils. Ensure that the warning tape color is orange as required by the American Public Works Association (APWA) Uniform Color Code, and has "CAUTION: CITY OF CAPE CORAL FIBER OPTIC CABLE BURIED BELOW, CALL BEFORE PROCEEDING" or other wording approved by the Engineer, permanently printed on its surface every 24 inches.

E. Locate/Tone Wire

- 1. The Locate/Tone wire shall be one #12 AWG electrical conductor, coated solid copper, insulated and shall be installed in the Orange conduit or as approved by the City of Cape Coral during the submittal process.

F. Installation Requirements

- 1. Warning Tape: Install buried cable warning tape 6 to 8 inches below the finish grade, directly over any installed conduit and cable run.
- 2. Locate Wire: Locate wire shall be buried inside the conduit system for water or bridge crossings, outside the conduit as shown on the drawings.

2.02 TERMINATION KIT

- A. Provide special termination kits from the conduit manufacturer for terminating the conduit in pull boxes or manholes. The kits shall provide for a water tight seal of conduit to structure wall and between inner ducts and outer ducts.

2.03 STUB-OUT

- A. Where designated on the plans, the Contractor shall provide a stub-out from a manhole or pull box. The stub-out shall be of the size and length indicated in the plans and shall be capped. If no length is indicated stub-outs shall be 2" rigid electrical conduits, at least 3 ft in length from the pull box.

2.04 PULL BOXES

- A. Pull boxes shall be a standard Tier 22 rated box, approximately 17 inches wide by 30 inches long by 24 inches deep, designed for intermediate traffic loading. Covers for pull boxes in paved areas shall be the same material as the box. Bolts shall be 316 stainless steel. Covers shall have the words "City of Cape Coral Fiber Optic" in raised letters on the top. Covers shall have locking devices and form a watertight seal to prevent surface water from entering. Pull Boxes shall be Quazite PG style, or City approved equal.
- B. When indicated on the plans, provide a H-20 traffic rated pull boxes. Pull box shall be precast concrete with galvanized steel lid in lieu of polymer concrete box. Precast concrete pull box shall be Christy by Oldcastle, or City approved equal.

2.05 SPLICE BOXES

- A. Splice boxes shall be a standard Tier 22 rated box, approximately 30 inches wide by 42 inches long by 24 inches deep, designed for intermediate traffic loading. Covers for pull boxes in paved areas shall be the same material as the box. Bolts shall be 316 stainless steel. Covers shall have the words "City of Cape Coral Fiber Optic" in raised letters on the top. Covers shall have locking devices and form a watertight seal to prevent surface water from entering. Splice Boxes shall be Quazite PG style, or City approved equal.
- B. When indicated on the plans, provide a H-20 traffic rated splice boxes. Splice box shall be precast concrete with galvanized steel lid in lieu of polymer concrete box. Precast concrete splice box shall be Christy by Oldcastle, or City approved equal.

2.06 CONDUIT DUCT PLUGS

- A. Conduit duct plugs shall be Jackmoon Simplex Duct Plugs with bushing sleeves or equal.

2.07 STANDARD ROUTE MARKER (SRM)

- A. Ensure that SRM posts are white with an orange top fitting cover with black or white lettering and graphics. Ensure that the SRM is a tubular configuration, and both the marker post and the top fitting are made from virgin Type 111 HDPE. Ensure that any fasteners used with the SRM are constructed of stainless steel.
- B. Ensure that all SRMs have a minimum outside diameter of 3.5 inches with a minimum wall thickness of 0.125 inches. Ensure that the top fitting cover is a minimum of 1.5 feet long and has an outside diameter of 3.75 inches with a minimum wall thickness of 0.125 inches. Ensure that each SRM provides a tensile strength of 4,200 pounds per square inch as required in ASTM D638. Ensure that each SRM is manufactured for use

in temperatures range of minus 30° to 65°F in accordance with NEMA TS 2.

- C. Ensure the SRM can withstand an impact force of 70 pounds per foot at 32°F in accordance with ASTM D2444, before and after UV conditioning for 2,000 hours in accordance with ASTM G 154. Ensure that the control sample of any material tested maintains a minimum of 70 percent of its original tensile strength.
- D. Ensure that SRMs installed at the minimum 2 foot depth can withstand at least one impact at 45 miles per hour by a vehicle weighing at least 3,500 pounds and that after impact, post returns to an upright position within 10 degrees of vertical alignment within 30 seconds from the time of impact. Ensure that SRMs installed at the minimum 2 foot depth can withstand at least one impact at 45 miles per hour by a vehicle weighing at least 3,500 pounds and that after impact, post returns to an upright position within 10 degrees of vertical alignment within 30 seconds from the time of impact.
- E. Provide SRM as manufactured by Mesa - Cottmark 503 & 512 markers or City approved equal.

2.08 ELECTRONIC ROUTE MARKER (ERM)

- A. Ensure ERMs meet the same material and performance requirements as the SRMs with the following exceptions. Equip each ERM with a removable, top-fitting cover that is black with white lettering. Ensure that each ERM contains a terminal board equipped with locate wire and ground connectors.
- B. Ensure that the terminal board is made from corrosion-resistant materials and includes terminal facilities labeled according to function and provides uniform spacing between connection points.
- C. Provide SRM as manufactured by Cottmark 503 & 512 markers or City approved equal.

PART 3 -- EXECUTION

3.01 CONDUIT INSTALLATION

- A. Primary mode of conduit installation will be horizontal direction drill, install conduit in accordance with FDOT section 555 and Section 02347.
- B. When impractical to use horizontal directional drill, install conduit via open cut in accordance with FDOT section 17721.
- C. Conduits shall be capped with manufactured caps (Duct Plugs) when installation is temporarily discontinued.
- D. Conduits shall be cleaned by passing a wire brush mandrel and/or rubber duct swab (or approved alternative) of appropriate size back and forth until all foreign materials and water are removed.

- E. Conduits shall be checked by pulling a round test mandrel, ¼ inch less than conduits size for each duct from both directions to remove obstructions.
- F. Conduits shall be provided with continuous 1250 pound tensile strength conduit measuring pull tape in each duct terminated to prevent pullout.
- G. No section of conduit shall have more than 270° of bends with a manhole or handhole installed for and access point.
- H. The minimum separation from other utilizes is a follows:
 - 1. Power up to one KVA:
 - a. 12 inches of well- packed earth
 - b. 4 inches of masonry
 - c. 3 inches of concrete
 - 2. Gas, Oil, Water, etc.:
 - a. 12 inches when parallel
 - b. 6 in. when crossing
- I. Install a 6" orange warning tape labeled fiber optics. Install tape 12 inches above the entire conduit or ductbank during open cut.

3.02 DIRECTIONAL BORING

- A. General – Refer to specification section 02347, Horizontal Directional Drilling for minimum requirements. Follow additional requirements listed here below.
- B. Boring Depths - Coil-able duct shall be directionally bored at standard burial depths of 36" of cover for ducts housing primary cables and 24"-36" of cover for ducts housing secondary cables. Engineer shall approve any exceptions in writing to the specified burial depths, up to a maximum 60" of cover from final grade.

3.03 PULLBOX INSTALLATION

- A. Refer to drawings for pull box details.
- B. The Contractor shall install the pull box covers so that the top of the cover is flush with the restored pavement. Pull boxes installed in soil areas shall be installed so that the top of the cover is at least one inch but not more than 4 inches above the final grade level of the restored surface to prevent accumulation of dirt, silt and debris on the top of the hand hole cover. Pull boxes installed in areas not subject to flooding or standing water shall have a minimum of five (5) ¾-inch drainage holes in the bottom of the box.
- C. Contractor shall perform conduit integrity tests for each section between the pull boxes

after installation. These tests shall be performed prior to installation of the pull rope.

- D. Pull box conduit entries shall be sealed with duct plugs to prevent the intrusion of water and debris into the pull boxes.
- E. Pull boxes shall be installed on a compacted level foundation consisting of 6 inches of gravel complying with Section 02200, Earthwork.
- F. Compaction around pull boxes and associated details shall be performed in accordance with Section 02200, Earthwork.
- G. Upon final acceptance of the conduit system all pull boxes shall be free of debris and water, and be ready for cable installation.

3.04 CONDUIT SYSTEM CLEANING AND TESTING

- A. Following the backfill placement and compaction, all conduits shall be cleared of loose material by brush and compressed air.
- B. Conduit shall be tested for leakage by air testing at 5 psi, maintaining the pressure for one hour without showing any leakage.
- C. Following the leakage test, a test mandrel 1/4 inch smaller than the inside diameter shall be passed through all conduits to detect alignment and deformation problems. Mandrel shall be passed in both directions.
- D. Cleaning and testing of the conduit shall be performed by the Contractor and witnessed by the Construction Manager. The cleaning and testing operation shall be conducted for each conduit section between adjacent pull boxes, a section at a time, for the entire route. The results of tests shall be documented by the Contractor and signed by the Construction Manager and the Contractor.
- E. The Contractor shall provide a five-day advance notice of the schedule and location of test to the Construction Manager. All tests shall be documented and signed by witnessing authorities that shall include Construction Engineers & City of Cape Coral representatives.
- F. The Contractor shall remove and replace conduit which fails either test and shall repeat the test.

3.05 ROUTE MARKERS

- A. Install route markers for fiber optic cable installations and ensure the following:
 - 1. Markers are plumb and level and the notification information is clearly visible when viewed from the side facing the roadway.
 - 2. Markers are set within the right-of-way.

3. Markers are placed at a 1-foot offset from the conduit system.
 4. The top of the marker post is a minimum of 5 feet and maximum of 6 feet above the finish grade.
 5. Markers are spaced a maximum of 500 feet apart.
 6. A clear line of sight is maintained from one marker to the next.
 7. Markers are installed on both sides of the roadway at any crossing point where the conduit system changes to the opposite side of the roadway.
 8. Markers are installed at the center point of any conduit run between two pull or splice boxes.
 9. Markers are installed at gate locations when the conduit system is adjacent to a fence line.
 10. Markers are installed on both sides of a stream, river, or other water crossing, and on both sides of aboveground attachments such as bridges and walls.
- B. Remove and replace all marker posts damaged during installation at no additional cost. Ensure that route marker signs are labeled with a unique identification number, as detailed in the Plans or as approved by the Engineer. Provide as-built documentation at the completion of installation that includes identification number and location of all installed route markers and correlates the marker to the fiber optic infrastructure that it signifies.
- C. Ensure that installation of ERMs includes connection of the route marker to the locate wire associated with the conduit run that the markers identify. Install locate wire through the base of the marker and terminate the locate wires to connectors mounted on the terminal board inside the marker. Install an underground magnesium anode a minimum of 10 feet away from the marker and perpendicular to the conduit system. Terminate the anode lead on the connector mounted on the terminal board inside the marker. Install the bond straps between the anode connector and all locate wire connectors to provide cathodic protection for the locate wire conductor.

3.06 MODIFICATIONS

- A. All dimensions and exact locations of underground substructures shall be field verified. Minor changes in locations of pull boxes which result in no additional costs for material or labor shall be made at no additional cost to the City. However, the Contractor shall prepare proposals consisting of detailed material lists, cost estimates, and schedules for rerouting the conduit around existing unforeseen underground utilities and structures which result in additional cost. The Construction Manager will consider the proposals in accordance with the provisions of the General Conditions.

END OF SECTION

SECTION 17250

REMOTE RADIO TELEMETRY UNITS AND APPURTENANCES

PART 1 -- GENERAL

1.1 GENERAL

- A. The Contractor shall furnish and install the new Radio Telemetry Unit (RTU) equipment as specified and as shown on the Contract Documents. It is the intent of these specifications to have a single Contractor be responsible for all hardware, software, system integration, programming, testing, and startup of all control systems. The Contractor shall supply a single copy of start-up software under this Contract.
- B. All remote telemetry units shall be of first-class workmanship and shall be entirely designed and suitable for outdoor services. All materials used in fabricating of the equipment shall be new and undamaged.
- C. The delivered equipment shall include all tools, diagnostic equipment, and documentation to install and maintain all future expansion capabilities. Each RTU shall be completely functionally interchangeable with any existing RTU in the existing SCADA system without modification. The input and output boards shall be field replaceable without the use of tools.

1.2 SUBMITTALS

- A. General: Prior to release for fabrication, the Vendor shall submit for approval shop drawings and other information for all equipment proposed in accordance with Section 01300 – Contractor Submittals.
- B. Operations and Maintenance Manuals: The Vendor shall submit operation and maintenance manuals for all equipment proposed.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All equipment parts shall be properly protected in accordance with manufacturer requirements so that no damage or deterioration will occur.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the City.
- C. Each box or package shall be properly marked to show its contents.

PART 2 -- PRODUCTS

2.1 REMOTE TELEMETRY UNITS AND APPURTENANCES

- A. The Remote Telemetry Units shall be microprocessor based, user programmable, which shall serve as an interface to accumulate, process, transmit and receive discrete and analog status

and control messages between the RTU base stations and the remote RTU sites located within an eight-mile radius of the base stations. The main processor shall support the PC/ 104 bus for input/output interface expansion. All components shall be off-the-shelf, readily available from more than one vendor. Proprietary equipment shall be strictly prohibited.

- B. All RTU components shall be modular and have “plug-in” type connections for all off- board connections. The panel must be constructed to allow the RTU board to be replaced without re-terminating the I/O Connections.
- C. The manufacturer shall also provide diagnostic and testing software that can be loaded on notebook PC for field use.
- D. Each RTU shall have sufficient battery backed RAM, and EEPROM nonvolatile backup memories to provide all discrete and analog status, monitoring and control functions and shall be designed to operate in an outdoor industrial environment. Batteries shall be sealed, no maintenance types. Provisions shall be made to prevent hydrogen gas explosion in the event battery out gassing due to accidental overcharge or battery failure.
- E. On-board LED indicators shall be provided to verify the presence of power supply output voltages, and power delivered to each I/O board or module. A power control assembly shall be provided to monitor the supply voltage and battery charge condition. Upon detection of power drop or voltage loss, power shall be automatically switched to the battery bank. Should the battery become depleted, the RTU shall automatically shut down to prevent damage. The RTU shall include internal alarms for low battery voltage and line power failure.
- F. The RTU logic processor shall be based on an Intel 486, 32-bit microprocessor. The minimum memory configuration shall be 64 KB EEPROM or FLASH memory for storage of configuration parameters and control logic programs, and 4MB of RAM for storage of transient data. Operating system and RTU system code shall be stored in PROM or EPROM. Each RTU processor shall be equipped with two EIA-232 serial communication ports capable of simultaneous independent operation at speeds from 1200 baud to 19.2 k baud.
- G. The RTU shall be designed to operate in an industrial environment. The RTU shall be capable of operation in an ambient temperature range of –30°to 60° C and a relative humidity of 5-95 percent, non-condensing. The RTU shall be capable of operation on supply voltages of 24VDC.
- H. All components of the RTU shall be of the same manufacturer who is regularly engaged in the manufacture of programmable controllers. The manufacturer shall have fully tested units similar to that being furnished in an industrial environment with associated electrical noise. The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.
- I. The RTU shall provide the following I/O points:
 - 1. Four analog inputs 4-20ma
 - 2. 16 discrete inputs 120V AC
 - 3. 8 discrete outputs rated 2A at 120V AC

- J. Each RTU shall be configured to provide the I/O and data communications equipment as indicated on the Drawings. In addition, all RTUs shall be sized to meet future expansion by providing two empty slots in the PLC for future I/O boards.
- K. The RTU shall include a software programmable ON/OFF watchdog timer, an operations monitor, and logic voltage supervisory circuitry. The on-board real-time clock shall measure time by the year, month, day, hour, minute, second, and 0.01 seconds. Each data change shall be time tagged at the RTU to 0.01-second resolution before transmission.
- L. All RTU's shall be powered with 120 VAC On-line UPS 60 Hz source and shall include an AC and DC power monitor with alarm output to the RTU on loss of AC or DC power. Power supply shall be of sufficient capacity to provide all required DC power to all RTU equipment, discrete and analog input/output circuitry, under full load, communications interface equipment, RF modems, radios, and other radio interface/conditioning equipment and appurtenances, as required. Batteries shall be sized to provide a minimum of 30 minutes of full load backup in the event of AC power loss.
- M. RTU shall be HSQ Model 25x86, or City approved equal (as determined by the City).
- N. Each RTU shall be lighted as shown on the Drawings.
- O. RTU inputs to detect the RTU door intrusion switch, control panel door intrusion switch, and wet well hatch cover intrusion switch shall be provided to report an event/alarm when the enclosure has been opened.

2.2 RTU COMMUNICATIONS INTERFACE

- A. Bi-directional communications of status, commands and radio diagnostic between the RTU's and the RTU base station shall be provided by the RTU communications interface subsystem. The data transmission rate shall be 9600 Baud (asynchronous).
- B. The RTU communications interface shall control the modem during any communication sequence. It shall be possible to assign a unique basic address to each RTU through the data interface. The addressing scheme shall allow a minimum of 255 RTU's for each data link. The communications protocol for radios shall be HSQ COS Protocol, no equal.

2.3 RTU RADIO SYSTEM AND APPURTENANCES

- A. A MDS radio capable of matching the existing system's power and frequency shall constitute the radio system of the RTU. The radio system shall be capable of supporting the communication functions supplied by the RTU block.
 - Support for polling sequences as a primary means of communication: RTU base to field RTU. All polling timers shall be operator adjustable.
 - Support for unsolicited messages by all RTU nodes from any RTU node
 - Support for a non-deterministic communication environment (i.e. collision detection and avoidance)

- Support for unique operator adjustable retry set points in the event of communication loss for each RTU node.
 - The transmission between the RTUs and the central stations shall be by HSQ Change of State Protocol.
- B. Contractor shall supply a directional Yagi antenna for remote sites not currently employing radio communications. Yagi antennae provided shall match make and model of those used at existing radio monitored/controlled lift station sites. Yagi Antenna shall be model #DB499-K with 25 ft. Belden #8237 Coaxial Cable, male N-Type #82-202 Amphenol connectors at each end.
- C. The complete communications subsystem including all interconnecting cables shall contain lightning, surge, and transient protection.
- D. Radios shall be Base Rx 928.00625 MHZ and Tx 952.00625 MHZ and shall be manufactured by Microwave Data Systems (MDS), or City approved equal.

2.4 PANELS

- A. The RTU shall be mounted in the same panel as the pump control panel.
- B. The temperature inside each enclosure containing an RTU shall be continuously monitored and shall generate an alarm input to the associated RTU input-output subsystem if the temperature rises to an adjustable, preset high temperature. A tamper switch shall be included to report the status of the access door to the associated RTU input/output subsystem.
- C. Enclosures shall be furnished with integral grounded RFI shielding.

2.5 ELECTRICAL TRANSIENT PROTECTION

- A. All electrical and electronic elements shall be protected against damage due to electrical transient induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All surge suppressor devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years.
- C. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:
1. At any connections between AC power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
 2. At the field, panel, or assembly connections of all analog signal circuits.
- D. Surge Suppressor Assemblies for 120-Volt AC Power Supply Connectors: Surge suppressors for connections to AC power supply circuits shall be assemblies that:

1. Have been provided with two-3-terminal barrier terminal strips capable of accepting No. 12 AWG solid or stranded copper wire. One terminal strip shall be located on each end of the suppressor unit.
 2. Are epoxy encapsulated within a nonflammable phenolic enclosure with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment. Epoxy encapsulation shall be flame retardant.
 3. Are constructed as multistage devices. The first stage shall be a high-energy metal oxide varistor element. The second stage shall consist of fast-acting high-power bipolar silicon avalanche devices. First and second stages shall be interconnected through a series air core inductor of sufficient current-carrying capacity to permit a continuous operating current of 15 amperes. Inductors having ferrous or other high permeability core materials are not acceptable. Suppressor assemblies shall be the automatic recovery type.
 4. Meet or exceed the following performance criteria based on a test surge wave shape with an 8-microsecond rise time and a 20-microsecond exponential decay time:
 - a. Minimum Operating Voltage: 110V AC
 - b. Maximum Breakdown Voltage: 150V AC
 - c. Maximum Operating Current: 15 amps
 - d. Peak First Stage Surge Current: 20,000 amps
 - e. Maximum First Stage Clamping Voltage: 350 volts
 - f. Maximum Second Stage Clamping Voltage: 21volts
 - g. Ambient Temperature Range: -20o C to +85o C
- E. Surge Suppressors for Analog Signal Connection: Surge suppressors for analog signal circuits shall:
1. Have four lead devices with a threaded mounting/grounding stud.
 2. Have a circuit consisting of 3-electrode gas tube and silicone avalanche devices to clamp each line to ground. High-energy gas tube and silicone avalanche devices shall be separated by a series impedance.
 3. Be epoxy encapsulated with a nonflammable phenolic enclosure. Epoxy encapsulation shall be flame retardant.
 4. Limit line-to-ground and line-to-line voltage to 30 volts on 24VDC circuits.
 5. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
 - a) Recovery: Automatic
 - b) Peak Source Current: 10,000 amps
 - c) Pulse Lift Before Failure: 100 occurrences
 - d) Minimum Voltage Clamp Rating: 30 Volts

- e) Series impedance: 24 Ohms Total
- f) Temperature Range: -20o C to +85o C
- g) Operating Voltage: Less than 30V DC
- h) Operating Current: 4 to 20 mA DC
- i) Resistance Line-to-Ground: Greater than 1 Mega Ohm

PART 3 – EXECUTION

3.1 GENERAL

- A. The City's INSTRUMENTATION PERSONNEL will check the complete installation and the Contractor will make all necessary adjustments for satisfactory operation of the new RTUs.
- B. The City's INSTRUMENTATION PERSONNEL shall program the RTUs and configure and program the central stations at the City's WTP and mount the RTU antenna.
- C. Cabinets and panels shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment, and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- D. Terminal blocks shall be factory assembled on a miniature mounting channel and the channel bolted to the steel strap. Terminals shall be miniature screw type unless otherwise required and shall be rated at least 300 volts, 20A, Square D type G, or City approved equal.
- E. The terminals shall be marked vertically with a permanent, continuous marking strip from top to bottom. One side of each terminal strip shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the City, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- F. Wiring shall comply with accepted standard instrumentation and electrical practices and codes. For each pair of parallel terminal blocks, the field wiring shall be between the blocks. Solderless horseshoe (spade) connectors, with insulating sleeves, shall be used for connecting wires to terminal blocks.
- G. All wiring shall be bundled and run open or enclosed in vented plastic wireways, as required. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic analog signals, discrete signals, and power wiring. A copper ground bus shall be installed the full length of each panel. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves.

- H. Wires shall be color coded as follows:

Neutral	-	White
Ground	-	Green
Power	-	Red
Signal	-	Black and White
Control	-	Violet

Special - Blue

- I. Panels shall be provided with 120-volt GFI duplex receptacles mounted on the RTU panel inner door.
- J. Panels shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device is Connected to Multiple Sources of Power." Letters shall be 1-inch high, white.
- K. Equipment shall be mounted on a removable sub panel (back plate) to permit withdrawal of the equipment for maintenance or adjustment. Panels shall be designed to permit front access for all service and removal of equipment. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.
- L. The Contractor shall be responsible for providing all conduit and wire between the RTU and the Local Control Panel and providing the RTU antenna pole. The height and the location of the antenna pole shall be such as to provide a clear line-of-sight without obstructions to the facility to which it is communicating.

END OF SECTION

SECTION 17251

REMOTE CELLULAR TELEMETRY UNITS AND APPURTENANCES

PART 1 -- GENERAL

1.1 GENERAL

- A. The Contractor shall furnish and install the new Remote Telemetry Unit (RTU) equipment as specified and as shown on the Contract Documents. It is the intent of these specifications to have a single Contractor be responsible for all hardware, software, system integration, programming, testing, and startup of all control systems. The Contractor shall supply a single copy of start-up software under this Contract.
- B. All remote telemetry units shall be of first-class workmanship and shall be entirely designed and suitable for outdoor services. All materials used in fabricating of the equipment shall be new and undamaged.
- C. The delivered equipment shall include all tools, diagnostic equipment, and documentation to install and maintain all future expansion capabilities. Each RTU shall be completely functionally interchangeable with any existing RTU in the existing SCADA system without modification.

1.2 SUBMITTALS

- A. General: Prior to release for fabrication, the Vendor shall submit for approval shop drawings and other information for all equipment proposed in accordance with Section 01300 – Contractor Submittals.
- B. Operations and Maintenance Manuals: The Vendor shall submit operation and maintenance manuals for all equipment proposed.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All equipment parts shall be properly protected in accordance with manufacturer requirements so that no damage or deterioration will occur.
- B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the City.
- C. Each box or package shall be properly marked to show its contents.

PART 2 -- PRODUCTS

2.1 REMOTE TELEMETRY UNITS AND APPURTENANCES

- A. The Remote Telemetry Units shall be microprocessor based, user programmable, which shall serve as an interface to accumulate, process, transmit and receive discrete and analog status and control messages between the RTU base stations and the City's SCADA system.
- B. All components shall be off-the-shelf, readily available from more than one vendor.
- C. The manufacturer shall also provide programming software (RSLogix 500 and/or RSLogix Micro) that can be loaded on notebook PC for field use.
- D. Each RTU shall have sufficient battery backed RAM, and EEPROM nonvolatile backup memories to provide all discrete and analog status, monitoring and control functions and shall be designed to operate in an outdoor industrial environment. Batteries shall be sealed, no maintenance types. Provisions shall be made to prevent hydrogen gas explosion in the event battery out gassing due to accidental overcharge or battery failure.
- E. On-board LED indicators shall be provided to verify the presence of power supply output voltages, and power delivered to each I/O board or module. A power control assembly shall be provided to monitor the supply voltage and battery charge condition. Upon detection of power drop or voltage loss, power shall be automatically switched to the battery bank. Should the battery become depleted, the RTU shall automatically shut down to prevent damage. The RTU shall include internal alarms for low battery voltage and line power failure.
- F. The RTU logic processor shall be microprocessor based. The minimum memory configuration shall be 10 KB EEPROM or FLASH memory for storage of configuration parameters and control logic programs, and 128 Kb of memory for storage of transient data. Operating system and RTU system code shall be stored in nonvolatile memory. Each RTU processor shall be equipped with two serial communication ports and one 10/100 Ethernet port.
- G. The RTU shall be designed to operate in an industrial environment. The RTU shall be capable of operation in an ambient temperature range of -20° to 60° C and a relative humidity of 5-95 percent, non-condensing. The RTU shall be capable of operation on supply voltages of 24VDC.
- H. All components of the RTU shall be of the same manufacturer who is regularly engaged in the manufacture of programmable controllers. The manufacturer shall have fully tested units similar to that being furnished in an industrial environment with associated electrical noise. The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.
- I. The RTU shall provide the following I/O modules:
 - 1. One 4-point 4-20mA analog input module
 - 2. Two 8-point 24 VDC input module
 - 3. Two 8-point 24 VDC output module

- J. Each RTU shall be configured to provide the I/O and data communications equipment as indicated on the Drawings. In addition, all RTUs shall be sized to meet future expansion by providing two empty slots in the PLC for future I/O boards.
- K. The RTU shall include a software programmable ON/OFF watchdog timer, an operations monitor, and logic voltage supervisory circuitry. The on-board real-time clock shall measure time by the year, month, day, hour, minute, second, and 0.01 seconds. Each data change shall be time tagged at the RTU to 0.01-second resolution before transmission.
- L. All RTU's shall be powered with 120 VAC On-line UPS 60 Hz source and shall include an AC and DC power monitor with alarm output to the RTU on loss of AC or DC power. Power supply shall be of sufficient capacity to provide all required DC power to all RTU equipment, discrete and analog input/output circuitry, under full load, communications interface equipment, RF modems, radios, and other radio interface/conditioning equipment and appurtenances, as required. Batteries shall be sized to provide a minimum of 30 minutes of full load backup in the event of AC power loss.
- M. RTU shall be Allen-Bradley MicroLogix 1400, or City approved equal (as determined by the City).
- N. Each RTU shall be lighted as shown on the Drawings.
- O. RTU inputs to detect the, control panel door intrusion switch, and wet well hatch cover intrusion switch shall be provided to report an event/alarm when the enclosure has been opened.

2.2 RTU COMMUNICATIONS INTERFACE

- A. Primary communication to the City's SCADA system is DNP3 over IP via cellular modem.
- B. Future secondary communication to the City's SCADA system is Ethernet/IP over fiber via City's outside cable plant.

2.3 CELLULAR MODEM AND APPURTENANCES

- A. An industrial cellular gateway is used for remote connectivity to the existing SCADA system. Modem shall have the following features:
 - Support for Verizon M2M communication
 - 2x2 MIMO antenna connection
 - 10/100 Ethernet Port
 - 24VDC
 - Operating temperature of -40C to +70C
- B. Provide a MIMO LTE antenna located at the top of the pump station control panel above the space reserved for the RTU. Antenna shall be provide by the cellular modem manufacturer.
- C. The complete communications subsystem including all interconnecting cables shall contain

lightning, surge, and transient protection.

- D. Modem shall be GE MDS Orbit MCR, or City approved equal.

2.4 PANELS

- A. The RTU shall be mounted in the same panel as the pump control panel.
- B. The temperature inside each enclosure containing an RTU shall be continuously monitored and shall generate an alarm input to the associated RTU input-output subsystem if the temperature rises to an adjustable, preset high temperature. A tamper switch shall be included to report the status of the access door to the associated RTU input/output subsystem.
- C. Enclosures shall be furnished with integral grounded RFI shielding.

2.5 ELECTRICAL TRANSIENT PROTECTION

- A. All electrical and electronic elements shall be protected against damage due to electrical transient induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All surge suppressor devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years.
- C. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:
 - 1. At any connections between AC power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.
 - 2. At the field, panel, or assembly connections of all analog signal circuits.
- D. 120 VAC surge protection shall be Phoenix Contact PLT series or equal.
- E. 24 VDC surge protection shall be Phoenix Contact PT series or equal.

2.6 24 VDC SUBSYSTEM

- A. Provide a 24 VDC subsystem which includes a 120 VAC to 24 VDC power supply and a backup battery. The 24 VDC system will power critical communication including the PLC, network switch, and cellular modem.
- B. The 24 VDC system will also provide power to the PLC digital and analog input/output power, wetwell floats, and 24 VDC control relays.
- C. 24 VDC power supply shall be Phoenix Contact TRIO UPS with external battery sized for the requirements above.

2.7 BACKUP PUMP CONTROLLER

- A. Provide a backup pump controller in an event the PLC fails. Backup pump controller shall be Wilkerson Instruments DR1920 or equal.

2.8 NETWORK ACCESSORIES

- A. Network switch shall be 4-port copper, 1-port fiber with ST connectors, 10/100Base, 24 VDC.
- B. Network switch shall be N-Tron 105FX, confirm exact model with City IT department or Engineer to confirm fiber requirements.
- C. Provide Corning WCH connector housing with ST connectors.

2.9 REQUIRED PLC INPUTS/OUTPUTS

- A. Provide the following digital inputs:
 - a. AC Power Fail
 - b. Pump No.1 Not in Auto
 - c. Pump No.1 Running
 - d. Pump No.1 Fault
 - e. Pump No.2 Not in Auto
 - f. Pump No.2 Running
 - g. Pump No.2 Fault
 - h. High Level Float
 - i. Low Level Float
 - j. Surge Protector Status
 - k. 24 VDC UPS Alarm Status
 - l. 24 VDC UPS in Battery Mode
 - m. Control Panel Door Intrusion
 - n. Wetwell Intrusion
 - o. Phase Fault
 - p. Spare Wired to TB
- B. Provide the following digital outputs:
 - a. Pump No.1 Start/Stop
 - b. Pump No.2 Start/Stop
 - c. Silence Horn
 - d. 1 Spare Wired to TB, Remainder Spares Not Used
- C. Provide the following analog inputs:
 - a. Wetwell Level
 - b. 1 Spare Wired to TB, Remainder Spares Not Used

PART 3 – EXECUTION

3.1 GENERAL

- A. The City's INSTRUMENTATION PERSONNEL will check the complete installation and the Contractor will make all necessary adjustments for satisfactory operation of the new RTUs.
- B. The Contractor shall program the RTUs and configure and program the SCADA system at the City's WTP.
- C. Cabinets and panels shall provide mounting for power supplies, control equipment, input/output subsystems, panel mounted equipment, and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- D. Terminal blocks shall be factory assembled on a miniature mounting channel and the channel bolted to the steel strap. Terminals shall be miniature screw type unless otherwise required and shall be rated at least 300 volts, 20A, Square D type G, or City approved equal.
- E. The terminals shall be marked vertically with a permanent, continuous marking strip from top to bottom. One side of each terminal strip shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the City, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- F. Wiring shall comply with accepted standard instrumentation and electrical practices and codes. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- G. All wiring shall be bundled and run open or enclosed in vented plastic wireways, as required. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic analog signals, discrete signals, and power wiring. A copper ground bus shall be installed the full length of each panel. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves.
- H. Wires shall be color coded as follows:

Black	-	120 VAC
Red	-	120 VAC Controlled
Yellow	-	120 VAC from external devices
White	-	120 VAC Neutral
Blue	-	24 VDC
Blue w/ White Stripe	-	24 VDC Ground
Green	-	Signal Ground
Green w/Yellow Stripe	-	Panel Ground
Red	-	4-20mA Positive Signal
Black	-	4-20mA Ground

- I. Panels shall be provided with 120 volt GFI duplex receptacles mounted on the RTU panel inner door.
- J. Panels shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device is Connected to Multiple Sources of Power." Letters shall be 1-inch high, white.
- K. Equipment shall be mounted on a removable sub panel (back plate) to permit withdrawal of the equipment for maintenance or adjustment. Panels shall be designed to permit front access for all service and removal of equipment. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.
- L. The Contractor shall be responsible for providing all conduit and wire between the RTU and the Local Control Panel, and antenna.

END OF SECTION